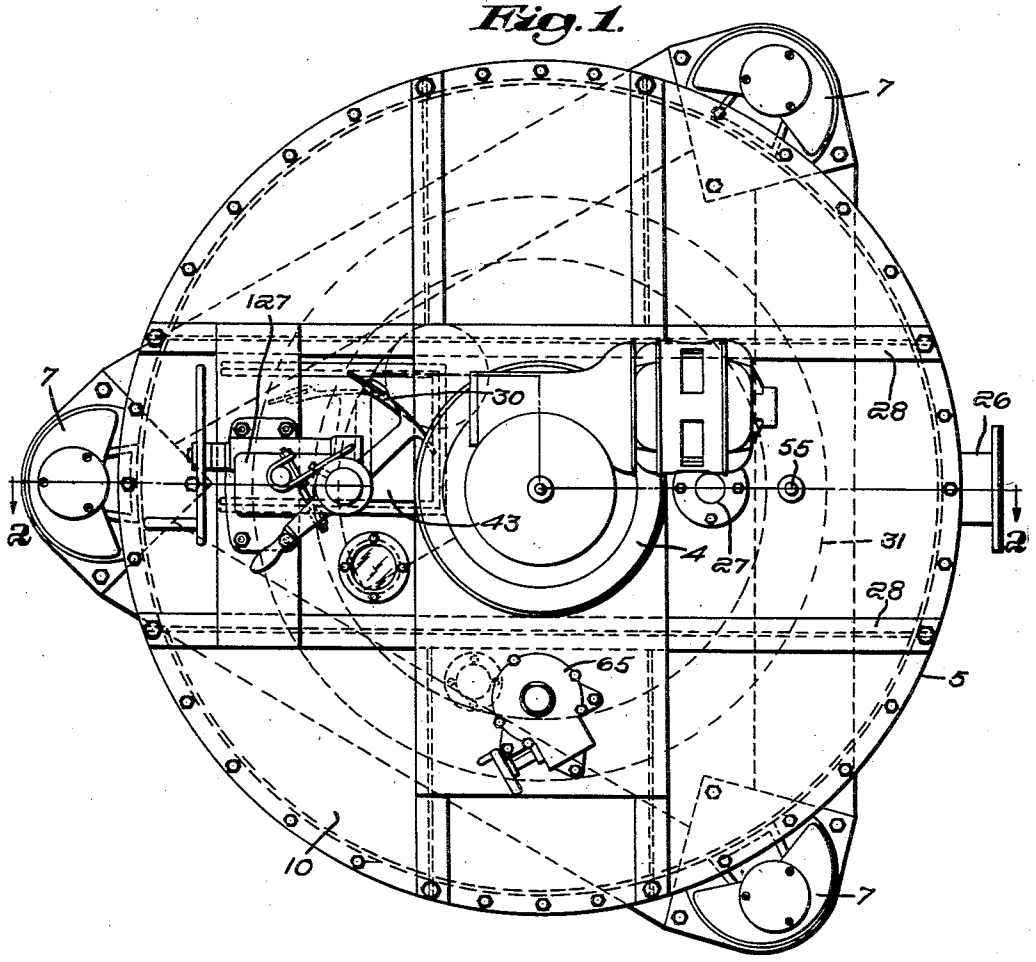
March 12, 1946. J. F. THOLL 2,396,622

CENTRIFUGAL SEPARATOR

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Fig. 1.



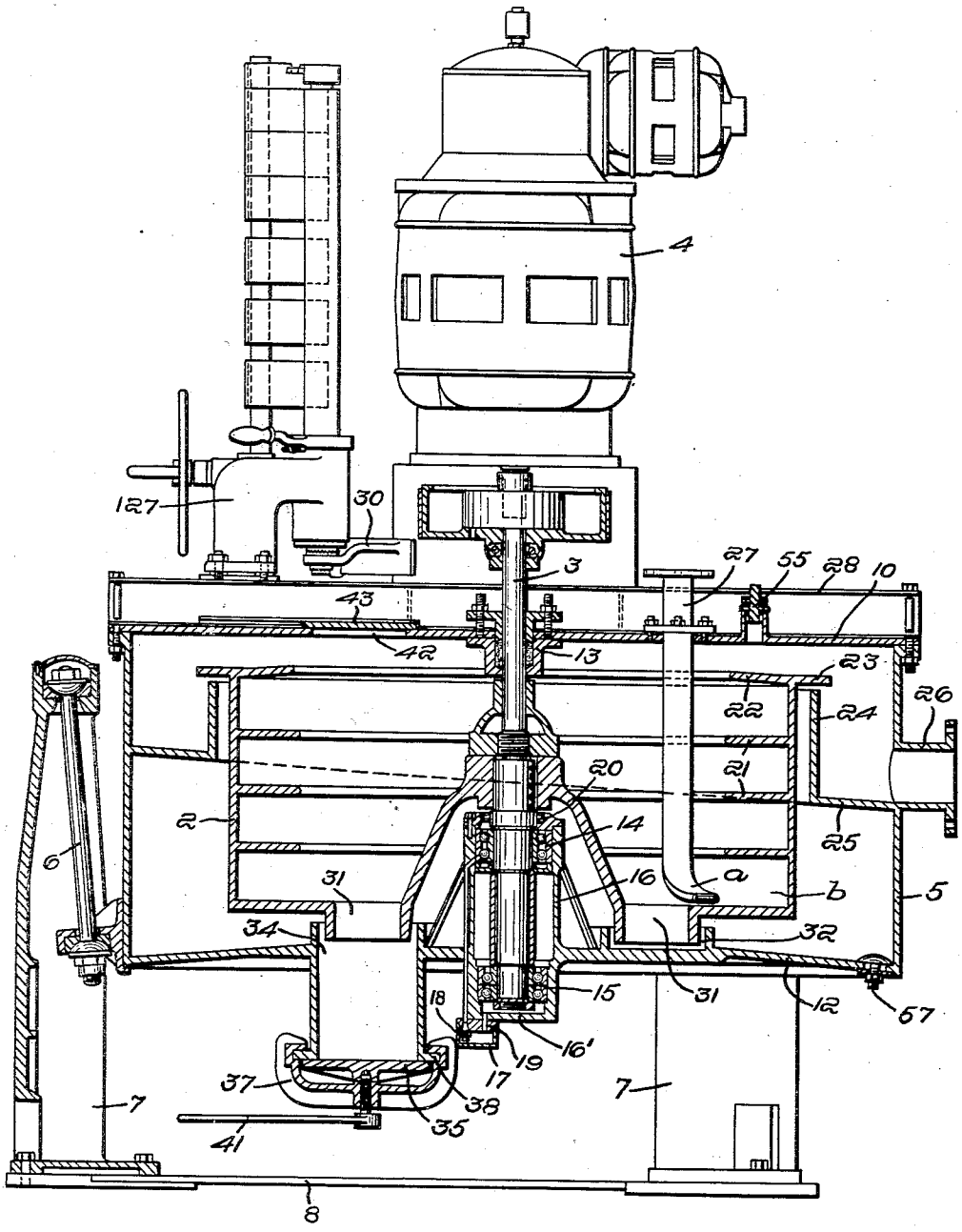
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Fig. 2.



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Fig. 3.

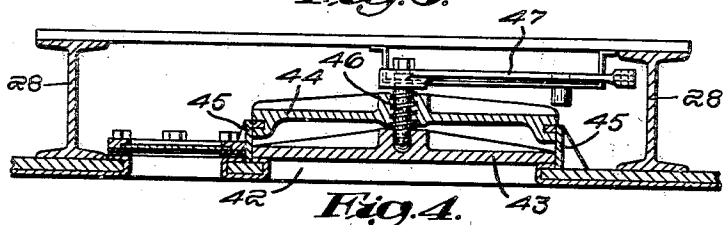
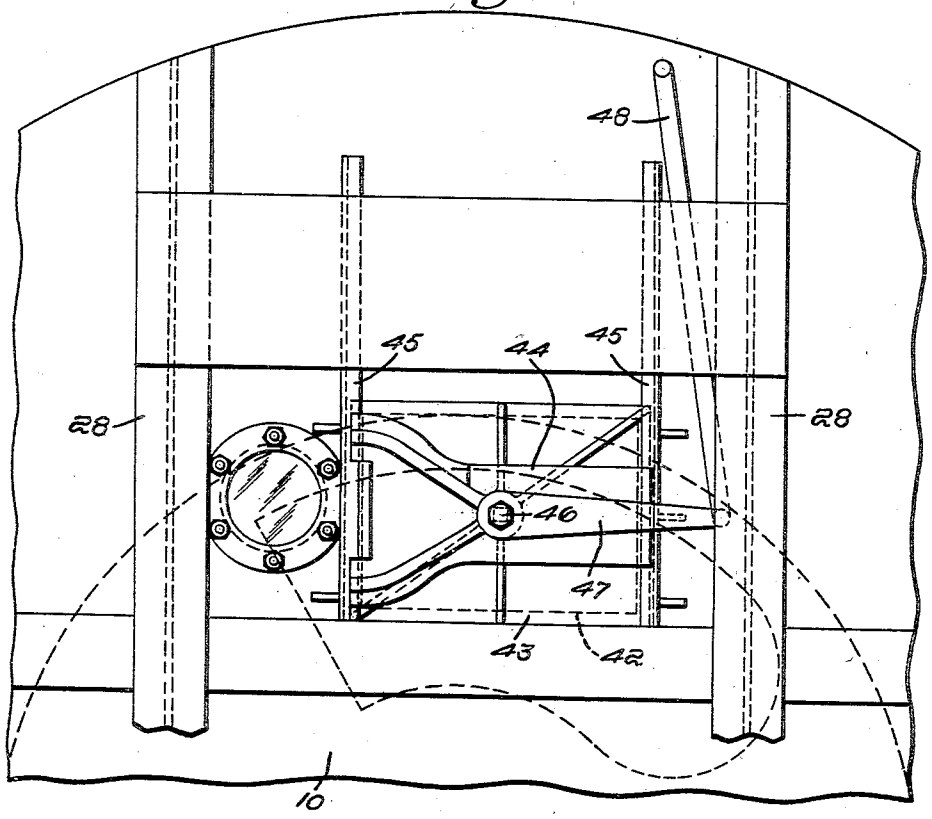


Fig. 4.



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Fig. 5.

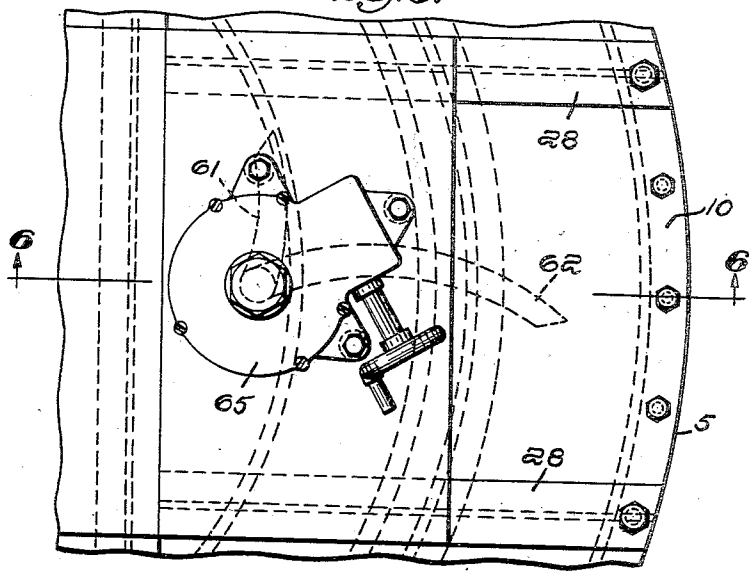
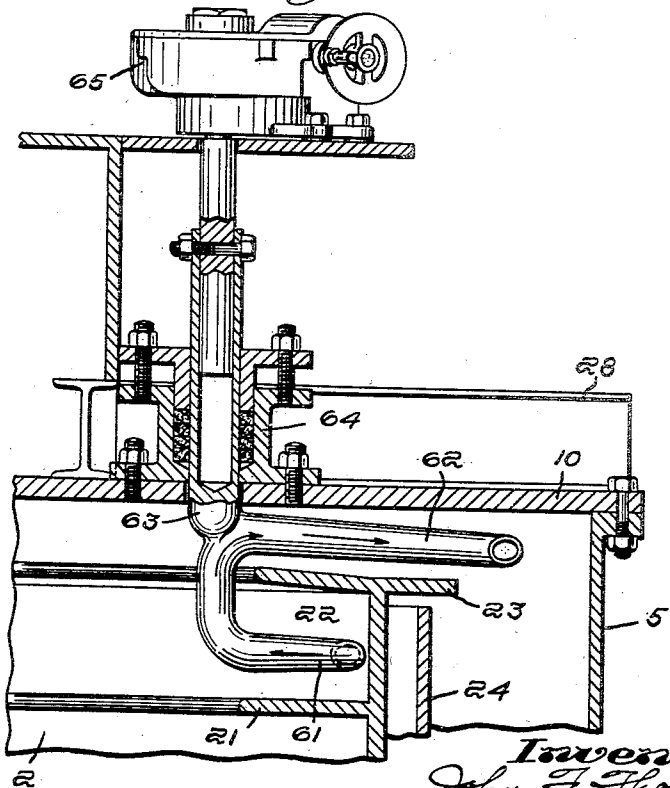


Fig. 6.



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Fig. 7.

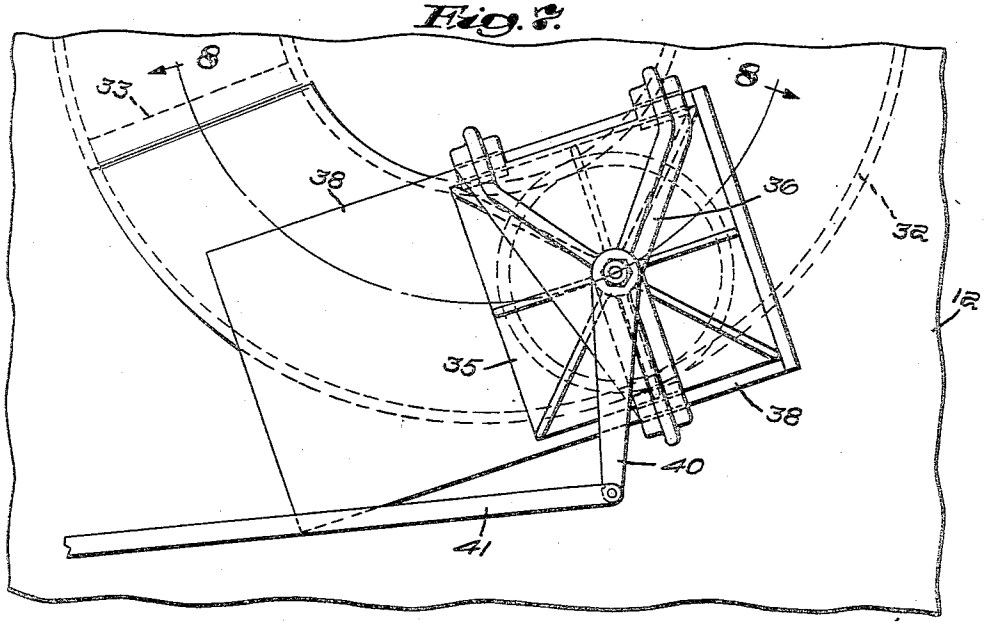
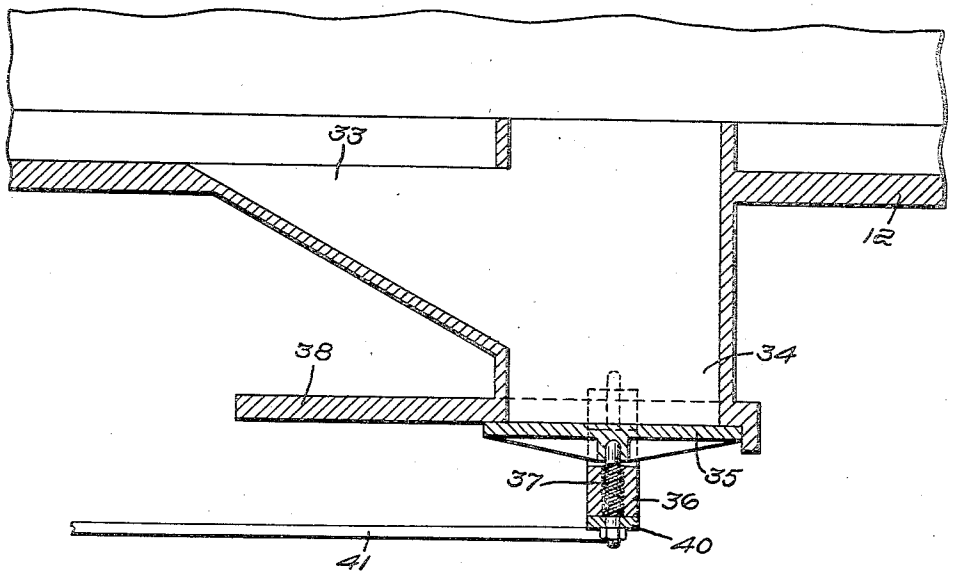


Fig. 8.



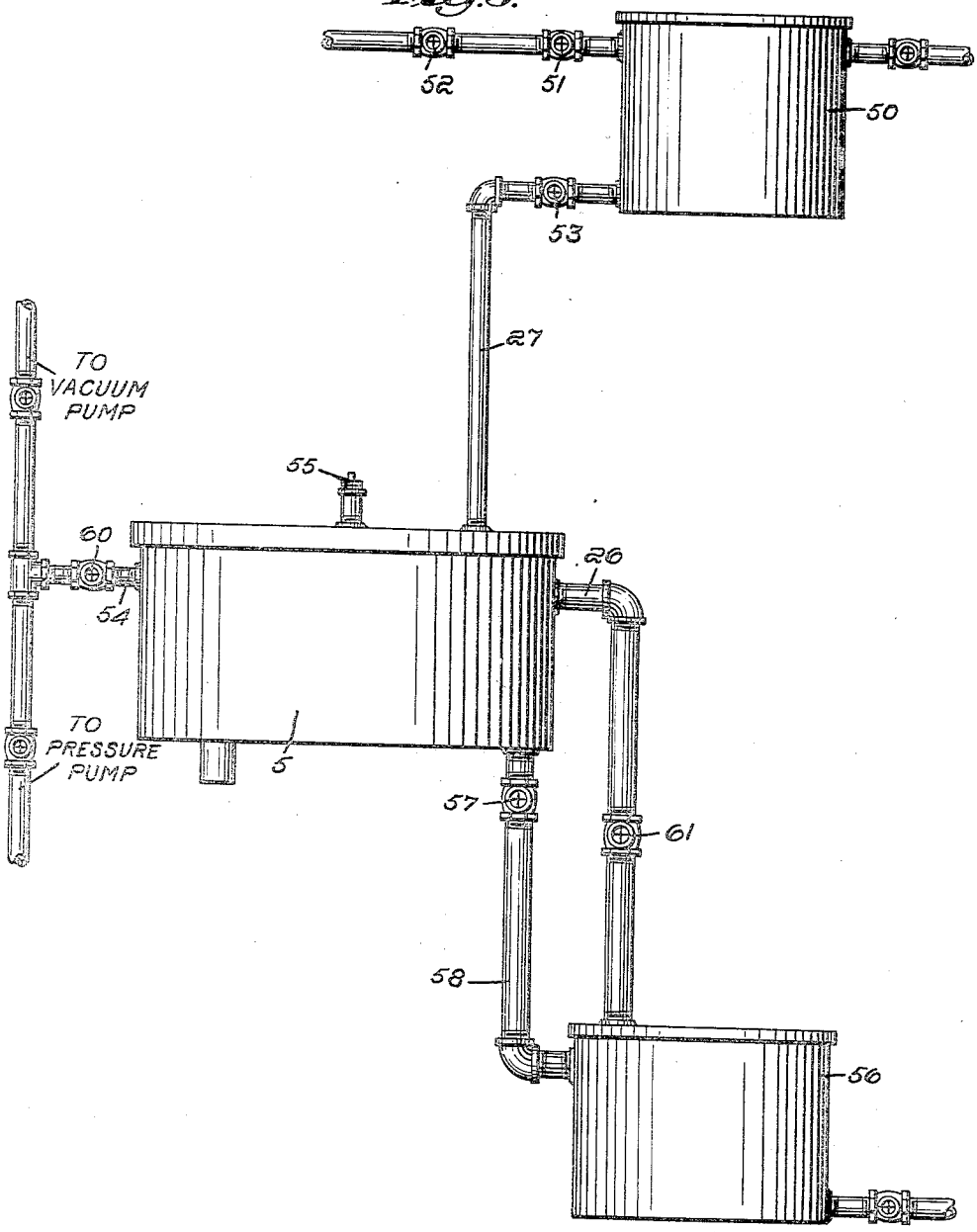
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Fig. 9.



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2,396,622

UNITED STATES PATENT OFFICE

2,396,622

CENTRIFUGAL SEPARATOR

John F. Tholl, Needham, Mass., assignor to American Tool & Machine Co., Boston, Mass., a corporation of Massachusetts

Application May 1, 1942, Serial No. 441,284

6 Claims. (Cl. 233—22)

In some industries it is desirable to perform a centrifuging operation under pressure as, for example, when the liquid phase of the material undergoing treatment is volatile or contains a highly volatile constituent, or to control foaming, or when it is desired to effect the separation in the presence of an inert gas. There are other situations, also, when it is desirable to conduct this operation under a vacuum, or to apply pressure or vacuum at certain stages of the process.

The present invention is especially concerned with these considerations and it aims to devise a centrifugal separator which will meet the requirements of situations of this character.

It is also an object of the invention to devise an apparatus of this type which can be operated continuously, so far as the matter of handling the liquid is concerned, while still operating under pressure or a vacuum, if desired, or with a gas differing in nature from the atmosphere.

The nature of the invention will be readily understood from the following description when read in connection with the accompanying drawings, and the novel features will be particularly pointed out in the appended claims.

In the drawings,

Figure 1 is a plan view of a centrifugal separator embodying features of this invention;

Fig. 2 is a vertical, sectional view taken approximately on the line 2—2, Fig. 1, but with some parts omitted;

Figs. 3 and 4 are sectional and plan views, respectively, of an arrangement for closing the opening through which the discharger plane is lowered and raised;

Fig. 5 is a plan view of a skimmer embodying a feature of the invention;

Fig. 6 is a sectional view approximately on the line 6—6, Fig. 5, but with one arm of the skimmer swung into a different plane for purposes of illustration;

Fig. 7 is a bottom view of a cover mechanism for opening and closing the outlet for the solid material;

Fig. 8 is a sectional view on the line 8—8 of Fig. 7; and

Fig. 9 is a diagrammatic view of parts of a system in which the centrifugal may be operatively connected.

Referring first to Figs. 1 and 2, the machine there shown comprises a centrifugal basket 2 mounted on a vertical shaft 3, which, in this particular form, is driven by a two-speed power unit 4 of the character shown in Patent No. 2,112,430. The basket is mounted in, and completely enclosed by, a stationary casing 5 suspended at three points around its periphery by links, one of which is shown in Fig. 2 at 6, and these links are hung from the upper ends of three pedestals 7, all supported on a base 8. This method of support is well known in this art.

As above indicated, provision must be made for maintaining the casing in an air tight condition, and for that reason it has, in addition to the usual circumferential wall, top and bottom plates 10 and 12, respectively, secured to the wall 5 by air tight connections. Also, at the point where the shaft 3 passes through the casing top 10 a stuffing box 13 is provided to prevent the leakage of air along said shaft.

The lower end portion of the shaft is supported in upper and lower sets of ball bearings 14 and 15, and these are enclosed in a tubular casing section 16 which is either made integral with, or is secured rigidly to, the bottom plate 12 to prevent the leakage of air therethrough. This casing section includes a bottom 16' and a cap 17 is screw-threaded to an extension of it so that it can be removed to permit access to a lubricant fitting 18 closing the lower end of a tube which conducts the oil, grease, or other lubricating material to the upper bearing 14. The surplus flows down to the lower bearing by gravity. In washing out the bearing the cap 17 may be removed, cleaning solvents can be forced through the fitting 18 into the upper bearing, and it will drain down through the bearing structures and out through the drain port 19 which normally is closed by the cap 17. A grease seal 20 just above the bearing 14 prevents the lubricant from working upwardly along the shaft.

The basket 2 is of the imperforate type and it includes a series of radial baffles 21, which divide the peripheral portion of the basket chamber into a series of superposed annular compartments. Also, it is provided at its upper edge with a flat annular rim or plate comprising an inwardly extending flange 22 and another outwardly projecting flange 23. The latter overlaps the upper and inner edge of a curb lying between the wall 5 of the casing and an inner wall 24 closely surrounding the basket, and above a bottom sheet 25, the bottom being inclined toward the right, Fig. 2, to produce a gravity flow of the discharged liquid through an outlet pipe 26.

Assuming, for example, that the apparatus is to be used to clarify a liquid containing a relatively small proportion of solid material, such liquid may be led into the basket through an intake pipe 27 which extends downwardly through

the main body of the basket and terminates in an outwardly curved tip *a* serving to direct the liquid into the lowermost compartment *b* in the basket. As the centrifuging operation proceeds and the solids are deposited in said compartment, the liquid will overflow into successively higher compartments and finally will be decanted over the upper face of the flange 22 and discharged into the curb. As these operations continue and successive compartments become filled with solids, it becomes necessary after a time to stop the machine and to unload the basket. For this purpose a novel construction of both the basket and the casing is provided.

A discharger of the character shown in my earlier Patent No. 2,063,472 is particularly suited to this purpose, and such an apparatus is shown in the drawings at 127 in Figs. 1 and 2 mounted on top of the casing, the latter being reinforced for this purpose by girders 28—28.

As explained in detail in said patent, this discharger includes a plough 30 mounted to be lowered into the basket and to be moved successively into position to scrape the solids out of the compartments between the baffles and to direct this material backwardly toward the central part of the basket.

An annular outlet for the discharge of this material is provided at 31, Fig. 2, through the bottom of the basket, this outlet, however, being bridged at suitable intervals with stiffening ribs connecting the concentric walls which define the opening. These walls project downwardly below the main bottom sheet of the basket into an annular groove 32 formed in the bottom 12 of the casing. Consequently, as the solids are dislodged and are guided inwardly by the plough while the basket revolves slowly, they fall through the opening 31 and are carried around the groove until they drop into an elongated slot 33, Figs. 7 and 8, formed through the bottom of the groove. This slot is curved about the axis of the basket and its bottom slopes downwardly to a circular hole or discharging opening 34 at the end of the slot. Normally this opening is closed by a cover 35 supported on a spider-shaped slide 36 by means of a central screw 37. The slide is mounted on ways 38 which are either integral with the bottom sheet 12, or are rigidly connected thereto, and the arrangement is such that by turning the screw 37 in the proper direction it will clamp the cover 35 in its closed position against the outer margin of the opening 34. For this purpose an arm or lever 40 is secured to the lower end of the screw 37 and it has a handle 41 pivoted to the outer end thereof so that by pulling on this handle the lever will be swung into line with the ways 38 and simultaneously the screw will be rotated about its own axis sufficiently to lower the cover 35. A further pull on the handle will draw both the slide 36 and the cover away from the opening 34 sufficiently to clear the latter entirely.

This operation is performed at the beginning of the discharging process and as the latter proceeds the solid material falls through the discharge outlet until the basket has been unloaded so far as it is practicable to do so. The discharge outlet then is closed by a reversal of the operations just described, and the discharger plough 30 is withdrawn to its inoperative position, as shown in Fig. 2.

It is necessary to have an opening in the casing top 10 for the introduction and removal of the plough and to provide a tight cover for that opening. Such an opening and cover are shown in Figs. 1, 3 and 4 at 42 and 43, respectively. The means for clamping this cover in its closed position, or opening it and moving it out of the way, are substantially like those provided for operating the cover 35. That is, the cover 43 is mounted on a slide 44 supported on guides 45—45, this mounting being effected through a screw 46 equipped with a lever 47 to which a handle 48 is connected. By pulling on the handle 48 the screw 46 will be rotated sufficiently to release the cover from its seat and a further pull will slide the cover and its support 44 outwardly away from the opening 42 for the passage of the discharger. A reversal of these operations returns the cover to its closed position and clamps it there.

Typical connections for using the machine as above described are shown in Fig. 9. The supply of liquid to be treated may be drawn from a supply tank 50, Fig. 9, into which it is forced from any suitable source and on which the desired pressure is maintained through a pressure regulating valve 51 leading from an air supply line or from a source of gas under pressure in the event that the process is being carried on with a gas other than air. A control valve 52 is connected in this line. The rate of flow of liquid into the centrifugal may be controlled by a valve 53. Suitable connections to a source of air pressure, gas under pressure, or to a vacuum pump, may be made through the pipe 54 and the valves necessary for controlling the flow. Preferably also an automatic pressure relief valve 55, Figs. 2 and 9, is connected into the top of the casing. As the centrifuged liquid is discharged through the pipe 26 it may be conducted into a reservoir or surge tank 56 and the drain plug or valve 57, Figs. 2 and 9, may be connected by a pipe 58 with the same tank.

Preliminary to starting the centrifuging operation, the pressure initially desired may be applied through the pressure pump or vacuum pump, depending upon whether a positive or negative pressure is to be used, and the control valve 60 in the pipe 54 then is closed. Thereafter sufficient pressure will be maintained by the incoming stream of liquid. Or, the connection through the pipe 54 with the pumps may include a pressure regulating valve to maintain such pressure. The discharged liquid flows through the pipe 26 by gravity into the tank 56 and the latter is under the same pressure maintained in the casing because the pipe 26 is made large enough to accomplish this result. The air or gas in the tank displaced by the incoming liquid simply flows back into the casing 5 and as pressure tends to build up, due to this action, it will be relieved automatically through the valve 55.

In some cases, it is preferable to conduct the liquid to be discharged out of the upper compartment of the basket rather than merely to allow it to overflow the upper edge of the basket, as above described. For this purpose, I have provided a skimmer of a novel form, including a tubular intake arm 61, integrally connected with a discharge arm 62, and similarly connected, also, with a supporting shaft 63 which extends upwardly through a stuffing box 64 mounted in the casing 5. Above the casing the shaft is connected with an operating mechanism enclosed in a casing 65. This mechanism may be like that disclosed in my prior Patent No. 2,242,713. Fig. 5 shows the arms 61 and 62 in approximately

their normal relationship, but in Fig. 6 they are shown shifted into substantially the same plane simply for purposes of illustration. As the centrifuging operation proceeds, the lower compartments will become loaded successively with solid material, while the liquid separated from such material will overflow through one compartment after another and finally into the uppermost chamber. The skimmer may be so set that it will pick up the liquid in the latter chamber due to the rapid rotation of the basket, and such liquid will be forced through the two communicating arms of the skimmer and discharged into the curb 24.

This arrangement is useful both in taking off the face liquor just before unloading the solid material and also in discharging the liquor with less liability of aeration, oxidation or foaming in dealing with those liquids susceptible to such action.

From the foregoing it will be evident that the invention provides a centrifugal apparatus with which the centrifuging operation may be performed continuously, so far as handling the liquid phase of the material being processed is concerned, it being necessary only to stop the machine to unload the solids. Also, that the separating operation can be performed under artificially created pressure conditions or with an inert gas, or special gaseous compositions, when desired. In some cases it is desirable to use a pressure above atmospheric at one stage of the centrifuging operation and a negative pressure at another stage, and the arrangement above described accommodates conditions of this nature.

Many of the features of the invention are equally useful with a perforated basket which can be of any one of the conventional types. When such a basket is used the baffles and the flanges 22 and 23 shown in Fig. 2 will be eliminated, together with the parts 24 and 25, and the outlet 26 will be moved down into the normal position at the bottom of the curb sheet 5.

While I have herein shown and described a preferred embodiment of my invention, it will be evident that the invention is not limited to embodiment in the particular form shown.

Having thus described my invention, what I desire to claim as new is:

1. In a centrifugal separator, the combination of a basket, a casing in which said basket is mounted to revolve around a vertical axis, said casing being adapted to be closed in an air tight condition, the top of said casing having an opening therethrough, a removable cover for making an air tight closure with said opening, a discharger mounted above said casing and including a discharging element supported for movement downwardly through said opening into its operative position in said basket and for movement upwardly out of said casing again into an inoperative position, means cooperating with said cover to clamp it in said closed position, said basket having an opening through the bottom thereof for the discharge of the solids separated from the treated material and removed by said discharger, the bottom of said casing having an outlet for said separated solids, a second cover for said outlet, means supporting the latter cover under the bottom of said casing for movement to open and close said outlet, and means for clamping said second cover in its closed position to make a substantially air tight joint with said outlet.

2. In a centrifugal separator according to preceding claim 1, a construction including means for supporting one of said covers for sliding movement into and out of position to close the opening with which it cooperates, said means for clamping the cover in its closed position being also operable to release it and including an arm movable to effect said release, said arm being further movable in a different direction to slide the cover away from said opening after such release.

3. In a centrifugal separator according to preceding claim 1, a construction including means for supporting one of said covers for sliding movement into and out of position to close the opening with which it cooperates, said means for clamping the cover in its closed position being also operable to release it and including an arm movable to effect said release, and means for operating said arm from a point remote from said opening to produce said release and thereafter to slide said cover away from said opening.

4. In a centrifugal separator according to preceding claim 1, a construction including a slide supporting one of said covers for sliding movement into and out of cooperative relationship to the opening which it normally closes, said clamping means for the cover including a screw connecting said cover with said slide, an arm extending laterally from said screw, and a handle pivoted to said arm and extending away from said cover in a direction generally parallel to the path of sliding movement of the cover and to a point remote from the cover, whereby said handle may be initially operated to turn said arm to release said cover and thereafter may be operated to slide the cover away from the opening which it normally closes.

5. A centrifugal separator according to preceding claim 1, in combination with a receptacle for receiving the liquid discharged from said basket, and pipe connections arranged to conduct said liquid from said casing into said receptacle and to conduct into said casing the gaseous atmosphere in the receptacle which is displaced by said liquid.

6. A centrifugal separator according to preceding claim 1, in combination with a supply tank from which the material to be centrifuged is drawn, pipe connections between said receptacle and said casing for conducting liquid from the tank to said casing, a valve in said pipe connections, a receptacle for receiving the liquid discharged from said basket, pipe connections between said casing and said receptacle for conducting liquid from the latter to the former and for conducting in to said casing the air or gas displaced in the receptacle by the flow of said liquid in to it, and additional valve means in the latter pipe connections operable to isolate the receptacle from the casing when desired.

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