E. W. BEACH.

CENTRIFUGAL SEPARATOR.

APPLICATION FILED JULY 16, 1912.

1,158,959.

Patented Nov. 2, 1915.

4 SHEETS—SHEET 1.

Fig. 1.

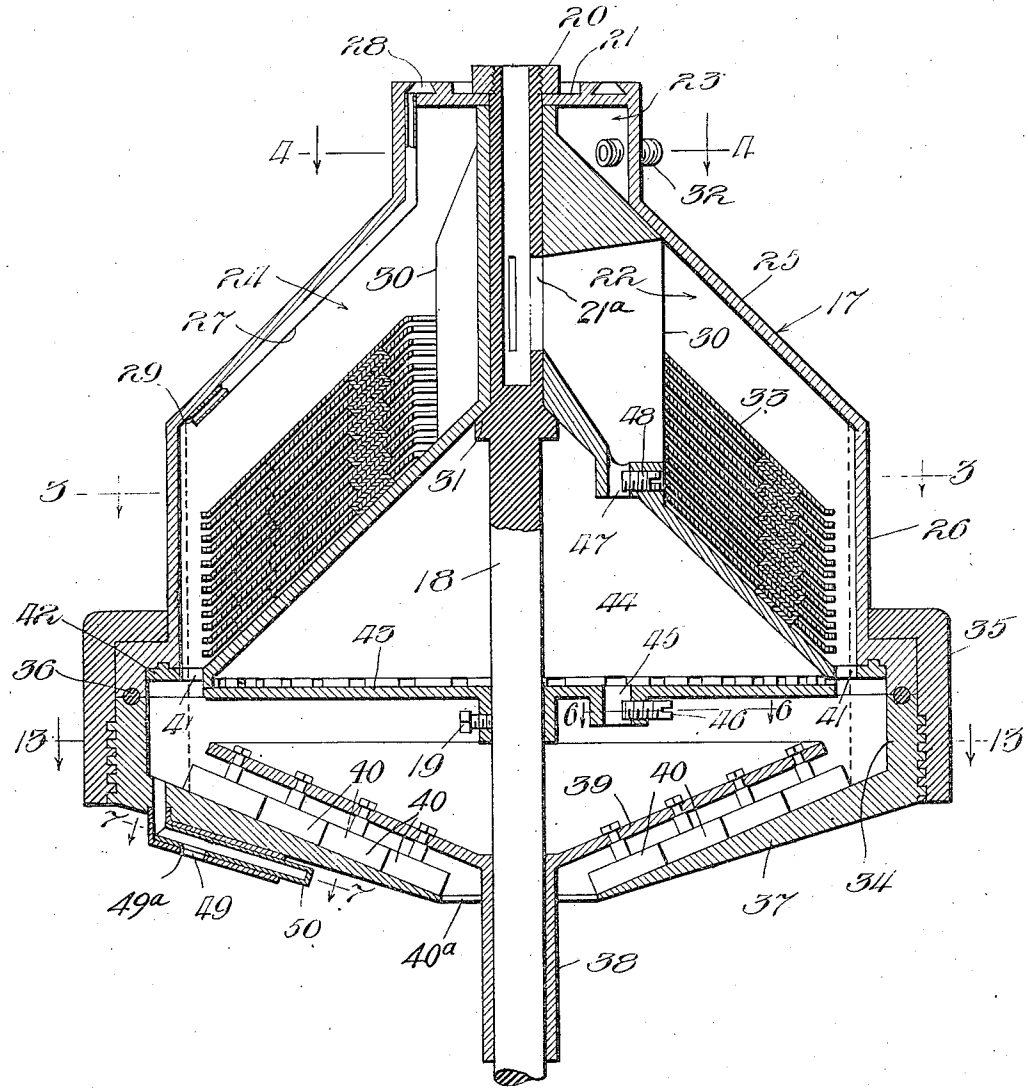
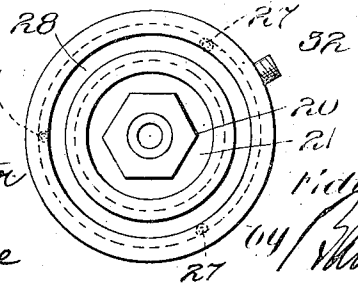


Fig. 2.



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4 SHEETS—SHEET 2.

Fig. 3.

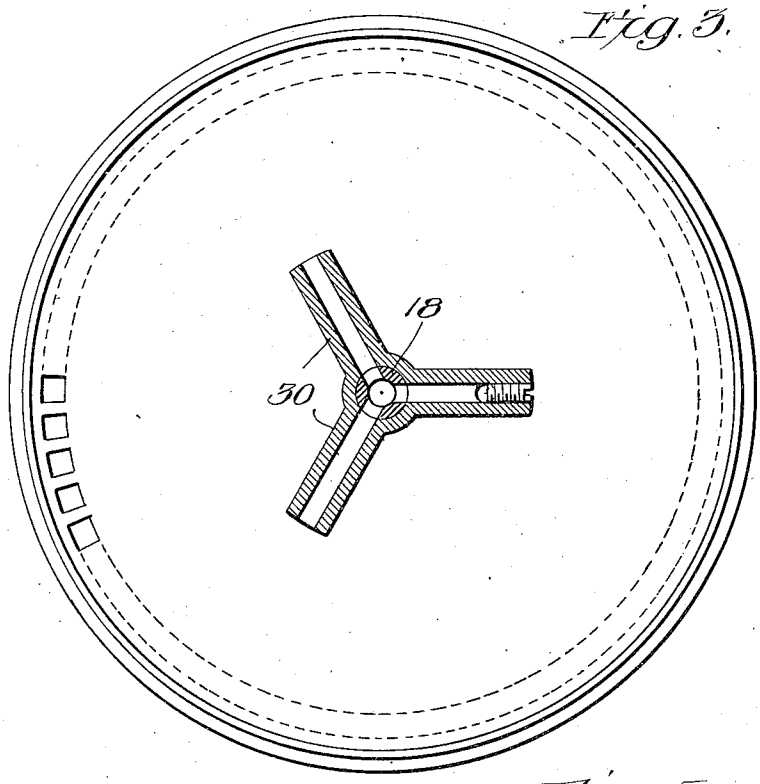


Fig. 4.

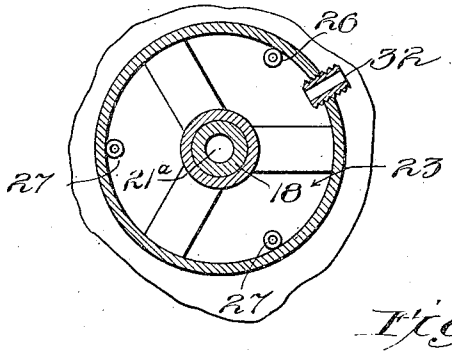
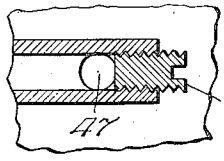


Fig. 5.



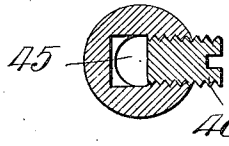
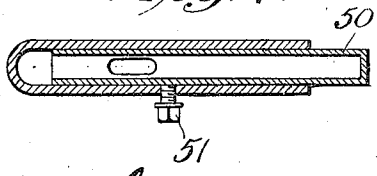


Fig. 6.

Fig. 7.



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4 SHEETS—SHEET 3.

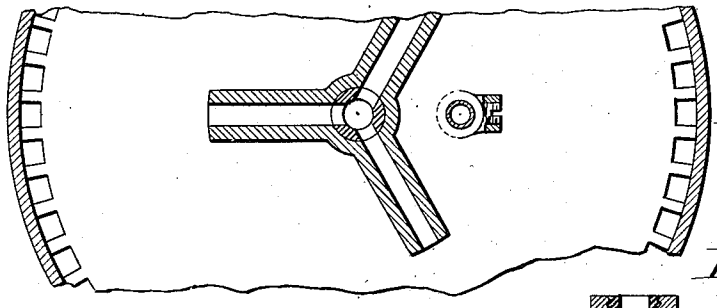
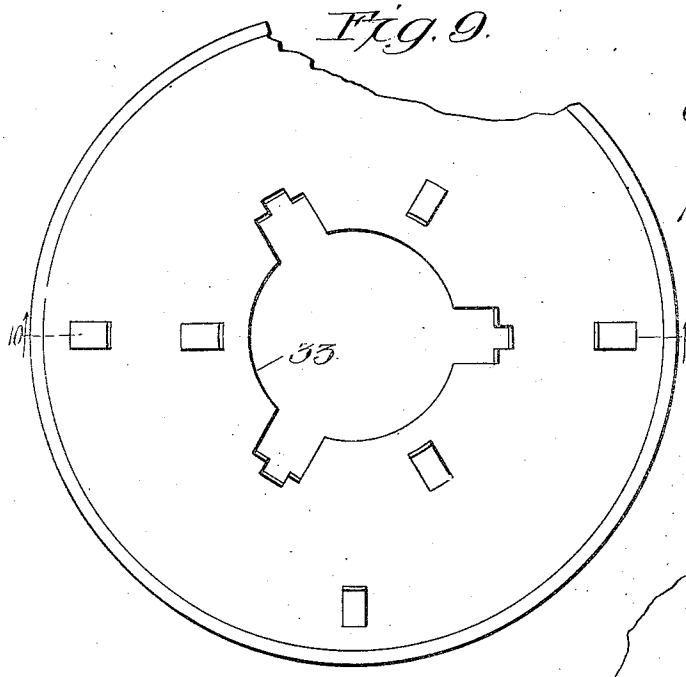


Fig. 8

Fig. 11

Fig. 9.



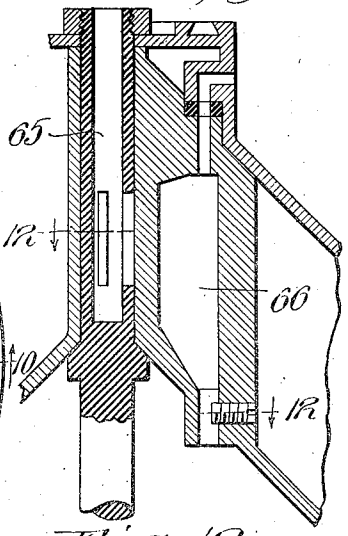


Fig. 12.

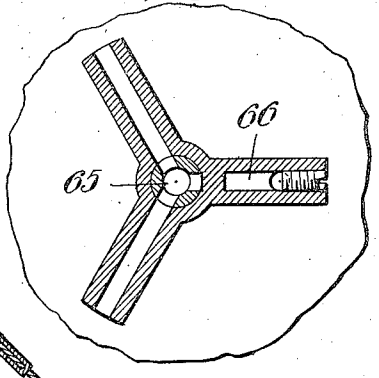
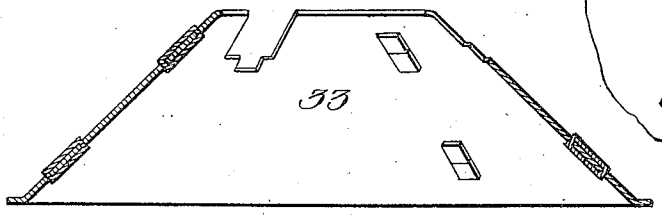


Fig. 10.



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CENTRIFUGAL SEPARATOR.

APPLICATION FILED JULY 16, 1912.

1,158,959.

Patented Nov. 2, 1915.

4 SHEETS—SHEET 4.

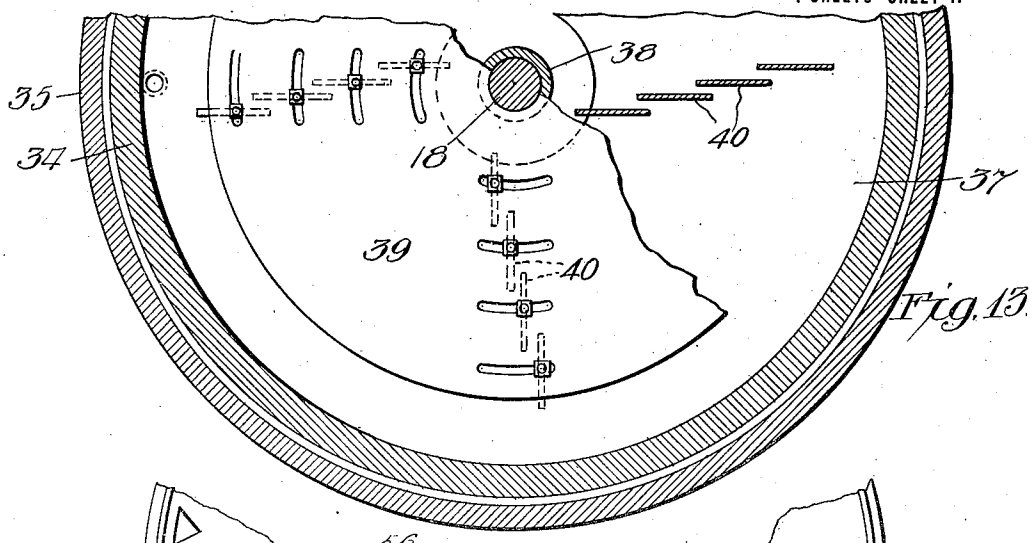

Fig. 13.

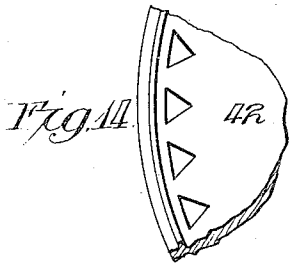

Fig. 14.

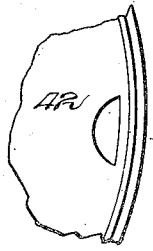

Fig. 15.

Fig. 16.

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UNITED STATES PATENT OFFICE.

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CENTRIFUGAL SEPARATOR.

1,158,959. Specification of Letters Patent. Patented Nov. 2, 1915.

Application filed July 16, 1912. Serial No. 709,716.

To all whom it may concern:

Be it known that I, EDWARD W. BEACH, a citizen of the United States, residing at Winnetka, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Centrifugal Separators, of which the following is a specification.

This invention relates to centrifugal separators adapted for the treatment of mixed solids and liquids, and has for its essential object to produce a construction, whereby a continuous separation and discharge is effected.

The natural tendency of the heavier constituents, under the influence of centrifugal force, is to be forced toward and against the periphery of the separator bowl, and the primary object is to provide a liquid or cushion back for regulating the movement of the heavier constituents within the separator bowl as the separating process or operation is effected.

Another object is to improve the construction, operation and utility of the separator, and the invention further consists in the features of construction and combination of parts hereinafter described and claimed.

In the drawings is shown a preferred form of device, wherein—

Figure 1 is a vertical sectional elevation taken through one form of bowl body; Fig. 2 a top or plan view looking down on the top or cap of the bowl; Fig. 3 a cross section taken through the separator bowl on line 3—3 of Fig. 1; Fig. 4 a cross section taken through the discharge port on line 4—4 of Fig. 1; Fig. 5 an enlarged sectional detail taken through the liquid passage between the primary and secondary separator chambers; Fig. 6 a cross section taken through the liquid passage between the separator base and the secondary chamber on line 6—6 of Fig. 1; Fig. 7 a cross section taken through the bowl base discharge pipe of Fig. 1; Fig. 8 a sectional detail showing the modification of a discharge passage intermediate the wings; Fig. 9 a top or plan view looking down upon the spaced plates or disks within the separator bowl; Fig. 10 a cross section taken through said plates or disks on line 10—10 of Fig. 9; Fig. 11 a vertical sectional detail taken through the upper portion of the separator bowl showing modified inlet constructions; Fig. 12 a cross section taken on line 12—12 of Fig. 11; Fig. 13 a cross section taken on line 13—13 of Fig. 1 through the base or lower portion of the separator bowl; Fig. 14 a detail, in plan, showing one form of discharge openings in the base plate intermediate the primary and secondary separator bowl chambers; Fig. 15 a detail, in plan, showing a modified form of discharge opening, as compared with Fig. 14, in said base plate; and Fig. 16 a vertical sectional elevation, showing a slightly modified form of separator bowl construction, having inclined side walls.

Referring to Fig. 1, this improved device is shown comprising a separator bowl or casing 17, mounted upon a spindle 18 which may hold the compartment plate in position by set-screws 19, and its upper threaded end may engage a lock nut 20 contacting the bowl top 21, or otherwise. As indicated, the upper portion of said spindle 18 has an elongated recess or passage 21^a opening laterally into a primary separating zone 22 for permitting the ingredients to be separated to be fed downwardly thereinto. The separator bowl may be of any desirable shape and configuration, and is shown as having a somewhat contracted top portion 23 merging into an enlarged chamber portion 24 formed by inclined side walls 25 merging into straight side walls 26, and liquid feeding pipes or openings 27 may be positioned adjacent or within said inclined side walls, and said pipes have their upper ends communicating with the inlet passages 28 in the top of the bowl, and may have their lower discharging ends 29 terminating at any desired point within the bowl chamber, whereby a liquid back or cushion is maintained for regulating and feeding downwardly and carrying toward the bowl base the heavier solids or constituents in the material to be separated.

A plurality of split wings or hollow members 30 may be employed for conveying the admitted material to the separating zone of the primary separating chamber, and, as shown, said wings or members are mounted upon said spindle and seated against a spindle ring 31. One form of said split wing construction is shown in Figs. 3 and 8, for distributing the material to be separated within the primary separating chamber. A hollow screw 32 is positioned toward the top of and through the chamber wall, in which the lighter separated ingredients will be ejected from the separator. This separator may be operated either with or without di-

viding plates or disks 33, as may be preferred, (see Figs. 1, 9, and 10) and without interfering with the separating operation, said plates or disks 33 being of any desired construction.

The bowl shell or casing 17 may be secured to a detachable base 34 having inclined walls of any suitable formation, the detachable base being secured to the bowl preferably by a locking collar or ring 35 in threaded engagement therewith, said connection being sealed by a rubber gasket 36, or otherwise. The base is shown having downwardly inclined walls 37, although it may be differently formed, and a sleeve 38 is positioned loosely about the spindle 18 having an obliquely disposed flanged portion 39 upon which may be carried adjustable spaced scrapers 40, as shown in Fig. 13, for contacting and moving the heavier constituents centrally of the base of the bowl for discharge therefrom.

The flanged portion 39 may be of any suitable formation to act as a carrier for the scrapers 40 and should preferably be provided with one or more openings to permit passage of liquid therethrough from one side thereof to the other.

Obviously, since a cushion or liquid back is provided for in the primary separating chamber, it follows that the amount of discharge from the said chamber into the bowl base is determined by the size of the openings 41 intermediate said chamber and base for regulating the travel of the solids therethrough. It is not intended to limit the construction to one having any particular form or character of discharge openings 41, and in Figs. 3, 14, and 15, several forms of openings are disclosed, said openings being preferably formed about the flanged base member 42 of the primary separating chamber. If desired, a transverse wall 43 can be formed intermediate the base 34 and secondary separating chamber 44, or may be dispensed with, since the device may be operative either way. However, the lower portion of the bowl in conjunction with the base forms, in effect, said secondary separating chamber 44 irrespective of the intermediate wall 43 which, when employed, has a passage 45 for enabling the liquid in the base of the bowl to travel thereinto, and a regulating screw 46 of any approved form may be used for adjustment of the vertical level of the lighter constituent, as in Fig. 6. This secondary separating chamber 44 has an upper discharge passage 47 in vertical alinement with outlets 32 and 45, and said passage 47 may be likewise controlled by an adjustable member 48, as in Fig. 5, for regulating the flow and travel of the lighter liquids therethrough. This fluid control is well illustrated in Fig. 1, wherein the passages 45 and 47 are shown in substantial vertical alinement with the discharging orifice screw 32 in the top of the casing, thus providing means for permitting the lighter liquids to be readily separated and ejected from the device. Manifestly, the position of the adjustable members 46 and 48 in the passages 45 and 47, with respect to the discharge orifice screw 32, will determine and regulate the travel and discharge of the lighter separated ingredients. However, any other practical arrangement of the liquid passages 45 and 47 with respect to the discharge orifice adjacent the top of the bowl may be used for the same purpose.

The solids or heavier constituents are gravitated toward the sides of the bowl, and the liquid or cushion back prevents said solids or constituents from adhering to the bowl and carries the same downwardly through the discharge openings 41 into the chamber base, and the lighter liquids within the base are forced upwardly through the separating chamber. A base discharge outlet 49, preferably adjustable, is provided so as to make said discharge outlet nearer to, or farther from the center of motion, as may be desired, and for bringing the discharge outlet in vertical alinement with the central balance of columns in the respective members. Moreover, this discharge outlet may be adjusted to establish a fixed or immovable liquid or cushion back throughout the period of operation, or to cause a continuous downward movement of said liquid or cushion back, as desired. Furthermore, the adjustment of said liquid or cushion back through said discharge pipe 49 controls the size of the clearance in said openings 41, since by adjustment the opening may remain in full size or be reduced, as desired, and the position of the discharge pipe determines the amount of infeed at 28. The liquid discharge pipe 49 may be of any suitable construction, and one form thereof is shown in Fig. 7, having an inner adjustable pipe section 50, and set-screw 51 for determining its position.

In Fig. 16, a slightly modified form of separator bowl is shown having inclined side walls 52 and 53 extending substantially its entire length, wherein liquid passages or pipes 54 may contact or be formed in the bowl walls, having their upper ends 55 communicating with inlet openings 56 at or toward the top of the bowl, and their outlet or discharge opening 57 at or adjacent to the lower portion of the bowl, and having a cushion or liquid back for carrying the heavier particles and constituents downwardly through the discharge openings 58 from a primary separating chamber 59 into a secondary separating chamber 60. The bowl base may be provided with scrapers, and an intermediate wall may be used or dispensed with depending upon the construction de-

sired, and dividing plates or disks 33, as in Fig. 1, may be used or eliminated. A liquid controlling passage 61 is made through the dividing wall 62 between the primary and secondary separating chambers, having an adjustable controlling member 63, or otherwise, and said opening 61 is preferably in vertical alinement with the discharge orifice toward the top of the bowl, which may be provided with a hollow screw member 64, through which the lighter separated liquids are ejected during the separating operation. Of course, the formation of the split wings or members 30 in the upper bowl portion may be varied to suit operating conditions, and in Figs. 11 and 12 a slightly modified construction is shown, wherein the admitted ingredient to be separated passes downwardly through the hollow spindle and passage 65 into the primary and auxiliary separating chambers, finally flowing into and out through the chamber 66. Two of the split wings are opened and the other one closed.

The operation is as follows: Liquid is inserted in the openings 28 in such quantity as to form a liquid or cushion back in the base of the bowl, and said liquid or cushion back may extend upwardly and along the side walls 25 and 26 of the bowl, in Fig. 1, and along the side walls 52 and 53 in Fig. 16, to such extent as to determine the desired clearances or passages in the openings 41 through the plate 42. The ingredient to be separated is admitted through the inlet passage 21, discharging through the opening 22 into the separating zone of the primary separating chamber. The heavier substance is forced to the bowl periphery and conveyed through the respective openings 41 into the chamber base 34. While the heavier substance is being carried toward the base of the bowl, the lighter liquid substance passes into the centrifugal level or column with the discharge port 32 in Fig. 1, and 64 in Fig. 16, and is discharged therefrom. Preferably, a series of spaced scraper members 40 contacts the lower base surface for the purpose of moving the solids to the point of discharge through the outlet opening provided centrally thereof. The heavier constituents are gravitated toward the periphery of the base, and as said solids are moved downwardly they become constantly freed from the lighter liquid substance, and practically entirely so by passing over the dry surface centrally of the vertical separating level toward the center of the base beyond the liquid column indicated by dotted lines in Figs. 1 and 16.

The peripheral flanged edge having the series of discharging openings 41 may be modified to suit various operating conditions. As shown in Figs. 1 and 16, the discharge openings may be located nearer to or farther from the bowl periphery, as circumstances may require.

In the separator to which certain features of the present invention relate use is made of a cushion around the periphery of the bowl or a portion thereof. It is contemplated to provide for the separation of one or more liquids or one or more solids, or both, from a mixture or aggregation of liquids, or liquids and solids, which facts will be more fully disclosed presently. Ordinarily, it is intended that the cushion shall be of such specific gravity that the same will occupy a position against the wall or periphery of the bowl, the various components or constituents of the aggregated material lying within, or toward the center of rotation of the cushion. The cushion contemplated in the present invention is a separating or conveying, or a separating and conveying cushion, as distinguished from a cushion the function and purposes of which are for the amalgamation or dissolving of constituents from the aggregate.

Where a stationary or non-traveling cushion is used in accordance with one feature of my invention, this cushion will perform a separating function, and the movement of the separated materials will occur by reason of other factors, in the manner to be more fully described. Where, however, a traveling or non-stationary cushion is used the cushion will serve to perform not only the separating function, but also will itself assist in conveying the separated materials from one portion of the machine to another.

In order that the nature of the cushion or cushions contemplated in the present invention may be more fully and perfectly realized and appreciated I will describe more in detail methods of operation contemplated with structures disclosed herein. For example in the arrangement shown in Fig. 1, the cushion material may be introduced by way of the groove or channel 28, passing down through the tubes 27 to occupy a position against the peripheral surfaces 26 and 34. Inasmuch as the machine is rotating the cushion material will be caused to stand out against these surfaces by reason of the centrifugal forces thus developed. The exact position which this material will assume will depend upon the peripheral speed of the machine, the specific gravity of the material, the shape of the bowls, etc., but ordinarily the inner surface of the cushion will be substantially vertical. The vertically extending dotted lines, shown in Fig. 1, indicate a convenient position for the surface of this cushion for certain classes of operation. The thickness of the cushion will depend upon the volume of cushion material contained within the machine as compared to the size and form of the various parts of the machine, and it will be readily apparent

that the thickness of the cushion can be regulated or adjusted or changed, if desired, by changing the volume of the contained cushion material. If no additional amount of cushion material be introduced, and if none of the material be allowed to escape, the volume contained within the machine will remain unchanged, with the result that, other things remaining constant, the thickness and other characteristics of the cushion will remain unchanged. Such a cushion may be designated a stationary cushion, and that is what I contemplate particularly when I use the term "stationary cushion". I do not mean by this term, necessarily, that the particles of the entrained cushion material do not move back and forth upon themselves, but I mean that there is no delivery of new cushion material into the machine, and that the total volume contained within the machine remains substantially unvaried. On the other hand, if there be a circulation of cushion material through the machine, following from the introduction of new cushion material, and the simultaneous withdrawal or escape of previously contained material, it is evident that there will be a circulation of the cushion material through the machine, the average travel of such material being from the point of inlet to the point of exit or delivery. Such a cushion may be designated a "traveling or moving cushion," and that is what I contemplate particularly when I use those terms. It is evident that if the rate of inlet and the rate of delivery of the cushion material be equal, the total volume of cushion material contained within the machine will remain constant, in which case the thickness of the cushion layer will also remain substantially constant, and we will have a traveling or moving cushion of substantially constant thickness. On the other hand, if the rates of inlet and delivery of the cushion material be unequal, the total volume of cushion material within the machine will either increase or decrease, and the result will be that not only will the cushion be traveling or moving, but also its thickness will be varying. It, therefore, follows that a moving or traveling cushion may be obtained of either constant or varying thickness.

From the foregoing it will be seen that it is possible to obtain either of several kinds of cushions, including a stationary cushion of uniform or unvarying thickness, a stationary cushion the thickness of which may be varied, a traveling cushion of uniform thickness, and a traveling cushion of varying thickness. I will now proceed to describe or state how these various kinds of cushions may be conveniently obtained by use of the particular mechanisms herein disclosed, although it will be evident that other forms of mechanism may be adopted, if desired, for securing the various kinds of cushions above enumerated.

In the particular arrangement illustrated, I have shown a discharge port 49 in the lower portion of the machine, the same being a port in an inwardly extending tube connected to the cup 34. Within this tube there is mounted the slidable sleeve or plunger 50 having a port which may be registered either partially or wholly with the port 49. If the edge of the port 49^a of the sleeve 50 be stationary at a certain point it is evident that the surface of the cushion within the machine will ordinarily be determined by the position of said edge, inasmuch as the cushion will fill to a point where it will begin to overflow past said edge, and an introduction of additional cushion material by way of the tubes 29 will simply result in a traveling cushion of substantially constant thickness, the material traveling downward or toward the port. If the sleeve 50 be adjusted either in or out the position of the edge 49^a will be varied, and, therefore, the excess of cushion material will overflow likewise the surface will be varied to change or modify the thickness of the cushion. Therefore, in this way a stationary cushion of desired thickness may be obtained, or a traveling cushion of desired thickness may be obtained, and in either case the thickness of the cushion can be adjusted or varied by adjusting the position of the tube 50. In Fig. 1 I have illustrated by means of the substantially vertical dotted lines one position of the surface of the cushion. Assuming that a cushion of the desired material and thickness has been established, the aggregate or mixed material will be introduced down through the opening in the upper end of the spindle 18. By reason of the rotation of the bowl, a centrifugal separating action will take place, the heavier materials moving outward to occupy the positions farthest from the axis of rotation. The lighter materials will collect farther in toward the axis of rotation, and will be drawn off or overflow through the discharge screw 32.

The heaviest materials will occupy the extreme outer positions, and will be thrown against the surface of the cushion. If this cushion be traveling, the materials so thrown against it will be assisted in their movement toward and through the openings 41, so that they will pass down through said openings and into the space in the lower portion of the separator. The ease or facility with which these materials will be allowed to pass down through the openings 41 will depend among other things upon the size or extent of such openings, as well as their contour or shape. By regulating the amount or extent of the openings, which can be accomplished by control of the thickness of the cushion, the ease with which the material

will be allowed to pass down into the lower portion of the separator can be controlled, and consequently the average specific gravity of the material allowed to pass through the openings 41 can be controlled in this way. The size of the openings 41 also controls the size and comparative quality of materials allowed to pass through them, and, therefore, the size and comparative quality of these materials can be controlled by varying the thickness of the cushion.

If the cushion be stationary, of a form which has been heretofore described, heavier materials will, nevertheless, pass down in contact with the surface of the cushion and through the openings 41, although such movement will not necessarily be facilitated to the same extent as would be the case with a traveling cushion. I desire to point out, however, that even where a stationary cushion is used the downward movement of the heavier materials will be facilitated because the surface of the cushion can move or slide on the body portions of the cushion so as to give a fluid action, inasmuch as the cushion consists of a liquid or fluid material as distinguished from the solid and unyielding material of which the bowl itself is composed. It will, therefore, be seen that, under any circumstances, the cushion will assist or facilitate the movement of the heavier materials toward the point of exit by reason of reducing the friction or resistance of said materials as compared to what it would be if said materials were caused to travel in contact with a solid and unyielding surface.

As the materials pass through the openings 41 and into the lower portion of the separator, a further separating action will occur, the heaviest materials remaining out toward the periphery or largest circle of rotation, and the lighter materials which have passed through the openings 41, being caused to work their way inward toward the axis of rotation. The heavier materials thus secondarily separated will be caught by the scrapers 40, or any other suitable mechanism, and worked inward toward the central discharge openings 40^a. The lighter materials will pass up and through the opening 45, if desired, so as to be again reseparated, or so as to find their way out through the screw discharge 32 if they be of proper specific gravity for such discharge. If on the other hand they contain heavier materials a still further separating action will occur, so that the materials will, in effect, circulate around in the machine until only the lighter portions discharge through the screw 32, and the heavier portions down through the central discharge opening 40^a.

If the aggregated material originally introduced contains ingredients or constituents which are of greater specific gravity than the cushion, such materials will penetrate the surface of the cushion and be thrown against the surface of the bowl. If the cushion be traveling, such materials will be gradually worked down while in contact with the surface of the bowl and will be discharged through the opening 41 into the lower portion of the separator. Here they will be thrown out against the surface of the bowl 34, and inasmuch as said surface is of greater diameter than that of the bowl 26 it follows that these heavier materials can collect against the surface 34, which will thus provide, in effect, a pocket for these materials, where they may collect until the machine is stopped for cleaning purposes. For example, certain of the precious metals may thus be separated and allowed to collect within the machine. Or, by providing a traveling cushion, certain of these heaviest constituents may be caused to discharge with the cushion material through the opening 40^a. Thus it will be seen that in either case it is possible to effect a separation of two heavy materials, such for example as two solids, and such separation can be effected particularly if one of these solids be of greater specific gravity than the cushion, and the other of lesser specific gravity than the cushion.

I have shown in the several drawings a partition 43 between the two major portions of the separator, said partition being provided with a perforation or opening 45, the size of which can be controlled by the screw 46. This partition 43 will serve to assist in controlling the separating action under some conditions, but I wish to point out the fact that frequently this partition may be done away with, a sufficiently accurate and correct separation being obtained without its assistance.

The material which will be used for the cushion, under any conditions, will be selected largely according to the constituents of which the aggregation is composed. For example, if the aggregation contains two solids which it is desired to separate, a cushion should preferably be chosen having a specific gravity approximately half way between or intermediate the specific gravities of said solids. But if there is a single solid to be separated, a cushion would preferably be chosen having a specific gravity greater than such solid; but if it were desired simply to effect separation of liquids, a cushion might be selected having a specific gravity greater than that of either of the liquid constituents. In this case also it would be desirable to select a cushion material which would not mix or chemically unite with either of the constituents.

As an example of one set of conditions I will assume that the aggregated material contains tungsten and nickel, as well as certain liquids. The specific gravity of the

tungsten is approximately 17.3, while the nickel has a specific gravity of approximately 8.7. Mercury, which is liquid at all ordinary temperatures, has a specific gravity of approximately 13.6, and, therefore, stands in between the nickel and tungsten. On account of the high specific gravity of the mercury the liquids contained in the aggregate would not penetrate the mercury cushion, and the nickel would be thrown out against the surface of the mercury cushion but would not penetrate the same. On the other hand, the tungsten, being of greater specific gravity than the mercury, would penetrate the same, so that the tungsten and nickel would be separated as previously described. The liquid constituents, of course, would be separated away from both of the solids, and would occupy positions in closer to the axis of rotation.

The foregoing example of a mercury cushion used under specific conditions is cited merely as an example, and obviously the composition and nature of the cushion may be varied or changed according to the particular work in hand, or according to the various constituents contained in the aggregation. In some cases water would be of sufficient specific gravity to act as a suitable cushion, as, for example, when certain oils were to be separated. Or, for example, the apparatus might be used for the separation of beer grains from the beer. In this case, a cushion of brine or carbon tetra-chlorid would be used, the beer grains being thrown out against the cushion, and delivered down through the openings 41, and ultimately delivered from the opening 40ª, while the separated beer would ultimately be delivered through the threaded nozzle 32.

In the operation of the machine there is a continuous discharge of all constituents separated within the bowl, with the exception that where two solids are present and separated the heavier may be retained behind the liquid or cushion back contacting the bowl periphery.

Although a vertical form of centrifugal separator has been shown and described, it is not intended to limit the invention thereto, since a horizontal construction and operation on the same principles may be employed for performing the separating operation. The formation of the separator bowl or vessel may be considerably modified to meet various operating conditions, and a different design of separating chamber may be employed, so long as the liquid or cushion back is employed. The base of the bowl may have flat, curved or inclined walls, with or without scrapers.

I claim:

1. In a separator, a separating bowl, comprising a plurality of separating compartments, a base plate intermediate said compartments and having peripheral openings therein, a liquid or cushion-back formed adjacent to the periphery of the bowl, and means for regulating the movement and discharge of said liquid back, substantially as described.

2. A centrifugal separator comprising a separating bowl having adjacent the periphery thereof passages through which a liquid may enter to form a peripheral liquid cushion therewithin, a bowl base constituting in effect a dam by which said liquid cushion is held and distributed upwardly within the separating bowl against the peripheral walls thereof, and a plate intermediate said bowl and base formed with a discharge opening therethrough, said opening being more or less restricted in size to regulate the discharge and travel therethrough of solids or heavy constituents according as the body of liquid forming the said liquid cushion is varied in quantity, substantially as described.

3. In a separator, a separating bowl, a plate within said bowl providing separating compartments therein, an opening in said plate adjacent the periphery of said bowl establishing communication between said compartments, and means for controlling the passage of a heavier separated constituent through said opening consisting of a liquid or cushion back adjacent the periphery of said bowl and extending normally into said opening, and means for regulating the thickness or body of said liquid or cushion back, whereby the unrestricted portion of said opening may be varied, substantially as described.

4. In a separator, a separating bowl arranged to provide main and secondary separating compartments therein, means for permitting a lighter separated constituent to pass into the main separating compartment of the bowl without interference for maintaining a harmonious balance of column, whereby the said lighter constituent may be continuously moved upwardly and a heavier constituent moved downwardly to discharge from the bowl base, substantially as described.

5. In a separator, a separating bowl comprising a plurality of separating compartments, passages between said compartments for enabling the lighter portions of an ingredient to pass therethrough to be ejected from the separator, said passages being adjustable to permit the column of separated lighter constituents in the several compartments to be brought into or out of balance with one another as desired, substantially as described.

6. In a machine of the class described the combination with an inclosing vessel, of a partition within the same serving to divide said vessel into primary and secondary sepa-

rating chambers, there being openings in the periphery of said partition to establish communication between the chambers, means for establishing a cushion on the peripheral surfaces of both chambers and through the perforations, and means for regulating the thickness of said cushion.

7. In a machine of the class described the combination with primary and secondary separating chambers and a partition dividing said chambers, there being perforations in the periphery of said partition, of means for establishing a cushion of material against the peripheral surfaces of both chambers and through said perforations, and means for regulating the thickness of said cushion.

8. In a machine of the class described the combination with primary and secondary separating chambers and a partition member interposed between the peripheral portions of said chambers, there being perforations in the periphery of said member to give communication between the peripheries of said chambers, of means for establishing a cushion against the peripheral surfaces of said chambers and through said perforations, and means for regulating the thickness of said cushion.

EDWARD W. BEACH.

Witnesses:
A. E. BARBER,
EDWARD F. WILLIAMS.