

April 7, 1936.

H. A. THOMPSON

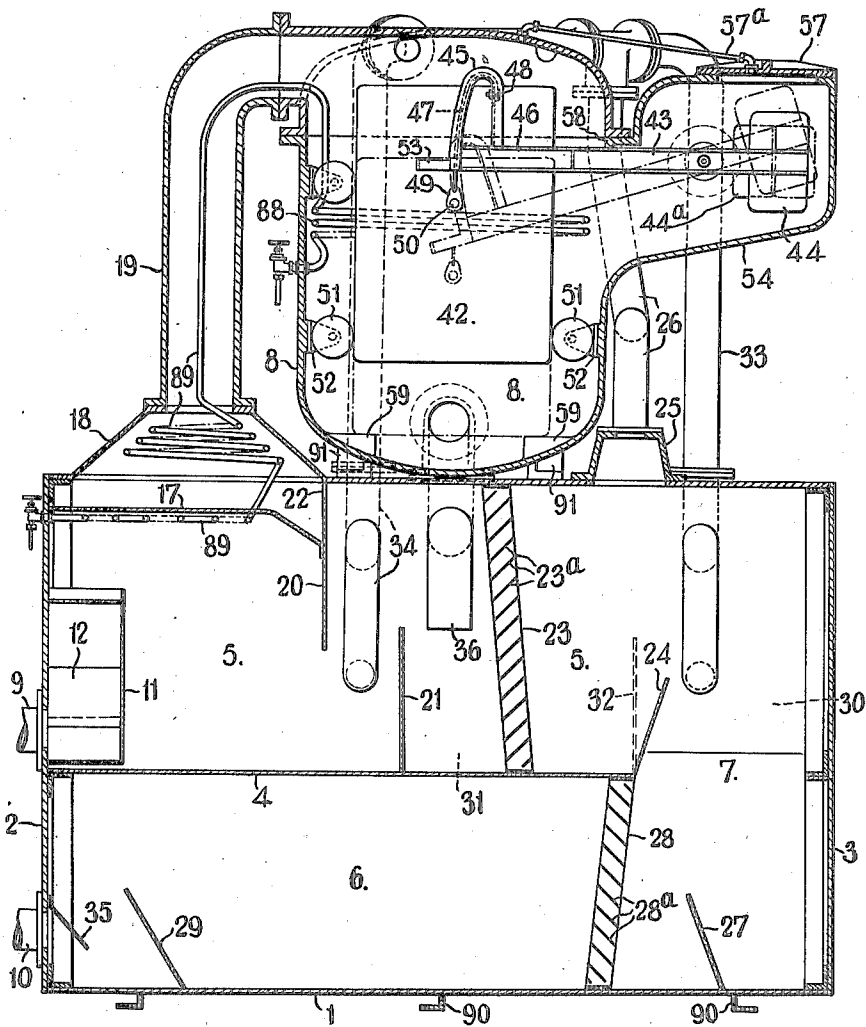
2,036,730

SEPARATOR FOR LIQUIDS HAVING DIFFERENT SPECIFIC GRAVITIES

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7 Sheets-Sheet 1

FIG. 1.



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FIG. 2.

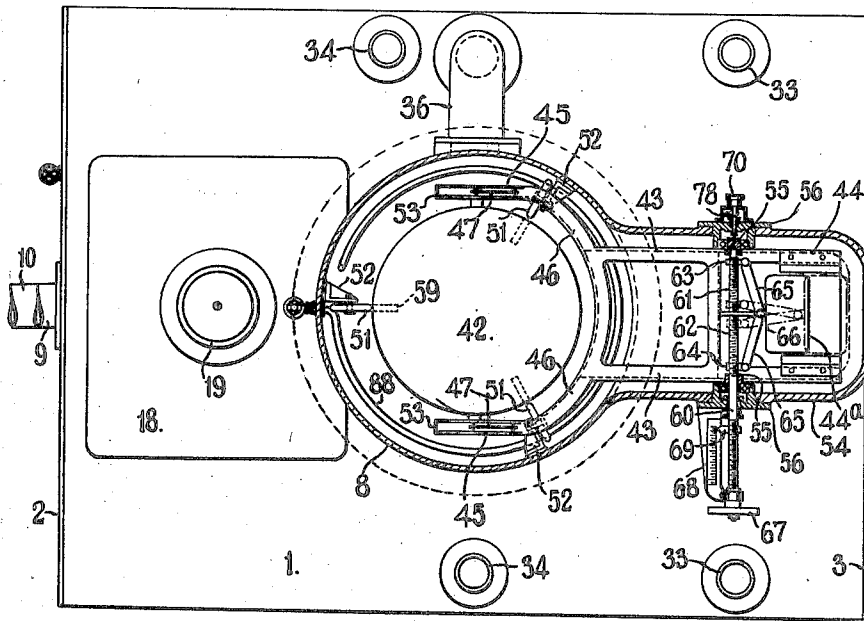
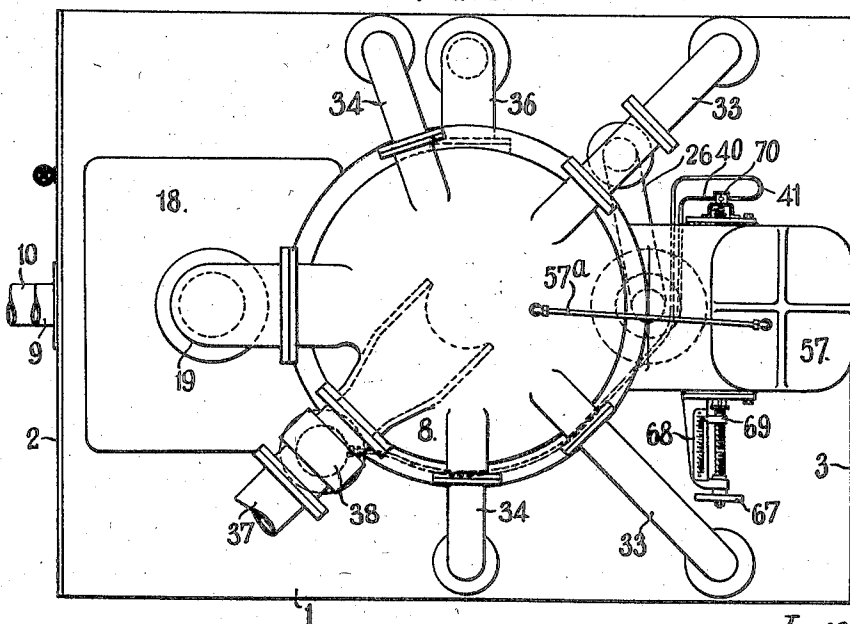


FIG. 3.



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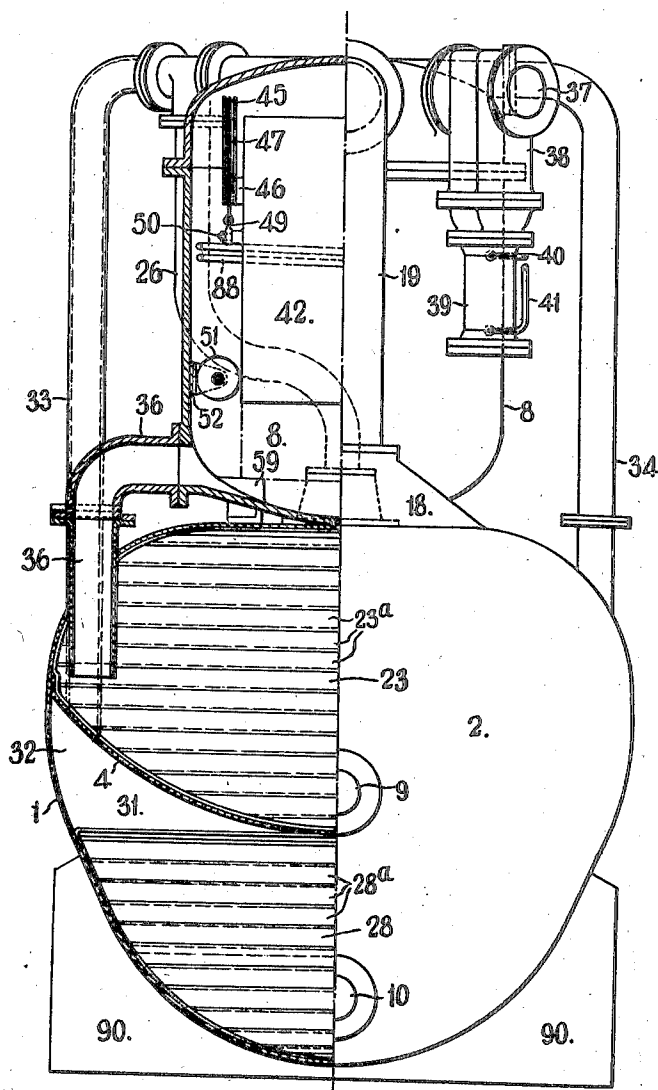
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FIG. 4.



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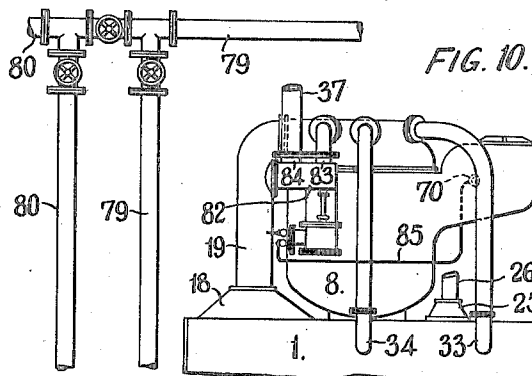
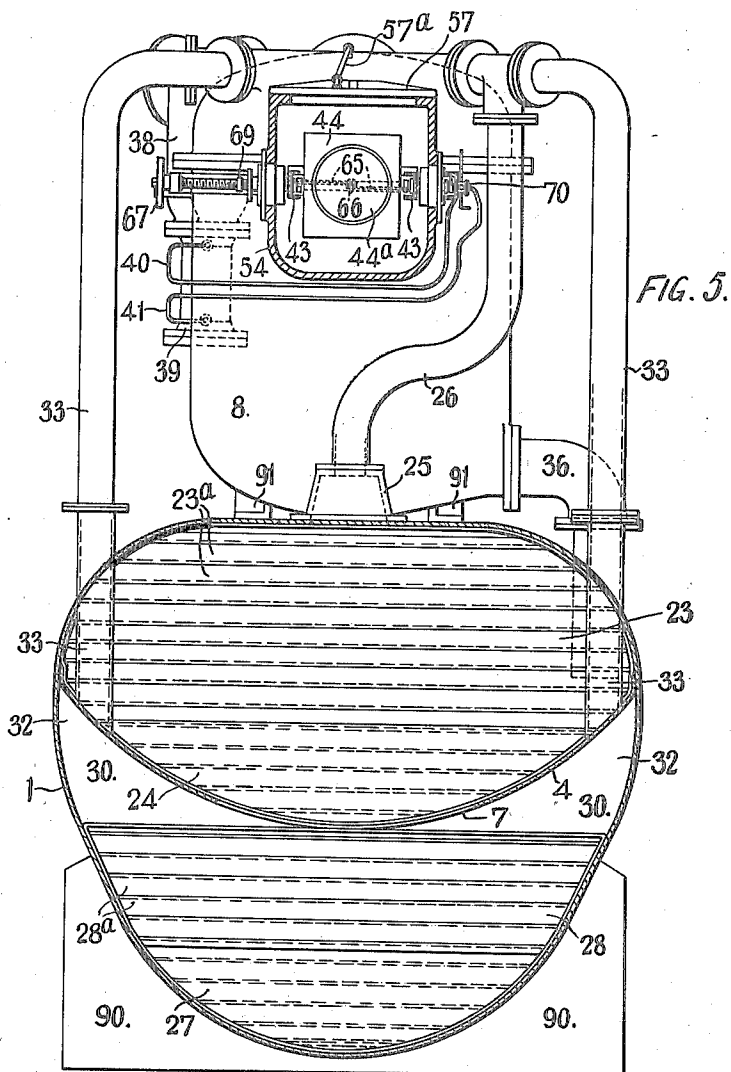


FIG. 10.

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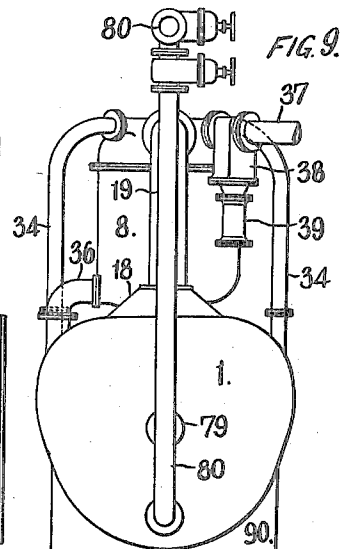
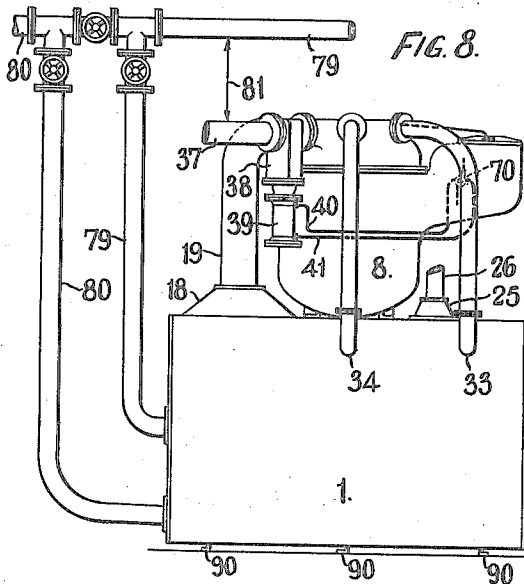
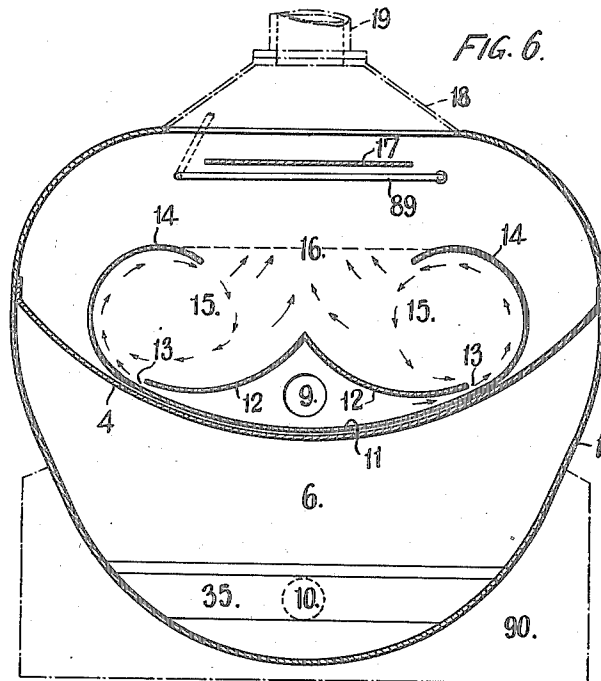
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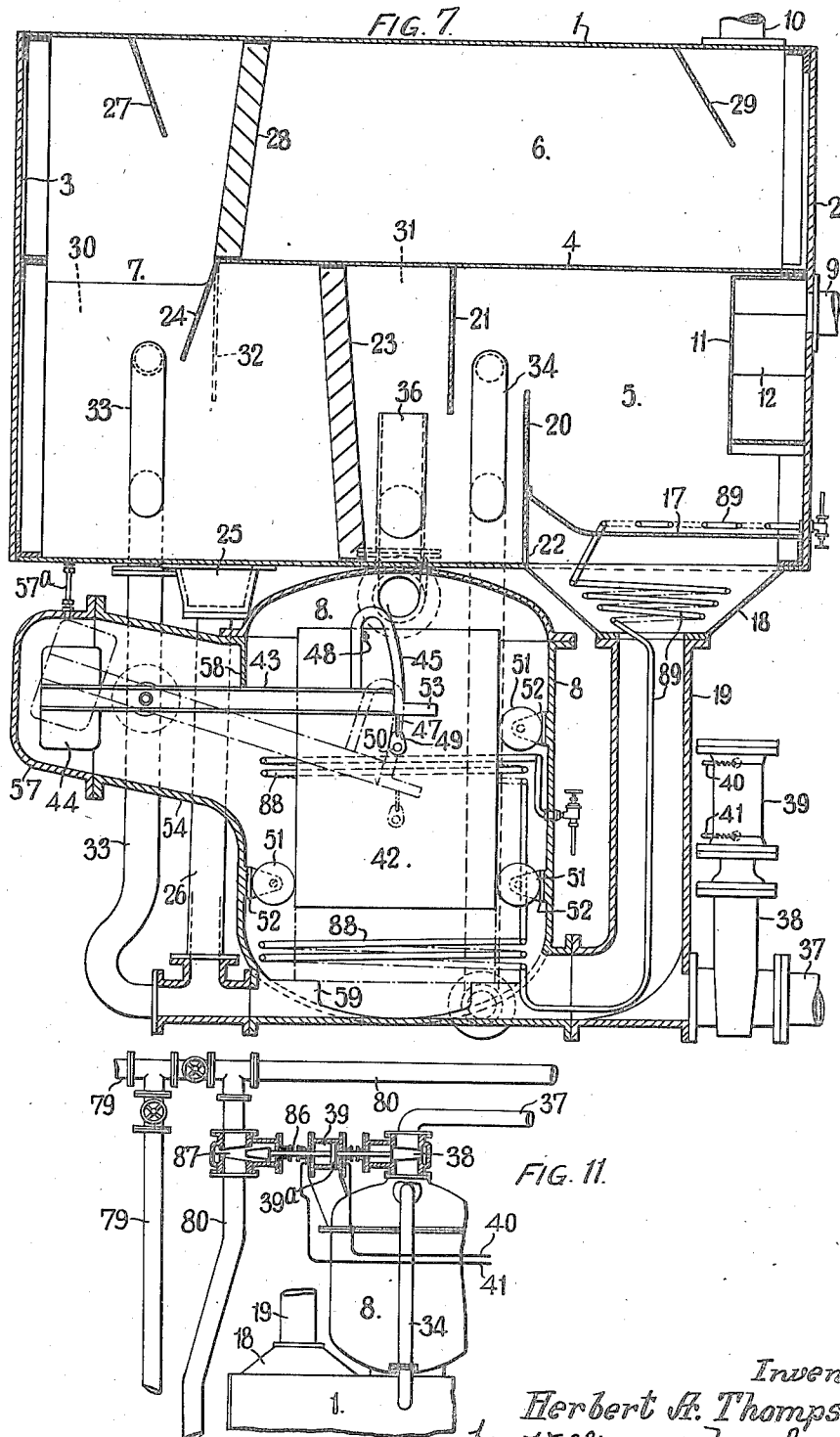
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7 Sheets-Sheet 6



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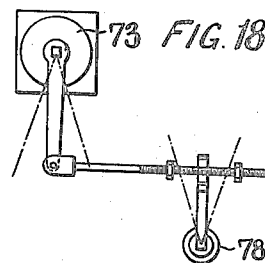
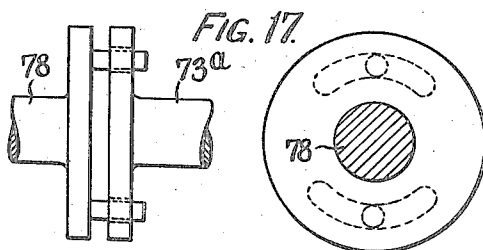
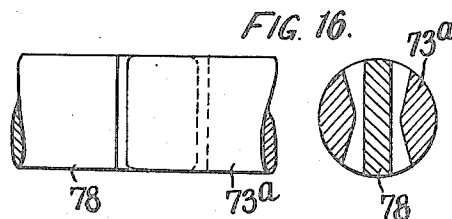
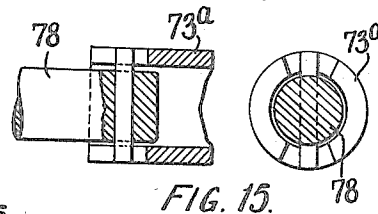
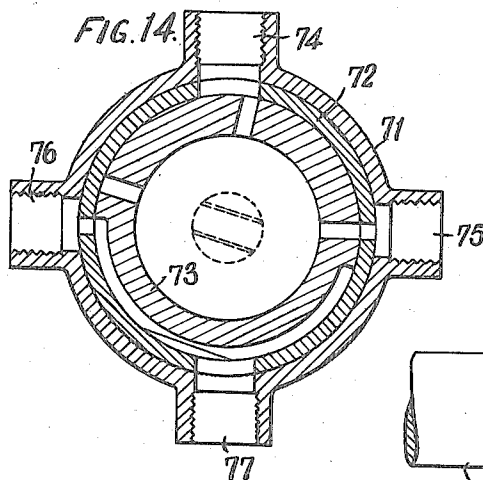
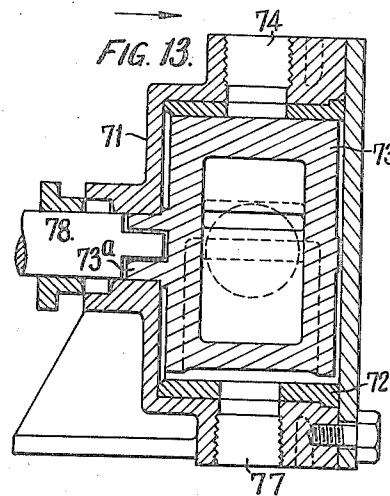
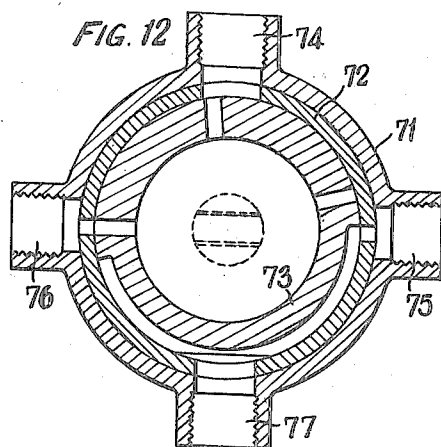
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SEPARATOR FOR LIQUIDS HAVING DIFFERENT SPECIFIC GRAVITIES

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7 Sheets-Sheet 7



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UNITED STATES PATENT OFFICE

2,036,730

SEPARATOR FOR LIQUIDS HAVING DIFFERENT SPECIFIC GRAVITIES

Herbert Alexander Thompson, Benton,
Northumberland, EnglandApplication May 28, 1934, Serial No. 728,013
In Great Britain April 16, 1934

15 Claims. (Cl. 210—54)

This invention relates to separating devices or the like for separating liquids of different specific gravities from a mixture of such liquids, which does not tend to form a true miscible solution, the separator being of the kind having a plurality of quiescence chambers, through which the mixture is caused to flow for the purpose of reducing the velocity of flow to an extent which will enable the difference in the specific gravities of the liquids forming the mixture to become effective in separating the liquids, the rate of flow of the liquid mixture through the apparatus being made as low as possible, and as free as possible from eddy currents and the like, for this purpose.

A separator of this kind is described and claimed in my U. S. Specification No. 594,959½, in which is described an apparatus for the separation of liquids of different specific gravities which consists of a plurality of quiescence chambers through each of which a mixture of the liquids to be separated is passed in turn and a collecting dome or chamber arranged out of the direct line of flow of the mixture and in which one of the separated liquids is collected, the quiescence chambers being of ovate or substantially triangular form in vertical cross-section arranged with their greatest horizontal cross-sectional area towards the collecting dome or chamber, while the entry of the mixture into any quiescence chamber is arranged to be at the level of greater horizontal cross-sectional area so that the entering liquid is enabled to distribute itself over the largest possible surface and thereby attain maximum quiescence as soon after entry as possible.

In a constructional example described in my prior specification, the separator is constructed with two shells of ovate form in vertical cross-section arranged one inside the other with division plates extending between them so that the internal shell and the spaces between the shells constitute a number of quiescence chambers, while at the inlet end of the separator is arranged a swirl chamber of compacting chamber, and the separated liquid collected in the collecting dome is arranged to be drawn off when a predetermined amount of separated liquid has collected in the dome by means of an automatic discharging mechanism controlled by a float within the collecting dome.

Although the arrangement described and claimed in my prior specification has been found to be extremely efficient and satisfactory in practice it is naturally capable of modification and

improvement as the result of the experience gained and the main features of the present invention therefore comprise modifications of the arrangement described and claimed in U. S. Specification No. 594,959½.

The main features of the previous arrangement are retained in the present invention, either substantially in their original form or somewhat modified; thus the various quiescence chambers are of ovate form in vertical cross-section, with the collecting dome out of the line of flow of the mixture, and the body of the separator is also preferably constructed from an outer shell of ovate vertical cross-section with an internal division plate to form a compartment of substantially similar cross-section inside it, while a swirl or compacting chamber is also provided adjacent the inlet.

As in the previous construction the separator is particularly suitable for the separation of the constituents of a mixture of oil and water and will be described with reference to the separation of such a mixture for the sake of clarity.

In the present invention the swirl chamber is modified by arranging that the inlet stream of mixture enters through a deflector having curved sides through which the inlet stream flows in two opposite jets which are caused to take circular paths, giving a greatly increased rate of circular motion, while the increased flow and the opposing jets result in a greater force of impact between the oil globules, causing them to coalesce much more rapidly. As previously pointed out in Specification No. 594,959½, it is highly desirable to remove these compacted masses of oil as quickly as possible from the main flow by passing them into the oil dome and in the present arrangement the oil masses are removed at a position immediately above the swirl chamber by means of an outlet passage together with a pipe leading direct to the top of the collecting dome. This arrangement avoids the recovered oil having to rise from the bottom of the dome and so over the float, as with heavy viscous oils this tends to put the float out of balance by reason of masses of oil adhering to the bottom and sides thereof. For similar reasons it is now preferred to employ pipes to convey the recovered oil from the collecting spaces between the outer and inner shells direct to the top of the dome.

A number of deflector plates and baffle plates are also provided within the quiescence chambers and their position and operation will be clear from the subsequent detailed description but, in

particular, certain of the baffles consist of a series of narrow strips or slats extending horizontally but set at an angle to the flow path, which are hereinafter termed for convenience "shutter baffles". By constructing the baffles in this manner it is possible to obtain flow direction with only the smallest possible increase of velocity as compared with the usual plate baffles.

The liquid collected in the dome is drawn off by hand or by means of an automatic device controlled by a float moving within the collecting dome and a further feature of the invention consists in the provision, in a separator in which one of the separated liquids is drawn off or discharged under the control of a float within a container in which the separated liquid collects, of a control float which is arranged so that its effective weight or what may be termed its "flotational moment" in the heavier liquid is varied as the float moves in a direction which will cause discharge of the collected liquid, to compensate for the viscosity resistance of the separated liquid, which in the case of viscous oils may be equal to the sinking effort in such oils obtained from the difference in specific gravities of the collected liquid and the mixture of liquid to be separated.

In one arrangement in which the float is supported on a balanced lever and moves downwardly to cause discharge of the collected liquid, the operative effect of the float, that is its turning moment about the fulcrum of the lever, is increased by connecting the float with the lever in such a manner that it moves in a straight vertical path so that its leverage moment is always constant, while the balance weight is rigidly attached to the lever and therefore moves in a curved path, having as its radius the distance of the weight from the fulcrum of the lever, so that as the float falls and the balance weight rises the horizontal distance between the lever fulcrum and the centre of gravity of the balance weight decreases and therefore the moment of the balance weight about the lever fulcrum decreases and the effective turning moment or operative effect of the float increases as it moves downwards.

In order to allow the float to travel in a straight vertical path it may be supported from the lever by means of slotted lever connections or other suitable connecting means, but it is preferably hung from the lever on chains or other flexible connections which pass over quadrants of arcuate form so that as the float moves up and down the flexible connections and quadrants enable it to travel in a true vertical path.

In order to make the apparatus suitable for use with mixtures of liquids of various specific gravities such as, for example, a mixture of oil and fresh water or of oil and sea water and to ensure that the float controlled discharge device always operates correctly when various such mixtures are used a portion of the balance weight is made movable towards or away from the fulcrum of the lever by devices which can be controlled from the exterior of the separator, such as by toggle levers which can be separated or brought closer together by means of nuts working on a screw co-axial with the lever fulcrum and having right and left handed threads, this screw being rotatable from the exterior of the separator. The discharging device controlled by the movements of the float can be of any of the types described in Specification No. 594,959½ and preferably consists of a gate valve or similar form of oil discharge valve with the valve spindle connected to

the piston rod of a piston moving within an operating cylinder to which steam or air or other fluid under pressure is admitted under the control of a rotary shuttle valve operated from the end of the shaft on which the lever carrying the float is pivoted, a suitable lost motion device being provided in the connection between the shaft and the rotary valve so that the latter is only operated when the float reaches the limits of its travel. In this case the collected liquid is discharged under the pressure of the head of mixture being supplied to the separator but where the head is insufficient the collected liquid may be discharged by means of a pump. Also, instead of controlling the discharging means by a mechanical device the float may be arranged to control the supply of current to an electrical device, such as an electric motor, which opens or closes the oil discharge valve or the float may control an electrically driven pump which empties the collecting dome where the liquid is not discharged by the pressure of liquid in the separator.

Examples and details of constructions according to the invention are illustrated in the accompanying drawings in which:—

Fig. 1 is a sectional side elevation of a complete separator.

Fig. 2 is a plan view thereof partly in section through the collecting dome.

Fig. 3 is an external plan view.

Fig. 4 is an end view partly in section looking towards the front or inlet and outlet end of the separator, that is from the left of Fig. 1.

Fig. 5 is a part-sectional end view looking from the rear of the separator, in the opposite direction to that which gives Fig. 4.

Fig. 6 is a view of a section through the swirl or compacting chamber looking towards left hand end of Fig. 1.

Fig. 7 is a sectional elevation of the device arranged in use for inverted position where the collected liquid is heavier than the liquid from which it is separated.

Figs. 8 and 9 are exterior side and end elevations of the complete separator connected to the supply and discharge pipe lines.

Fig. 10 is a fragmentary view of a modification when a pump is employed to empty the collecting dome.

Fig. 11 is a fragmentary view partly in section through a modified form of discharge and inlet control apparatus.

Figs. 12, 13 and 14 are enlarged sectional views respectively of the shuttle valve which is actuated by the float to control mechanism which effects the discharge of liquid from the collecting dome, Figs. 12 and 14 being sections looking in the direction of the arrow in Fig. 13, while Figs. 15 to 18 show alternative forms of lost motion connection between the shuttle valve and its operating shaft.

Assuming for the sake of clearness in description that a mixture of light oil and water is to be separated and referring first to Figs. 1 to 6 the body of the separator is constructed from an outer shell 1 of ovate form in vertical cross-section provided with end plates 2 and 3, while within the shell 1 is arranged an internal division plate 4 which extends completely across the shell 1 from side to side and divides the latter into an upper compartment 5 of substantially ovate form in vertical cross section and a lower compartment 6 formed by the lower part of the outer shell 1. The only direct communication be-

tween these compartments is by means of an opening 7 cut in the rear end of the plate 4. On the top of the shell 1 is arranged a collecting dome or chamber 2 in which the lighter of the separated liquids (i. e. the oil) collects and this dome 2 is only in communication with the body of the separator through pipes, as will be hereinafter described.

The front end plate 2 is provided with an inlet connection 9 through which the mixture of liquids to be separated enters the apparatus and with an outlet connection 10 through which the heavier of the separated liquids is allowed to flow away.

The inlet 9 opens into a swirl chamber or compacting chamber 11 which is shown in transverse section in Fig. 6, which is a view looking towards the end plate 2. The compacting chamber is provided internally with a combined inlet hood and deflector plate 12 which form a pair of nozzles 13 between the wings of the deflector plate 12 and the base of the chamber 11. If desired the wings of the plate 12 may be adjustable to vary the openings of nozzles 13. The sides of the chamber are curved round towards one another as at 14 to form right and left rotation spaces 15 and an outlet opening 16 at the top of the chamber.

The stream of mixture entering through inlet 9 is thus divided into two opposite jets which issue through the nozzles 13 and follow the path shown by the arrows. This arrangement results in a greatly increased rate of circular motion by reason of the nozzling effect and the directions given to the issuing streams and results in an increased force of impact between the oil globules causing them to coalesce much more rapidly. The circular or rotary course given to the flow produces a hammering or compacting effect on the oil-globules so that they are formed into large masses, which more readily separate from the flow water.

As pointed out in my Specification No. 594,959 1/2 it is highly desirable to remove these compacted masses of oil as quickly as possible from the main flow and accordingly the compacted oil globules rising from the compacting chamber 11 pass upwardly round the edges of a horizontal plate 17 through a tapering connection 18 and by way of pipe 19 direct to the top of the oil dome 3. This stage rids the flow-water of the majority of the oil that is present in the water, and practically only the oil-encased water-globules, that have nearly the same specific gravity as the water, now remain therein.

The main flow is directed onwards by the horizontal plate 17 and downwardly by its curved end to pass downwards between the rear end of the swirl chamber and the fixed downcast plate baffle 20, and after flowing below this baffle 20 it is caused to flow upwards by a fixed-upcast plate baffle 21, any oil which leaves the mixture at this stage being passed to the dome 3 by way of a port or opening 22 in the top of baffle 20 and the connection 18 and pipe 19. The flow now passes downwards between baffle 21 and what is termed for convenience a "shutter baffle" 23 which consists, as will be seen more clearly in Figs. 4 and 5, of a number of strips 23a extending horizontally but inclined to the direction of flow as will be clear from Fig. 1.

The flow is caused to take an upward direction by the plate-baffle 21, just referred to, and therefore it must now flow downwards between that baffle 21 and the shutter-baffle 23 and in doing so

it must flow over the inclined strips 23a before being able to pass through between the same.

This shutter-baffle 23 gives flow direction with only the smallest possible increase of velocity as compared with the usual plate-baffles which obstruct the flow by exactly their total area, whereas the shutter-baffle may be constructed of very thin plates, so that the only loss of sectional area is the total thickness of the plates in the shutter, and not the area of their combined surfaces. Beyond the shutter baffle is arranged an inclined plate-baffle 24 by which is obtained what I term dead-water between it and the shutter-baffle, which dead-water in itself forms a liquid baffle to the flow-water coming from the shutter baffle.

This causes the flow path to ascend at an angle which is variable to the rate of flow and I therefore term the combination of the shutter baffle and the dead-water, an "hydraulic baffle".

Such a baffle is of great advantage, as it spreads or diffuses the flow across the whole area, with only the small amount of friction or resistance that arises from a liquid flowing within its own mass.

The angle of rise varies proportionately to the flow velocity, so that the correct upward angle is obtained without interposing plate-baffles which obstruct the area.

This combination of baffles 23 and 24 and the dead-water between them I have termed an hydraulic-baffle, because it has the peculiar effect of diffusing and spreading the flow across the whole area of the quiescence chamber in such an even manner that the rate of flow drops to a very low one equivalent almost to the true flow possible in a fluid moving at even velocity throughout its mass across the whole sectional area.

The low flow-rate achieved enables the troublesome oil-encased water-globules to assert their slight upward specific-gravity lift and so reach the top of the chamber 5, where they collect and pass out by way of the tapering connection 25 and pipe 26 to the top of the oil-dome 3. At an intermediate position between baffles 23 and 24 the fluid resistance of the mass of dead-water causes the flow to take an upward path at an angle which is proportional to the rate of flow, so that the flow is automatically altered in angle without the intervention of plate baffles which would obstruct the flow and cause increase of velocity, which is very detrimental to the separation of the oil and water from each other.

This fluid baffle also gets rid of disturbing currents or eddy currents in bringing the flow to the top of the chamber 5 where it is necessary to bring it so that any oil is left as near the top as possible before the flow proceeds downward through passage 7 into the lower chamber 6. Beyond the plate baffle 24 is the opening 7 by which the upper quiescence chamber 5 is in communication with the lower quiescence chamber 6 and the flow now proceeds through the opening which is positioned so that the flow enters at the level of greatest cross-sectional area of the lower chamber.

An inclined angled baffle 27 under the opening 7 causes the flow to proceed down over another shuttle-baffle 28, formed of inclined strips 28a, which is fitted in conjunction with a plate baffle 29, which, with the dead-water between them form another hydraulic-baffle giving similar effects and results to that described in the upper chamber 5. During the flow through this lower chamber the last of the oil-globules, if any are still present, rise into the oil-collecting pockets

30 and 31 which are formed at each side of the shell 1 where the division plate 4 joins the shell 1, the total length of the whole pockets so formed being divided up into two lengths, at least, by means of a vertical division plate 32 at each side as will be clear from Figs. 1, 4 and 5. In Fig. 1 the division plates 32 are shown fitted immediately over the inlet side of shutter-baffle 23 so that the oil pockets 30 are formed at each side between the division plates 32 and the end cover 3 while the oil pockets 31 are formed at each side between the division plate 32 and the end cover 2. Any oil which collects in the pockets 30 is led direct to the top of the oil dome 8 by pipes 33 whilst any oil which collects in the pockets 31 is led to the dome by pipes 34.

The cleansed water now flows on past baffle 29 and can now increase its velocity, passing under plate 35 to the outlet 10 where it resumes its normal rate of flow, to enable it to be discharged to any suitable place, such as the sea in the case of the apparatus being used on ships for dealing with their bilge or ballast water discharge over-board.

By leading any separated oil direct to the top of the oil dome by pipes as above described the oil does not need to rise from the bottom of the dome and so over the discharge control float, as with heavy viscous oils their flow over the float may put the latter out of balance by reason of masses of this oil adhering to the bottom and sides. To prevent, as far as possible, any oil occupying the bottom of the dome, a pipe 36 is provided to connect the oil-dome with the upper chamber 5 at a point as low as possible.

This pipe is to allow water to pass from the dome equal in quantity with the volume of oil which is collecting in the top of the dome and inversely, when the collected oil is being discharged from the dome, this pipe allows an equal quantity of water to enter to take the place of the oil.

The construction of the separator when it is to be used for separating oils heavier than the water is, as shown in Fig. 7, similar to the construction just described and the arrangement of the parts and their function will be clear from the preceding description.

The oil which collects in the dome 8 is discharged therefrom when a predetermined amount has collected, through pipe 37 (Figs. 3 and 4) the passage of oil through which is controlled by the oil discharge device consisting of a gate valve 38 or similar type of valve which has its spindle connected to a piston moving within a cylinder 39, fluid under pressure being admitted to the cylinder on either side of the piston, to move the latter and open or close the valve, through pipes 40 and 41 which are appropriately connected to a source of fluid under pressure by a rotary or shuttle valve actuated by movements of a control float 42 located within the oil dome 8 and moving downwardly with the level of the collected oil, the float being attached to one end of a lever 43 having a balance weight 44 at its other end.

A feature of the present invention consists in the arrangement of this float in such a manner that its controlling effect that is, the turning movement by which it rotates the shuttle valve is increased as it moves in a direction which will cause the oil discharge valve to be opened to allow the collected oil to be discharged from the collecting dome. The reason for this is that it has been found that viscous oils tend to retard

the movements of the float and it is necessary to provide a compensating leverage to balance the viscosity resistance of viscous oils, which in many cases is an effort equal to the specific gravity effort of such oils.

If the specific gravity effort is nullified by the viscosity effort, the float will be supported, wholly or partly, in the oil, and in due proportion to this, there will be a partial or complete loss of effort transmitted by the lever 43, so that if any power is transmitted it may not be sufficient to operate the shuttle-valve which controls the open and closed positions of the oil-discharge valve.

To obtain the required increased turning moment or leverage the float is attached to the lever 43 in such a manner that it moves in a straight vertical path as it turns the lever about its fulcrum so that the leverage moments of the float about the lever fulcrum are always constant, while the balance weight is directly secured to the lever and therefore travels in a curved path as the lever turns, the curved path being an arc having as radius the distance of the centre of gravity of the balance weight from the lever fulcrum. As a result of such arcuate movement the horizontal distance between the lever fulcrum and the centre of gravity of the balance weight, and therefore the moment of the weight about the fulcrum, decreases as the balanced end of the lever rises and the resulting effect is that of an increased turning moment by the float as it moves downwardly as the collected oil in the dome increases.

The float 42 may be caused to travel in a straight vertical path by means of guides, slotted-levers or other like devices, but preferably the effect is obtained with the minimum of frictional loss, by attaching arcuate quadrants 45 to the lever at the end used for carrying the float, the radii of the quadrants being that of a distance equal to the vertical centre-line of the float from the fulcrum of the lever while the amount that the quadrant path projects above the lever is a distance equivalent in radial travel at least to the vertical travel of the float downwards. The end of the lever carrying the quadrants is forked to provide two arms 46 and a quadrant is attached to each arm and the float is hung from the top ends of these quadrants, by means of any suitable flexible connections 47 such as wire-ropes, chains or like fittings which are attached at 48 to the quadrants 45 and pass thereover and have at their free ends eyelets 49 which receive bolts 50 screwed into the float. This provides that whatever vertical position the float is in during its stroke, it is always at constant distance from the fulcrum and therefore at constant leverage.

To prevent any swaying movement of the float when the apparatus is fitted to ships suitable guides, such for instance, as guide-wheels 51 carried in brackets 52 attached to the sides of the dome are provided around the inside of the oil-dome to allow the float to pass freely up and down in a vertical path, while the lower ends of the quadrants are formed into looped guides 53 which prevent the flexible connections 47 from leaving the quadrants.

The balance weight 44 moves in an extension chamber 54 formed at the side of the collecting dome 8, the lever 43 being pivoted on stub-shafts 55 carried in ball bearings in glands 56 secured into the side walls of the extension chamber 54. The extension 54 is provided with a removable cover 57 and an air pipe 57a connects the cover 57 with the top of the oil dome to allow any air

trapped in the chamber 54 to pass to the oil dome and thence out with the discharged oil.

The float end of the lever 43 is prevented from rising above a horizontal position by a fixed or adjustable stop 58 formed in the wall of the oil dome while downward movement of the float is limited by fixed or adjustable stops 59 formed at the bottom of the dome. The normal positions of the float, lever and balance weight (i. e. when there is no oil in the dome) are shown in full lines in Fig. 1, while the position which they occupy when oil is to be discharged are shown in chain-dotted lines and it will be clear from a comparison of the two positions that, with the arrangements above described, the float moves in a straight vertical path while the horizontal distance between the centre of gravity of the balance weight and the lever fulcrum is less in the raised (dotted) position of the weight 44 than in the normal (full line) position, that is, in effect, the weight has travelled horizontally inwards towards the fulcrum. This inward travel of the balance weight towards the fulcrum means a loss of leverage at that side of the fulcrum and therefore is equivalent to an increase of leverage moment on the float side; this increasing leverage moment of the float as it descends enables viscosity resistance to be overcome. The amount of inward travel of the balance weight must not be allowed to reach a point which would cause the float to become heavier than the water, otherwise it would not rise to the top again when the oil-discharge valve allowed the oil to pass from the dome.

As the float rises, its leverage moment will decrease, as the balance weight is travelling outwards and increasing its leverage effort, which is equivalent to the float becoming lighter, and this ensures that the float has sufficient power, towards the end of its upward stroke, to operate the shuttle valve controlling the oil-discharge valve.

In the case of the inverted arrangement shown in Fig. 7 the normal position of the float, when there is no oil in the dome 2, is at the bottom of its stroke as shown by the chain-dotted lines. As the oil collects the float rises to the position shown in full lines to open the discharge valve 32, the rise of the float being assisted by the increasing moment of the balance weight 44 as the lever 43 moves to the horizontal position.

To make the apparatus suitable for main-flow liquids of different specific gravities, such as fresh or salt water, I provide a device to alter the setting of the balance weight in relation to the fulcrum. When the weight is furthest from the fulcrum, then it suitably balances the float for the fresh water, which is of lighter specific gravity, and when set to that position it moves up and down with the lever as previously described.

By bringing the weight nearer the fulcrum, the float is then balanced for salt water, which is of greater specific gravity than fresh water. This balance-weight shifting device provides for the weight being accurately moved the requisite setting distance and then for the weight remaining fixed thereat whilst the apparatus is working and also for the change of setting being carried out whilst the apparatus is actually in use. The shifting device is so arranged that it does not absorb the power effort of the float acting on the shuttle valve when the float moves up or down.

Either the whole balance weight 44 may be moved to suit the variation in specific gravity of the main flow or, as in the arrangement shown,

this weight is made in two parts and only a smaller central portion 44a is moved through a longer distance to achieve an equal setting.

By this means I obtain a finer setting through having a longer travel of adjustment to work on, and at the same time I am enabled to use a lighter construction of mechanism through only having to move a smaller weight.

Movement of the weight 44a may be effected by rams, pistons-gear-wheels, levers or like devices, but preferably the weight 44a is moved, as in the present construction (see Figs. 2 and 5), by means of a shaft 60 provided with right and left hand screw threads 61, 62, on which are fitted two traversing nuts 63, 64, to each of which is attached one end of a lever 65 by a hinge pin.

These two levers 65 are connected at their other ends by means of a common hinge-pin or bolt 66 which also passes through an eye bolt or bracket fixed to the movable part 44a of the balance weight.

When the double screw shaft 60 is rotated by means of an external hand wheel 67, this causes the traversing-nuts 63, 64, to travel either towards or away from one another, and so draw in or push away the connected ends of their levers 65 which thus act as a toggle so that the movable part 44a of the balance weight is also made to travel in or out.

The main lever fulcrum shafts 55 are made hollow so that this double-threaded screwed shaft 60 can be fitted through the centre, thereby ensuring that in whatever position the weight is set, it is free to move with the main lever 43 about the lever fulcrum as centre, as the two nuts 63, 64, simply move round the screws without operating the same.

One end of the doubled threaded shaft 60 passes out through a stuffing-box and a suitable tell-tale gear consisting of a scale 68 and screw-operated pointer 69 may be fitted to show, externally, the specific gravity setting of the balance-weight.

At the opposite side of the balance-weight chamber 54 the main lever fulcrum shaft 55 is suitably connected to the shuttle valve 70 which controls the opening and closing of the oil-discharge valve 38.

This shuttle valve is of a rotary or semi-rotary type to reduce the frictional resistance and, as shown in detail in Figs. 12 to 14, comprises an outer casing or body 71 within which is a liner 72 having steam and exhaust ports and within the liner moves the rotary shuttle or piston 73 having suitable ports which co-act with those in the liner 72. The body is provided with four unions or screwed sockets which receive pipe connections as follows: to 74 is attached a pipe supplying fluid, such as steam, air, or water, under pressure; 76 receives the combined pressure and exhaust pipe 40 which connects the shuttle valve with the top port of the oil discharge valve operating cylinder 39; to 75 is connected the combined pressure and exhaust pipe 41 leading to the bottom port of cylinder 39, while to 77 is connected an exhaust pipe leading to atmosphere or a condenser.

The rotary shuttle 73 is connected with the main lever fulcrum shaft 55 by means of an extension shaft 78 which is coupled to a stub shaft 73a on the shuttle 73 through a lost motion device, such as any of the arrangements illustrated in Figs. 15 to 18 which are self explanatory.

The connections between the separator and the supply and discharge pipe lines are shown in

Figs. 8 and 9 in which 79 is the pipe for the supply of mixture to the separator and 80 is the pipe for the flow of cleansed water or other heavier liquid from the separator. 81 indicates the static head of inlet and outlet pipe-lines 79, 80, above the oil discharge pipe line 37 to cause oil to be forced out of the dome, when the valve 38 is opened. The amount of this static head difference will be fixed to suit individual requirements of separators when they are installed, as the distance of the oil receiving tank away from or above the separator will be the deciding factor.

The operation of the automatic discharge device for emptying the dome of collected oil is as follows:—

When the apparatus is first used it is filled with clean water, salt or fresh, the weight moving device consisting of the shaft 60, the two traversing nuts 63, 64 the links 65, are operated by means of the hand wheel 67 to cause the movable weight 44a to be moved either in or out to the desired specific gravity position for salt or fresh water as being used through the separator.

Assuming fresh water was employed, then the balance weight would be moved away from the fulcrum to a position for a specific gravity of 1.0.

This would bring the float 42 to the top of its stroke, there being then no oil present in the dome 8, the float being buoyant in fresh water but sinkable in oils of less specific gravity than 1.0.

In reaching this position the float 42 will have acted through the fulcrum shaft extension spindle 78, upon the rotary shuttle 73 causing it to rotate within the body 71, until the port admitting steam or other fluid pressure to the bottom of cylinder 39, is opened, admitting pressure to lower side of the piston therein thereby closing the oil-discharge valve 38 so that there can be no discharge from the dome 8. At the same time the upper end of the cylinder 39 is connected to exhaust, the position of the shuttle valve 73 being as shown in Fig. 14. As oil begins to collect in the dome 8 as a result of oil-mixture being pumped through the separator, the float 42 will descend with the water-oil level and an equal volume of water to that of the collected oil will be passed out of the bottom of dome 8 through pipe 36 to the inner chamber 5.

On reaching the bottom position of its travel, the float 42 will cause the fulcrum-shaft extension-spindle 78 to reverse the position of the shuttle 73, as shown in Fig. 12 and by admitting steam or fluid pressure to the upper side of the piston in the cylinder 39 and opening the lower side to exhaust, the oil-discharge valve 38 will be opened to allow the oil collected to pass out of the dome 8 to pipe 37 for conveying same to a suitable oil-bunker or tank.

Whilst the collected oil is being discharged, the float 42 will ascend with the oil-water level, and so reverse the position of the rotary-shuttle valve 73 and the oil valve will again be closed when the float 42 reaches the top of its stroke.

These automatic cycles of opening and closing the discharge valve 38 will be repeated as long as the apparatus is working and oil collecting. Such automatic control gear ensures perfect accuracy in the working of the separator, and prevents water being discharged with the oil which is delivered to the bunker and likewise ensures that water only is discharged through pipe 80.

The complete absence of hand operated skimming devices such as are used with other separators, enables all human attendance to be dispensed with, except for starting and stopping the

pump which delivers the oily mixture to the separator, and for altering the setting of the movable balance weight, should at any time the flow water be fresh instead of salt or vice versa, but this only amounts to operating, in the latter case, the handwheel 67 and observing that the tell-tale pointer 69 is at the correct specific gravity setting.

In cases where the flow liquid, as in certain industrial process work, may change during the pumping, from one specific gravity to another, I may employ a pilot float to operate an automatic device for shifting the movable balance weight, instead of having to resort to hand operation. This pilot float would be constructed so that it would float at various specific gravity levels, within a given range, and would be connected to suitable fluid pressure or electric control gear for moving the balance weight to the correct position to equal the specific gravity of the flow-water then being recorded by the pilot float.

The discharge of the oil from the dome as previously described, requires that the inlet and outlet water pipes 79 and 80 to the separator be kept at a higher level than the oil-discharge pipe 37 in order to have the necessary pressure to force the oil out of the dome and with this arrangement the discharge of water automatically ceases, as it rises instead inside the dome to take the place of the oil which it is forcing out; this takes place without any water discharge valve having to be closed or opened, as the volume of flow through the separator seeks the easier way out by the lower level pipe, which is the oil-pipe 37 but before water can get out the float closes the oil-discharge valve 38, thereby ensuring that oil only is discharged.

If it should be found in certain cases, when installing the apparatus, that it is impossible to obtain the necessary static head difference 81 between the water pipe 79 and 80 and the oil discharge pipe 37, then a suitable oil-pump 82 (Fig. 10) driven by fluid pressure or electric power would be used to empty the dome 8, by connecting the pump suction 83 to the oil-outlet in the top of the dome, the valve 38 being dispensed with, and the pump delivery 84 to the oil discharge pipe 37 to the bunker.

The stopping of the oil pump or the starting of the same would be controlled as before by the float operating a rotary shuttle-valve 73 to supply or cut off power via pipe 85 to the pump, in accordance with the float strokes, or in the case of an electric pump the float would operate an electric switch to stop and start the pump.

Such arrangements of power driven pumps would enable the oil dome to be automatically emptied of collected oil irrespective of the pressure on the flow-liquid passing through the separator, and the oil could be delivered to any distance or height necessary.

The oil-dome may also be emptied by means of the arrangement shown in Fig. 11, but in this case the shell 1, dome 8, and their respective connecting pipes and covers etc. must be made strong enough to stand the maximum pressure which can be exerted by the pump employed to deliver the flow-mixture via pipe 79 to the separator.

The oil discharge valve 38 and its operating cylinder 39, containing piston 39a, and supplied with pressure fluid through pipes 40 and 41 under the control of the shuttle valve are retained but the piston rod is extended, on the opposite side from valve 38, to form an additional rod 85 which is coupled to a valve 87, similar in design to the

oil-discharge valve 38 but this valve 87 is inserted in the water-outlet pipe 80. The valves 38 and 87 are so coupled, that when one of them is open the other is closed or vice versa.

5 The resultant effect is that when the float opens valve 38 as previously described, it now closes at the same time valve 87 thereby cutting off all flow via water-outlet pipe 80, but as the oil discharge valve 38 is open, an equal flow is set
10 up through the oil pipe line 37, at a pressure equal to the pump pressure supplying the mixture.

As the oil is discharged, the float 42 rises with the oil-water level in dome 8, so that shuttle valve is reversed, and the valve 38 again closed before
15 any water can pass into oil-pipe 37; at the same time valve 87 will be opened to allow the flow of discharge-water to be resumed.

As the valves 38 and 87 open and close in unison, but in reverse, to each other, no shock effects can
20 be set up in the apparatus, when the flow paths are thus changed in direction.

With all my forms of automatic discharge-valve devices, any air which may be introduced with the flow mixture and gather at the top of
25 dome 8, will, in a similar manner to the oil, be discharged via the pipe 37, as the float will react either to oil or air in the dome as if the float sinks in oil, it will do so in air.

Due to this there is no necessity with my apparatus for any air-discharge device of a special
30 nature for this purpose to be fitted to the separator, thereby reducing the cost of manufacture.

If the apparatus is used in the inverted position as shown in Fig. 7 to enable oils that are
35 heavier than water to be removed, the accumulations of air would not occur, as the air is free to pass out with the discharge-water via outlet 10.

To prevent air accumulating under the internal baffles or divisions, it will only be necessary
40 to provide tiny air holes in the top of these to allow any air to free itself and pass on with the flow.

A steam heating coil or electric heating element 88 is provided in the dome 8 for the purpose
45 of rendering viscous oils fluid enough to flow out of the discharge valve 38 when the latter is opened and this coil forms part of a steam pipe or heater 89 extending through the pipe 19 and under the plate baffle 17 to ensure that the oil flows freely.
50 For a similar purpose the shutter-baffle plates 23a and 23a, may, if desired, be made from thin flattened tubes, welded or otherwise fastened into another flattened tube which will be bent round and welded together to fit inside the ovate cham-
55 bers 5 and 6, the whole forming steam or electric heating elements, so that oil-encased water-globules impinging thereon will be broken down, thereby enabling the specific gravity rise of the oil to operate and cause it to ascend out of the
60 main-flow water.

The separator shown in Figs. 1 to 6 is supported on suitable feet 90, while brackets 91 are provided to carry the oil dome 8 on the body 1.

The drawings of the apparatus have omitted
65 from them any form of stiffening bars or frames, as these will be added as required according to the usual manufacturing requirements for strengths of the parts to bear the necessary working pressure to which they will be subject.

70 The degree of quiescence obtained by my devices, is so effective that greatly increased outputs of discharge can be obtained as compared with that from separators using the well-known method of stepped-plate flow chambers, as these
75 plates accelerate the flow over or under them to

such an extent, that the apparatus has to be of very large dimensions to allow of the correct flow rate through the passages over or under the plates, but even then eddy and boring currents
5 are set up by the plates which still tend to make that type of apparatus much less efficient than a very much smaller apparatus of my design, made in accordance with the information and drawings given in my present application.

Where it is vitally important that not even the
10 slightest trace of oil can under any circumstance whatever pass from my apparatus, such as when it is used for dealing with boiler feed-water, or in certain industrial processes, internal or external filters of any suitable kind may be fitted
15 in conjunction with my apparatus, to make it comply with regulations or special requirements.

The separator according to the invention may be fitted into, or constructed in the form of, a barge or lighter, to make it suitable for portable
20 use in harbours for dealing with discharge water from ships not fitted with any form of oil-separating device. Also the separator may be built into ships as part of their structure, for example as part of the ballast-tanks or double
25 bottom-tanks, or pump-rooms to assist in the economizing of weight and space on board.

In cases where the space available for installing the separator is very limited in height, the oil-dome may be fitted in a remote position,
30 above the level of the top of the separator body the connecting pipes between the separator and dome, as shown in the various figures, merely having to be lengthened to suit. The fitting of the oil-dome in a remote position in this manner
35 does not in any way adversely affect the efficiency or operation of the apparatus as a whole.

What I claim as my invention and desire to secure by Letters Patent is:—

1. Apparatus, for the separation of liquids of
40 different specific gravities from a mixture of such liquids, comprising a plurality of quiescence chambers of ovate form in vertical cross-section through which the mixture is passed, an inlet
45 said apparatus and an outlet therefrom, a collecting chamber arranged out of the direct line of flow of the mixture and in which one of the separated liquids is collected, the quiescence
50 chambers being arranged with their greater horizontal area towards the collecting chamber, a swirl chamber adjacent the inlet to the apparatus in which the entering liquid is subjected to a
55 swirling or compacting action whereby the globules of the collected liquid are caused to coalesce, a pipe for conducting the coalesced globules direct
60 to the collecting chamber, such pipe opening at one end immediately adjacent the outlet from the swirl chamber and opening at its other end into the end of the collecting chamber remote
65 from the quiescence chambers, pipes extending from the quiescence chambers to the end of the collecting chamber remote from said quiescence
70 chambers whereby any liquid which subsequently separates out is led direct to the collecting chamber, and means for discharging the collecting
75 liquid from the collecting chamber.

2. Apparatus for the separation of liquids of different specific gravities from a mixture of such liquids comprising a plurality of quiescence
70 chambers of ovate form in vertical cross-section through which the mixture is passed, an inlet and an outlet from said quiescence chambers, a collecting chamber arranged out of the direct
75 line of flow of the mixture and in which one of the separated liquids is collected, the quiescence

chambers being arranged with their greater horizontal area towards the collecting chamber, shutter baffles in said quiescence chambers formed of a plurality of narrow strips extending horizontally one above the other but inclined to the direction of flow through the chambers, and means for emptying the collecting chamber of collected liquid.

3. Apparatus for the separation of liquids of different specific gravities from a mixture of such liquids comprising a plurality of quiescence chambers of ovate form in vertical cross-section through which the mixture is passed, an inlet to said apparatus and an outlet therefrom, a collecting chamber arranged out of the direct line of flow of the mixture and in which one of the separated liquids is collected, the quiescence chambers being arranged with their greater horizontal area towards the collecting chamber, means for discharging the collected liquid from the collecting chamber, shutter baffles in the quiescence chambers formed of a plurality of narrow strips extending horizontally one above the other but inclined to the direction of flow through the chambers, and plate baffles in combination with said shutter baffles to provide a quantity of stationary liquid to form dead water between the shutter baffle and said plate baffle to form hydraulic baffles.

4. Apparatus for the separation of liquids of different specific gravities from a mixture of such liquids comprising a plurality of quiescence chambers of ovate form in vertical cross-section through which the mixture is passed and forming the body of the apparatus, a collecting chamber arranged out of the direct line of flow of the mixture and in which one of the separated liquids is collected, the quiescence chambers being arranged with their greater horizontal area towards the collecting chamber, an inlet for the mixture to be separated, a swirl chamber surrounding the inlet and consisting of a combined inlet hood and deflecting plate formed of two curved side wings which form with the bottom of the swirl chamber a pair of nozzles, the sides of said swirl chamber being curved round inwardly towards one another whereby entering mixture is caused to form two opposing streams which issue from the nozzles and are given a rotary motion by the inwardly curved sides, a pipe for conducting the resulting globules of collected liquid direct to the collecting chamber, said pipe opening at one end immediately adjacent the outlet from the swirl chamber and opening at its other end into the end of the collecting chamber remote from the quiescence chambers, pipes extending from the quiescence chambers to the end of the collecting chamber remote from said quiescence chambers whereby any liquid which subsequently separated out is led direct to the collecting chamber, an outlet from the body of the apparatus and means for discharging the collected liquid from the collecting chamber.

5. In a separating device for the separation of liquids of different specific gravities from a mixture of such liquids and in which the lighter or the heavier liquid as the case may be, is collected in a chamber and discharged therefrom under the control of a float within the collecting chamber and moving up and down with the level of the collected liquid, a lever within the chamber, the float being hung from the lever by means of flexible connections passing over arcuate guides on the end of the lever, so that the float can move up and down in a true vertical path as

it turns the lever about its fulcrum, whereby its moment about the fulcrum of the lever remains constant, and a balance weight rigidly attached to the other end of the lever so that it moves in an arcuate path whereby its moment about the lever fulcrum varies as it moves up or down, giving the effect of an increase in the moment or effective controlling weight of the float as it moves downwardly, in the case of a lighter liquid, to allow discharge of the collected liquid or giving the effect of a decrease in the moment or effective controlling weight of the float as it moves upwardly to allow discharge of the collected liquid in a case where the heavier liquid is collected.

6. In a separating device for the separation of liquids of different specific gravities from a mixture of such liquids and in which one of the separated liquids is drawn off or discharged under the control of a float within a chamber in which the separated liquid collects and moving up and down with the level of the collected liquid, a control float arranged to move in a vertical path and connected to one end of a lever the other end of which carries a balance weight having a portion thereof movable towards or away from the fulcrum of the lever to enable the control to operate correctly when dealing with main flow liquids of different specific gravities, the said movable portion of the balance weight is capable of being moved towards or away from the lever fulcrum by means of a shaft extending through the lever fulcrum and having right and left-handed screw threads on which work traversing nuts connected by links with the movable portion of the balance weight, the links forming a toggle so that rotation of the screwed shaft to move the nuts towards or away from one another causes the movable part of the balance weight to recede from or approach the lever fulcrum.

7. Apparatus for the separation of oil and water from a mixture thereof comprising a plurality of quiescence chambers of ovate form in vertical cross-section through which the mixture is passed and arranged with their greater horizontal area towards the top of the apparatus, an inlet to said apparatus through which the mixture enters, an outlet from the lower end of said quiescence chambers through which the water flows away, an oil dome arranged above said quiescence chambers and in which the oil collects, a swirl chamber surrounding the inlet to the apparatus in which the entering mixture is subjected to a swirling action whereby the globules of oil are caused to coalesce, a pipe for conducting the coalesced oil globules direct to the oil dome and opening at one end immediately above the swirl chamber and opening at its other end into the top of the oil dome, pipes extending from the upper parts of said quiescence chambers to the top of the oil dome, a control float movable vertically within said oil dome and moving up and down with the level of the collected oil, a lever carrying said float, a balance weight on the end of the lever remote from the float, a discharge valve for controlling the discharge of the oil from the oil dome, a piston connected to the spindle of said valve, a cylinder within which said piston is movable, and control means operated by movement of the lever to control the supply of pressure to said cylinder to move the piston therein and open and close the oil discharge valve, whereby the oil is allowed to collect in said dome and is automatically dis-

charged when a predetermined amount has collected.

8. Apparatus for the separation of oil and water according to claim 7, in which the control means operated by movement of the lever comprises a rotary valve connected to the fulcrum of the lever and turned by movement of the lever fulcrum, as the float moves up and down, to admit fluid under pressure on one side of the piston connected to the discharge valve and connect the other side of the piston to exhaust as the float reaches the lower limit of its movement so that the discharge valve is opened and to admit fluid under pressure to the other side of the piston and connect the first mentioned side to exhaust to close the oil discharge valve when the float reaches the upper limit of its vertical movement.

9. Apparatus for the separation of oil and water from a mixture thereof comprising a plurality of quiescence chambers of ovate form in vertical cross-section through which the mixture is passed and arranged with their greater horizontal area towards the top of the apparatus, an inlet to said apparatus through which the mixture enters, an outlet from the lower end of said quiescence chambers through which the water flows away, an oil dome above said quiescence chambers and in which the oil is collected, a swirl chamber surrounding the inlet to the apparatus in which the entering mixture is subjected to a swirling action whereby the globules of oil are caused to coalesce, a pipe for conducting the coalesced oil globules direct to the oil dome and opening at one end immediately above the swirl chamber and opening at its other end into the top of the oil dome, pipes extending from the upper parts of said quiescence chambers to the top of the oil dome, an extension on one side of said oil dome, a lever fulcrumed in the side walls of said extension, a control float movable up and down within said oil dome with the level of the collected oil and connected to said lever by flexible connections passing over arcuate guides on one end of the lever whereby the float is enabled to move vertically, a balance weight on the other end of said lever and moving in a curved path within the extension of the oil dome, a portion of said balance weight being movable towards or away from the lever fulcrum by means of a shaft coaxial with the lever fulcrum and having right and left handed screw threads on which are movable two traversing nuts connected by links with the movable part of the balance weight, said screwed shaft projecting at one end through a side wall of the extension of the oil dome and having an operating hand-wheel and indicator on its projecting part, a rotary valve situated at the opposite side of the oil dome extension from that through which the screwed shaft projects and connected to the movable lever fulcrum through a lost motion connection, an oil discharge valve controlling the discharge of oil from the oil dome, and a power operated device for opening and closing said discharge valve and comprising a piston connected to the spindle of said valve and movable within a cylinder, the supply of working fluid to said cylinder being controlled by rotation of the rotary valve as the float moves up and down in the oil dome with the level of the collected oil to open the oil discharge valve when a predetermined amount of oil has collected in the dome and to close the oil discharge valve when the float reaches the top limit of its vertical travel as the collected oil is discharged.

10. Apparatus for the separation of oil and water according to claim 9 in which the piston connected to the oil discharge valve is also connected to a valve in the water outlet pipe and arranged to be closed when the oil discharge valve is opened and to open as the oil discharge valve is closed.

11. Apparatus for the separation of oil and water from a mixture thereof comprising a plurality of quiescence chambers of ovate form in vertical cross-section through which the mixture is passed and arranged with their greater horizontal area towards the top of the apparatus, an inlet to said apparatus through which the mixture enters, an outlet from the lower end of said quiescence chambers through which the water flows away, an oil dome above the quiescence chambers and in which the oil is collected, a swirl chamber surrounding the inlet to the apparatus in which the entering mixture is subjected to a swirling action whereby the globules of oil are caused to coalesce, a pipe for conducting the coalesced oil globules direct to the oil dome and opening at one end immediately above the swirl chamber and opening at its other end into the top of the oil dome, pipes extending from the upper parts of said quiescence chambers to the top of the oil dome, an extension on one side of said oil dome, a lever fulcrumed in the side walls of said extension, a control float movable up and down within said oil dome with the level of the collected oil and connected to said lever by flexible connections passing over arcuate guides at one end of the lever, whereby the float is able to move vertically, a balance weight on the other end of said lever and moving in a curved path within the extension of the oil dome, a portion of said balance weight being movable towards or away from the lever fulcrum by means of a shaft coaxial with the lever fulcrum and having right and left handed screws on which are movable two transversing nuts connected by links with the movable part of the balance weight, said screwed shaft projecting at one end through a side wall of the extension of the oil dome and having an operating hand-wheel and indicator on its projecting part, a rotary valve situated at the opposite side of the oil dome extension from that through which the screwed shaft projects and connected to the movable lever fulcrum through a lost motion connection, a pump connected at its suction side to the top of the oil dome and at its discharge side to an oil discharge pipe and a power operated device for operating said pump, the supply of power to said device being controlled by the rotary valve to set the pump in operation when a predetermined amount of oil has collected in the dome and stop the pump when the collected oil has been discharged.

12. Apparatus for the separation of liquids of different specific gravities from a mixture of such liquids comprising a plurality of quiescence chambers of ovate form in vertical cross-section, arranged with their greater horizontal area towards the top, through which the mixture is passed and forming the body of the apparatus, the quiescence chambers being formed by an outer shell of ovate form in vertical cross-section and a division plate extending completely across the outer shell about midway of its height to divide it into an upper quiescence chamber and a lower quiescence chamber having oil collecting pockets formed at the junction of a division plate with the outer shell, an inlet to the body of the apparatus above the division plate, an outlet for the

water at the bottom of the lower quiescence chamber, an opening in said division plate connecting the upper quiescence chamber with the lower chamber, baffles in said quiescence chambers, an oil dome above the top of said outer shell, a swirl chamber surrounding the inlet and having its outlet at the top, a pipe opening at its lower end above the outlet from the swirl chamber and at its upper end into the top of the oil dome, a pipe opening at its lower end into the top of the upper quiescence chamber over the opening in the division plate and at its upper end into the top of the oil dome, pipes extending from said oil pockets to the top of the oil dome, a pipe connecting the lower end of the oil dome with the upper quiescence chamber, an extension on one side of the oil dome, a normally horizontal lever fulcrumed in the side walls of the extension and forked at one end, a control float hung by flexible connections passing over arcuate guides on the forked end of the lever and movable up and down in a vertical path with the level of the collected oil whereby the lever is turned, guide wheels for said float on the sides of the oil dome, stops limiting the upward and downward movements of the float, a balance weight attached to the end of the lever remote from said float, and moving in a curved path in the extension of the oil dome, a portion of said balance weight being movable towards or away from the lever fulcrum by means outside the oil dome, heating means in the upper quiescence chamber and in the pipe extending from above the swirl chamber to the top of the oil dome and in the oil dome and surrounding the float, power operated means for effecting the discharge of oil from the oil dome, and means operated by turning movement of the lever to control said power operated means to cause discharge of the collected oil when the float reaches the lower limit of its vertical movement and to stop the discharge of collected oil when the float reaches the upper limit of its vertical movement.

13. Apparatus for the separation of oils heavier than water from a mixture of such oils and water, comprising a plurality of quiescence chambers of ovate form in vertical cross-section through which the mixture is passed and arranged with their greater horizontal area towards the bottom of the apparatus, an inlet to said apparatus through which the mixture enters, an outlet from the upper end of said quiescence chambers through which the water flows away, an oil dome arranged below said quiescence chambers and in which the oil collects, a swirl chamber surrounding the inlet to the apparatus in which the entering mixture is subjected to a swirling action whereby the globules of oil are caused to coalesce, a pipe for conducting the coalesced oil globules direct to the oil dome and opening at its upper end immediately below the swirl chamber and opening at its lower end into the bottom of the oil dome, pipes extending from the lower parts of said quiescence chambers to the bottom of the oil dome, a control float movable vertically within said oil dome and moving up and down with the level of the collected oil, a lever carrying said float, a balance weight on the end of the lever remote from the float, a discharge valve for controlling the discharge of the oil from the oil dome, a piston connected to the spindle of said valve, a cylinder within which said piston is movable, and control means operated by movement of the lever to move the piston therein and open and close the oil discharge valve, whereby the oil is allowed to

collect in said dome and is automatically discharged when a predetermined amount has collected.

14. Apparatus for the separation of oil heavier than water from a mixture of such oil and water, comprising a plurality of quiescence chambers of ovate form in vertical cross-section through which the mixture is passed and arranged with their greater horizontal area towards the bottom of the apparatus, an inlet to said apparatus through which the mixture enters, an outlet from the upper end of said quiescence chambers through which the water flows away, an oil dome below said quiescence chambers and in which the oil is collected, a swirl chamber surrounding the inlet to the apparatus in which the entering mixture is subjected to a swirling action whereby the globules of oil are caused to coalesce, a pipe for conducting the coalesced oil globules direct to the oil dome and opening at its upper end immediately below the swirl chamber and opening at its lower end into the bottom of the oil dome, pipes extending from the lower parts of said quiescence chambers to the bottom of the oil dome, an extension on one side of said oil dome, a lever fulcrumed in the side walls of said extension, a control float movable up and down within said oil dome with the level of the collected oil and connected to said lever by flexible connections passing over arcuate guides on one end of the lever whereby the float is enabled to move vertically, a balance weight on the other end of said lever and moving in a curved path within the extension of the oil dome, a rotary valve situated at the exterior of one side of the oil dome extension and connected to the movable lever fulcrum through a lost motion connection, an oil discharge valve controlling the discharge of oil from the oil dome, and a power operated device for opening and closing said discharge valve and comprising a piston connected to the spindle of said valve and movable within a cylinder, the supply of working fluid to said cylinder being controlled by rotation of the rotary valve as the float moves up and down in the oil dome with the level of the collected oil to open the oil discharge valve when a predetermined amount of oil has collected in the dome and to close the oil discharge valve when the float reaches the bottom limit of its vertical travel as the collected oil is discharged.

15. Apparatus for the separation of oils heavier than water from a mixture of such oil and water, comprising a plurality of quiescence chambers of ovate form in vertical cross-section, arranged with their greater horizontal area towards the bottom, through which the mixture is passed and forming the body of the apparatus, the quiescence chambers being formed by an outer shell of ovate form in vertical cross-section and a division plate extending completely across the outer shell about midway of its height to divide it into a lower quiescence chamber and an upper quiescence chamber having oil collecting pockets formed at the junction of a division plate with the outer shell, an inlet to the body of the apparatus below the division plate, an outlet for the water at the top of the lower quiescence chamber, an opening in said division plate connecting the lower quiescence chamber with the upper chamber, baffles in said quiescence chambers, an oil dome below said outer shell, a swirl chamber surrounding the inlet and having its outlet at the bottom, a pipe opening at its upper end below the outlet from the swirl chamber and at its lower end into the bottom of the oil dome, a pipe opening at its upper

end into the bottom of the lower quiescence chamber below the opening in the division plate and at its lower end into the bottom of the oil dome, pipes extending from said oil pockets to the bottom of the oil dome, a pipe connecting the upper
5 end of the oil dome with the lower quiescence chamber, an extension on one side of the oil dome, a lever fulcrumed in the side walls of the extension and forked at one end, a control float hung
10 by flexible connections passing over arcuate guides on the forked end of the lever and movable up and down in a vertical path with the level of the collected oil whereby the lever is turned, guide wheels for said float on the sides of the oil dome,
15 stops limiting the upward and downward movements of the float, a balance weight attached to

the end of the lever remote from said float, and moving in a curved path in the extension of the oil dome, heating means in the lower quiescence chamber and in the pipe extending from below the swirl chamber to the bottom of the oil dome
5 and in the oil dome and surrounding the float, power operated means for effecting the discharge of oil from the oil dome, and means operated by turning movement of the lever to control said
power operated means to cause discharge of the
10 collected oil when the float reaches the upper limit of its vertical movement and to stop the discharge of collected oil when the float reaches the lower limit of its vertical movement.

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