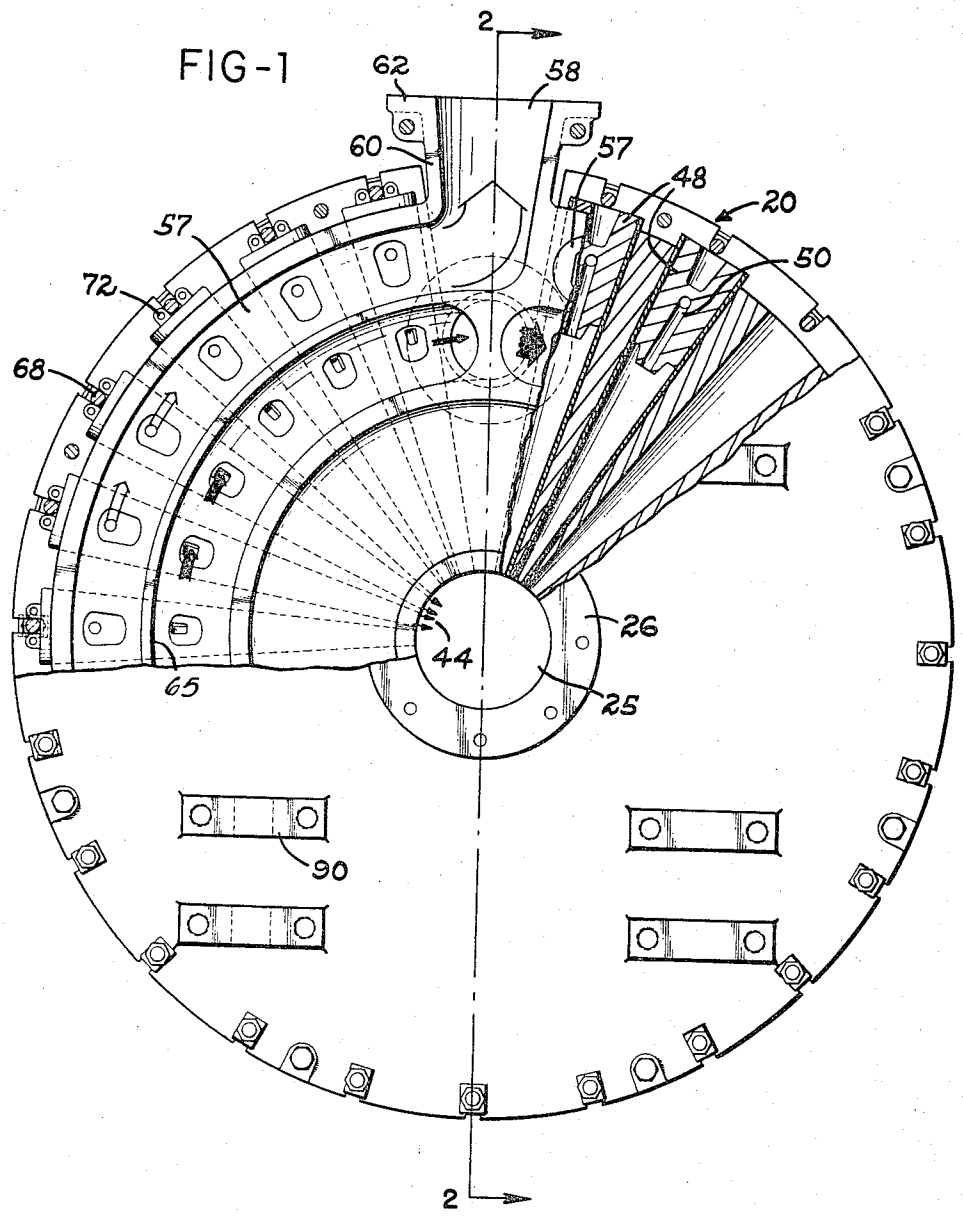
Aug. 15, 1967 J. BAXTER, JR 3,335,860

CENTRIFUGAL CLEANER FOR PAPER MAKING STOCK AND THE LIKE

Filed July 27, 1964

4 Sheets-Sheet 1

FIG-1



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FIG-2

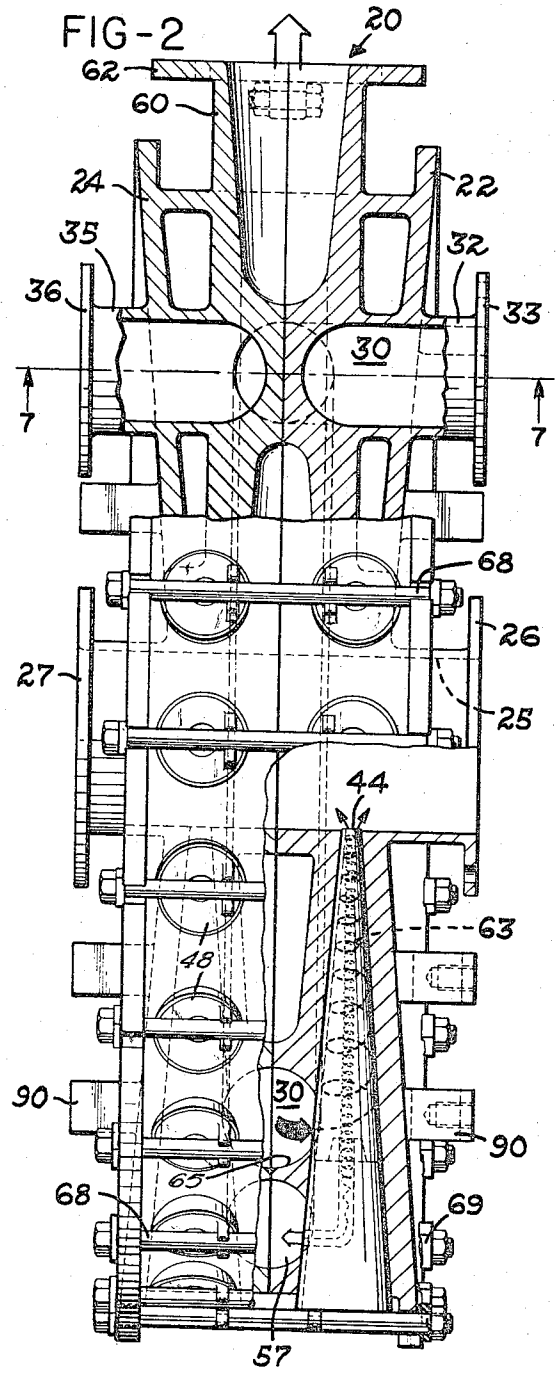


FIG-4

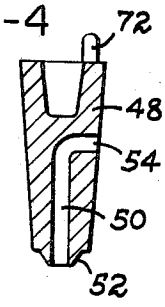


FIG-3

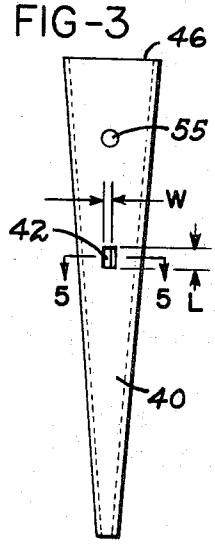
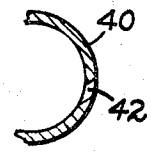


FIG-5



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FIG-6

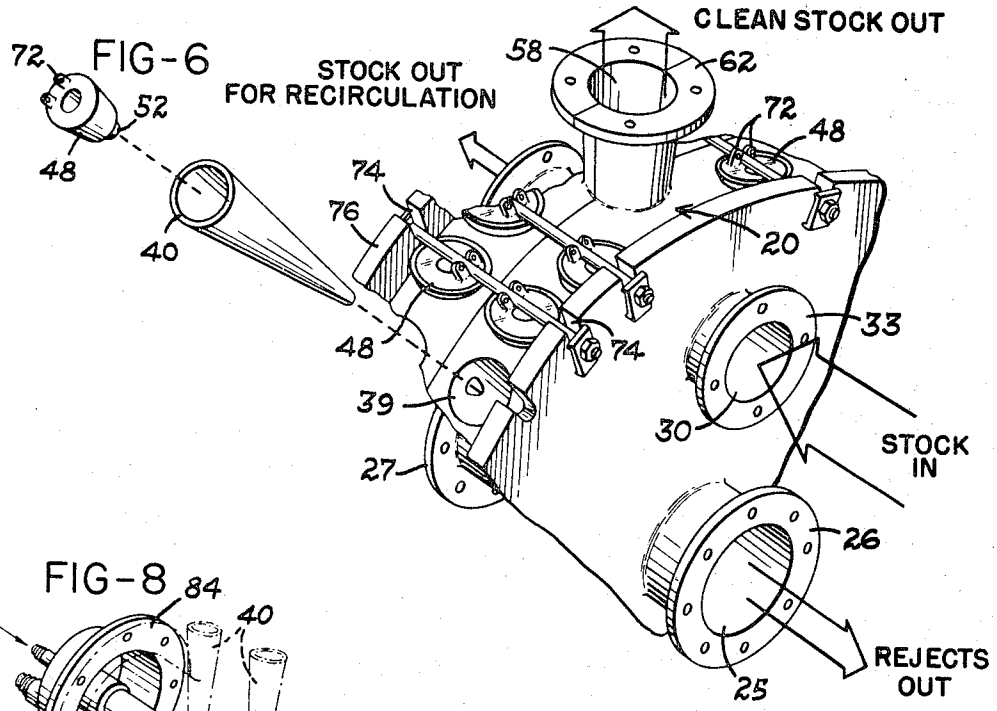


FIG-8

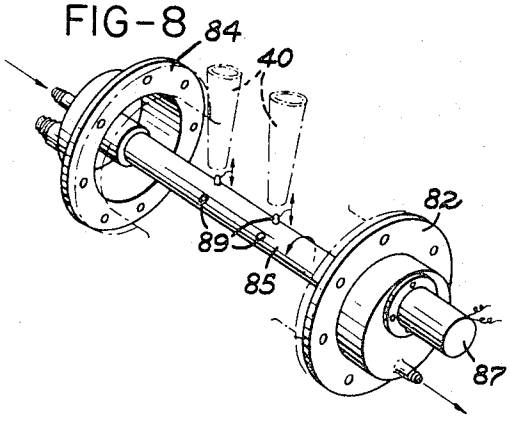
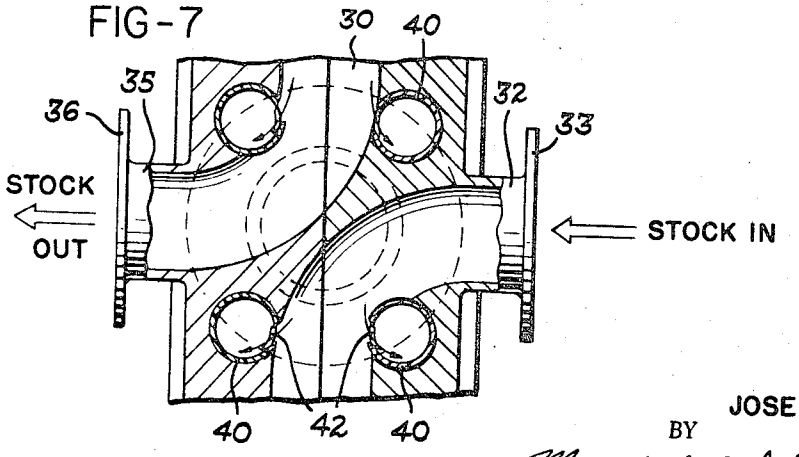


FIG-7



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FIG-9

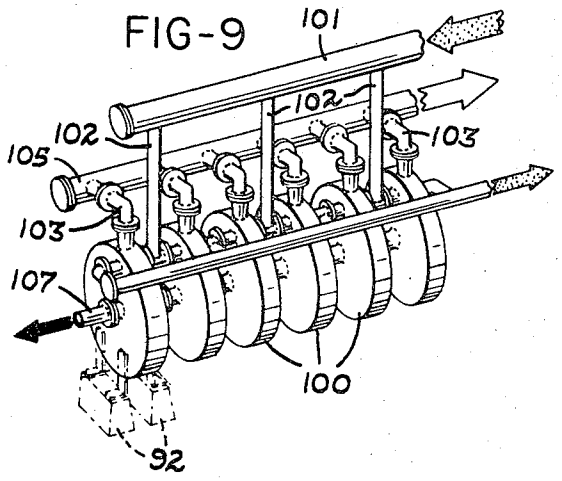


FIG-12

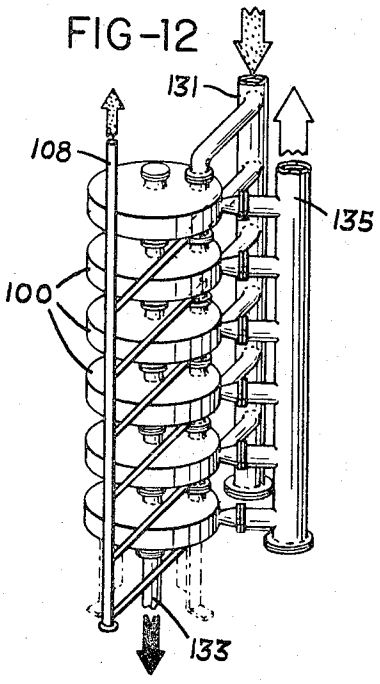


FIG-10

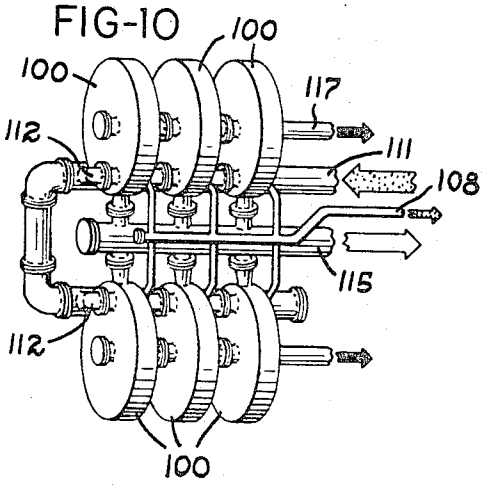
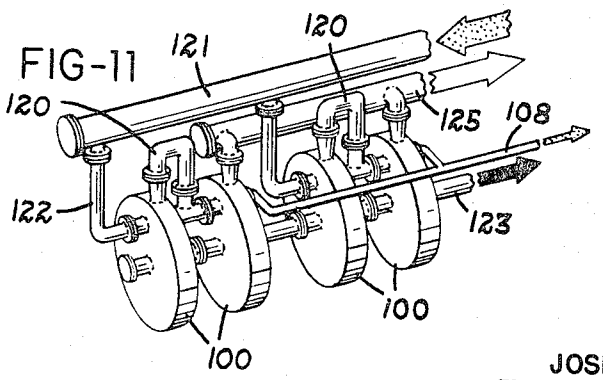


FIG-11



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United States Patent Office 3,335,860 Patented Aug. 15, 1967

3,335,860

CENTRIFUGAL CLEANER FOR PAPER MAKING STOCK AND THE LIKE

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Filed July 27, 1964, Ser. No. 385,261
7 Claims. (Cl. 209—211)

This invention relates to apparatus for cleaning paper making stock and other liquid suspensions by removing therefrom particles having higher specific gravities than its carrier liquid.

The invention has relation to cleaning apparatus of the general class of vortex cleaners typified by Samson et al. United States Patent No. 2,377,524 which have come into relatively wide use in the paper industry for the treatment of paper making stock to remove dirt particles such as bark specks, shives, abrasive particles and the like, some of which may have specific gravities relatively close to that of the paper making fibers.

It is a primary object of the invention to provide a novel centrifugal cleaning apparatus for paper making stock and like liquid suspensions comprising a single housing which incorporates a plurality of individual vortex cleaner units, a single supply conduit for supplying stock to be cleaned to all of the vortex cleaner units, a single outlet for discharging accepted stock from the housing, and a single outlet for discharging reject material from the housing.

It is a special object of the invention to provide cleaning apparatus as outlined above wherein the stock supply conduit is constructed and arranged to serve as a primary or first stage cleaner for removing coarse dirt particles from the stock before it reaches any of the vortex cleaner units.

It is also a special object of the invention to provide cleaning apparatus as outlined above wherein each of the individual vortex cleaner units is provided with a liner insert of abrasion resistant material for protection against the abrasive action of solid particles in the stock in use, and wherein also the construction is such that it facilitates rapid removal and replacement of liner inserts in the event of wear thereof.

Another object of the invention is to provide cleaning apparatus as outlined above which incorporates a novel mechanism for preventing the reject discharge ends of the individual vortex cleaner unites from becoming clogged by reject material in use.

An additional object of the invention is to provide centrifugal cleaning apparatus as outlined above wherein the housing assembly is especially adapted to facilitate connecting of a plurality of such assemblies together in either parallel or series arrangements for correspondingly increased capacity or effectiveness of the resulting stock cleaning system.

Other objects and advantages of the invention will be apparent from the following description, the accompanying drawings and the appended claims.

In the drawings—

FIG. 1 is an elevational view, partially in section, of apparatus according to the invention showing the overall radial arangement of the vortex cleaner units and their spaced relationship in the housing with the inlet and discharge conduits;

FIG. 2 is an end view of the apparatus of FIG. 1, partially in section on the line 2—2 of FIG. 1, showing the overall relationship between the two banks of vortex cleaner units and their connections with the inlet and discharge conduits;

FIG. 3 is a detail view in elevation of a liner insert

for the vortex cleaner units in the apparatus of FIGS. 1–3;

FIG. 4 is a sectional view of the closure for the liner insert of FIG. 3;

FIG. 5 is a fragmentary section on the line 5—5 of FIG. 3;

FIG. 6 is a fragmentary perspective view of the apparatus of FIG. 1;

FIG. 7 is a fragmentary section on the line 7—7 of FIG. 2 showing details of the inlet conduit construction;

FIG. 8 is a perspective view of the mechanism for preventing the clogging of the reject discharge ends of the vortex cleaner units;

FIG. 9 is a perspective view of an in-line cluster of apparatus according to the invention combined in a parallel arrangement;

FIG. 10 is a perspective view showing a stacked cluster of apparatus according to the invention, also arranged in a parallel combination;

FIG. 11 shows another cluster of apparatus according to the invention, arranged in a series parallel arrangement; and

FIG. 12 is a perspective view of a stacked cluster of apparatus according to the invention connected in parallel.

Referring to the drawings, which illustrate preferred embodiments of the invention, FIGS. 1 and 2 show a main body or housing 20 which preferably is formed in two mating half sections 22 and 24 having cavities in their mating surfaces so that when joined together, they define a central discharge conduit 25 for receiving the impurities or rejects separated from the stock. Formed on opposite ends of the discharge conduit 25 are mounting flanges 26 and 27 which are adapted to be coupled with corresponding flanges of additional similar apparatus when they are combined into clusters.

Concentrically disposed in relation to the discharge conduit 25 is an inlet conduit 30 which is curvilinear or generally toroidal in configuration and is conveniently formed one-half within the section 24 and one-half within the mating section 22. The inlet conduit 30 is adapted for receiving dirty stock through the neck portion 32 from a supply line which is connected by means of the flange 33. The outlet end of the inlet conduit 30 includes a similar neck 35 and flange 36 which are integrally formed as part of the section 24 and are aligned with the neck 32 and flange 33 of section 22, as shown in FIG. 7.

Formed in each of the sections 22 and 24 adjacent opposite sides of the inlet conduit 30 are a series of radially extending and conically shaped bores 39 each of which is adapted to receive a liner insert in the form of a tubular cone 40. Preferably, the cones 40 are constructed from a refractory material, such as ceramic or glass, and include a rectangularly shaped inlet 42 through which the stock flows tangentially into the cone 40 from the inlet conduit 30. As can be seen in FIGS. 3 and 5, the inlet passageway 42 is so formed that the stock flows tangentially into the cone 40 and spirals inwardly towards its smaller open end 44.

In operation, the angular velocity of the stock which enters a cone 40 through its inlet 42 increases as the material spirals downwardly due to the constantly reducing diameter. This increases the centrifugal forces on the dirt particles or rejects and causes the rejects to continue to flow downwardly into the discharge conduit 25 due to the somewhat higher specific gravity of the dirt or rejects in comparison to the remaining stock solution. Simultaneously, the clean material or accepted stock is forced centrally within the vortex of the cone 40 and upward toward the larger open end 46, due to the relatively lighter specific gravity of the accepted stock.

As shown in FIGS. 1 and 6, each of the cones 40 is fitted with an internally mounted closure 48 which in-

cludes a passageway **50** centrally located to receive the accepted stock ascending within the vortex of the cones **40**. Preferably, the closure **48** includes a tubular projection **52** which extends slightly inward past the center of inlet **42** which functions as a vortex finder and also tends to prevent the dirty stock from short circuiting from inlet **42** directly to outlet passageway **50**.

As shown in FIGS. 2 and 4, the centrally arranged passageway **50** within the closure **48** is connected to a radial passageway **54** which is aligned with the opening **55** within the tubular cone **40**. The clean stock which flows through the passageways **50** and **54** and out the opening **55** is received within an outlet conduit **57** which also is generally annular or toroidal in configuration but spaced radially outward from the inlet conduit **30**. As FIG. 1 shows, the outlet conduit **57** includes only one open end **58** which is defined by the neck portion **60** and is adapted to be connected to the clean accept stock pipe line by the flange **62**.

As shown in FIG. 2, the inlet conduit **30** and outlet conduit **57** are adapted to serve simultaneously the two parallel banks of radially positioned tubular cones **40**, the wall of each of which projects slightly into the inlet conduit **30** to assure that the material flowing through the conduit will enter each cone **40** in a tangential direction through its inlet **42**. This tangential stream is required to direct the material along the spiral path **63** which, in turn, produces the centrifugal cleaning action.

An important feature of the apparatus results from the toroidal configuration of the inlet conduit **30**. As the dirty stock flows through the conduit **30**, the dirt having the higher specific gravity is forced outwardly towards the inlet surface **65** and remains in the outward portion of the conduit **30** while the stock flows through the conduit. This produces a primary separation in that a portion of the dirt having a higher specific gravity is prevented from flowing into the inlets **42** of the cones **40**.

It becomes apparent that the velocity of the dirty stock within the inlet conduit **30**, and thus the centrifugal forces acting upon the dirt particles to accomplish primary separation, can be controlled by restricting the outflow of the dirty stock through the outlet neck portion **35**. It has been determined that if the outflow of dirty stock through the neck portion **35** is limited to approximately 15% of the incoming dirty stock through the neck portion **32**, there will be a sufficient velocity within the conduit **30** to provide for effective primary separation in the conduit **30** and also to provide for the necessary velocity of the stock as it enters the cones **40** in order to create the secondary centrifugal separation.

The bolts **68** and the leveling spacers **69** are spaced around the periphery of the body **20** directly above the cones **40**, and in addition to clamping the two sections **22** and **24** together, also serve to retain the closures **48**. The projections **72** extending from each closure **48** are spaced on each side of the bolts **68** to prevent the closure **48** from turning within the cone **40** in order to maintain the alignment between the radial passageway **54** and the opening **55**.

When it is desirable to close off one or more of the cones **40**, as for example, when not all of the cones are needed, it is only necessary to rotate each such cone **40** within the body **20** by such an amount that its inlet **42** is no longer in fluid communication with the inlet conduit **30**. The slots **74** are provided within the flange **75** and **76** so that the bolts **68** may be easily removed for replacing or cleaning a cone **40**. In order to retain the two sections **22** and **24** together during assembly or after removal of all the bolts spaced above the cones **40**, several of bolts **68** extend through holes within the flanges **75** and **76**.

One feature provided by constructing the body **20** in two half-sections **22** and **24** is the easy forming of the inlet conduit **30** and outlet conduit **57**. In addition, this provides for simplified cleaning of the several conduits and passageways. Furthermore, the open construction of the conduits within each of the sections **22** and **24** enables the interior surface of the conduits to be coated for protection against corrosion and/or finished to provide for smooth flow of the stock through the conduits. The split construction of the body **20** further enables the inlet conduit **30** to be formed with a gradually decreasing cross sectional area as the conduit extends through the body **20** and thus provide for a constant velocity of the stock flowing past and through the inlets **42** to assure the desired centrifugal action within the cones **40**.

For the highest cleaning efficiency, it has been determined that each inlet **42** should have a length L which is at least four times the width W. This rectangular configuration of the inlets **42** provides for flat tangential stream against the inner surfaces of the cones **40** and has been found helpful for obtaining cleaning efficiencies of substantially 100% with a cone angle of approximately 9°.

As a result of the simplified configuration of the cones **40**, they may be formed from a hard to form refractory material such as, for example, glass or ceramic. These materials have been found to reduce substantially the erosion which commonly results from the impinging stream of stock against the interior surface of conical shaped cleaners. Of course, the cones **40** can also be easily formed from a rubber or plastic material, if desired. With any of these materials, however, it can be seen that the conically shaped openings **39** within the body **20** provide a backing support for the cones **40** and thus prevents the liners from being either accidentally fractured or punctured, or expanding when a resilient cone is used.

Referring to the machanism shown in FIG. 8, the covers **82** and **84** are adapted to mount on the flanges **26** and **27** to support the rod **85** within the central discharge conduit **25**. The rod **85** is mounted for planetary rotation about the entral axis of the discharge conduit **85** by a planetary gearing system (not shown) located within the cover **82** and adapted to be driven by the motor **87**. Projecting radially outward from the rod **85** are a series of pins **89** which are spaced to extend into and retract from the small open ends **44** of the cones **40** as the rod **85** rotates in a planetary manner. The operation of this mechanism is effective to prevent the small open ends of the cones **40** from clogging by a collection of rejects. In most installations, however, this mechanism will not be required since the dirt particles will be substantially smaller than the opening **44** of each cone **40** and will be discharged with such velocity that the opening, in effect, will be self-cleaning.

For many installations, a single apparatus or unit as described up to this point may provide adequate capacity and cleaning efficiency, and it may be mounted in the desired location simply by suitable connections to the pipes which carry stock and reject material to or from the apparatus. Alternatively, the body sections **22** and **24** may be provided with brackets **90** on their outer sides arranged to cooperate with mounting standards **92** as best seen in FIG. 9.

The individual apparatus or assembly of the invention is also especially adapted for connection with a plurality of similar units, either in parallel for increased capacity or in series for additional multi-stage cleaning purposes. Several illustrative arrangements are illustrated in FIGS. 9–12 as now described.

In FIG. 9, six of the cleaning apparatus or units **100** are arranged in line with each pair of units supplied with dirty stock from the main supply line **101** by a feeder line **102**. The clean or accepted stock is delivered from each unit by a line **103** to the manifold **105**, and the reject stock is distributed out the line **107**. In order to maintain the desired velocity for primary separation of the dirty stock within the inlet conduit **30** of each unit **100**, the flow is so controlled that the appropriate amount of dirty stock passes through all the units without entering

any of the cleaner units, which is about 15% as already noted. This through flow is collected within the line **108**, and preferably is distributed for recirculation through still another unit where the dirty stock is cleaned again.

Another arrangement of the units which may be desirable when floor space is limited somewhat is shown in FIG. 10, where six units **100** are arranged in parallel with three upper units spaced above three lower units. Here the ditry stock enters the units through the manifold **111** and elbows **112**. The accepted stock is collected in the manifold **115** and the reject stock within the line **117**, and the line **108** has the same function as in FIG. 9.

With some stock having an exceptionally high dirt content, it may be desirable to connect the cleaning units in series, as shown in FIG. 11, where one pair of series connected units **100** is arranged in parallel with another pair of series connected units **100**. By series connection, it is meant that the accepted stock from one unit is used to supply the inlet conduit **30** of another unit, as shown by the U-shaped connections **120**. The balance of this system includes an inlet manifold **121**, inlet lines **122**, a reject manifold **123** and an outlet manifold **125** for accepted stock. While FIG. 11 shows only two units connected in series, it is to be understood that more than two units can be connected in series if it is necessary in order to obtain accepted stock which is 100% free of dirt.

When it is desirable to install a cluster of units within a limited area of floor space, a stacked arrangement can be made, as shown in FIG. 12. Here the units **100** are arranged in parallel and are fed with dirty stock through the manifold **131**, the reject stock flows downwardly out the line **133**, and the accepted stock flows out through the manifold **135**. The small percentage of dirty stock which passes through the inlet conduit **30** of each unit is distributed for recirculation through the manifold line **108**.

From the different combination of units shown in FIGS. 9–12, it can be seen that a unit or apparatus according to the invention has a high degree of versatility which enables a number of them to be arranged or combined for the best combination depending upon the floor space provided, and the different types of concentrations of dirt within the stock and upon the flow rate of stock which must be cleaned.

While the form of apparatus herein described constitute a preferred embodiment of the invention, it is to be understood that the invention is not limited to this precise form of apparatus, and that changes may be made therein without departing from the scope of the invention which is defined in the appended claims.

What is claimed is:

1. Apparatus for centrifugally cleaning a fluid material having particles of higher specific gravity dispersed therein, comprising means defining a generally toroidal shaped inlet conduit having inlet and outlet openings arranged for directing a continuous flow of material in a manner that a portion of the larger particles are urged outwardly in said conduit by centrifugal force, a plurality of tubular cones each having open ends and an intermediate tangential inlet passageway, each said cone extending radially in relation to said toroidal shaped inlet conduit, means connecting each said passageway to said inlet conduit to receive material from the inward portion of said inlet conduit, means defining a reject conduit interconnecting the smaller open ends of said cones, a closure for the larger end of each said cone and each closure including a central passageway, and an outlet conduit interconnecting the central passageways of said closures to receive the clean material from each of said cones.

2. Apparatus for centrifugally cleaning a fluid material having particles of higher specific gravity dispersed therein, comprising a body defining a generally toroidal shaped inlet conduit having inlet and outlet openings arranged for directing a continuous flow of material in a manner that a portion of the particles are urged outwardly in said conduit by centrifugal force, a plurality of tubular cones extending radially within said body in relation to said toroidal shaped inlet conduit, each said cone having open ends and an intermediate tangential inlet passageway, means connecting each said passageway to a side of said inlet conduit to receive material from the inward portion of said inlet conduit, a reject conduit interconnecting the smaller open ends of said cones, a closure for the larger end of each of said cones and including a projection extending past the center of the inlet passageway of said cone, each said closure including means defining a central passageway, and an outlet conduit interconnecting the central passageways of said closures to receive the clean material from each of said cones.

3. Apparatus for centrifugally cleaning a fluid material having particles of higher specific gravity dispersed therein, comprising a body defining a generally toroidal shaped inlet conduit having inlet and outlet openings arranged for directing a continuous flow of material in a manner that a portion of the particles are urged outwardly in said conduit by centrifugal force, a plurality of tubular cones each having open ends, said cones spaced adjacent opposite sides of said conduit and extending radially in relation to said conduit, said cones each having a tangential inlet passageway in fluid communication with said conduit, said body defining a central discharge conduit connected for fluid communication with the smaller open ends of said cones, a closure for the larger end of each of said cones and including a central passageway for receiving clean material ascending within said cone, and means within said body defining a generally toroidal shaped outlet conduit spaced radially outward of said inlet conduit and including openings for fluid communication with said passageways of said closures.

4. Centrifugal apparatus of the character described for cleaning stock comprising a body defining a generally toroidal shaped inlet conduit having inlet and outlet openings arranged for directing a continuous flow of material in a manner that a portion of the particles are urged outwardly in said conduit by centrifugal force, a plurality of tubular cones supported within said body and open at the ends thereof, said cones extending radially in relation to said inlet conduit, a portion of the outer wall of each of said cones projecting within said inlet conduit, each of said wall portions having an inlet slot in fluid communication with said inlet conduit to receive dirty stock tangentially therethrough, a discharge conduit for reject stock extending through said body in direct fluid communication with the open smaller ends of said cones, an outlet conduit for clean stock extending through said body adjacent said cones and on the opposite side of said inlet conduit from said discharge conduit, a closure for the larger end of each of said cones and including tubular means projecting within said cone approximately as far as said inlet slot thereof, and means in each said closure defining an outlet passageway connected for fluid communication with said outlet conduit to transfer clean stock flowing spirally in the reverse direction through said cones from the smaller end thereof to said outlet conduit.

5. Apparatus for centrifugally cleaning a fluid material having particles of higher specific gravity dispersed therein, comprising a body formed of two separable half-sections which define when joined together a generally toroidal shaped inlet conduit for receiving a continuous flow of material, a plurality of tubular cones within each said section of said body and extending radially in relation to said inlet conduit, said cones having open ends and spaced adjacent said conduit with a portion of each cone projecting into said conduit, said cones each having a tangential inlet passageway in fluid communication with said inlet conduit, said body defining a central discharge conduit connected for fluid communication with

the smaller open end of said cones, said discharge conduit having means for connecting the apparatus to another apparatus in a stacked relationship, a closure for the larger end of each of said cones and including a central passageway, and means within said body sections defining when joined together a generally toroidal shaped outlet conduit spaced radially outward of said inlet conduit and including openings in fluid communication with said passageways of said closures for receiving the clean material forced upward towards the large end of said cones.

6. Apparatus for centrifugally cleaning a fluid material having particles of higher specific gravity dispersed therein, comprising a body formed of two separable half-sections which define when joined together a generally toroidal shaped inlet conduit for receiving a continuous flow of material, means defining a series of conical shaped holes within each section of said body, said holes extending radially in relation to said inlet conduit, a plurality of tubular cones each having open ends and mounted within said holes, said cones formed of a refractory material and each having a tangential inlet passageway in fluid communication with said conduit, said body defining a central discharge conduit connected for fluid communication with the smaller open end of each of said cones, a closure for the larger end of each of said cones and including a projection extending past the center of said inlet passageway within said cone, said closure including means for defining a central passageway for receiving clean material ascending within said cone, means within said body sections defining a generally toroidal shaped outlet conduit when said two half-sections are joined together, said outlet conduit spaced radially outward of said inlet conduit and including openings in fluid communication with said passageways of said closures, and means within said central discharge conduit for automatically preventing clogging of the smaller ends of said cones.

7. Apparatus for centrifugally cleaning a fluid material having particles of higher specific gravity dispersed therein, comprising means defining a generally toroidal shaped inlet conduit having inlet and outlet openings arranged for directing a continuous flow of material in a manner that a portion of the particles are urged outwardly in said conduit by centrifugal force, a plurality of tubular cones each having open ends and an intermediate tangential inlet passageway, said passageway having a length which is at least four times the width and connected to said inlet conduit in a manner to receive material from the inward portion of said inlet conduit, each said cone extending radially in relation to said toroidal shaped inlet conduit, means defining a reject conduit interconnecting the smaller open ends of said cones, a closure for the larger ends of said cones and each closure including a projection extending inwardly past the center of said inlet passageway within said cone and including a central passageway, and an outlet conduit interconnecting the central passageways of said closures to receive the clean material from each of said cones.

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FRANK W. LUTTER, *Primary Examiner.*