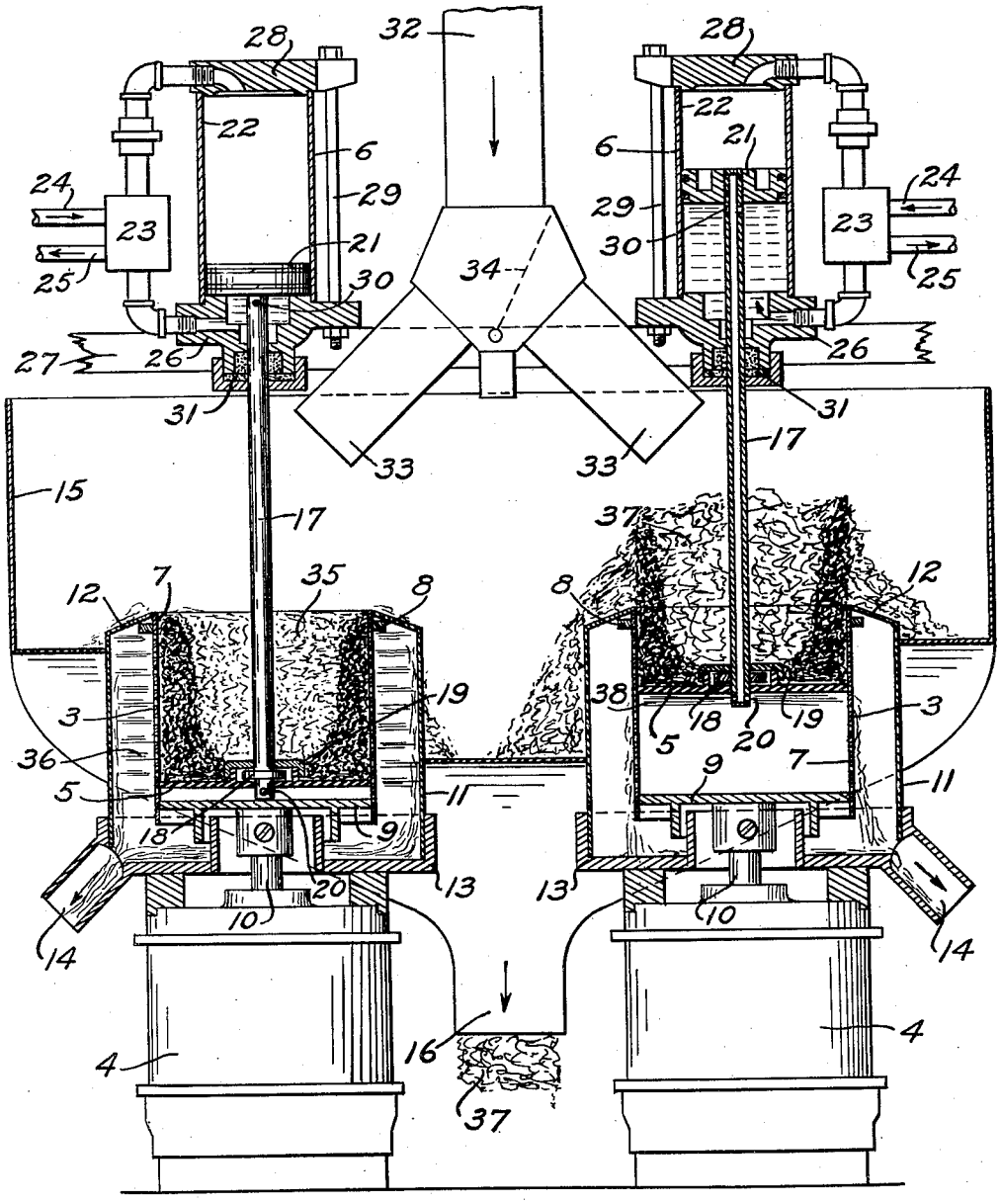
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CENTRIFUGE

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CENTRIFUGE

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My present invention relates in general to improvements in the art of separating the constituents of mixtures, and relates more specifically to various improvements in the construction and operation of rotary centrifugal separators or centrifuges.

Generally defined, an object of the present invention is to provide an improved centrifuge which is simple in construction and efficient in operation.

It has heretofore been common commercial practice to separate various mixtures of materials into ingredients or constituents thereof, with the aid of centrifugal force induced in batches of the materials while being revolved at high speed, and this method of separation is especially useful in the separation of liquids from solids. While many types of centrifugal separators known as centrifuges have heretofore been proposed and used with more or less success, most of these prior machines are relatively complicated and suitable for some particular purpose only; and none of the simpler prior rotary separators of the centrifugal type have been well adapted for efficient separation of ice from free liquid in which the ice is carried in suspension or with which the ice in granular or flake form is saturated. It is frequently desirable to quickly and automatically remove excess liquid from ice in relatively granulated condition such as slush ice or chipped ice, and in some cases the excess liquid may be brine while in others this fluent constituent may be pure water or other liquid.

It is therefore a more specific object of my present invention to provide an improved centrifugal separator especially adapted for the purpose of effectively removing excess free liquid from an ice mixture.

Another specific object of my invention is to provide a new and useful rotary separator for effecting removal of liquid from a mixture of liquid and solid material.

A further specific object of this invention is to provide an improved centrifuge which can be readily loaded and unloaded, and which is highly efficient in normal use.

Still another specific object of the invention is to provide an improved twin system of operating centrifuges whereby batches of material may be treated to produce continuous delivery of the separated constituents.

An additional object of my invention is to provide improved instrumentalities for effecting removal of the solid ingredients which are separated from liquid in a centrifuge, and for maintaining such machines in most effective operating condition.

A further object of the present invention is to provide an improved centrifuge which is compact and durable in construction, which may be manufactured and operated at moderate cost, and which is especially adapted to convert sea water into fresh water.

These and other objects and advantages will be apparent from the following description.

A clear conception of the several features constituting the present invention, and of the mode of constructing and operating centrifuges embodying the improvement, may be had by referring to the drawing accompanying and forming a part of this specification wherein like reference characters designate the same or similar parts in the various views.

The single figure of the drawing is a somewhat diagrammatic central vertical section through a twin centrifuge assemblage showing one of the units in operation while the other is being unloaded.

While the invention has been shown and described herein as having been embodied in a twin assemblage especially adapted for the purpose of continuously separating excess liquid from ice, it is not my desire or intent to thereby unnecessarily restrict the scope or utility of the improvement.

Referring to the drawing, the twin centrifuge assemblage shown therein comprises in general a pair of similar centrifugal separator units each consisting of a perforated circular member or open topped basket **3** adapted to be rotated at several speeds about a vertical axis by means of an electric motor **4**, and each having therein a plate element or piston **5** adapted to be moved vertically within its confining basket by means of a hydraulic jack **6**.

Each of the open topped circular separating members or baskets **3** has an annular perforated shell **7** provided with an upper re-enforcing ring **8** and with an imperforate supporting bottom **9**, and the latter is detachably attached to the driving shaft **10** of the corresponding motor **4**. The rotor or basket **3** of each centrifuge unit is revolvable within an annular stationary housing or casing **11** the upper end of which has an inwardly extending flange **12** which co-operates with the adjacent rotor ring **8** to form a seal, and the lower extremity of which is mounted in a drain basin **13** carried by the corresponding motor **4** and provided with a liquid discharge conduit **14**. A common hopper **15** for receiving

the relatively solid material separated from the free liquid in both of the centrifuge units, may also be provided at the exteriors of the fixed casings 11, and this hopper has a discharge spout 16 located between the two machines. The electric motors 4 for driving the baskets 3, are of well known construction, and each of these motors is preferably operable at high and low speeds so controlled, that each motor may be operated at high speed during centrifugal separation, and at low speed during loading and unloading of the basket 3. Each motor should also be provided with a switch permitting either independent or simultaneous operation of the two centrifuges.

The ice removers or pistons 5 which are movable within and along the central vertical axes of the perforated baskets 3, may be loosely suspended from the lower ends of hollow piston rods 17 by means of collars 18 secured to these rods and coacting with removable caps 19 secured to the pistons 5. The pistons 5 are thus free to rotate with their respective baskets 3 both when in lowermost position and while being elevated or lowered, and these pistons provide imperforate load carrying bottoms for the baskets and should have rather snug peripheral coaction with the interiors of the basket shells 7. The hollow piston rods 17 have their extreme lower and upper ends sealed, but are provided with lower liquid discharge orifices 20 beneath the plate pistons 5.

Each of the load lifting devices or hydraulic jacks 6 comprises a plunger 21 secured to the upper end of the adjacent piston rod 17 and being slidable within a cylinder 22; and a control valve 23 of any suitable construction for admitting liquid under pressure to the plunger displacement chambers from a supply pipe 24, and for permitting escape of the liquid from these chambers to an exhaust or drain pipe 25. The lower end heads 26 of the cylinders 22 may be stationarily mounted upon a fixed support 27, and may be tied to the upper end heads 28 by means of tie-bolts 29; and the displacement chambers beneath the plungers 21 are preferably connected with the interiors of the piston rods 17 directly beneath the plungers 21 by means of small orifices 30. The lower cylinder heads 26 are preferably provided with suitable packing glands 31 for preventing undesirable escape of liquid from the jacks 6, and the travel of the plungers 21 should be sufficient to permit vertical movement of the plate pistons 5 from lowermost position within the baskets 7 as shown at the left of the drawing, to uppermost position with the upper surfaces of the pistons 5 flush with the tops of the baskets.

A downwardly directed mixture supply duct 32 is disposed between the jacks 6 and has inclined supply spouts 33 at its lower extremity, which are directed toward the upper open ends of the perforated baskets 7. The junction of this duct 32 with the spouts 33 may be provided with an adjustable diverter valve 34 for interchangeably directing fresh material which is to be treated, into the two centrifuge units, and this valve 34 may be connected to the liquid pressure control valves 23 so as to cause properly timed alternate delivery of fresh material to the two centrifuges when operating at low speed. This operation may be produced either mechanically or electrically with simple means of obvious construction, and the mechanism should permit independent operation of the two separating units if so desired. When the centrifuges are employed to separate free liquid from ice, the supply duct 32 may communicate directly with an ice producing machine adapted to deliver either slush or chipped ice mixed with excess liquid.

During normal operation of the improved twin centrifuge, the baskets 7 are being constantly revolved by the motors 4 and either of these baskets 7 may be laden with a mixture 35 of relatively solid material and free liquid as indicated at the left of the drawing, and when a basket 7 is thus laden with mixture 35 the driving motor 4 thereof should be operating at high speed. Due to the action of centrifugal force upon the mixture 35, the solid material will collect upon the interior of the basket 3 in the form of a hollow cylinder of ice, and the free liquid will then be discharged through the perforations of the rapidly revolving basket in the form of spray 36 and the separated liquid will gravitate from the machine through the discharge conduit 14. During this separating operation of the centrifuge, the plate piston 5 should be in its lowermost position and may revolve with the perforated basket 7.

Simultaneously with this operation of one of the centrifuges, the other centrifuge may be operated at low speed during unloading as indicated to the right of the drawing. Liquid under pressure will then be admitted by the control valve 23 of this other centrifuge, to the displacement chamber beneath the plunger 21 and this admitted liquid will elevate the plunger 21 and the corresponding piston 5 and will lift the relatively solid hollow cylinder of ice 37 which will be broken up in the manner shown at the right of the drawing, and will eventually be deposited by centrifugal action into the hopper 15 from which it will gravitate through the spout 16 as indicated. Simultaneously with this elevation of the load, liquid under pressure will be delivered through the orifices 30, piston rod 17 and discharge ports 20 in the form of spray 38 against the interior of the revolving basket 7, and during this unloading operation the driving motor of the basket 7 should preferably be operated at low speed. When the separating operation in one basket has been completed, and complete unloading and refilling of the other basket at low speed has been effected, the operation of the two centrifuges may be interchanged by merely operating the valves 23, 34 and by causing the motor 4 at the left to operate at low speed while the other motor is caused to operate at high speed. The cycle of operation may thus be continued or repeated to produce substantially continuous operation or separation of the solids from the liquid, except for possible slight intervals lost in reloading the baskets 3 with fresh material while rotating at low speed. However, if intermittent treatment of successive batches of mixture 35 is all that is required and an intermittent supply of fresh material is available, then either of the centrifuge units may be operated alone to produce intermittent separation.

The admission of liquid to the piston rods 17 and delivery of fresh liquid spray 38 against the interiors of the baskets 7 is especially desirable when separating ice from excess liquid, since it prevents closure of the perforations by freezing, and facilitates movement of the pistons 5 within the baskets 7. By taking this fresh liquid supply from the jack actuated system, the structure is reduced to its simplest form and a spray 38 of desired velocity is readily obtainable. Since the plate pistons 5 should be snugly fitted within the perforated baskets 7, it is also relatively impor-

tant that these pistons 5 be permitted to rotate with the baskets, and the suspension collars 18 will permit such simultaneous rotation without necessarily causing the piston rod 17 from which the pistons 5 are suspended, to rotate. These solids removing lifting elements or pistons 5 need not necessarily be flat, but may be formed as helical auger plates or spiral troughs for lifting the hollow cylinder of ice during unloading. The baskets 3 need not be circular but may also be polygonal, and all parts of the two machines may be made interchangeable with each other thereby facilitating manufacture of the units, and the improved centrifuges need not be furnished in pairs, but may also be supplied individually.

From the foregoing detailed description it will be apparent that my present invention provides an improved centrifuge which is relatively simple and compact in construction, and which is moreover highly efficient and automatic in operation. By operating the centrifuges in twin sets, a continuous supply can be used, and the improved units while being adapted to separate any solid constituents from a mixture of liquid and solid, are especially adapted for the purpose of removing ice from free liquid with which the granulated ice may be initially mixed. The improved centrifuge has proven highly successful for this particular purpose, and may therefore be used to advantage for the specific purpose of converting ocean or sea water containing a small percentage of salt, into fresh or drinking water.

It should be understood that it is not desired to limit this invention to the exact details of construction or to the precise mode of operation, herein shown and described, for various modifications within the scope of the claims may occur to persons skilled in the art.

I claim:

1. In combination, a perforated open-topped basket rotatable about an upright axis, a lifting element for solid material movable within said basket along said axis, a hydraulic jack having a displacement chamber coacting with a movable member to elevate said element and to thereby effect removal of solid material through the open top of said basket, and a hollow rod connecting said movable jack member with said lifting element, the hollow interior of said rod communicating with said jack chamber and having lower outlet openings for delivering liquid from the displacement chamber against the interior of said basket during elevation of said element.

2. In combination, a perforated circular open-topped basket rotatable about an upright axis, a lifting piston for solid material movable within said basket along said axis, a hydraulic jack having a displacement chamber coacting with a movable plunger to elevate said piston and to thereby effect removal of solid material through the open top of said basket, and a hollow rod connecting said plunger with said piston, the hollow interior of said rod communicating with said displacement chamber and having outlet openings for delivering liquid from said chamber against the interior of said basket beneath said piston during elevation of the latter.

3. In combination, a perforated open-topped cylindrical basket rotatable about an upright axis, a lifting piston for solid material slidable within said basket along said axis, a hydraulic jack located above said basket and having a displacement chamber coacting with a movable plunger to elevate said piston and to thereby effect upward removal of solid material through the open top of said basket while rotating, and a hollow motion transmitting rod connecting said plunger with said piston, the hollow interior of said rod communicating with said displacement chamber and having outlet openings for delivering liquid from said chamber against the interior of said basket beneath said piston during elevation of the latter.

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