Nov. 23, 1954 H. R. DRURY 2,695,133

CENTRIFUGAL SEPARATOR

Filed Aug. 26, 1953 2 Sheets-Sheet 1

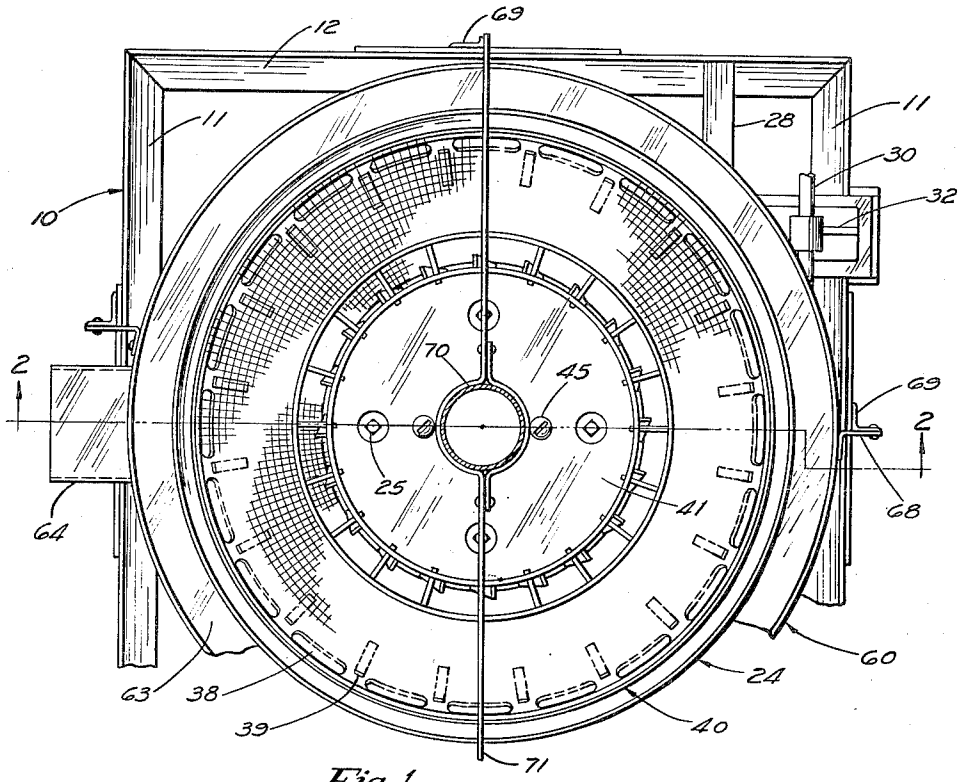


Fig. 1

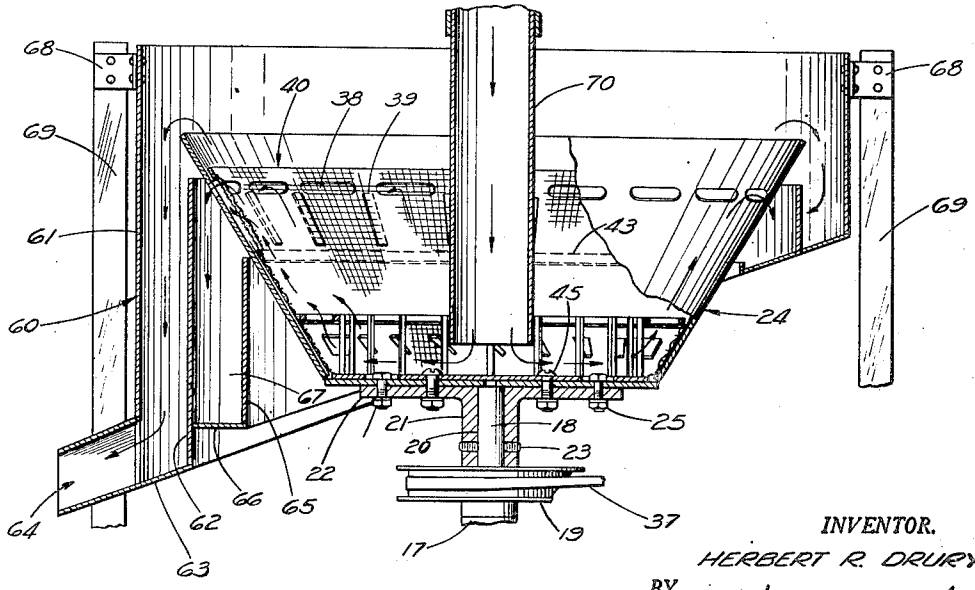


Fig. 2

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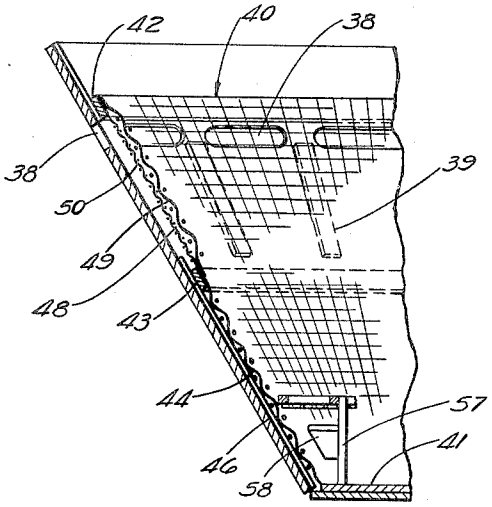


Fig. 3

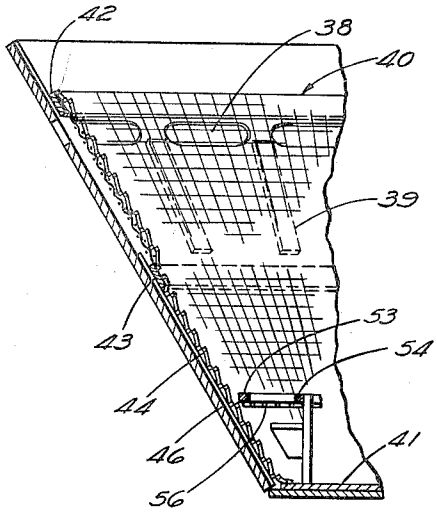


Fig. 4

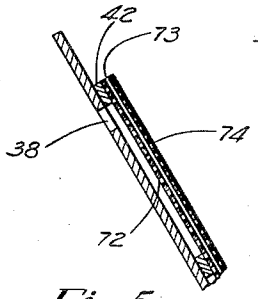


Fig. 5

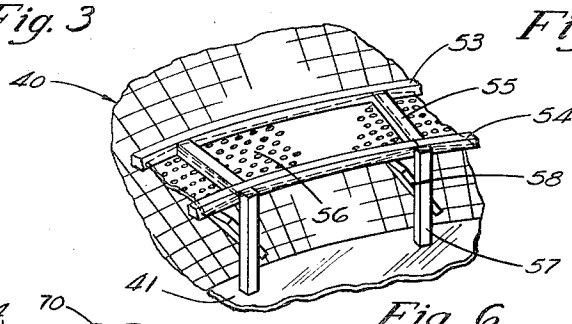


Fig. 6

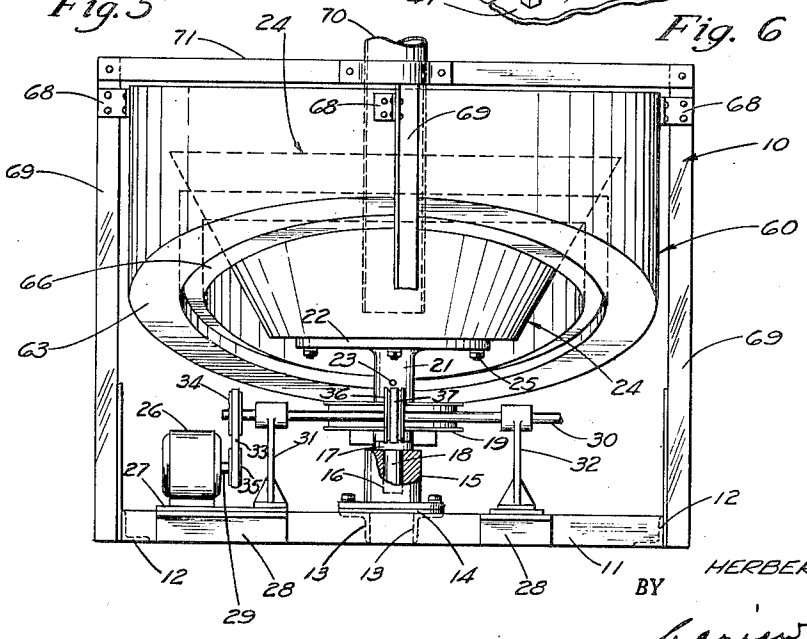


Fig 7

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CENTRIFUGAL SEPARATOR

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9 Claims. (Cl. 233—2)

This invention relates to centrifugal separating devices and more particularly to separating apparatus for classifying or separating substances containing precious or valuable metals or other valuable mineral containing substances and to such apparatus employing a rotating bowl for imparting centrifugal action to the material under treatment.

Heretofore, in separating precious metals, particularly gold, from alluvium or gangue, placer gravels and sand or mine residue in which it is found, there has always been a considerable amount of black sand present as an undesirable element. The presence of black sand had presented a problem in gold separation as it interfered with the separation process, clogging the separating equipment and was therefore discarded as a nuisance.

Owing to recent discoveries that black sand contained valuable mineral substances such as ilmenite, chromite, thorium and magnetite, there is a growing demand for such black sand in reasonably clean concentration, particularly from the gravels and sands obtained from the rivers and beaches of California and Oregon. It has been determined that the black sands in these areas contain one pound uranium thorite in every ton. This mineral substance has a seven percent concentration of uranium oxide and a seventy percent concentration of thorium. Although the black sand can be separated from the gray sands or gravels by electromagnetic treatment, such process is comparatively expensive due to the fact that the sands or gravel must be baked to absolute dryness before being treated electrically.

By the present invention, there is provided a method and apparatus therefor, for treating sands, gangue, gravel and the like, containing precious metals and black sand which overcomes the difficulties present in prior practices which serves to effectively separately classify and recover precious metals and black sand in a single operation. Accordingly, it is among the objects of my invention to provide centrifugal concentrating apparatus whereby valuable metals and black sand may be efficiently and economically separated from alluvium or gangue, placer gravel and sand or mine residue. A further object of the invention is to provide centrifugal concentrating apparatus for treating material to separately recover precious metals and black sand wherein the precious metals are separated in one zone of the apparatus and the black sand in another zone as the material under treatment passes through the apparatus.

These and other objects and advantageous features of the invention not at this time more particularly pointed out will become more apparent as the nature of the invention is better understood from the following detailed description taken in conjunction with the accompanying drawings wherein like reference characters denote corresponding parts, and wherein:

Figure 1 is a fragmentary top plan view of a centrifugal separating device embodying the present invention,

Figure 2 is a transverse sectional view taken on the line 2—2 of Figure 1 with parts broken away and omitted,

Figure 3 is an enlarged sectional detail of the preferred type of liner construction for the device,

Figure 4 is an enlarged sectional detail view of a modified form of liner construction,

Figure 5 is an enlarged sectional detail of a further modified form of liner construction,

Figure 6 is an enlarged perspective detail of the impeller and riffle construction disposed at the lower portion of the side wall of the liner for the bowl, and

Figure 7 is a side elevational view of reduced scale of the device of the invention with parts thereof broken away and in section.

With reference to the accompanying drawings, there is illustrated a centrifugal separating device constructed in accordance with the teachings of the present invention and comprising a base or supporting frame **10** including opposed side frame members **11** and **12**, the adjacent ends of which are mitered and welded together to form a rectangular base frame. Extending between the side frame members **11** (see Figure 7) are a pair of spaced angle irons **13** upon which is centrally positioned a supporting plate **14**. Mounted on the plate **14** and secured to the angle irons **13** is an upstanding journal box **15** formed with an internal axial bore **16**.

The journal box **15** supports in the bore **16** thereof a vertically disposed shaft **18** rotatably mounted in a thrust bearing **17** which is supported on the upper surface of the journal box **15**. Keyed to the shaft **18** above the bearing **17** is a sheave **19** which is connected to a suitable source of power for rotating the shaft **18** as will be described hereinafter. The upper end of the shaft **18** extends into the bore **20** of a depending hub **21** formed on the lower surface of a supporting disk **22** and is maintained therein by means of set screws **23** (see Figure 2). Mounted on the upper surface of the disk **22** is a frustro-conical concentrating bowl **24** which may be made of any suitable material such as aluminum, iron, steel, plastic or molded hard rubber if desired. The bowl **24** is secured to the disk **22** for rotation therewith by means of suitable bolts **25**.

The apparatus for rotating the bowl **24** and the supporting structure therefore is best illustrated in Figure 7 of the drawings and includes a motor **26** mounted on a plate **27** supported between spaced angle members **28** secured to the frame **10**. Although an electric motor is illustrated in the drawing, any other suitable power means may be employed depending upon the particular site where the separating bowl is to be set up and used. Extending parallel to the drive shaft **29** of the motor is a countershaft **30** suitably supported in spaced brackets **31** and **32** also mounted on the frame **10**. A pulley belt **33** operatively connects pulley **34** keyed to the end of the countershaft **30**, to pulley **35** on the motor shaft **29**. Mounted on the countershaft **30** is a sheave **36** which is aligned with and arranged to drive the sheave **19** of the bowl supporting assembly through a belt **37**.

The bowl **24** is preferably frustro-conical in configuration being formed with a smooth interior surface, with the base thereof resting on the upper surface of the disk **22** and being secured thereto by the bolts **25**. The side wall of the bowl may extend at an angle of between fifty and sixty degrees to the plane of the base, however, it has been found that if the pitch of the side wall is approximately fifty-eight degrees with respect to the base, the material introduced into the bowl is properly worked as it passes upwardly along the side wall of the bowl and maximum separation is obtained before it is discharged from the bowl. Furthermore, maximum speed of operation and capacity is obtained with the aforesaid angulation of the side wall. Spaced from the upper edge of the bowl and extending circumferentially about the side wall of the bowl is a plurality of narrow elongated openings or slots **38**. Between each pair of slots **38** there is secured to the inner surface of the bowl a flow strip **39** extending from the slots **38** downwardly into the bowl. The function of the flow strips and slots will become more apparent from the description hereinafter.

Mounted in the bowl **24** so as to substantially cover the entire inner wall surface thereof is a frustro-conical liner or basket **40**. The basket **40** includes a base plate **41** arranged to be secured to the bottom of the bowl by means of removable bolts **45**, a rigid ring **42** of sufficient diameter to seat within the open end of the bowl and a second ring **43** of a diameter sufficient to permit seating intermediate the ring **42** and the base member **41**. Extending between the plate **41** and ring **43** and preferably welded to each is a wall portion **44** which is suitably formed of wire mesh, or expanded metal

lath (Figure 4). Disposed between the wire mesh wall portion **44** and the interior wall of the bowl is a covering **46** made of a suitable fabric material such as burlap or blanket material. This covering serves to entrap and hold the particles of precious metal separated from the material treated in the lower portion of the bowl. The wall portion **48** of the basket **40** between the ring members **42** and **43** is constructed of an outer layer of wire mesh **49** and an inner layer of fine mesh wire screening or filter material **50**. The wall portion **48** of the basket is maintained in spaced relation to the inner wall surface of the bowl by means of the spaced metal flow strips **39** which extend in an axial direction and are secured to the wall in any suitable manner. The strips **39** serve to space the fine wire mesh from the inner surface of the wall and thereby define a passageway therebetween which terminates in the slots **38**.

Mounted in the bottom of the basket **40** adjacent to the intersection of the side wall portion **44** thereof and the base plate **41** is a riffle ring **53** suitably welded to the wall portion **44** at a point vertically spaced from the base plate **41**. Spaced diametrically with respect to the outer riffle ring **53** is an inner riffle ring **54** which is connected to the outer ring by means of a plurality of tie members **55**. A series of perforated plate segments **56** are supported by the frame formed by the inner and outer riffle rings. Extending between the inner riffle ring **54** and the base plate of the basket and serving to support the former in spaced relation to the latter are a plurality of vertically extending finger members **57**, each of which is arranged to support an impeller plate **58**. The impeller plates are preferably mounted at an angle of forty-five degrees to the members **57** and have their inner edge surface spaced from the wall portion of the basket and extending parallel thereto.

A circular launder **60** is coaxially positioned about the rim of the discharge edge of the bowl. The launder **60** includes an outer cylindrical wall **61**, an inner cylindrical wall **62** and a flat inclined bottom **63**, thus forming an asymmetrical annular chamber. A rectangular discharge chute **64** is provided adjacent the lower portion of the bottom **63**. The walls, bottom and chute are suitably secured together as by welding to form a complete unit. Spaced from the wall **62** and supported therefrom is a wall member **65** which together with a bottom wall **66** connecting the bottom of the wall **65** to the wall **62** defines an auxiliary launder **67** which serves to collect material discharged from the bowl **24** through the slots **38** in the wall thereof. The launder **60** and auxiliary launder **67** connected thereto are supported by a plurality of angle brackets **68** bolted or otherwise secured to upright frame members **69** mounted on the base **10**.

The bowl **24** receives material to be separated or classified from a feed chute **70** which opens into the interior of the bowl adjacent the bottom thereof. A suitable bracket **71** (Figure 1) extending from the upright members **69** serves to maintain the chute in proper operating position within the bowl.

With reference to Figure 5 there is illustrated a modified construction for the upper portion of the basket. In lieu of the wire mesh **49** and wire cloth **5** I provide a perforated wall **72** which is supported on the flow strips **39**. Disposed on the wall **72** is filter skin **73** which may be made of plastic or other suitable material. Superimposed on the filter skin is a perforated wall member **74** preferably made of stainless steel and serving to protect the filter skin and allow the accumulation of coarse sand on the skin to be washed away and fine material such as black sand to penetrate the filter skin freely.

In using the separating bowl of the present invention the gangue or conglomeration containing precious metallic substances and black sand mixed with sufficient water to carry it is introduced into the bowl **24** through the feed chute **70** and deposited in the bottom of the bowl which is being rapidly rotated. I have found that where a bowl with a diameter of thirty-six inches is used a speed of about two hundred R. P. M. is preferable. The rapid rotation of the bowl creates a centrifugal force which moves the material radially outwardly along the bottom of the basket where it engages the impellers **58** which agitates and breaks up the flow. The turbulence in the flow of material caused by the impellers **58** segregates the fine material from the coarser particles, the former passing through the perforated riffle plate **56** and the latter being forced to pass outwardly around the plate leaving the gold nuggets disposed under the riffle.

The fine material which has passed through the riffle plate is worked against the wire mesh **44** as it moves upwardly along the wall of the basket. The mesh causes the material to separate and the heavier particles of gold to pass through the mesh and become entrapped by the fabric liner disposed therebeneath. The black sand being heavier than the remaining material will pass through the mesh but being lighter than the gold does not prevent the latter from working itself into the fabric where it is retained. The remaining material including the black sand moves upwardly along the wall of the basket to that portion above the ring **43**. In this section the finer particles including the black sand are worked by the wire mesh **49** against the wire mesh cloth **50**. The mesh cloth is such that the black sand will pass therethrough but the balance is excluded. The black sand passes upwardly along the wall of the bowl through the passage defined by the flow strips and the wire cloth and is directed into and through the slots **38** where it is received in the auxiliary launder **67** from which it passes to a suitable place of storage not shown. The balance of the material under treatment passes outwardly over the peripheral edge of the bowl into the launder **60** and is directed to a suitable place of disposal by the discharge chute **64**. This action continues until the fabric liner **46** has become fairly well saturated with gold or other precious metal at which time the feed of solid material into the bowl is first cut off and then rotation of the bowl is stopped. The bolts **45** are removed and the water is permitted to drain out of the bowl into suitable receptacles. The wire basket is removed from the bowl after which the fabric liner or bag is carefully washed to remove therefrom the gold or other precious metal particles which have become entrapped therein. After the bag and basket have been replaced in the bowl the device is ready to continue the separating operation.

Having thus described my invention so that those skilled in the art may practice the same, what I desire to obtain by Letters Patent is defined in the appended claims.

I claim:

1. A centrifugal separator comprising a frustro-conical bowl for receiving materials to be treated including a base and a side wall, means for rotating said bowl at high speed, a removable frustro-conical basket complemental to the inner surface of the bowl and adapted to be received therein, said basket including a base plate arranged to seat on the base of the bowl, a ring member arranged to engage within the peripheral edge of the bowl, and a second ring engageable with the wall of the bowl intermediate the base and said first ring, open mesh material spanning the space between said rings and said base plate, fabric material disposed adjacent to the wall of bowl between said second ring and the base plate, and wire cloth disposed between the bowl wall and the open mesh material between said first and second rings.

2. A centrifugal separator comprising a frustro-conical bowl for receiving materials to be treated including a base and a side wall, means for rotating said bowl at high speed, a removable frustro-conical basket complemental to the inner surface of the bowl and adapted to be received therein, said basket including a base plate arranged to seat on the base of the bowl, a ring member arranged to engage within the peripheral edge of the bowl, and a second ring engageable with the wall of the bowl intermediate the base and said first ring, open mesh material spanning the space between said rings and said base plate, said side wall having a ring of spaced slots formed adjacent said first ring, fabric material disposed adjacent to the wall of bowl between said second ring and the base plate, wire cloth disposed between the bowl wall and the open mesh material between said first and second rings, and a plurality of elements secured to the wall and serving to maintain the wire cloth spaced from the inner surface of said bowl wall.

3. A centrifugal separator comprising a frustro-conical bowl for receiving materials to be treated including a base and a side wall, means for rotating said bowl at high speed, a removable frustro-conical basket complemental to the inner surface of the bowl and adapted to be received therein, said basket including a base plate arranged to seat on the base of the bowl, a ring member arranged to engage within the peripheral edge of the bowl, and a second ring engageable with the wall

of the bowl intermediate the base and said first ring, open mesh material spanning the space between said rings and said base plate and a riffle ring including a plurality of impellers mounted adjacent the intersection between the mesh material and the base plate.

4. A centrifugal separator comprising a frustro-conical bowl for receiving materials to be treated including a base and a side wall, means for rotating said bowl at high speed, a removable frustro-conical basket complemental to the inner surface of the bowl and adapted to be received therein, said basket including a base plate arranged to seat on the base of the bowl, a ring member arranged to engage within the peripheral edge of the bowl, and a second ring engageable with the wall of the bowl intermediate the base and said first ring, open mesh material spanning the space between said rings and said base plate, fabric material disposed adjacent to the wall of bowl between said second ring and the base plate, wire cloth disposed between the bowl wall and the open mesh material between said first and second rings and a riffle member mounted adjacent the joint between the mesh material and said base plate.

5. A centrifugal separator comprising a frustro-conical bowl for receiving materials to be treated including a base and a side wall, means for rotating said bowl at high speed, a removable frustro-conical basket complemental to the inner surface of the bowl and adapted to be received therein, said basket including a base plate arranged to seat on the base of the bowl and an open mesh side wall, fabric material positioned between the lower portion of said mesh side wall and the wall of the bowl, and a filter element positioned between the upper portion of said mesh side wall and the wall of the bowl.

6. A centrifugal separator comprising a frustro-conical bowl for receiving materials to be treated including a base and a side wall, means for rotating said bowl at high speed, a removable frustro-conical basket complemental to the inner surface of the bowl and adapted to be received therein, said basket including a base plate arranged to seat on the base of the bowl and an open mesh side wall, fabric material positioned between the lower portion of said mesh side wall and the wall of the bowl, a filter element positioned between the upper portion of said mesh side wall and the wall of the bowl and spaced from the latter, and means for directing material passing through said filter into a place of storage.

7. A centrifugal separator comprising a frustro-conical bowl for receiving materials to be treated including a base and a side wall, means for rotating said bowl at high speed, a removable frustro-conical basket complemental to the inner surface of the bowl and adapted to be received therein, said basket including a base plate arranged to seat on the base of the bowl and an open mesh side wall, fabric material positioned between the lower portion of said mesh side wall and the wall of the bowl, a filter element positioned between the upper portion of said mesh side wall and the wall of the bowl and spaced from the latter, and riffle means mounted on said base plate adjacent the side wall of the basket.

8. A centrifugal separator comprising a frustro-conical bowl for receiving materials to be treated including a base and a side wall having a plurality of circumferentially arranged openings spaced from the peripheral edge thereof, means for rotating said bowl at high speed, a removable frustro-conical basket complemental to the inner surface of the bowl and adapted to be received therein, said basket including a base plate arranged to seat on the base of the bowl and an open mesh side wall, fabric material positioned between the lower portion of said mesh side wall and the wall of the bowl, adapted to receive heavy particles separated from the material in the lower portion of the bowl, and filter material positioned between the upper portion of said mesh side wall and means for directing material passing through said filter material into the openings in the side wall of the bowl.

9. A centrifugal separator comprising a frustro-conical bowl for receiving materials to be treated including a base and a side wall having a plurality of slots arranged circumferentially adjacent the upper edge thereof, means for rotating said bowl at high speed, a removable frustro-conical basket complemental to the inner surface of the bowl and adapted to be received therein, said basket including a base plate arranged to seat on the base of the bowl and an open mesh side wall, a ring member separating said side wall into upper and lower portions, fabric material positioned between the lower portion of said mesh side wall and the wall of the bowl, a filter element positioned between the upper portion of said mesh side wall and the wall of the bowl and spaced from the latter, and means for maintaining said filter element spaced from the wall of the bowl, said means and filter element defining a passageway through which material passing through said filter element is directed into said slots.

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