United States Patent

Conley

[15] **3,669,265**

[45] **June 13, 1972**

[54] CLASSIFYING APPARATUS WITH ADJUSTABLE FINES OUTLET

[72] Inventor: **Kurt H. Conley,** 214 Grandview Avenue, Hamden, Conn. 06514

[22] Filed: **July 17, 1969**

[21] Appl. No.: **842,540**

[52] **U.S. Cl.** **209/144**
[51] **Int. Cl.** **B04c 3/06**
[58] **Field of Search** ..... 209/139 A, 144, 154, 211, 493, 209/495; 241/59–61; 251/212; 55/393

[56] **References Cited**

UNITED STATES PATENTS

1,470,892	10/1923	Sturtevant	209/139 A
3,040,888	6/1962	Hosokawa et al	209/144
3,433,422	3/1969	Guenther	209/144 X

FOREIGN PATENTS OR APPLICATIONS

628,622	10/1927	France	209/144
22,540	8/1910	Great Britain	209/139 A
767,895	2/1957	Great Britain	209/144
908,042	10/1962	Great Britain	251/212

Primary Examiner—Frank W. Lutter
Assistant Examiner—Ralph J. Hill
Attorney—Nelson E. Kimmelman and Maleson, Kimmelman & Ratner

[57] **ABSTRACT**

In a centripetal classifier an adjustable "fines" outlet opening is provided consisting of a circular array of vertical elongated trapezoidal segments which are mounted by shafts through apertures in a horizontal apron. There are five "control" segments spaced equally around the circle whose lower shaft ends engage five respective arcuate slots in a rotatable cam plate disposed beneath the apron. Between adjacent ones of the control segments are located four interleaved "slave" segments having shorter shafts which do not engage the arcuate slots. A horizontal rod is attached to the cam plate and passes through the enclosure and terminates in a handle outside of the enclosure. When the handle is pulled out or pushed in, the cam plate rotates and the lower shaft ends of the control segments are tilted inwardly or outwardly thereby tilting or pivoting the trapezoidal segments outwardly and inwardly to change the effective size of the outlet opening and hence the fines "cut." Since the control and slave segments are interleaved, the slave segments are similarly caused to pivot.

13 Claims, 10 Drawing Figures

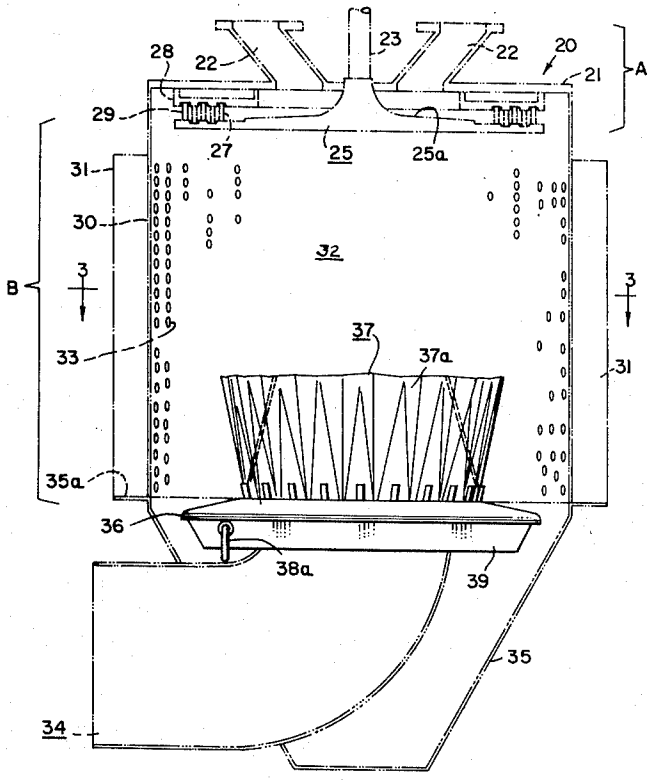


FIG. 2

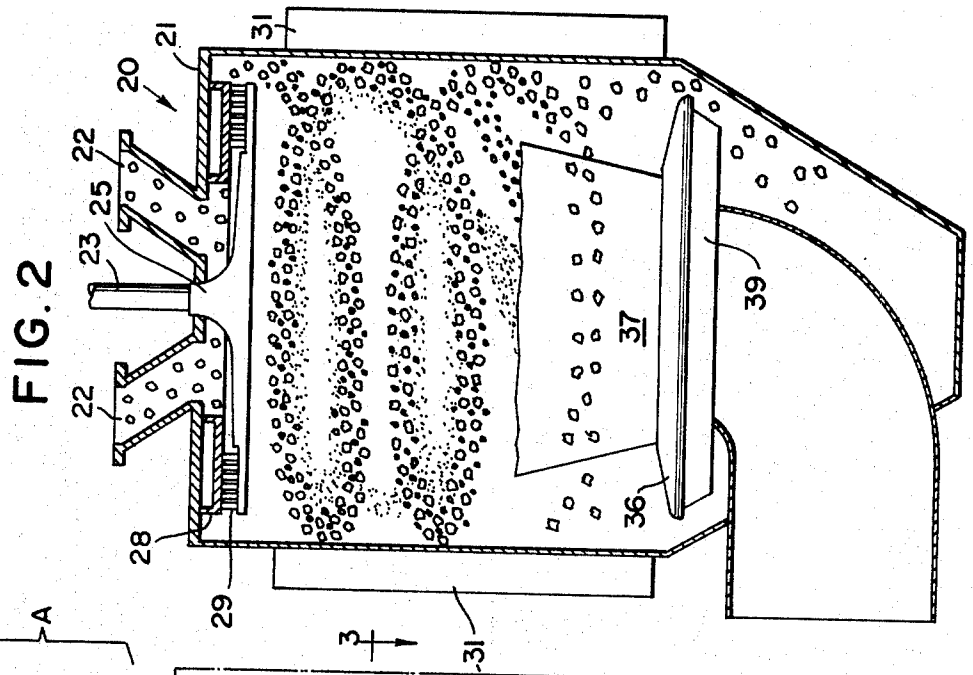
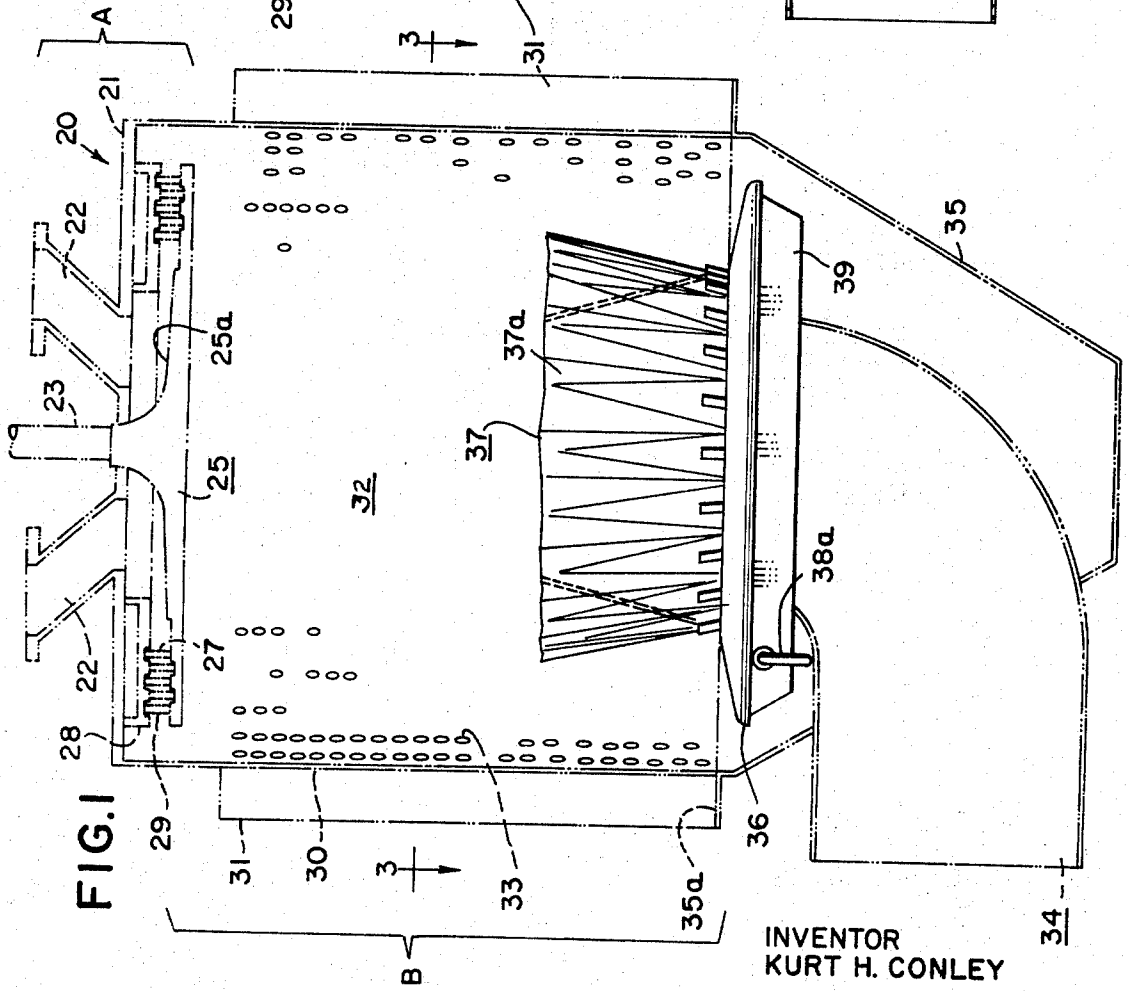


FIG. 1



INVENTOR
KURT H. CONLEY

BY

Maleson, Kimmelman + Ratner
ATTORNEYS

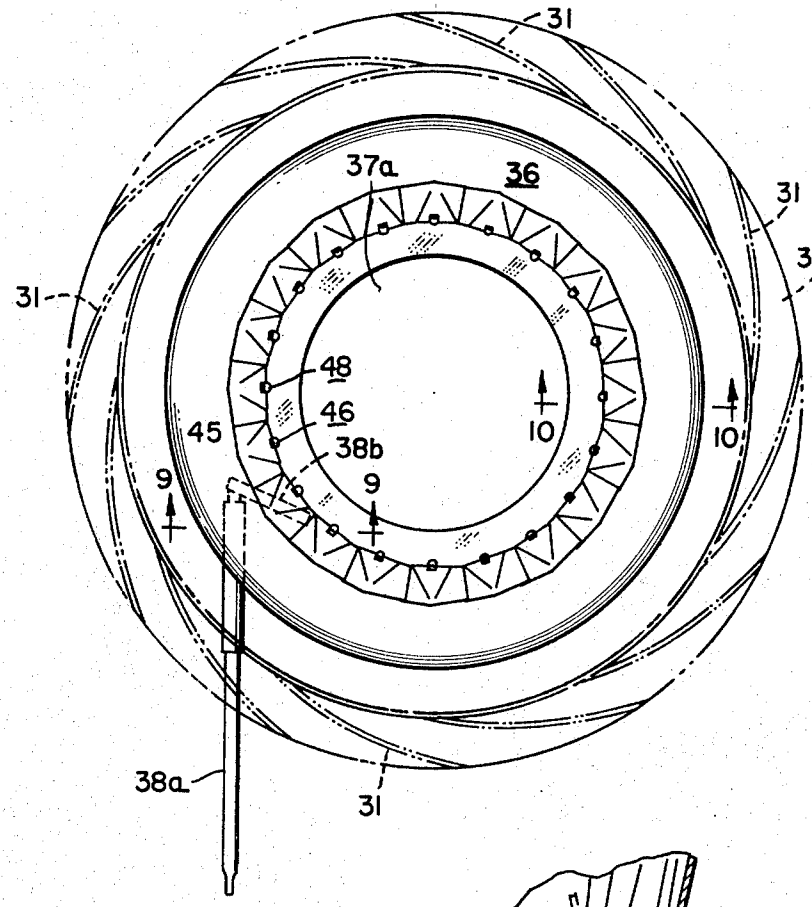


FIG. 3

FIG. 9

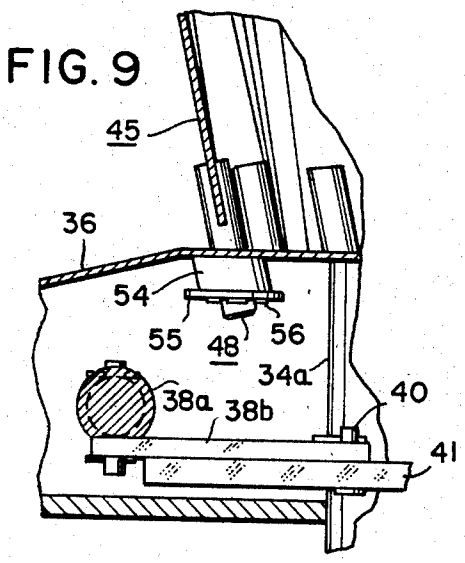
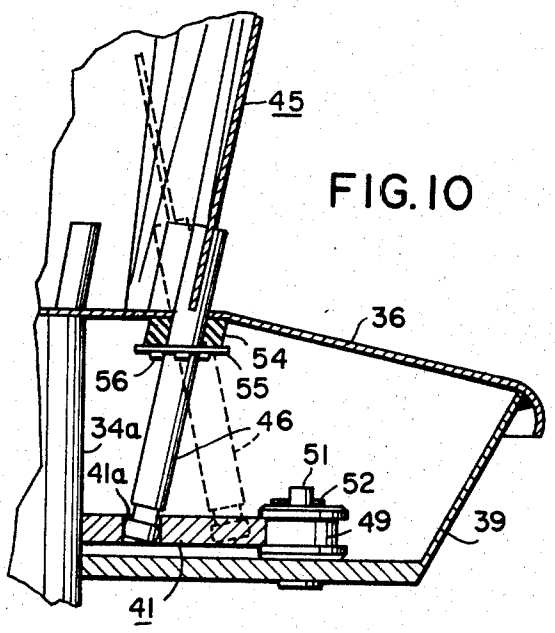


FIG. 10



INVENTOR.
KURT H. CONLEY

BY

Malesow, Kimmelman + Ratner
ATTORNEYS

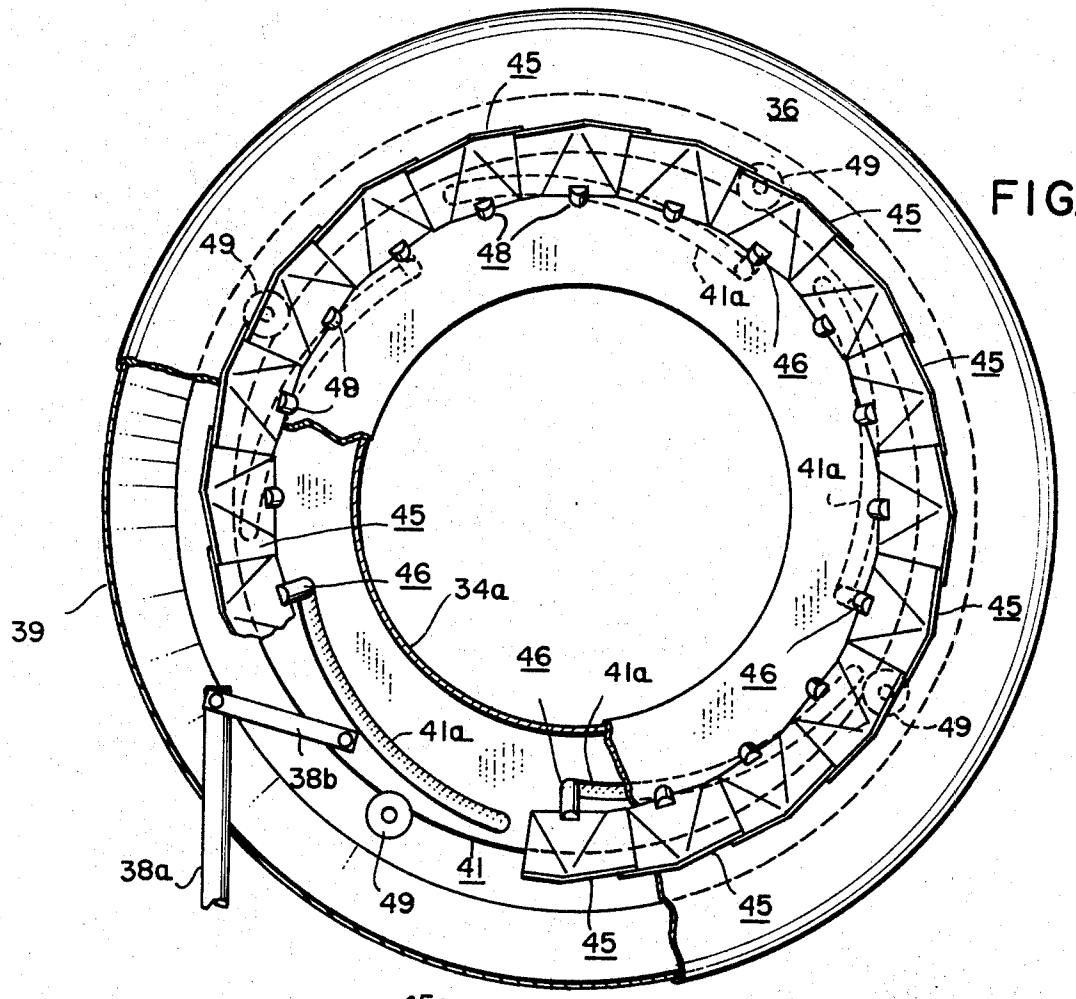


FIG. 4

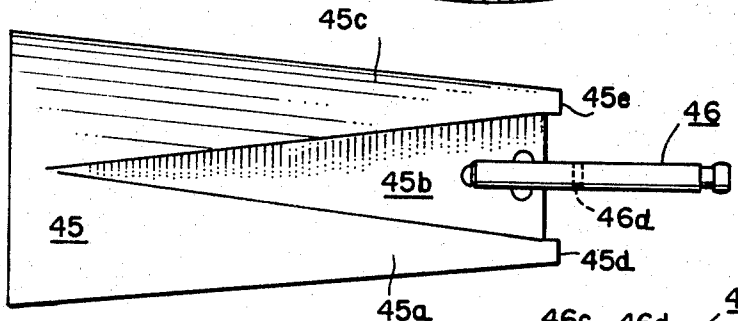


FIG. 5

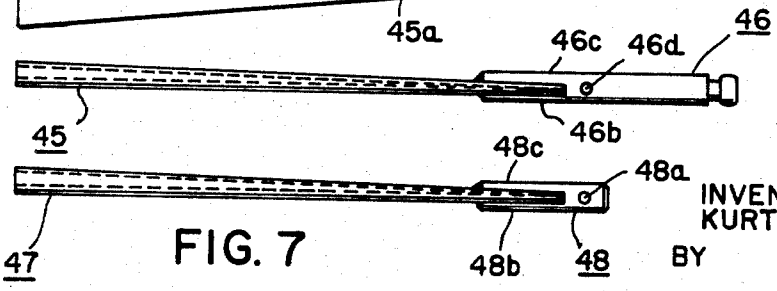


FIG. 6

FIG. 7

INVENTOR
KURT H. CONLEY
BY
Malsow, Kimmelman + Ratner
ATTORNEYS

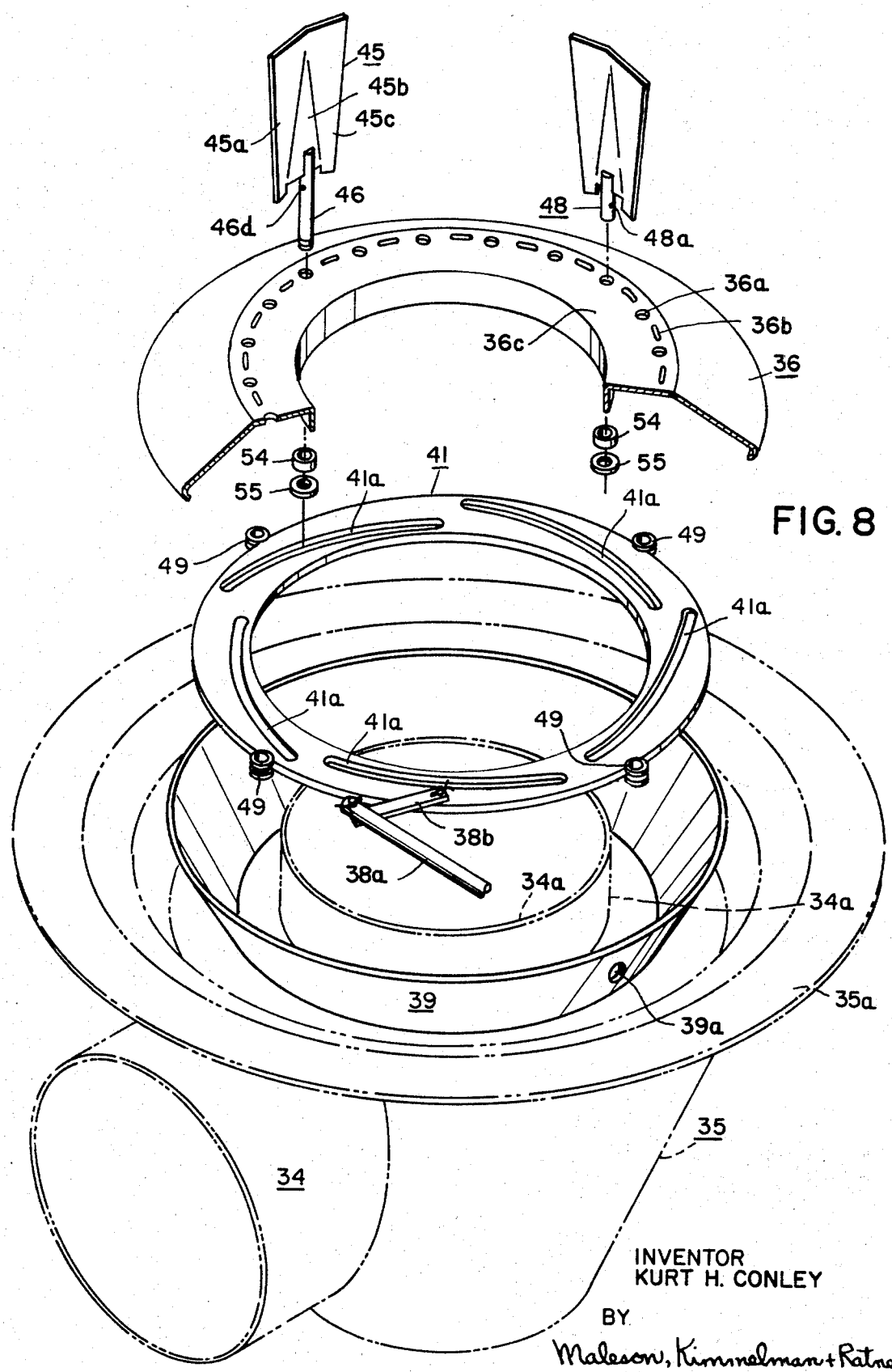


FIG. 8

INVENTOR
KURT H. CONLEY

BY
Maleson, Kimmelman & Ratner
ATTORNEYS

CLASSIFYING APPARATUS WITH ADJUSTABLE FINES OUTLET

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to classifiers, especially centripetal classifiers having an axial take-off of the finer particles of a mixture of particles to be classified.

2. Prior Art

In centripetal classifiers, as exemplified by the one shown in U.S. Pat. No. 3,433,422 issued to W. P. Guenther, the "fines" take-off was located centrally toward the bottom of a generally cylindrical classifying chamber. The "cut" at which the fines were extracted from the descending spiralling mixture depended upon the effective area of the mouth of the outlet but it was necessary to disassemble the lower portion of the apparatus to substitute an outlet opening of a different size when the fines cut was to be modified. The present invention obviates disassembly of the apparatus for changing the effective cross-section of the opening by removing and/or substituting a differently shaped or sized outlet.

BRIEF SUMMARY OF THE INVENTION

In a classifier wherein pulverulent material is to be classified by creating an inwardly spiralling current of a gas (air) transverse to the falling material, thereby to produce a downwardly spiralling flow of centripetally classified product, an outlet opening is provided intermediate the beginning and ending point of the flow whose size may be manually varied from outside the apparatus. Variations in its size determine the fines cut. In the form shown the outlet comprises a plurality of interleaved upstanding segments which, in response to push-pull movement of an external handle, pivot in unison about their respective horizontal axes thereby to vary the "capture" cross-section of the outlet opening.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a side-elevation view of the apparatus according to the present invention with the main features shown in full lines and the rest in phantom lines.

FIG. **2** is a side-elevation schematic view of the apparatus shown in FIG. **1** and showing the general flow path of the particles processed in the apparatus shown in FIG. **1**.

FIG. **3** is a sectional view of the apparatus shown in FIG. **1** taken along the section lines **3—3** thereof.

FIG. **4** is an enlarged view of part of the apparatus shown in FIG. **3**, partly broken away.

FIG. **5** is an enlarged side elevation view of one of the components shown in FIG. **4**.

FIG. **6** is an edge view of the apparatus shown in FIG. **5**.

FIG. **7** is an edge view of another of the components shown in FIG. **4**.

FIG. **8** is an exploded view, partly in phantom of some parts of the apparatus shown in FIG. **1**.

FIG. **9** is an enlarged sectional view of part of the apparatus shown in FIG. **3** and taken along the section line **9—9**.

FIG. **10** is a sectional view of part of the apparatus shown in FIG. **3** taken along the section line **10—10**.

DETAILED DESCRIPTION OF THE DRAWINGS

Referring now to FIGS. **1** and **2** in particular, there is shown generally at the numeral **20** a combination centrifugal impacting mill-classifying apparatus. It includes a mill section A and a classifying section B. The mill section comprises an upper casing **21** in which are formed two feed or input chutes **22**. A motor shaft **23** passes through the casing **21**, the upper portion of the shaft **23** being coupled by a conventional means to an appropriate source of rotary power such as a motor (not shown).

Within the casing **21** there is located a depending generally annular stator **28** which is fixed to the lower surface of the casing **21** by welding, for example, or by any other means. The stator **28** includes a plurality of circular concentric rows of depending stator impacting elements **29**.

The shaft **23** is connected at its lower end to a rotor indicated generally at the numeral **25** which includes, for example, three concentric rows of upstanding impacting elements **27**. The material to be milled and classified is fed in through the chutes **22** and drops onto the surface **25a** whence it is flung outwardly at high speed against the interdigitating rows of impactors **27** and **29** which, by centrifugal impact, reduce the size of the product into a mixture of coarse, intermediate and fine particles as may be seen in FIG. **2**. This stream proceeds spirally down the length of the classifying chamber whose construction will now be explained.

The classification chamber is bounded substantially by the apertured wall **30** having apertures **33** formed therein. Surrounding the chamber **32** and acting as air inlet guides are a plurality of curved vanes **31** which are welded or otherwise fixed at their bottom edge to the generally annular flange section **35***a*. It is these vanes which, when a suction device (not shown) is connected to the external end of the conduit **34**, guide the air into the classification chamber to produce an inwardly spiralling current of air generally transverse to the axis of the apparatus **20**. Conduit **34** is attached to the adjustable-diameter iris assembly **37**. The air entering the chamber in the region thereof above the upper edge of the iris assembly **37** and the effects of gravity on the particles issuing from the mill section A cause the particles to flow in this region as shown in FIG. **2**. The curved vanes **31** help to impart the inwardly spiralling motion to the incoming air.

In the region of the chamber **32** below the upper edge of the iris **37**, the air will tend to come inwardly in a spiral flow, then be obstructed by the sides of the iris **37** and then be forced upward as more air comes in due to the suction in conduit **34**. This inward and upward current in the lower region of the chamber **30** will tend to bring upwardly any fine particles which may have fallen down past and outwardly of the upper edge of the iris assembly **37**. When these finer particles are carried up into the region of the upper edge of the iris **37** they are sucked down through inlet opening **37***a* and then out of the apparatus through the conduit **34**.

All of the foregoing operation of the mill-classifying apparatus is substantially identical to the operation of the apparatus described and claimed in U.S. Pat. No. 3,433,422 issued Mar. 18, 1969 and referred to above. Shown in that patent, instead of the adjustable iris **37**, was a conical member with a fixed effective outlet area. It was therefore impossible to change the fine "cut" of the particle flow taken out along the axis of the classification apparatus without changing the conical section itself from within the chamber **32**.

In accordance with the present invention the iris assembly **37** is made to have an effective upper inlet diameter and shape adjustable from outside the apparatus **20**. A handle **38***a* is attached to the segments **45** (FIG. **10**) of the iris **37** in such a way that pushing and pulling the handle inwardly and outwardly causes the segments to be pivoted between their most inwardly and outwardly inclined positions (FIG. **10**) as well as all intermediate positions.

Referring now in particular to FIGS. **3–10** it will be seen that the iris assembly **37** including the generally annular apron **36** and the lower pan-shaped member **39** are all supported within the chamber **32** by the upper end **34***a* of the conduit **34**. The conduit **34** passes through the coarse particle collecting hopper **35** whose lower end is connected to a drum (not shown) or other collecting container. The most coarse particles move downwardly past the outer edges of the apron **36** and the member **39** and into the coarse-receiving hopper **36** as shown in FIG. **2**.

The apron **36** is substantially frustro-conical and its upper horizontal surface **36***c* is formed to include a circular row of circular openings or holes **36***a* which alternate with a plurality of elongated slots **36***b*. From FIG. **4**, it will be observed that every fifth hole **36***a* is engaged by a long mounting shaft **46** attached by bifurcated portions **46***b* and **46***c* to one of the seg-

ments 45 whereas the intervening four circular openings are engaged by the relatively short shafts 48 attached by bifurcated portions 48*b* and 48*c* to the segments 45. The long-shafted (46) segments 45 in the form of the invention shown are only five in number whereas the shorter-shafted (48) ones are 15 in number as shown. For reasons which will become obvious those of the segments 45 connected to long shafts 46 are known as "control" segments because they are the only ones which are directly driven to their particular inclined position whereas the shorter-shafted (48) segments are "slave" or "idler" segments which are indirectly guided or driven to their particular position by one of the control segments, either directly or indirectly, as will be explained below.

The segments 45 are each constructed, as shown in FIGS. 5–8, of a central triangular section 45*b* surrounded by inverted triangular sections 45*a* and 45*c* which are bent inwardly with respect to the segment 45*b*, all of the segments being coated with Teflon, the trademarked tetrafluroethylene composition of the E. I. DuPont Company. The lower ends 45*d* and 45*e* of the segments 45*a* and 45*c* engage the slots 36*b* on either side of the holes 36*a* through which the long and short shafts 46 or 48 pass.

By reference to FIG. 4 it is seen that the segments 45 are overlapped so that when the long-shafted (46) control segments are inclined inwardly, they will force the four adjacent (clockwise) segments 45 inwardly. Conversely, when the control segments are pivoted outwardly, each one will urge the adjacent (counter-clockwise) four idler segments outwardly.

Just below the apron 36 and within the pan-shaped member 39 is a cam-plate 41 whose circumferential edge is held in place for rotation of the plate between four nylon rollers 49.

The rollers 49 are themselves mounted by means of pins 51 passing upward through them and through holes in the base of the member 39. The cotter pins 52 keep the pin 51 from moving downward. There are five arcuate slots 41*a* formed in the plate 41. Attached to the cam-plate 41 via pin 40 is a member 38*b* which itself is connected to a rigid member 38*a*. Member 38*a* passes through a hole 39*a* in a member 39 and through hopper 35 and terminates in a bent handle 38*a*.

It will be seen that only the lower ends of the long shafts 46 are disposed in the arcuate segments 41*a* (FIGS. 4 and 10). All of the control segments 45 are fixed to the long shafts 46 and are kept in place by virtue of their associated shafts 46 which pass through the circular openings 36*a* whereas portions 45*d* and 45*e* fit into the elongated slots 36*b*. Just below the openings 36*a* there are a plurality of rubber or other resilient washers 54 which also act to seal those openings. These washers are held in place by rigid washers 55 that are kept up by cotter pins 56 that are passed through holes 46*a* formed in shafts 46.

The shorter shafts 48 do not engage the arcuate slots 41*a* of the cam-plate 41. Instead, as shown in FIGS. 8 and 9, they pass through associated ones of the holes 36*a*, through the resilient washers 54 and aligned rigid washers 55, and are maintained in place by cotter pins 56 which pass through the transverse holes 48*a* therein.

It is seen that circular movement of the cam-plate 41 will cause the control shafts 46 to pivot between two extreme positions defined by their location in the slots 41*a*. As shown in FIG. 4, the lower ends of shafts 46 are in their innermost position, whereas the segments 45 attached thereto are inclined most outwardly. This position is also shown in full lines in FIG. 10. Conversely, when the lower ends of the shafts 46 are in the position shown in phantom lines in FIG. 10, their associated segments 4 are inclined inwardly to the greatest extent.

As stated before when the control segments pivot inwardly and outwardly they necessarily cause the adjacent slave segments 45 to move the same way.

While the invention has been shown in terms of a segmented variable iris structure it should be appreciated that there are many other ways (not shown) of producing an adjustable inlet opening for the suction conduit 34. For example, the segments 45 might be made as moldings of a plastic material particularly suitable for contacting the specific particles being classified, the shafts 46 and 48 being either separate or integral.

The longer control shafts might be extended upward to the proper height and, in lieu of individual segments, surrounded by a stretchable band secured to said extended stems. Such a variation would, however, assume a polygonal rather than an approximately circular shape.

In case of a very large apparatus, the segments might be cast from metal appropriate for contacting the particles being classified, the shafts 46 and 48 being either separate or integral.

I claim:

1. In the classifying apparatus including means for introducing a mixture of various-sized particles and means for causing said mixture to move in an inwardly-spiraling flow in a predetermined direction parallel to the axis of said spacing flow, the combination comprising:

a. an outlet opening assembly disposed within said apparatus substantially concentric with said spiral flow in the path of said flow downstream of said introducing means, said assembly including variable means for varying the effective cross-sectional area of said opening thereby to intercept and remove from said mixture a predetermined inward fraction thereof and

b. means coupled to said assembly and extending outside of said apparatus for operating said variable means.

2. The invention according to claim 1 wherein said variable means comprising a plurality of interleaved segments.

3. The invention according to claim 2 wherein said segments include a plurality of control segments which are directly caused to change their angular position by said adjusting means and a plurality of slave segments which are interleaved with one another and with said control segments and are thereby impelled indirectly to assume the same angular position as said control segments.

4. The invention according to claim 3 wherein said control segments have attached thereto shafts and wherein said adjusting means includes a rotatable cam plate located in a substantially horizontal plane in proximity to said control segments and having a plurality of arcuate slots each of which is engaged by at least one of said shafts, and also includes a lever coupled to said cam plate for causing rotation thereof, said lever being accessible outside said apparatus.

5. The invention according to claim 4 wherein said slave segments are attached to shafts which are shorter than the shafts attached to said control segments and said assembly includes a generally horizontal annular apron between said slave and control segments and said cam plate, said apron having a circular array of apertures through which said shafts of said slave and control segments respectively extend and wherein means are provided which prevent said slave and control segments and their associated shafts from being detached from said cam plate yet allows them to pivot about substantially horizontal axes in response to movement of said control segments upon rotation of said cam plate by said lever.

6. The invention according to claim 2 wherein said interleaved segments are upstanding and mounted for pivoting about respective horizontal axes and are attached to respective shafts and wherein said adjusting means includes an externally operable cam plate which is engaged by at least predetermined ones of said shafts thereby to cause said segments to tilt about their axes in response to operation of said plate.

7. The invention according to claim 6 wherein said cam plate is mounted for rotation within its own plane.

8. The invention according to claim 1 wherein said adjusting means includes externally operable cam means which engages said variable assembly.

9. The invention according to claim 1 wherein said spiralling flow is also generally downward.

10. The invention according to claim 1 wherein said variable means varies the axial location of said opening of said assembly in said direction of flow.

11. In a classification apparatus which comprises means toward the upper end thereof for feeding a mixture of various-

sized solid particles, means including a chamber defined by an apertured wall extending downward from said feeding means for creating a first spiral flow of gas, the improvement which comprises: an assembly disposed toward the lower end of said apparatus substantially concentric with said flow which has an outlet opening means having a variable cross-sectional area for removing a predetermined central fraction of the particles in said flow and means coupled to said assembly and accessible on the outside of said apparatus for adjusting the area of said opening means.

12. The invention according to claim 11 wherein said variable outlet opening includes a circular row of substantially vertical segments which are pivotable about respective horizontal axes in response to operation of said adjusting means.

13. The invention according to claim 12 wherein said assembly rests on the terminal portion of a conduit adapted to be connected to a suction source.

* * * * *