

[54] VERTICAL CLASSIFIER

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[56] **References Cited**

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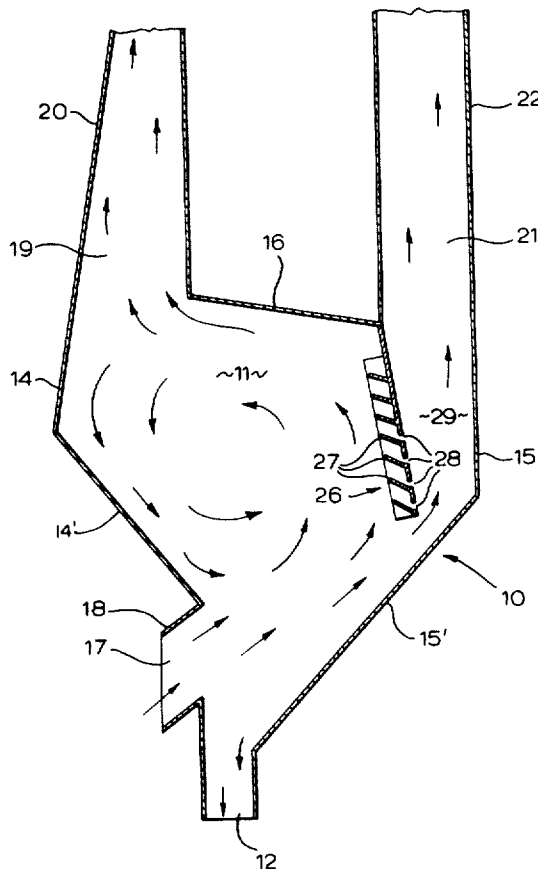
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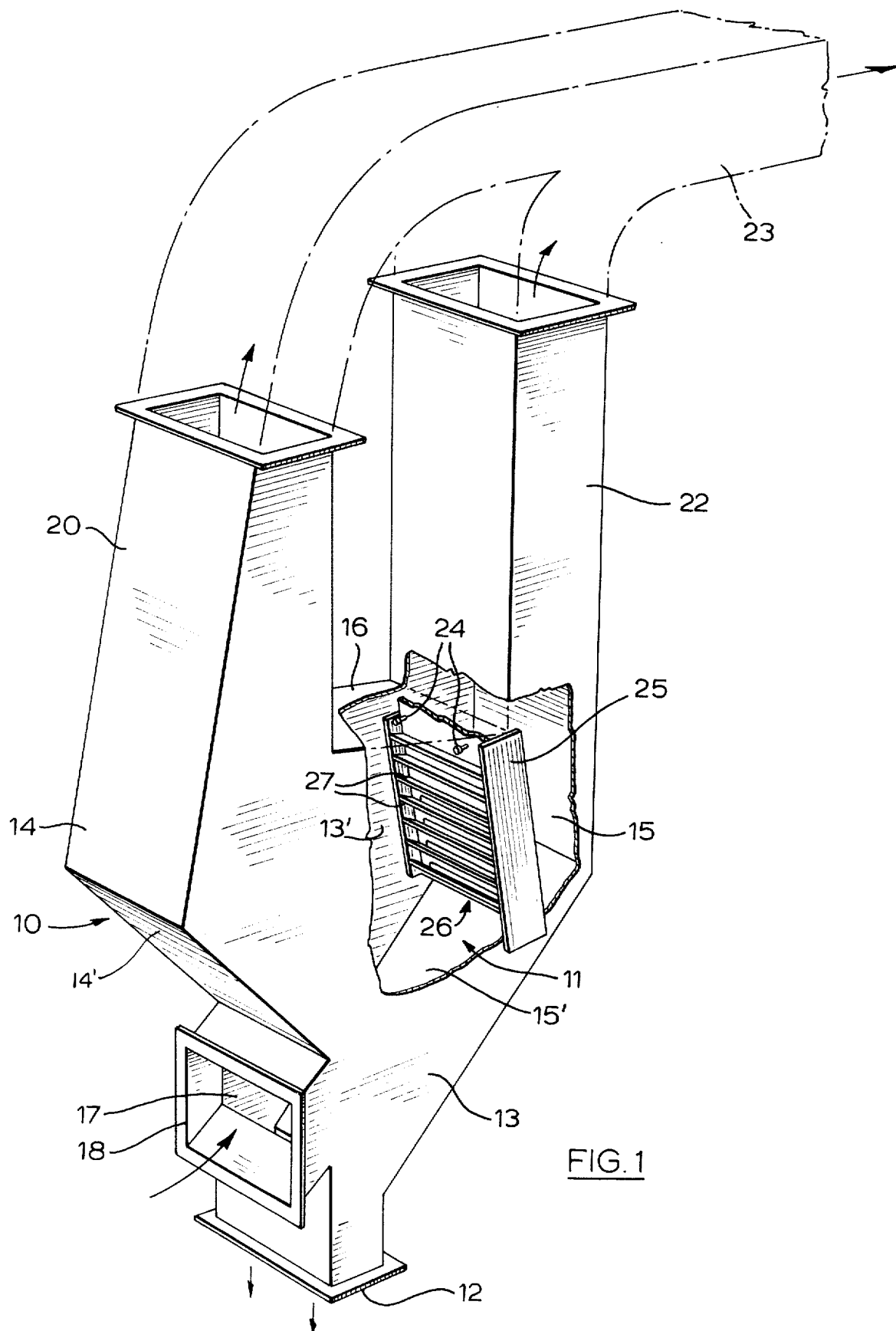
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[57] **ABSTRACT**

In a vertical classifier, a high efficiency of separation is achieved by recirculating a portion of the main fluid stream within the classifier so as to create a horizontal vortex whereby larger particles are prevented from passing with the fine fraction; incoming fluid serves to carry fines from such recirculated portion of the fluid stream.

6 Claims, 2 Drawing Figures





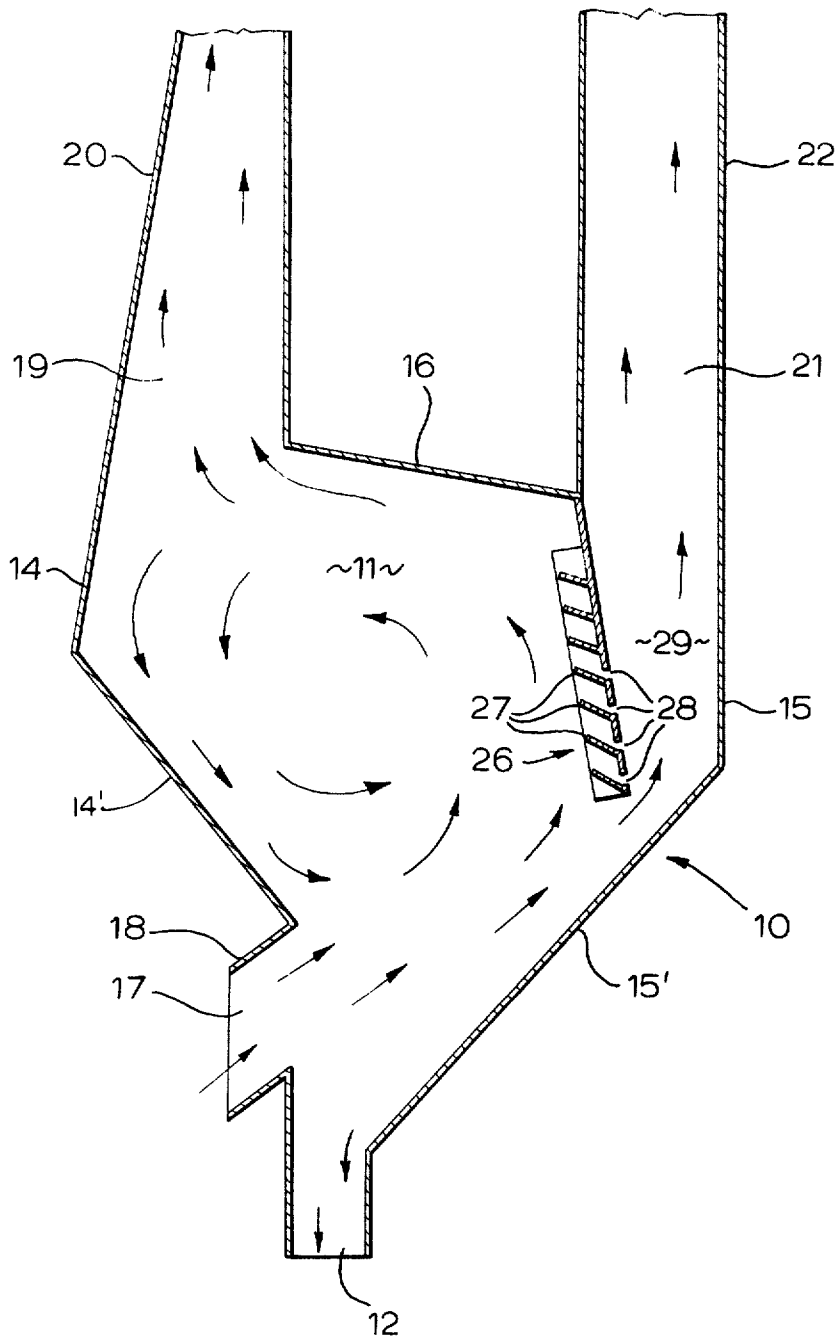


FIG. 2

VERTICAL CLASSIFIER

This invention relates to classifiers for the classification or collection of particulate solid material, and is concerned particularly with vertical classifiers wherein the solid material is entrained in a fluid carrier, usually air, which is caused to follow an upwardly curved flow path to effect centrifugal separation of solid material having a mesh size greater than a certain value, the separated material being discharged gravitationally from the classifier.

In known classifiers of this type, high fluid velocities together with large deflections in the fluid flow produce large centrifugal forces; in consequence a large fraction of the entrained material of all particle sizes is caused to impinge on baffles or other surfaces in the separation chamber of the classifier. While much of this separated material runs down behind the baffles and is discharged by the classifier, a substantial amount is deflected back into the main fluid stream and is reentrained. The result is poor classification; the separated product contains many fines, while a significant proportion of the coarser particles are passed from the classifier in the fluid stream in which they remain entrained.

It is an object of the invention to provide an improved classifier of the vertical type having a greater efficiency of separation than can be achieved with known classifiers.

This is achieved by providing within the classifier an internal reflux system in which a portion of the fluid carrier is recirculated in a vortex flow pattern so as to be swept through the product cascaded from the baffles in the separation chamber. Any of the coarser particles which are entrained in the fluid stream become entrained in the downward leg of the vortex flow pattern and are discharged into the discharge fluid stream.

According to the invention, therefore, there is provided a vertical classifier for particulate solid material entrained in a fluid carrier, comprising a vessel defining a horizontally oriented separating chamber having a bottom discharge opening for the discharge of separated solid material means defining an inlet passage communicating with a lower portion of the chamber, means defining an outlet passage communicating with an upper portion of the chamber, said inlet and outlet passage means defining an upwardly curved flow path to effect centrifugal separation of solid material from the fluid stream within the chamber, baffle means located in the chamber at a position to intercept the flow of inflowing fluid, and deflector means positioned to induce a downward flow of a portion of said fluid stream thereby to create a horizontal vortex within the chamber.

In order that the invention may be readily understood, one embodiment thereof will now be described by way of example with reference to the accompanying drawings, in which:

FIG. 1 is a general perspective view of the classifier, partly broken away to show internal parts; and

FIG. 2 is a vertical sectional elevation of the classifier.

The vertical classifier shown in the drawings is intended to be used as a primary classifier in a mill system, wherein coarse product is separated from an air stream in which it is entrained, the fines being conveyed by the air stream to a secondary classifier. Systems comprising more than one classifier are well

known, and so the present description will be confined to the construction and operation of the primary classifier, which is the subject of the present invention.

The classifier comprises a vessel 10 defining a horizontally oriented separation chamber 11, having a bottom discharge opening 12 for the discharge of the separated coarser material. The term "horizontally oriented separation chamber" is used herein to mean a chamber having a horizontal axis, that is to say a chamber of substantially uniform cross-sectional shape. The vessel 10 has a pair of side walls 13,13' constituting the ends of the chamber 11, a front wall 14, a rear wall 15, and a top wall 16. The front wall provides an inlet opening 17 communicating with a lower portion of the separation chamber, and an upwardly inclined duct 18 of rectangular cross section is connected to the front wall and communicates with the inlet opening 17 so as to direct high velocity air with entrained material in an upwardly inclined direction into the separating chamber. The rear wall 15 has a rearwardly inclined portion 15' extending to the discharge opening 12 to provide a chute for separated material, the inclined portion 15' extending approximately in the direction of the inlet duct 18.

The top wall 16 has a first outlet opening 19 positioned adjacent to the front wall 14 and communicating with a vertical duct 20. The top wall also has a second outlet opening 21 positioned adjacent to the rear wall 15 and communicating with a vertical duct 22; the ducts 20 and 22 merge into a duct extension 23 whereby reflux air with fines is conveyed to a secondary classifier. The front wall 14 has a downwardly and rearwardly inclined portion 14' terminating adjacent to the inlet opening 17; this inclined portion is adapted to provide a deflector surface, as hereinafter defined, positioned to induce a downward flow of a portion of the air stream within the separating chamber thereby to create a horizontal vortex flow pattern.

Spaced from the rear wall of the vessel, and secured by means of bolts 24 and end plates 25, is a baffle plate 26. The baffle plate 26 is located in the chamber 11 at a position to intercept incoming air from the inlet opening 17, the incoming air with entrained solids impinging on the baffle plate. The baffle plate is formed with a number of horizontal steps or shelves 27, and is formed with horizontal slots 28 through which air and solids may pass to a flow passage 29 behind the baffle plate, the latter passage being aligned with the outlet opening 21 and the duct 22.

In operation of the classifier, a high velocity air stream with entrained solid material enters the separating chamber 11 via the inlet duct 18. The stream flows in an upwardly inclined direction, some passing behind the baffle plate 26 along the passage 29 and into the duct 22, and some impinging on the front of the baffle plate where much of the entrained material is caught and caused to cascade downwards. A portion of the material is caught by the baffle plate and passes through the slots 28. Thus the air stream which passes beneath the baffle plate into the passage 29 sweeps the material which cascades down the front and rear faces of the baffle plate and serves to reflux fines therefrom. However, some of the solid material which impinges on the baffle plate is reentrained by the air stream; larger particles are carried towards the front of the classifier while fines are carried away via the duct 20. The larger particles, instead of being entrained in the air which passes along the duct 20 are entrained in a portion of

the air stream which is deflected downwardly along the front wall of the chamber, this portion of the air stream following a vortex flow pattern as indicated by arrows in FIG. 2. In consequence the downwardly directed larger particles must pass through the inflowing air before reaching the discharge opening 12, the inflowing air serving to reflux fines from this fraction of the product.

Since the main air stream passes directly through the classifier, most of the dynamic fluid pressure is maintained or recovered. Consequently the classifier can handle large volumes of material with relatively little pressure loss. Furthermore, the efficiency of separation at a given mesh size is very high. The reason for this is twofold. First, the vortex created in the separating chamber serves to entrain larger particles which would otherwise be entrained with the outflowing stream carrying fines to the outlet duct 20, such larger particles being carried downwardly towards the discharge opening 12 or on towards the baffle 26. Second, the vortex stream carrying the larger particles is itself swept by the incoming air stream to remove fines from the fraction which would pass to the discharge opening.

The geometry of the classifier may be varied to meet particular requirements without affecting the general principles of operation described herein, which are primarily dependent upon the creation of a horizontal vortex flow pattern. The baffle plate need not be positioned as shown, although this arrangement of the baffle plate is particularly suitable in situations involving high material flow rates. Furthermore, although the side walls of the illustrated classifier are parallel and vertical, it may be advantageous in certain situations, particularly where a product split is required at a fine size, for the side walls to diverge along the main flow path.

What we claim as our invention is:

1. A vertical classifier for particulate solid material entrained in a fluid carrier, comprising a vessel defining a horizontally oriented separating chamber having a bottom discharge opening for the discharge of separated solid material, said vessel having a pair of side walls, a front wall providing an inlet opening communicating with a lower portion of the chamber, a rear wall, and a top wall providing an outlet opening communicating with an upper portion of the chamber and positioned adjacent to the front wall, inlet passage means communicating with said inlet opening, outlet passage means communicating with said outlet opening, said inlet passage means providing an upwardly inclined

duct for directing inflowing fluid in an upwardly inclined direction towards the rear wall, and said rear wall having a rearwardly inclined portion extending from the discharge opening approximately in said upwardly inclined direction, said inlet and outlet passage means defining an upwardly curved flow path for effecting centrifugal separation of solid material from the fluid stream within the chamber, baffle means located in the chamber at a position to intercept the flow of inflowing fluid and deflect a portion of the entrained material inwardly of said curved flow path, and means defining a deflector surface positioned to induce a downward flow of a portion of said fluid stream thereby to create a horizontal vortex within the chamber, said means defining a deflector surface being constituted by a downwardly and rearwardly inclined portion of said front wall terminating adjacent to said inlet opening.

2. A vertical classifier according to claim 1, said top wall providing a second outlet opening positioned adjacent to the rear wall, the classifier having a second outlet passage means communicating with said second outlet opening.

3. A vertical classifier according to claim 1, wherein said baffle means is constituted by a baffle plate extending across the separating chamber and spaced from the rear wall to define a flow passage behind the baffle plate.

4. A vertical classifier according to claim 3, said top wall providing a second outlet opening positioned adjacent to the rear wall, the classifier having a second outlet passage means communicating with the second outlet opening and aligned with said flow passage behind the baffle plate.

5. A vertical classifier according to claim 4, wherein the baffle plate is formed with horizontal slots.

6. A method of classifying particulate solid material entrained in a fluid stream which comprises directing the fluid stream along an upwardly curved path, causing said fluid stream to impinge upon a baffle surface positioned to intercept solid material entrained in the stream and deflect such material inwardly of said curved flow path, deflecting a portion of the fluid stream after impinging on the baffle surface in a downward direction, the downwardly deflected portion of the fluid stream impinging upon upstream fluid thereby to follow a horizontal vortex pattern wherein larger particles are entrained by the downward leg of the vortex and fines are refluxed therefrom by said upstream fluid.

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