

June 15, 1937.

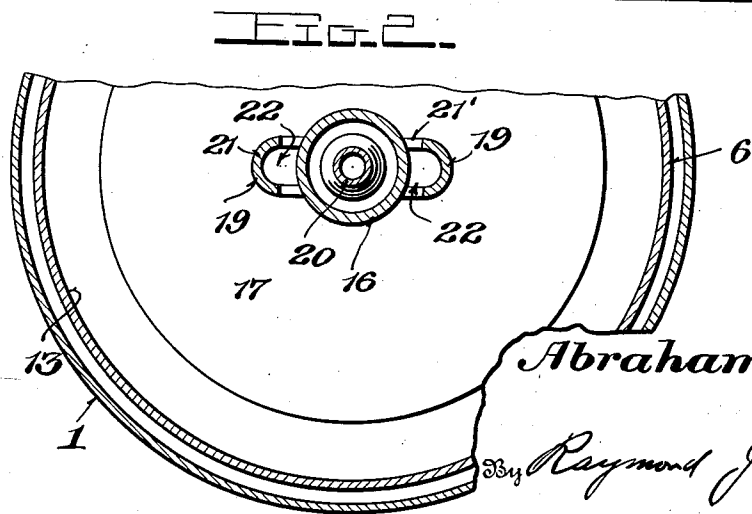
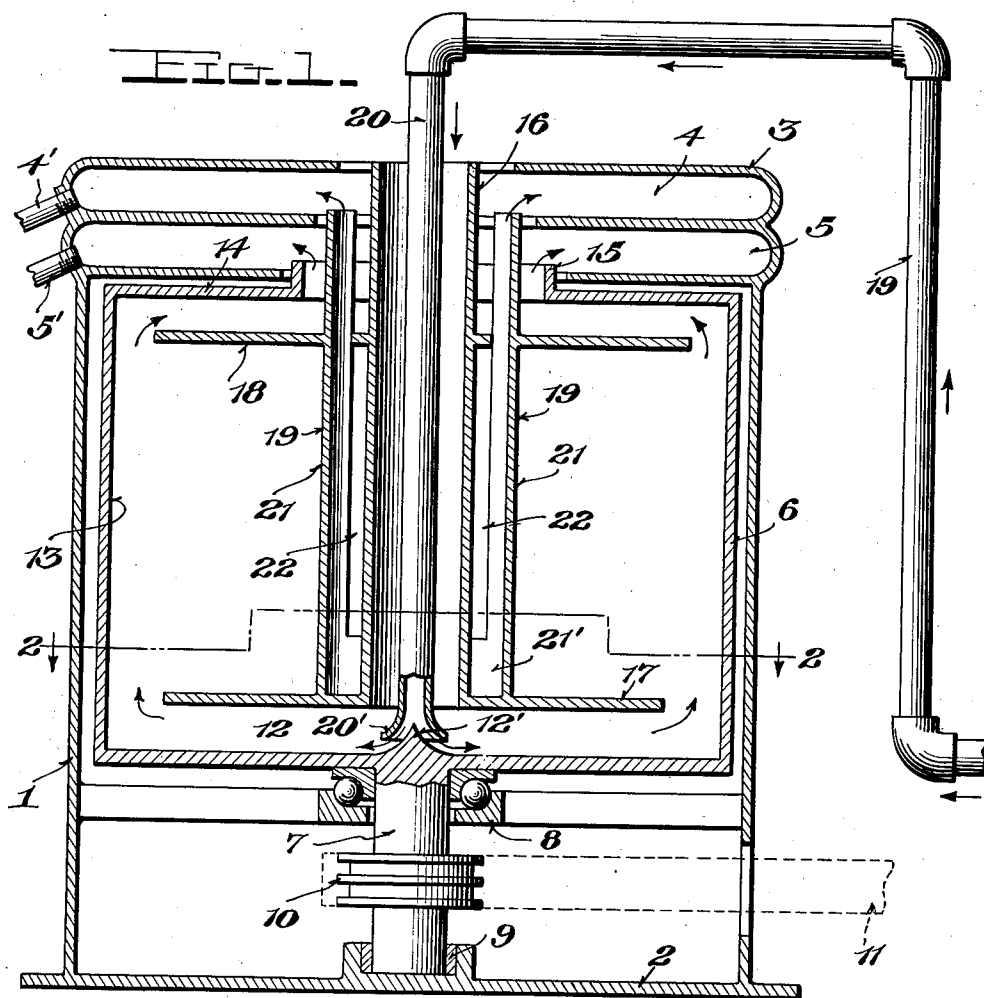
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2,083,809

BOWL CENTRIFUGE

Filed June 2, 1934

4 Sheets-Sheet 1



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4 Sheets-Sheet 2

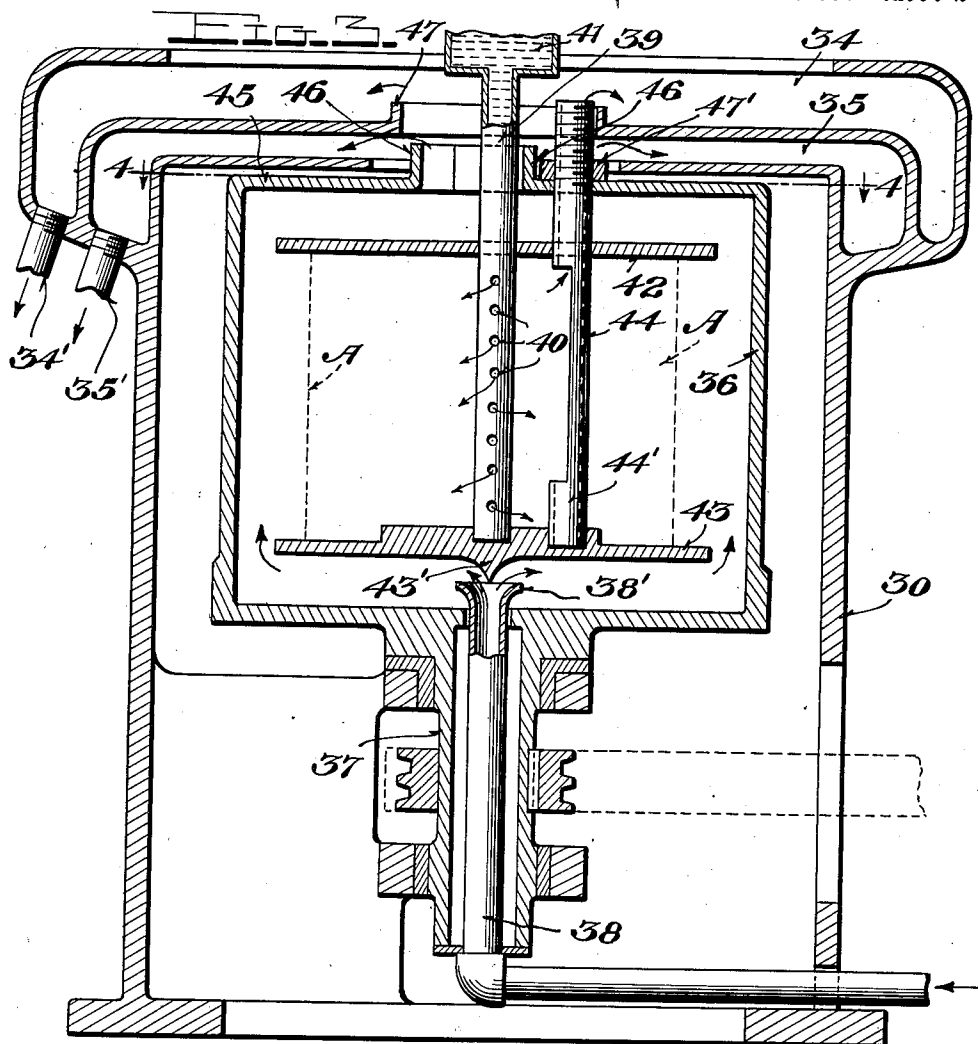
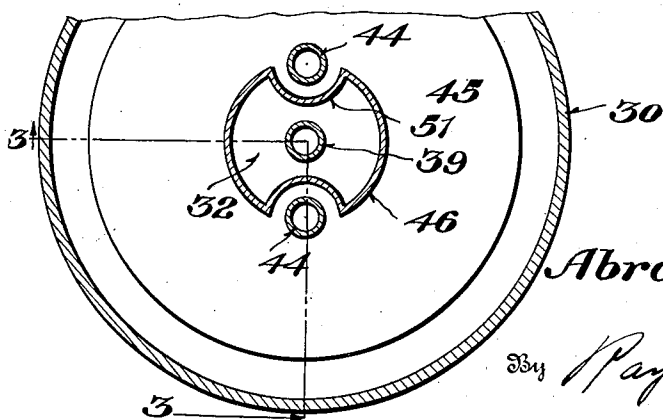


FIG. 4



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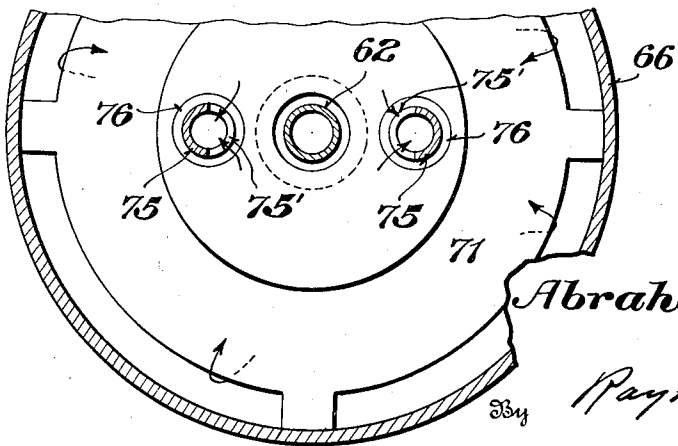
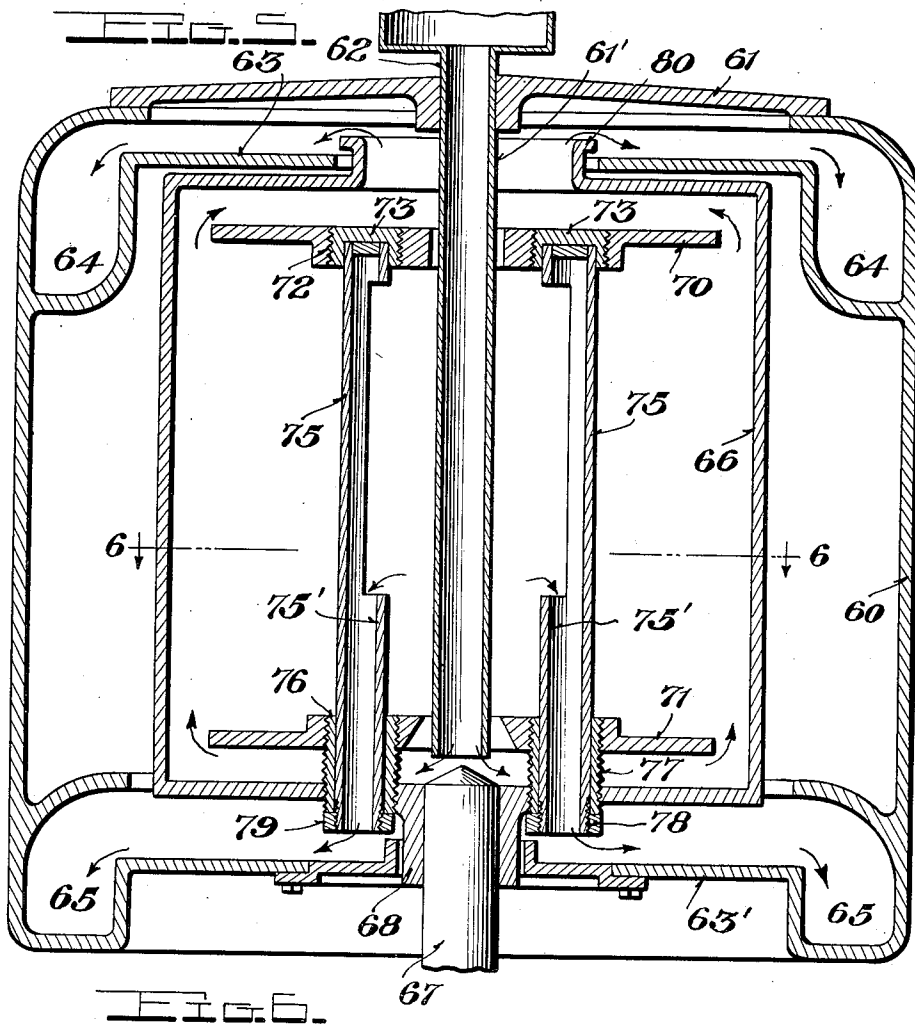
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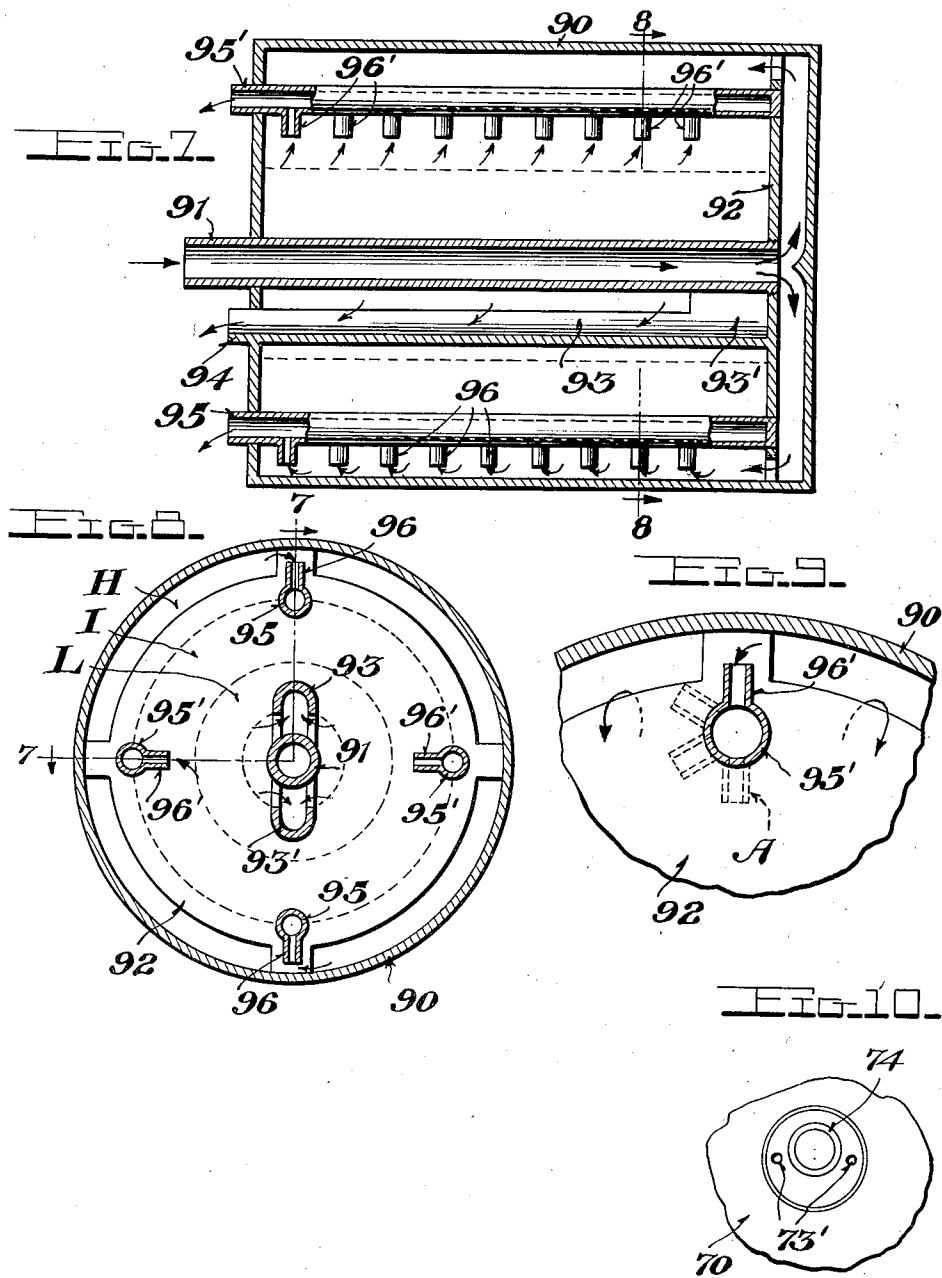
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4 Sheets-Sheet 4



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UNITED STATES PATENT OFFICE

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BOWL CENTRIFUGE

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Application June 2, 1934, Serial No. 728,748

1 Claim. (Cl. 233—21)

This invention relates to a method of separating materials having a differential specific gravity and more particularly to an improved method of and apparatus for centrifuging.

5 In the typical bowl centrifuge now employed the material to be concentrated or clarified is fed in and carried to the periphery of the bowl where stratification obtains. The strata are then withdrawn at a relatively high velocity through outlets at the end of the bowl. Considered more
10 specifically, the prior types of centrifugal separators comprise essentially a container of relatively great capacity rotating at a great speed and two or more eductors of relatively small dimensions as compared to the volumetric capacity
15 of the bowl through which the segregated phases or components of the treated mass are discharged at high velocity.

The efficiency of the separation or clarification depends upon a number of factors, many of which have been recognized, and based upon such recognitions, improvements have been suggested. Thus such desiderata as high peripheral speed, bowl length to diameter ratios and similar structural correlations have been expressed and
20 sought.

A factor of salient importance, toward the achievement of which little advance has been made, is the increased efficiency attainable by
30 prolonging the detention period of the treated mass within the bowl. It is clear, upon a consideration of the structure and operation of the prior devices, that the detention period is very small and much less than that attainable from
35 a machine of a given volumetric capacity. The typical machine comprises substantially an open bowl into one end of which the material to be treated is admitted and from the other end of which the segregated components or phases are
40 withdrawn at high velocity. Theoretically, the movement of the several phases is radial, that is to say the heavier constituent is presumed to move radially outwardly toward the periphery and the lighter constituent, being displaced by
45 the heavier, to move radially inwardly; at the same time the body of liquor is assumed to move axially across the bowl at a velocity proportional to the quantity fed and the inverse of the cross section. At one extreme end, the two phases are
50 withdrawn through apertures which are very small with respect to the volume of material. As a result the efflux velocities are relatively high. These high velocity streams tend to induce a similar direction of flow of the mass within the
55 bowl, and the actual direction of flow of a con-

siderable quantum of the mass is the resultant of this influence. In the prior art devices the heavier constituent has had to flow around a dividing baffle of a diameter larger than the diameter of the dividing ring of the constituents. The effect
5 of this baffle was to more or less minimize the effect of the heavier component draw-off currents, although not placed there for this purpose. The lighter components however had immediate access to the relatively small aperture and the
10 currents set up carried a considerable portion of the body of the liquor along with it, causing diagonal flow instead of radial, decreasing the effective cross section of movement thru the bowl, increasing the velocity and concomitantly de-
15 creasing the detention time, separating utility, and efficiency.

I have found that improved separation may be secured in a centrifuge of any given capacity by modifying the direction of flow of the stock being treated and correlating this with a special method
20 of withdrawing the stratified constituents.

It is a major object of the present invention, therefore, to provide an improved method of centrifugal separation.

Another object is to provide a novel type of centrifuge.

A further object is to increase the retention period of treated stock in a centrifuge of any given capacity.

Yet another object is to increase the axial component of the body of the liquor in a centrifuge of a given capacity and speed.

Yet another object is to increase the radial component of movement of a light liquid phase in a centrifuge of a given capacity and speed.

With these and other equally important and related objects in view, the invention comprehends the concept of establishing in a zone of the centrifuge a volume of material in which forces
40 tending to deflect the flow of the body of the liquid from an axial path are neutralized. In effectuating this concept the material to be treated is constrained to follow a special path of movement and the separated constituents are withdrawn in a
45 special manner designed to largely minimize or eliminate the induction effect of a high velocity efflux. This is achieved by establishing a series of deflectors or bafflers within the centrifuge and correlating these with a novel axial light liquor
50 draw-off extending relatively deeply into the body of the material.

In order to more clearly explain the underlying principles of the invention, typical physical em- 55

bodiments are shown in the accompanying drawings, in which:

Figure 1 is a longitudinal section through a centrifuge constructed according to the invention.

Fig. 2 is a cross section taken on line 2—2 of Fig. 1.

Fig. 3 is a section taken on line 3—3 of Fig. 4 of another form of centrifuge.

Fig. 4 is a cross section of the device shown in Fig. 3.

Fig. 5 is a longitudinal section of a further modification.

Fig. 6 is a cross section on line 6—6 of Fig. 5.

Fig. 7 is a showing in diagrammatic form of yet another modification.

Fig. 8 is a cross section taken on line 8—8 of Fig. 7.

Fig. 9 is an enlarged detail of one of the axial launders shown in Fig. 7.

Fig. 10 is an enlarged detail of the launder adjustment.

In carrying out the improved method, a wide variety of centrifuges of specifically different design may be utilized. As will be observed more fully hereinafter, the several devices shown in the drawings are designed to carry out the new method which involves the salient features of special conformation of the path of the liquid undergoing treatment coupled with a novel type of deep axial withdrawal of the light and/or heavy fraction or constituents. In order to simplify the drawings, certain of the conventional parts of a centrifuge, such for example as the receiver or cover, transmission or driving mechanism and the like, have been illustrated diagrammatically, these features being well understood by those skilled in the art and being largely a matter of design.

The improved method of separation may be effectuated by a machine having the essential characteristics of that shown in Fig. 1. Such machine may comprise a casing 1 provided with an integral or separate base plate 2 and an integral or separate receiver or cover 3. The receiver, in the usual manner, is provided with passages 4 and 5 for the separated light and heavy constituents respectively. Eductor conduits 4' and 5' communicate with these passages.

Mounted concentrically within the casing is the bowl shell 6. This is connected to the driving shaft 7 suitably journaled for rotative movement as for example in the bearings 8 and 9. Such bearings may be of any suitable design and location. The shaft is adapted to be connected to a motor as by the pulley 10 and belt 11. Obviously any suitable power source and transmission mechanism are contemplated.

The bowl may be of any desired configuration and relative dimensions. That shown is rectangular in cross section, including the bottom 12, integral side walls and top 14. The top plate 14 terminates in the dam or weir 15, positioned closely adjacent the circular passage 5. It will be understood that the dam 15 may be a detachable member and that other members having a different internal diameter may be substituted so as to vary the size of the weir outlet to secure the proper liquid balance for any particular fluids undergoing treatment. The bottom of the passageway 5 is spaced a sufficient distance from the top of the rotor to provide operative tolerance.

Suitably positioned within the bowl is tubular member 16. This extends downwardly well into the rotor and terminates a short distance above

the bottom. Attached to the bottom of the tube 16 is a deflector ring or baffle plate 17. This is detachably secured to the tube by any suitable means and is adapted to be moved vertically on the tube and to be locked in any predetermined position of adjustment. The baffle 17, as shown, is of considerable diameter, being spaced from and extending substantially parallel to the bottom of the rotor and terminating adjacent the side wall 13 of the rotor. The baffle may be secured to the side walls at spaced points as by suitable spiders or webs (not shown).

Similarly, at its upper portion the tube 16 carries the upper baffle ring 18. This is detachably mounted on the tube and is movable longitudinally of the tube so as to be adjusted and locked in any optionally selected position of adjustment. The plate 18 and lower baffle 17 may be suitably attached to the bowl at spaced points. The tube 16 and baffles thus rotate with the bowl.

The siphon feed line 19 includes a pipe 20 extending downwardly through the tube 16 and terminates in an outwardly flanged discharge nozzle 20' adjacent the conal projection 12' of the rotor. This association of the cone 12' and the similarly conformed discharge nozzle tends to prevent frothing and deflects the feed in a smooth stream radially outwardly. The nozzle 20' may be mounted for axial adjustment on the tube 20 so as to establish and maintain the optimum conditions of flow for a given installation.

As indicated hereinbefore, means are provided for withdrawing the lighter constituents in a novel manner. As shown in Fig. 1, such means comprises a channel or series of channels extending well down into the rotor, and hence, into the body of liquid undergoing treatment. Into such channels the lighter segregated fraction decants or flows and passes therethrough to the passage 4. The specific construction which insures such a controlled directional flow may comprise two or more launders 21 positioned concentrically of the rotor and detachably secured to the upper and/or lower baffles 18 and 17. Such launders in effect comprise axial channels and, as shown, may consist of tubes having a relatively enlarged opening 22 which opening extends substantially the full length of the launder. The lower end of the launder closed off at 21' is secured to the baffle 17 and the upper section passes through the baffle 18 and terminates above the dam 15 and adjacent the light liquor passageway 4. Liquid flowing upwardly through the launders thus discharge into the passage 4 and are withdrawn through discharge outlet 4'.

This type of structure differs in major particulars from the usual type of centrifuge. In the latter, light and heavy liquor discharges are positioned at the upper end of the rotor and consist essentially of small apertures. Through such apertures the separated phases move with high velocity. As a result of such a constricted opening, there exists a differential velocity of a liquid phase along an axial and diagonal path and the highest velocity is at the confluence of these paths; namely, the dam or weir. The area below such weir thus constitutes a vena contracta and the liquid in the body of the bowl moves in from all sides along curved stream lines. These curved stream lines extend generally diagonally outwardly from the weir toward the wall of the rotor, that is to say, toward the heavy liquid layer and tends to induce or deflect some of the heavy liquid toward the light liquid discharge opening. The result is the setting up of currents which

tend to deflect the body of liquid from an axial to a diagonal direction. Such diagonal path, being the shortest distance between the inlet of the liquid and the discharge opening, correspondingly decreases the retention period of the liquid in the rotor, increases the turbulence when quiescence is desired and increases the dead or inactive space within the rotor.

The flow of materials in the described device is markedly different. When the rotor is operated and the bowl is rotated, the liquid charge continuously or intermittently admitted through inlet pipe 20 tends to move outwardly under the effect of the centrifugal action. Due to the lower baffle 17, the entire volume of material admitted is constrained immediately to move outwardly to the peripheral zone adjacent the wall 13. The lower portion of the bowl, in which closed end 21' of the launder is located, then constitutes a relatively quiescent zone in which the liquid is submitted fully to centrifugal action and in which stratification is instituted. In other words, the lower section of the bowl forms a zone of relatively large diameter in which the inverse radial currents of the light and heavy components are instituted. The flow of the body of liquor in this area is then quite low, its velocity being diminished on passing from the relatively constricted area defined by the baffle 17 and bottom of the rotor to the enlarged separating zone.

As the feed stock is continuously admitted it displaces the stock within the rotor vertically upwardly at a predetermined rate depending on the dimensional characteristics of the rotor and feed pipe and the hydrostatic head in the pipe. Concomitantly, as explained, the heavier fraction is thrown toward the periphery and the lighter fraction is displaced radially inwardly. The length of the closed launder section 21' is correlated with respect to the other factors mentioned, as well as the physical characteristics of the stock, to provide a sufficient height in the quiescent zone to permit segregation or stratification of the phases. After such stratification is instituted, it is of course maintained by the centrifugal force obtaining. Thereupon the light liquid fraction is withdrawn through the axial channel and from above the area of stratification, that is to say the area above the section 21'. Due to the number and lengths of the launders, the effective withdrawal weir length is large. The light liquor drawoff which is the source of short circuiting and currents in the prior art is effected in a slow, gentle manner by allowing the light constituent to decant into these launders. It will be appreciated that such withdrawal is effected at a low velocity, and due to construction described the light liquor flow within the rotor is largely radial.

The heavy liquor flows upwardly along the peripheral zone and is then deflected laterally through the channel defined by the top of baffle 18 and the upper portion of the rotor and is thence discharged over the dam 15 into the spillway or receiving channel 5. The baffle 18 shields the light liquor stratum from any localizing currents set up by the flow of heavy liquor through the weir. It is likewise to be observed that the launder is so positioned that its open face is adjacent the inner wall of the rotor and hence permits the maximum radial travel for the light stock.

It will thus be appreciated that the combination of the end baffles and the axial launders not only permits of the establishment of the lower

separating zone in which the effectiveness of the full radial flow components are utilized, but also minimizes or eliminates the localizing currents and their undesirable concomitant; namely, a generally diagonal resultant flow and a low detention period of stock.

The novel combination described, insures low exit velocity of the light constituents. Similarly, while the exit velocity of the heavy liquor may be quite high, as when a small diametric weir is employed, yet nevertheless, in leaving the effective separating zone, its velocity is low. Any localizing currents in the vena contracta of the heavy liquor outlet are screened from the dominant mass or pool within the bowl.

The method effectuated by the apparatus therefore may be considered as the establishment of a relatively quiescent zone in which effective stratification takes place and the extenuation and maintenance of this quiescent zone while withdrawing the stratified or segregated liquid components.

It will be appreciated that within the scope of the major concepts of the invention, a wide variety of mechanical ramifications are permissible. The process may be carried out, for example, in a centrifuge equipped for counter current washing or for the introduction of any second body of liquid for whatever purpose. Such a type of apparatus is essentially similar to the device shown in Fig. 3. It may comprise the casing 30 in the upper portion of which is a receiver having the spillways 34 and 35 and liquid drawoffs 34' and 35'. This device is similarly provided with the bowl 36 suitably attached to or mounted on the driven shaft 37. This shaft is provided with appropriate bearings and is preferably hollow to receive the spaced inlet or feed line 38. A second feed line 39 extends downwardly into the bowl and may be provided with a series of apertures 40 through which the liquid, such as wash water, flows outwardly at any desired velocity into the bowl in a direction generally counter-current to the flow of stock treated. This line may be connected to any suitable source of supply 41.

Within the rotor are mounted the baffles 42 and 43 and the axial launders 44. The lower baffle 43, on its lower face, is formed with the deflecting cone 43' which is aligned with and juxtaposed to the flared outlet nozzle 38'. Baffles 42 and 43 are attached at spaced points to the wall of the bowl so as to rotate therewith.

The launders 44, as shown, are attached to the baffles and held in spaced relation thereby. The launders may be attached to any suitable member, as for example, to the removable bowl plate 45. The top of the bowl terminates in a dam or weir 46 of any suitable adjustable construction and over which the separated heavier liquor flows into the receiving channel 35.

The upper ends of the launders 44, as shown, are of tubular formation and project through the plate 45 radially outwardly of the weir and discharge their contents to the receiving channel 34. Such upper ends may be externally threaded to receive locking means, such as nuts 47. The lower ends of the launders, like those of Fig. 1, are formed with closed tubular portions 44' which, as has been described, aid in establishing the lower quiescent separating zone.

It will be noted that the upper section of the launder 44 may be of closed tubular construction and that such sections may extend down to the baffle or to any predetermined position be-

low the baffle. With this type of construction, the flow of liquid through the launder has no influence on the heavy constituent flowing toward the weir 46.

The feed tube 39 may be securely attached to the baffles so as to rotate therewith, by providing a suitable coupling above the bowl or it may be non-rotatably mounted with the bowl by utilizing suitable packing glands in the manner well known to those skilled in the art.

The operation of this type of machine is essentially similar to that shown in Fig. 1. The feed stock admitted through the line 38 is discharged through the special nozzle 38' into the bowl. By reason of the baffle 43, the liquid is constrained to flow outwardly toward the periphery through a relatively small channel and then enters the enlarged quiescent area, of low fluid velocity, between the baffles. At and above a predetermined height in this zone, defined by the top of closed launder section 44' the light stratified liquor is withdrawn at a relatively low velocity along an axial path, and is discharged into spillway 34. The interface of the phases, in ordinary circumstances, is within the plane of the baffles and may be considered to be approximately at the line A. Heavy liquor passes upwardly between the inner wall of the rotor and the baffle 42 thence along the relatively enlarged channel comprehended between the upper surface of baffle 42 and the lower surface of cover 45, and is discharged thence over the weir 46 into the spillway 35.

Wash liquor or a third phase such as a brine may be charged through pipe 39. This passes through the apertures 40 and moves radially outwardly into the bowl intimately mixing with the material within the bowl and then discharges through the heavy or light liquor drawoffs depending on its specific gravity relative to that of the other component or components.

It will be appreciated that with the described type of operation a clear cut separation of components is permissible. In many circumstances as where a particular machine is employed to treat a number of specifically different materials, it is desirable to make the axial launder adjustable with respect to its distance from the axis of rotation or the interface of the segregated phases. This may readily be done as shown in Figs. 5 and 10 by so mounting the launders in the baffles that they may be moved radially inwardly or outwardly within predetermined limits.

Again, it will be appreciated that the improved method of centrifuging may be carried out in machines having outlets at each end of the machine, a typical example of which is shown in Fig. 5.

As shown, this may comprise a casing 60 provided with the removable cover 61. The cover 61 has a central boss portion 61' which serves to rigidly mount and hold the feed pipe 62. The upper and lower sections of the casing 60 are so formed as to provide receivers for the heavy and light liquid phases respectively. Near its top, the casing is provided with the plate member 63 which is substantially parallel to the upper surface of the bowl. This plate section terminates in a spillway or trough 64 which may be provided with outlets for the separated heavy liquid in the manner well known to those skilled in the art. Similarly, the lower portion of the casing is formed with a plate 63'. At one end, this is conformed into the trough section 65 from which the separated light liquid may be withdrawn through

suitable outlets. The plate 63' terminates closely adjacent the axis of the machine and subjacent the axial drawoffs. The inner portion of the plate 63' may be made detachable so as to facilitate adjustments to be described hereinafter.

The bowl 66 is suitably mounted for rotation upon the shaft 67 as by means of the elongated boss 68. The end of the shaft 67 is of conoidal form so as to prevent frothing of the feed in the manner described hereinbefore. As in the devices hereinbefore described, the bowl is provided with the upper baffle 70 and lower baffle 71. The upper baffle is provided with a central aperture through which the feed line 62 projects. If desired, the aperture may be provided with a packing gland so as to prevent movement of fluid from the body of the bowl upwardly towards the upper outlet. The baffle 70 is attached to the wall of the bowl at spaced points so as to be rigidly secured thereto. Similarly, the lower baffle 71 is attached to the bowl as by means of web extensions at spaced points throughout its circumference.

As shown, particularly in Figs. 5 and 10, the upper baffle is tapped and internally threaded as at 72 to receive the plug 73. At its upper surface, this plug is provided with two or more holes 73' for the insertion of a suitable tool by means of which the plug may be rotated in its socket. The lower face of the plug is bored or tapped to provide a circular socket 74 which is eccentric with respect to the outer circumference. Into this socket is fitted the tubular end of the axial launder 75.

The lower baffle 71 is similarly bored and internally threaded as at 76, and into this is screwed the correspondingly threaded sleeve 77. The lower extreme end of the launder 75 is threaded as at 78 to screw partway into sleeve 77 and to receive the locking means 79 whereby the launder is locked in position.

The central channel or interior of the sleeve 76 is eccentric with respect to the outer circumference. As will be seen in Fig. 5, the sleeve 76 engages both the baffle 71 and the bottom portion of the bowl with a screw threaded locking engagement. In assembling the apparatus, the axial launder 75 is forced upwardly through the sleeve 76 until the upper end nests firmly within the socket of the upper plug 73. The locking nut 79, is then screwed on to lock the launder in its assembled position.

If it is desired to adjust the launder radially of the basket, the plug 73 and sleeve 76 are rotated about their axes. Due to the position of the launder in the plug and sleeve, this latter is moved readily inwardly or outwardly of the bowl. Such a type of adjustment is advisable in circumstances where a wide variety of different materials are to be treated in a single machine.

It will be observed that the operation of this type of machine is essentially the same as those already described. The feed stock is introduced through the inlet line 62 and passes thence under the baffle 71 to the main quiescent zone of the basket. In the lower section of the basket, that is to say, the portion defined by the tubular section 75 of the launder, direct radial movement and stratification of the phases takes place. Above such area, the light component decants into the axial launder and flowing downwardly, is discharged into the spillway or trough 65. The heavy liquid passes axially upwardly through the bowl and is discharged over the weir 80. It will be understood that the dam may be made de-

tachable and other ring members of a greater or less internal diameter substituted so as to control the velocity of efflux of the heavy liquid component. In this type of machine, the same improved mode of operation is established while utilizing the drawoffs at different ends.

As intimated hereinbefore, the principle of the axial drawoff and especially from deeply within the basket, may be applied to the heavy as well as the light liquid layer. A typical example of such a mode of operation is shown in Figs. 7, 8 and 9. In order to clarify the description, certain parts of the machine such as the casing, driving mechanism and receiver are omitted, the installation of these being well known to those skilled in the art.

As shown in these figures, the improved centrifuge may comprise a basket or bowl 90. Centrally mounted within the bowl is the feed line 91. This is shown as being rigidly secured to the basket, it being understood that a suitable coupling is provided in the main feed line so as to permit rotation of the section 91. It is observed, however, that if desired, the tube 91 may be maintained stationary and suitable packing may be provided between it and the adjacent rotating parts. The lower end of the tube 91 terminates adjacent the lower baffle 92 which, as in the apparatus already described, is attached at spaced points to the wall of the basket so as to rotate therewith. Attached to the baffle 92 and extending the full length of the basket and projecting beyond confines of the bowl are the light liquid axial drawoffs 93. The lower section of these launders comprise closed tube portions 93' and such lower closed portions define the quiescent zone or area of the basket in the manner already described. The upper section of the launder 94 extends through the top portion of the basket and, as will be understood, discharges into the light liquid channel of the receiver.

This particular modification, the heavy liquid similarly is drawn off in an axial manner from substantially the full length of the bowl. This may be done, as shown, by means of the axial launder 95, positioned relatively closely adjacent the periphery of the bowl. This member comprises a closed tube having the short inlet pipe sections 96 positioned at spaced points along its length. The lowermost one of such inlet tubes, as will be noted from an inspection of Fig. 7, is just above the quiescent area, that is, above the zone defined by the closed launder section 93'. The launder 95 may be externally threaded and is adapted to be screwed into or otherwise detachably secured to the upper portion of the bowl and likewise into the baffle 92.

With this type of structure, it will be appreciated that the same essential mode of operation already described obtains with the exception that the heavy liquid is withdrawn at low velocity from well within the stratified zone. Due to the utilization of the axial launder for the heavy liquid drawoffs, the upper baffle need not be employed, the same functions being achieved by the utilization of the launder 95.

It will likewise be appreciated that with this type of structure it becomes possible to withdraw more than two phases. By reason of the mounting of the launder 95 in the bowl this member may be rotated about its axis in the manner shown in Fig. 9 and in the upper portion of Fig. 7. It will be observed that the launder 95', which may be identical in construction with the launder 95, is

provided with the short inlet tubes 96'. These tubes, however, terminate inwardly of the bowl and are displaced radially a considerable distance from the wall of the bowl. It will readily be appreciated that during operation of the device a light liquid phase is withdrawn through the launder 94, the heaviest component through the launder 95, and a component of intermediate specific gravity through the launder 95', such stratification being indicated by the phase line L, I and H.

It will likewise be appreciated that such a type of structure readily lends itself to a flexible operation. If desired, the launder 95' may be rotated with respect to the bowl and moved from the dotted line position A (Fig. 9) to the full line position. In these circumstances, the unit then comprises a centrifuge with a plurality of light liquid drawoffs and a plurality of heavy liquid drawoffs so as to secure only the two phase separation.

In the preferred construction of this type of device, as shown in Fig. 8, four of such closed launders are provided. Two of these, launders 95, may be adjusted so that their inlet openings 96 are closely adjacent the wall of the bowl while another pair, launders 95', are so adjusted that their openings 96' are directed inwardly and are adapted to withdraw the intermediate third phase. It will be appreciated that by suitably constructing the receiver, the three phases may be separately discharged.

It will be appreciated that the several modifications described each effectuate the major principles involved and accomplish the stated result; namely, a marked increase in the detention period of a stock within the centrifuge and a concomitant increase in the efficiency of a particular machine.

Each of the several apparatus described operate upon a principle which differs markedly from prior devices. In the theoretically ideal centrifuges the movement of the several constituents is truly radial and the movement of the body of liquor is axial. However, as noted hereinbefore, the effective movement of the body of liquor in prior constructions was in fact diagonal and not axial. Thus in the usual type of prior device the diameter of the light liquor drawoff was about one-fifth of the diameter of the bowl. The heavy constituent moved with a velocity which was proportional to the diameter of the load, whereas the light liquor constituent moved with a velocity proportional to a much smaller velocity; hence in such prior constructions the velocity of the light constituent was of the order of five times that of the heavy. Hence as pointed out, due to the currents necessarily set up in these circumstances, the light liquor became contaminated with the heavy, giving inefficient separation.

In the improved devices described the flow of the body of liquor is more truly axial. The permissive low velocity discharge of the light liquor constituent, insured by the novel constructions described, enables a greater separating efficiency.

While preferred modifications have been described, it is to be understood that these are given merely as typical embodiments of the concepts defined herein; the invention, therefore, is conceived not to be limited to the particular apparatus shown and described except as such limitations are clearly imposed by the appended claim.

What I claim is:

A centrifuge comprising a bowl mounted to rotate on a vertical axis, a baffle positioned within the bowl spaced in substantially parallel relation-

ship to the lower end of the bowl and closely adjacent thereto, a feed line discharging into the space between the baffle and the bowl; a second baffle positioned closely adjacent the upper end of the bowl and defining therewith a draw off channel for the heavier constituent of the mass being treated; an axial launder mounted in the lower baffle and extending through and beyond the

upper baffle, the launder being open to the liquid throughout a greater portion of its length but being closed for a predetermined distance adjacent the lower baffle to establish with a baffle a relatively quiescent area where stratification takes place. 5

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