Dec. 11, 1951 J. D. L. SMITH 2,578,456

CENTRIFUGAL SEPARATOR

Filed July 31, 1946 3 Sheets-Sheet 1

Fig. 1

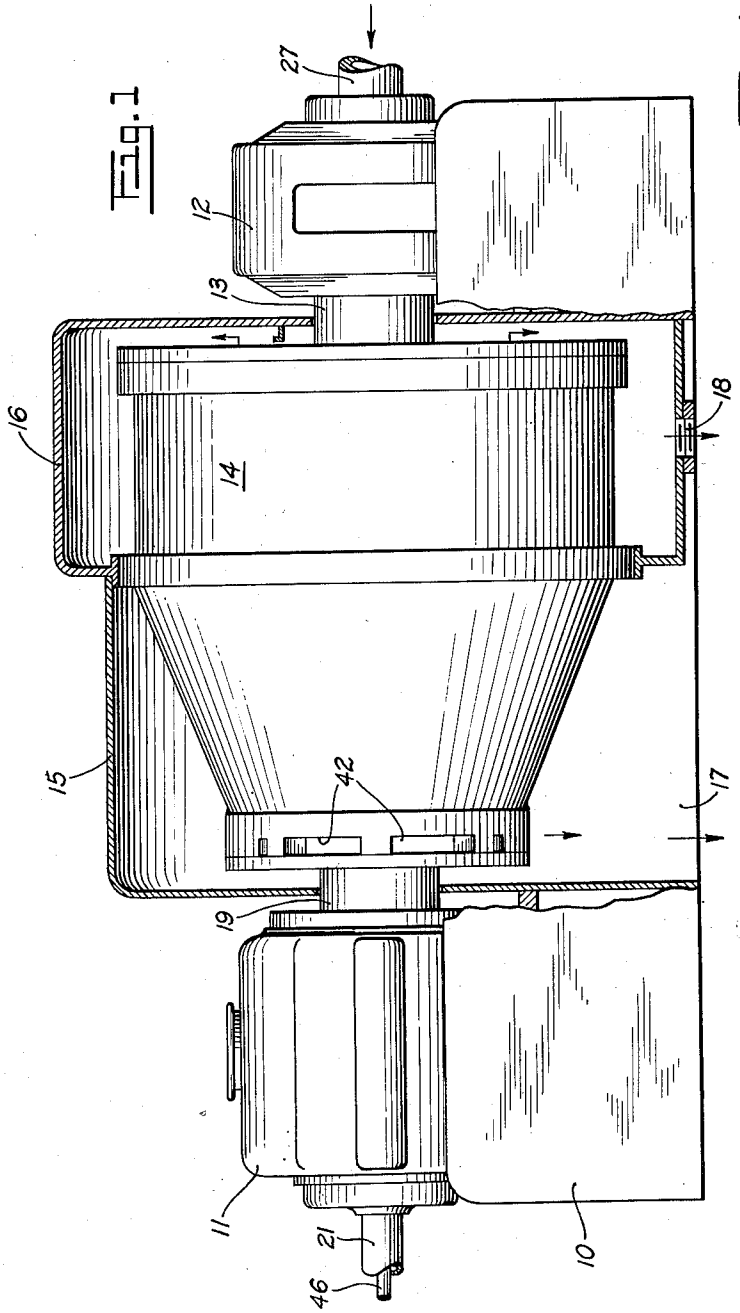
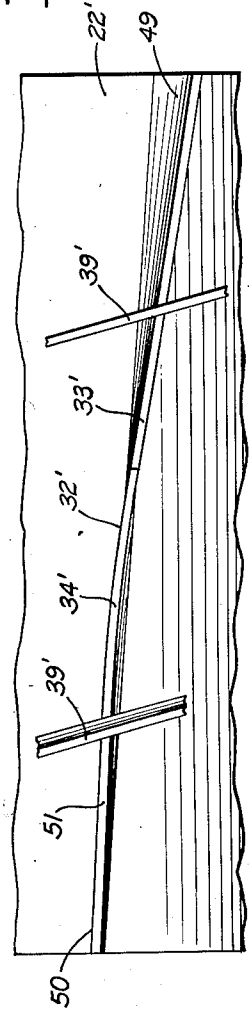


Fig. 4



INVENTOR
John D.L. Smith
BY
Howard L. Thompson
ATTORNEY

Dec. 11, 1951 J. D. L. SMITH 2,578,456

CENTRIFUGAL SEPARATOR

Filed July 31, 1946 3 Sheets-Sheet 2

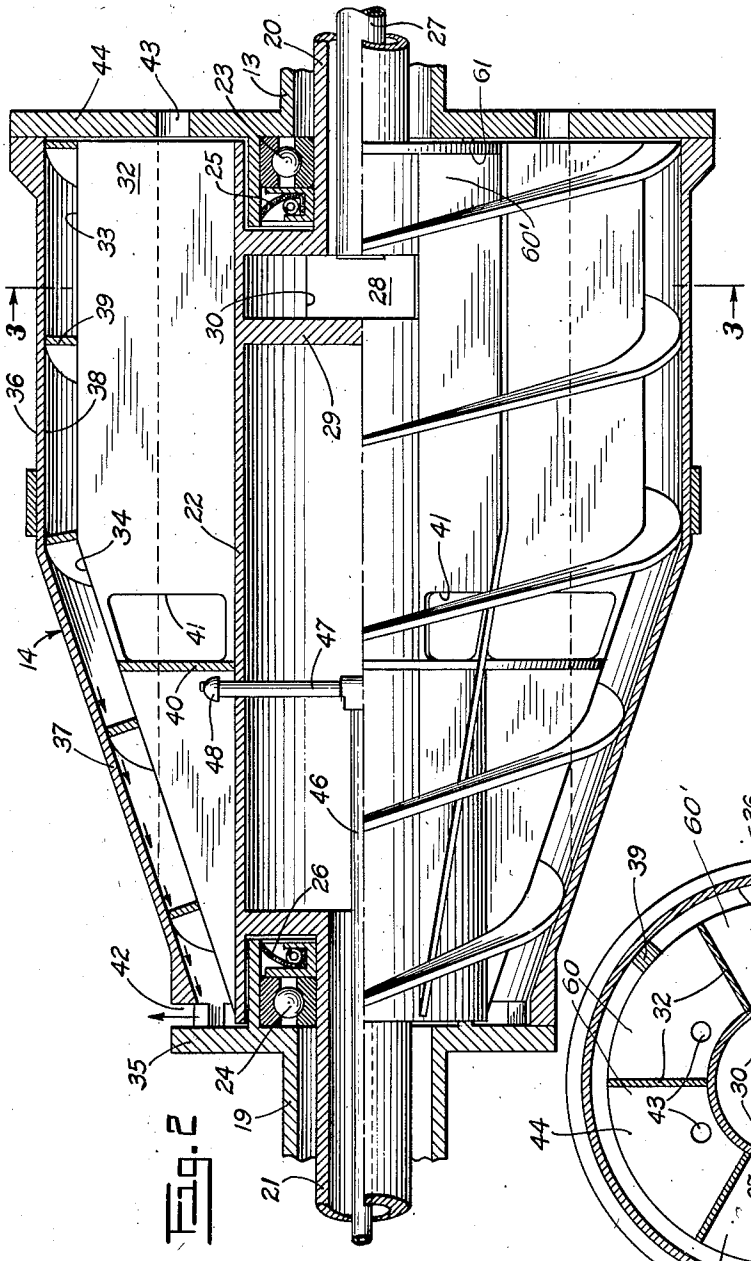


Fig. 2

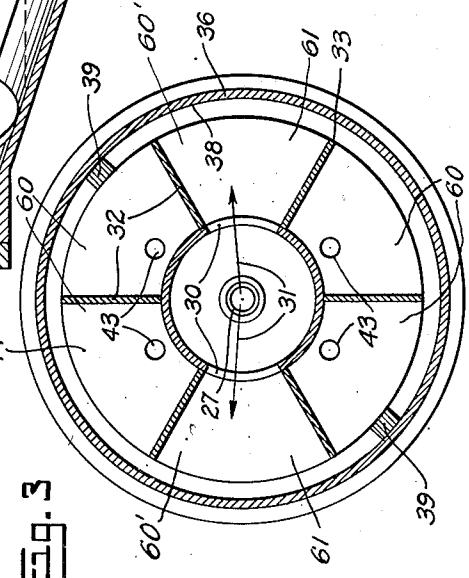


Fig. 3

INVENTOR.
John D.L. Smith
BY
Howard E. Thompson
ATTORNEY

Dec. 11, 1951 J. D. L. SMITH 2,578,456

CENTRIFUGAL SEPARATOR

Filed July 31, 1946 3 Sheets-Sheet 3

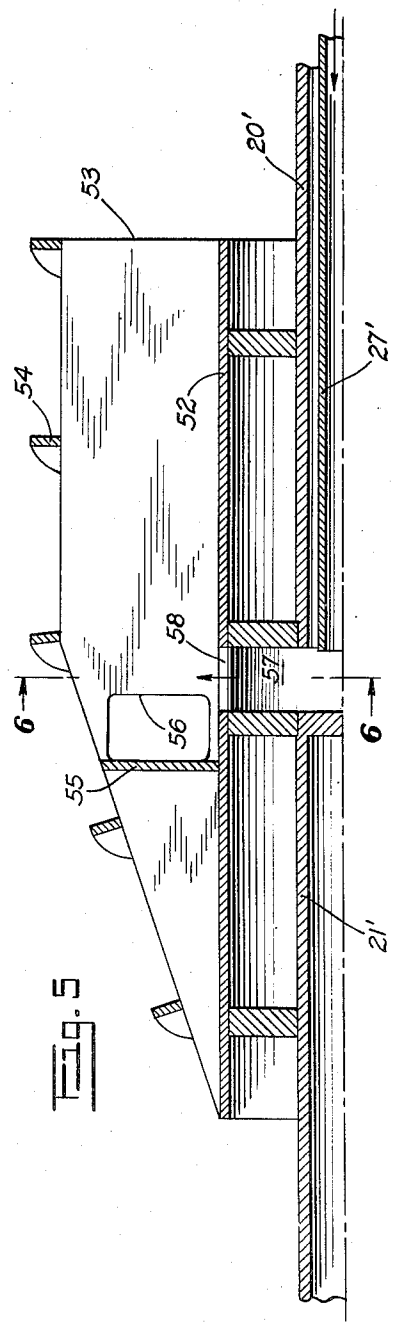


Fig. 5

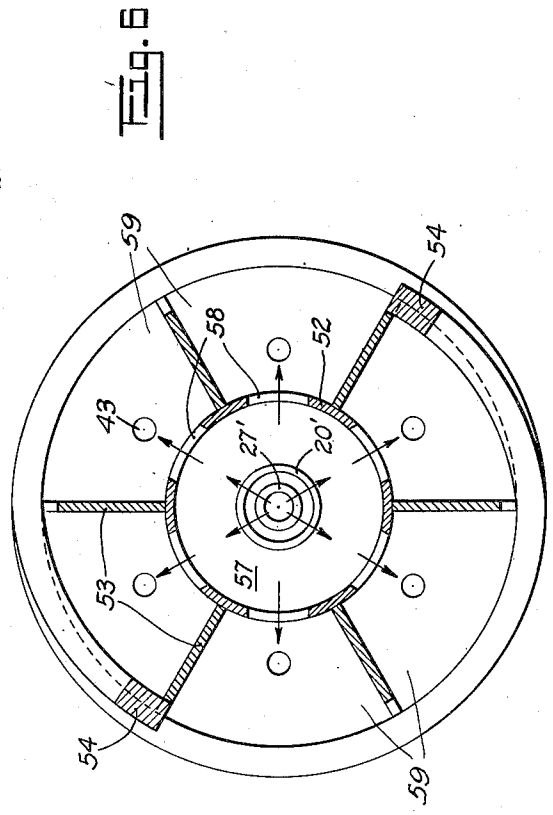


Fig. 6

INVENTOR.
John D.L. Smith
BY
Howard C. Thompson
ATTORNEY

Patented Dec. 11, 1951

2,578,456

UNITED STATES PATENT OFFICE

2,578,456

CENTRIFUGAL SEPARATOR

John D. L. Smith, Freeport, N. Y., assignor to Centrifuge Mechanical Equipment, Inc., Hoboken, N. J., a corporation of New Jersey

Application July 31, 1946, Serial No. 687,456

6 Claims. (Cl. 233—7)

1

This invention relates to separators of the type and kind employing a propeller or rotor operating within a rotatable casing, wherein a difference in speed of rotation between the propeller and casing amounts to a few revolutions per minute. More particularly, the invention deals with a novel type of propeller or rotor structure to improve separation of solids from fluids in control of the feed of the solids and the direction of travel in the casing. Still more particularly, the invention deals with a control for introduction of solids into the casing and the chambers formed by the radial blades of the rotor or propeller and, still more particularly, the invention includes the introduction of a fluid into the material being treated at a point in advance of discharge of material from the casing.

The novel features of the invention will be best understood from the following description, when taken together with the accompanying drawing, in which certain embodiments of the invention are disclosed and, in which, the separate parts are designated by suitable reference characters in each of the views and, in which:

Fig. 1 is a side view of a centrifugal separator apparatus showing the general assemblage.

Fig. 2 is a longitudinal sectional view through the casing and rotor or propeller of the apparatus with part of the rotor or propeller shown in elevation.

Fig. 3 is a section on the line 3—3 of Fig. 2 on a reduced scale.

Fig. 4 is a diagrammatic face view of a propeller or rotor showing a modified form of construction.

Fig. 5 is a view similar to Fig. 2 showing only a part of the construction and showing a modification; and

Fig. 6 is a section on the line 6—6 of Fig. 5 taken through the complete rotor or propeller.

My present invention deals with apparatus or machines of the general type and kind disclosed, for example, in the patent to Laughlin No. 1,710,316 of April 23, 1929, particularly with respect to the style of casing and rotor propeller employed therein.

In apparatus of the type and kind under consideration, it has been customary to employ a rotor or propeller having wall portions generally conforming to the contour of the wall portions of the casing with a screw blade arranged in the chamber between said walls for feeding the solids longitudinally of the casing in the operation of separating the same from the fluids, while the casing and propeller are operated at a relatively high speed of rotation. In apparatus of this kind, it is customary to rotate the propeller at a slightly greater number of revolutions per minute than the speed of rotation of the casing, both being rotated in the same direction. As an example, the propeller may travel at one thousand revolutions per minute with the casing travelling at say nine hundred and ninety-six revolutions per minute.

2

It is the purpose of my invention to provide a propeller or rotor for apparatus of the class described, wherein the axis of the propeller or rotor is tubular in form and the material to be treated is fed into the tube and discharged radially into the casing outwardly of said tube. Still further, I employ on the tube a plurality of circumferentially spaced and radially or, substantially radially, extending vanes, outer edges of which are arranged in spaced relation to and conform with the contour of the casing in forming an annular chamber in the casing at peripheral edges of the vanes. It will be understood that the radial vanes form longitudinal feed chambers which open into said annular feed chamber and a suitable baffle is provided on the tube to prevent direct longitudinal feed of the material in the chambers between said vanes.

The screw blade of the propeller or rotor is mounted on the outer edges of the vanes and may be welded or otherwise secured thereto. As another feature of the invention, I employ means for introducing a fluid into the casing at a point preferably beyond the baffle to provide a wash or other action upon the solids, preparatory to discharge of the same from the casing.

In Fig. 1 of the drawing, I have diagrammatically illustrated a general assemblage of the apparatus, in which 10 represents a suitable frame, upon one end of which is supported the usual differential gear box 11, which controls the different ratio of speed of the casing or bowl with respect to the rotor, propeller or screw. At 12 is shown a suitable bearing, or support, for the tubular end portion 13 of the bowl or casing 14.

Around the bowl or casing 14 is a sludge collector 15 and, at 16, is shown an effluent collector. The sludge collector has an open bottom 17 for discharge of the sludge; whereas the collector 15 has a discharge, as at 18.

At 19 is shown the other tubular end of the casing or bowl 14.

Now turning to Fig. 2 of the drawing, it will appear that, within the tubular ends 13 and 19, are arranged reduced tubular extensions 20 and

21 of a tubular rotor, propeller or screw element 22. Suitable bearings 23 and 24 are provided for free rotation of the element 22 in the casing 14, sealing gaskets 25 and 26 being employed to facilitate lubrication of the bearings without contamination of the material being treated.

Suitably supported within the tube 20 is a feeding pipe 27 for feeding material to be processed into the casing. The inner end of the tube 27 opens into an axial distributing chamber 28, baffled by a wall 29 of the tubular element 22, the wall of the element 22 having one or more discharges 30, two being shown in Fig. 3, for delivery of the material outwardly and radially into the casing, as indicated by the arrows 31 in Fig. 3 of the drawing.

Arranged upon the wall of the tubular element 22 and extending longitudinally and radially are a plurality of vanes 32, six of which are shown in cross-section in Fig. 3 of the drawing. The vanes 32 have outer edges 33 paralleling the axis of the element 22 and inclined edges 34, which are contracted in the direction of the discharge end 35 of the casing. The casing, in like manner, has correspondingly arranged walls 36 and 37, respectively, spaced with respect to said edges 33 and 34 to form about said edges a circumferential chamber 38. The wall 37 forms a conical portion. Welded or otherwise secured to the edges 33 and 34 is a continuous feed screw blade 39 which, in the construction shown, has its wall portion arranged perpendicularly to the edges 33 and 34.

Extending radially from the tubular element 22, between the vanes 32, is a series of plates forming a circumferential baffle wall 40, preferably at a point where the chamber 38 starts to contract in the direction of the discharge end 35 of the casing. The vanes 32, adjacent the baffle wall 40, have large openings 41 to allow for passage of the solids therethrough, while the baffle 40 compels the solids to pass radially into the annular chamber 38.

Up to the point of location of the apertures 41, it will be understood that the vanes 32 have a definite action upon the solids in the differential rotation of the element 22 with respect to rotation of the casing 14, but, adjacent the baffle 40, there will be substantially no action of the vanes upon the solids in this respect.

At this point, it may be said that the chambers between the vanes form feed channels for the material to be treated. The holes 41, at the ends of these channels, adjacent the baffle 40, allow the effluent to circulate between the different channels.

The discharge end 35 of the casing 14 has a series of circumferential discharges 42, through which the solids or sludge is discharged into the collector 15. At 43 is shown a series of circumferential discharge ports at the other closed end 44 of the casing for the discharge of fluid or effluent, these holes being so located as to provide the required depth of liquid in the casing or bowl to provide the desired operation of the apparatus. When the holes 43 are located farthest from the axis of rotation, or located at an appreciable distance from the axis of rotation a relatively dry sludge is produced and a cloudy effluent. On the other hand, when the discharge holes 43 are located near the axis of rotation, a wetter sludge is produced and a clearer effluent.

At 46, I have shown a fluid admission pipe which extends into the apparatus through the reduced tubular end 21 of the element 22 and has a radially extending portion 47 opening into one of the chambers or channels between vanes 32 in a nozzle 48 beyond the baffle 40, as clearly seen in Fig. 2. With this construction, water or other fluids can be introduced into the apparatus to wash or otherwise treat materials being processed in the apparatus.

In Fig. 4 of the drawing, I have shown diagrammatically a slight modification where 22' indicates part of the outer surface of an element, similar to the element 22, and on this element is illustrated one modified form of vane 32', which differs from the vanes 32 in that the vane is arranged angularly to the longitudinal plane of the axis, as shown in Fig. 2. In other words, the end 49 of the vane is offset with respect to the end 50 and, in Fig. 4, is illustrated diagrammatically the contour of the end portion 51 of the vane which conforms with the contracted end portion of the casing, as seen in Fig. 2. In other words, the surface 33' is similar to the surface 33 and the surface 34' is similar to the surface 34. This results in the peculiar illustration of the vane, as seen in Fig. 4. In Fig. 4, I have shown at 39' two portions of a screw, similar to the screw 39, one portion of the surface 33' and the other portion on the surface 34' to further illustrate the angularity referred to above.

In Figs. 5 and 6 of the drawing, I have shown a slight modification of the construction shown in Figs. 1–3, inclusive. In these figures 52 represents an element, similar to the element 22; 53 vanes similar to the vanes 32; 54 a screw, similar to the screw 39; 55 a baffle, similar to the baffle 40; 56 openings, similar to the openings 41. The primary difference between the two structures is in the provision of long tubular ends 20', 21', instead of the short tubular portions 20, 21, as in Fig. 2, and forming within the element 52 substantially centrally thereof an annular discharge chamber 57 having circumferentially spaced discharges 58 through the element 52, note Fig. 6, and in providing a long feed tube 27', which extends to and opens into the chamber 57. In other words, in Figs. 5 and 6, the material being processed is fed into the casing substantially centrally thereof and as shown at positions adjacent the apertures 56 and the baffle 55.

This construction brings the feed nearer the sludge discharge of the apparatus and will operate to more efficiently provide the desired separation and would be suitable for certain types and kinds of materials to be processed.

It will be apparent that, in all forms of construction shown, the solids or sludge is fed in the direction of the discharge end of the casing or bowl and with vanes of the type and kind disclosed in Figs. 2 and 5, the longitudinal channels aid in the distribution of the material, the baffles 40—55 forming some resistance, particularly to circumferential movement of the materials in the apparatus. This resistance is amplified to an extent in the angular arrangement of the vanes, as seen in Fig. 4. The angularity of the vanes builds a greater resistance to longitudinal travel of the solids and also assisting in drainage.

It will be understood that the illustrations in the accompanying drawing show my novel features as applied to one type and kind of centrifugal separator, but these features are also applicable to other types of separators, particularly where the wall structure of the casing or bowl is different from that herein disclosed.

The blades or vanes 53 form a plurality of

longitudinally extending chambers or passages around the element 52, some of which passages are designated by the reference character 59 in Fig. 6 of the drawing. In like manner, the vanes 32 form similar longitudinal passages, four of which are designated by the reference character 60, the two upper and two lower as appearing in Fig. 3, whereas the other or side passages are designated as 60'. These latter passages have baffle walls 61 at the right-hand ends thereof, as seen in Fig. 2, one of the walls 61 being here shown in elevation and these walls prevent direct transmission of the material through the openings 43, as will be apparent. In other words, the material enters the chambers or passages 60' through the radial openings 30 and then extend into the chamber 38 and the other passages 60, some of the material also passing through the openings 41.

Having fully described my invention what I claim as new and desire to secure by Letters Patent is:

1. A separator comprising a casing, the casing having outwardly extending reduced tubular end portion for rotatable mounting of said casing, an element mounted for rotation in the casing, said element comprising a unitary tubular member having reduced tubular ends arranged in the reduced tubular end portions of said casing, said element having circumferentially spaced vanes extending longitudinally thereof within and throughout the full length of said casing, peripheral edges of the vanes being parallel with and arranged in spaced relation to the walls of said casing, leaving an annular chamber in the casing outwardly of said vanes, a spiral feed screw mounted on said edges of the vanes and arranged in said annular chamber in control of feed of material through the casing, means for admitting material to be processed into the casing through one of the reduced tubular extensions of said element and radially through said element into said annular chamber between said vanes, said vanes forming longitudinal passages on said element between the vanes, and means for baffling said passages intermediate the ends of said vanes.

2. A separator comprising a casing, the casing having outwardly extending reduced tubular end portions for rotatably mounting of said casing, an element mounted for rotation in the casing, said element comprising a tubular unitary member having reduced tubular ends arranged in the reduced tubular end portions of said casing, said element having circumferentially spaced vanes extending longitudinally thereof within and throughout the full length of said casing, peripheral edges of the vanes being parallel with and arranged in spaced relation to the walls of said casing, leaving an annular chamber in the casing outwardly of said vanes, a spiral feed screw mounted on said edges of the vanes and arranged in said annular chamber in control of feed of material through the casing, means for admitting material to be processed into the casing through one of the reduced tubular extensions of said element and radially through said element into said annular chamber between said vanes, said vanes forming longitudinal passages on said element between the vanes, means for baffling said passages intermediate the ends of said vanes, and the vanes at the admission side of the baffle walls having openings forming a circumferentially continuous passage at said side of said baffle.

3. A separator comprising a casing, the casing having outwardly extending reduced tubular end portions for rotatable mounting of said casing, an element mounted for rotation in the casing, said element comprising a unitary tubular member having reduced tubular ends arranged in the reduced tubular end portions of said casing, said element having circumferentially spaced vanes extending longitudinally thereof within and throughout the full length of said casing, peripheral edges of the vanes being parallel with and arranged in spaced relation to the walls of said casing, leaving an annular chamber in the casing outwardly of said vanes, a spiral feed screw mounted on said edges of the vanes and arranged in said annular chamber in control of feed of material through the casing, means for admitting material to be processed into the casing through one of the reduced tubular extensions of said element and radially through said element into said annular chamber between said vanes, said vanes forming longitudinal passages on said element between the vanes, means for baffling said passages intermediate the ends of said vanes, the vanes at the admission side of the baffle walls having openings forming a circumferentially continuous passage at said side of said baffle, and means at the other discharge side of said baffle for introducing a fluid into the material being processed.

4. An apparatus of the class described comprising a casing having a wide diameter inlet end, a narrow diameter outlet end joining the wide end in a conical portion, both ends of the casing having reduced tubular portions for rotatable mounting of said casing, a unitary element rotatably mounted in the end portions of the casing and extending the full length of said casing, said element having outwardly projecting tubular ends, said element having adjacent the first named end of the casing an axial discharge chamber opening into the casing, the tubular end portion of the element at the first named end of the casing providing means for delivering material to be processed to said chamber of the element, means arranged longitudinally of and spaced circumferentially of said element forming circumferentially spaced longitudinal passages, the casing beyond the periphery of said last named means having an annular passage, a feed screw on the last named means and arranged in said annular passage for feeding material in the direction of the second named end of the casing, said passage opening into circumferential discharges at the second named end of the casing, said element having a baffle closing the longitudinal passages of the element intermediate end portions of said passages, the means forming the longitudinal passages of said elements comprising vanes, and said vanes, adjacent and at the delivery side of the baffle, having apertures.

5. An apparatus of the class described comprising a casing having a wide diameter inlet end a narrow diameter outlet end joining the wide end in a conical portion, both ends of the casing having reduced tubular portions for rotatable mounting of said casing, a unitary element rotatably mounted in the end portions of the casing and extending the full length of said casing, said element having outwardly projecting tubular ends, said element having adjacent the first named end of the casing an axial discharge chamber opening into the casing, the tubular end portion of the element at the first named end

of the casing providing means for delivering material to be processed to said chamber of the element, means arranged longitudinally of and spaced circumferentially of said element forming circumferentially spaced longitudinal passages, the casing beyond the periphery of said last named means having an annular passage, a feed screw on the last named means and arranged in said annular passage for feeding material in the direction of the second named end of the casing, said passage opening into circumferential discharges at the second named end of the casing, said element having a baffle closing the longitudinal passages of the element intermediate end portions of said passages, the means forming the longitudinal passages of said elements comprising vanes, said vanes, adjacent and at the delivery side of the baffle, having apertures, and means at the other discharge side of the baffle and extending into the other tubular end of said element for introducing a fluid into said casing.

6. An apparatus of the class described comprising a casing having a wide diameter inlet end, a narrow diameter outlet end joining the wide end in a conical portion, both ends of the casing having reduced tubular portions for rotatable mounting of said casing, a unitary element rotatably mounted in the end portions of the casing and extending the full length of said casing, said element having outwardly projecting tubular ends, said element having adjacent the first named end of the casing an axial discharge chamber opening into the casing, the tubular end portion of the element at the first named end of the casing providing means for delivering material to be processed to said chamber of the element, means arranged longitudinally of and spaced circumferentially of said element forming circumferentially spaced longitudinal passages, the casing beyond the periphery of said

last named means having an annular passage, a feed screw on the last named means and arranged in said annular passage for feeding material in the direction of the second named end of the casing, said passage opening into circumferential discharges at the second named end of the casing, said element having a baffle closing the longitudinal passages of the element intermediate end portions of said passages, the means forming the longitudinal passages of said element comprising vanes, said vanes, adjacent and at the delivery side of the baffle, having apertures, means at the other discharge side of the baffle and extending into the other tubular end of said element for introducing a fluid into said casing, and means for sealing end portions of said element in the tubular portions of the casing.

JOHN D. L. SMITH.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
775,320	Van Kirk	Nov. 22, 1904
924,376	Phillips	June 8, 1909
945,592	Phillips	Jan. 4, 1910
994,497	Berrigan	June 6, 1911
1,064,184	Wels	June 10, 1913

FOREIGN PATENTS

Number	Country	Date
291,930	Germany	May 16, 1916
297,914	Great Britain	Oct. 4, 1928
417,374	Great Britain	Oct. 3, 1934

OTHER REFERENCES

Rock Products, pages 84–86, August 1943. MacLean Pub. Corp., 309 W. Jackson Blvd., Chicago 6, Ill.