Sept. 27, 1966 F. RASMUSSEN 3,275,140

AIR SEPARATOR WITH FLUIDIZED DISCHARGE

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FIG. 1

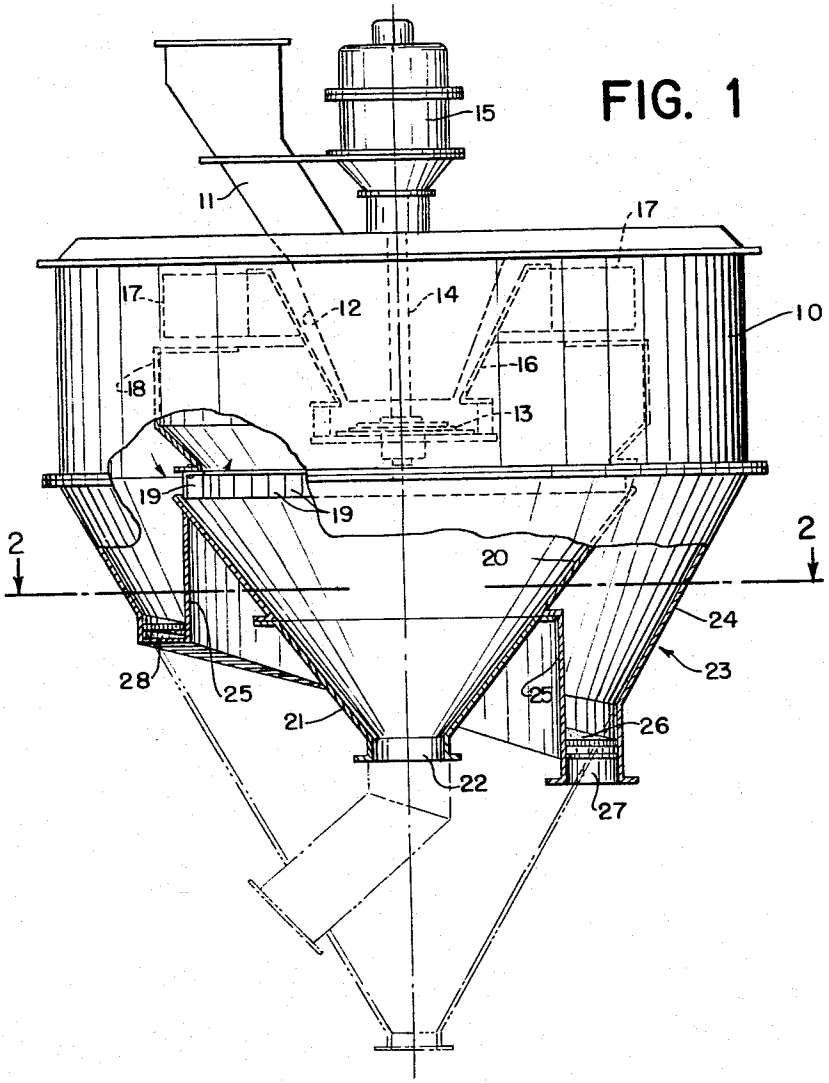
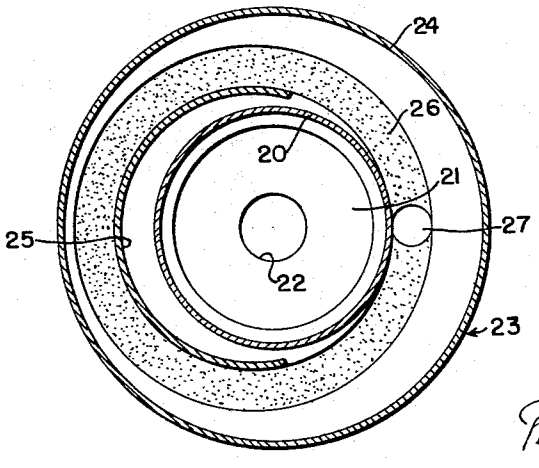


FIG. 2



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FIG. 3

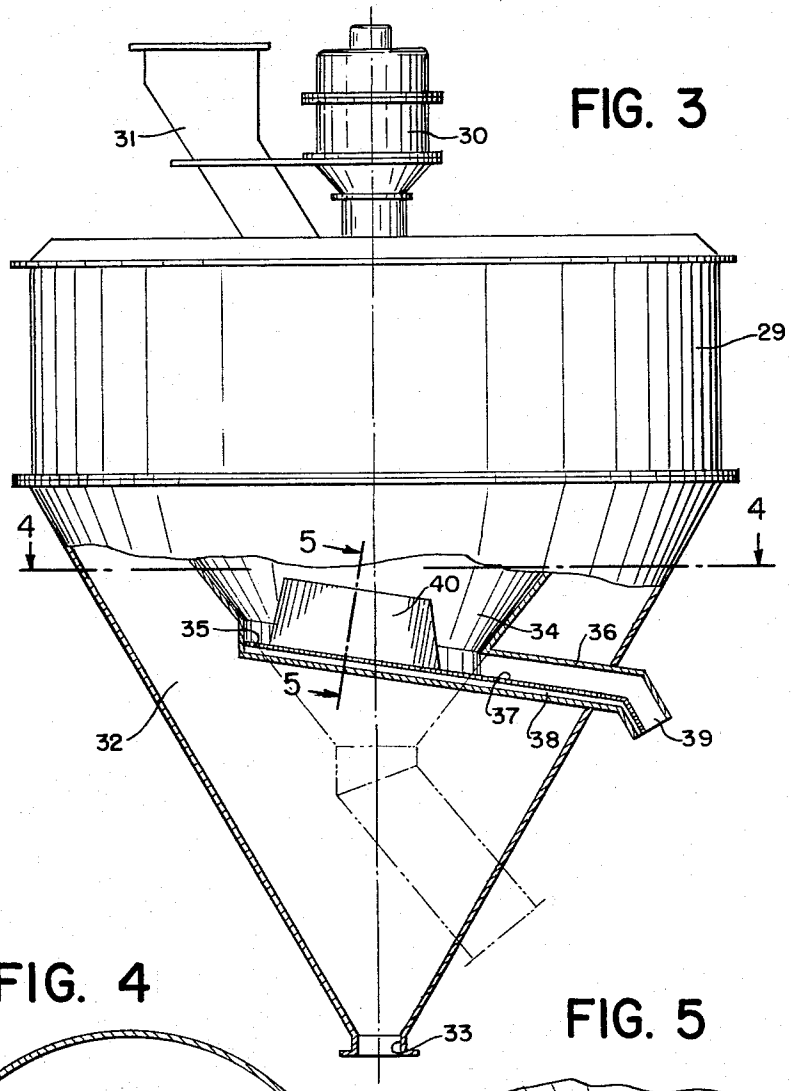


FIG. 4

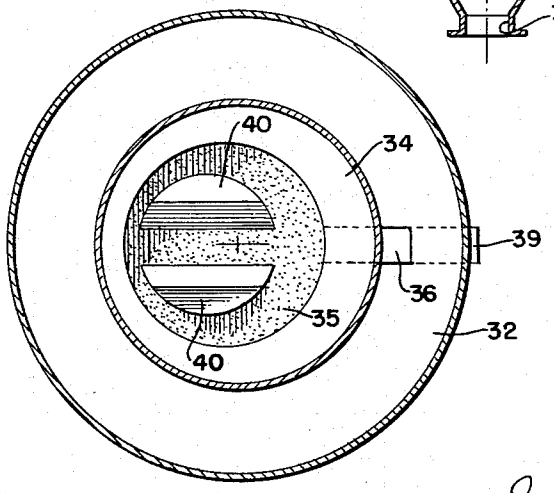
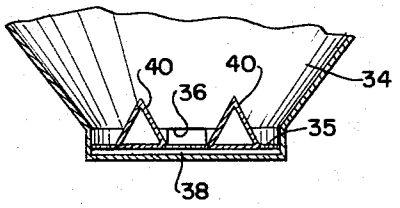


FIG. 5



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AIR SEPARATOR WITH FLUIDIZED DISCHARGE

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5 Claims. (Cl. 209—139)

This invention relates to air separators for separating finely divided material into coarse and fine fractions and is concerned more particularly with an improved air separator of the closed circuit type which offers a number of advantages over similar separators as constructed heretofore.

In one well-known type of closed circuit air separator, the material to be separated is thrown outward centrifugally in a thin sheet from a rotating spreader plate into the path of an upward current of air. The coarse particles are not entrained in the air stream and fall into an inner collecting chamber, while the fine particles are carried along in the current and, subsequently, fall out of the stream in an outer collecting chamber, in which the velocity of the air current is reduced. The air current is then directed upward past the rotating plate and the separating action described continues.

In a conventional closed circuit air separator, the lower parts of the collecting chambers are conical and are provided with bottom openings, from which outlet pipes lead. As the outer chamber for collecting the fine fraction surrounds the inner chamber for collecting the coarse fraction, the outlet pipe for the coarse fraction necessarily extends across part of the outer chamber and passes outward through the wall of that chamber. In order that the material may flow to the bottom openings of the chambers, the chamber walls must be inclined at an angle greater than the angle of repose of the material collected, and the cross-sectional areas of the chambers must taper to the size of the outlet pipes. Also, the oulet pipe from the inner chamber must pass through the outer chamber at an inclination at least equal to the angle of repose of the coarse fraction in order to insure that the fraction will flow through the pipe under gravity. It is, therefore, necessary that the chambers be of considerable height and the large amount of space occupied by such separators is one of their objectionable features.

When the coarse fraction leaving a separator is passed through a closed circuit grinding installation and then returned to the separator, as is often the case, the power consumed by the elevator or conveyor for returning the material to the separator depends in part on the distance between the levels of the separator inlet and the outlet for the coarse fraction. It is, therefore, desirable to reduce this difference in level as much as is reasonably possible and thus lower the power consumption.

The closed circuit air separator of the present invention is superior to similar prior separators in that it is provided with means by which at least one of the fractions is fluidized, so that the fraction may flow out of the separator in a fluidized state. As a result of the fluidization of the fraction, it is no longer necessary to provide the chamber containing the fraction with a conical or funnel-shaped bottom having walls inclined at an angle greater than the angle of repose of the fraction and the height of the chamber may be substantially reduced. Preferably, the collecting chamber for the fine fraction is provided with the means for fluidizing the material and the bottom of this chamber is provided with a closure which extends annularly around the inner collecting chamber, in which the coarse fraction is collected. The closure may be air-pervious and supplied with air from a chamber beneath it, although other known fluidizing means may be employed, if desired. The closure is symmetrical in relation

to a vertical plane passing through the axes of the separator and the outlet for the fine fraction and slopes downward toward the outlet at such an angle as to insure that the fluidized material will flow over the surface of the closure to the outlet.

Although the coarse fraction, if passed through a closed circuit grinding installation, may contain crushed grinding bodies and coarse lumps of material originating from the grinding mill, which make fluidization difficult, the chamber for collecting the coarse fraction may be provided with means for fluidizing the fraction, if desired. In that case, the bottom closure of the chamber is symmetrical in relation to a vertical plane passing through the axes of the separator and the outlet pipe for the coarse fraction and slopes downward toward the pipe. The closure may have air-pervious areas along its circumference and along a diameter leading to the outlet pipe and the fluidizing air may be diffused through the air-pervious areas of the closure from an air chamber beneath the closure.

For a better understanding of the invention, reference may be made to the accompanying drawings, in which

FIG. 1 is a view partly in elevation and partly in vertical section of one form of separator embodying the invention;

FIG. 2 is a sectional view on the line 2—2 of FIG. 1;

FIG. 3 is a view similar to FIG. 1 of a modified form of the separator; and

FIGS. 4 and 5 are sectional views on the lines 4—4 and 5—5, respectively, of FIG. 3.

The separator shown in FIGURE 1 is of the closed circuit type and of conventional construction in a number of respects. It includes a casing **10** having an inlet pipe **11** for feeding material to be separated into a hopper **12** leading to a spreader plate **13** mounted on a vertical shaft **14** driven by a motor **15** mounted on top of the casing. A hollow hub **16** attached to the plate carriers a plurality of fan blades **17** near the top of the casing and the space within the casing below the blades is subdivided by a partition **18** into concentric chambers. The partition has a top opening and is provided at its lower end with a series of adjustable vanes **19**.

A conical collecting chamber **20** leads downward from the vanes **19** and is provided with a detachable lower end section **21** having an outlet opening **22**. An outer collecting chamber **23** attached to the lower end of the casing **10** encircles the chamber **20**. The chamber **23** is annular in cross-section and has an outer conical wall **24** and an inner cylindrical wall **25**. The bottom **26** of the chamber **23** is annular in shape and made of air-pervious material, such as a porous plate. The bottom plate is inclined downwardly toward an outlet opening **27** at an angle steeper than the angle of repose of the fluidized fine fraction and is symmetrical in relation to a vertical plane through the axes of the separator and of the opening **27**. The bottom plate **26** forms the top of a chamber **28** which is supplied with air under pressure through a suitable line.

In the operation of the separator described, the fan blades **17** maintain an upwardly flowing current of air from the vanes **19** through the chamber inside the partition **18** and out through the opening at the top of the partition. The stream then flows radially outwardly through the casing and down outside the partition **18** to the vanes. The material to be separated is fed through the pipe **11** into the hopper **12** and falls upon the rotating spreader plate **13**, from which it is thrown into the path of the air stream. The heavier particles fall through the stream and collect as a coarse fraction in the bottom end section **21** of the inner collecting chamber **20** to be removed through the opening **27**. The fine particles are entrained in the air stream and are carried out through the opening at the top of the partition **18** and into the

space within the casing **10** outside of the partition. In this space, the velocity of the air current decreases, so that the particles drop out of the stream and collect in the outer chamber **23** upon the air-pervious bottom plate **26**. The air flowing from the chamber **28** passes through the plate **26** and is diffused into the material to render it fluent and the fluidized material then flows down the sloping bottom **26** to be discharged through the outlet opening **27**.

In FIGURE 1, the broken lines indicate the construction of the coarse and fine fraction collecting chambers of a conventional closed circuit separator and it will be noted that the overall height of the separator of the invention is substantially less than that of the prior separator by reason of the outlet from the collecting chamber for the fine material being at a substantial height above the level where the outlet lies in the conventional separator. Also, the distance between the level of the outlet from the coarse collecting chamber and the level of the separator inlet is substantially reduced. By making the end section **21** of the inner collecting chamber **20** detachable, independent access to the two chambers is provided and this facilitates repairs to the interior of the separator.

The separator shown in FIGURE 3 is of the conventional closed circuit type and includes a casing **29** within which are mounted a spreader plate and a fan driven by a motor **30**. The interior of the casing is subdivided by a partition similar to the partition **18** and the material to be separated is fed through a pipe **31** into a hopper leading to the spreader plate. The fine material collects within an outer conical chamber **32** having a bottom outlet opening **33**, while the coarse fraction collects in an inner conical chamber **34** having a circular bottom **35** of air-pervious material, such as a porous plate. The bottom plate **35** lies at an angle to the horizontal steeper than the angle of repose of the fluidized coarse fraction and a discharge pipe **36** extends from an opening in the wall of the chamber at the low point of the bottom plate and through the wall of the chamber **32**. The pipe **36** is provided with an air-pervious bottom plate **37**, which may be a continuation of the bottom plate **35**, and the plates **35** and **37** form the top of a chamber **38** supplied with air through a suitable line. The bottom **35** of chamber **34** is symmetrical in relation to a vertical plane through the axis of the separator and the outlet **39** at the outer end of the passage **36**. A pair of solid wedges **40** are mounted on top of the bottom plate **35**, so that the air-pervious area of the bottom is formed of outer curved sections along the circumference of the plate and an area extending along the diameter of the plate and leading to the outlet pipe **36**.

The separator shown in FIGURE 3 operates in the same manner as that shown in FIGURE 1, except that the coarse fraction collected in the chamber **34** is fluidized and flows outward through the pipe **36**, while the fine fraction is collected in the usual way in the outer collecting chamber **32** for discharge through the outlet **33**.

In FIGURE 3, the shape of the collecting chamber for the coarse fraction and of the outlet pipe leading from the chamber in a conventional separator are indicated in broken lines and it will be apparent that the difference in level between the outlet from the collecting chamber for the coarse fraction and the separator inlet in the new separator is substantially less than the corresponding distance in a conventional separator. As a result, when the separator of FIGURE 3 is used in closed circuit grinding, a substantial saving in power is achieved by reason of the shorter distance that the coarse fraction must be elevated from the outlet from the collecting chamber for that fraction to the separator inlet.

I claim:

1. In an air separator of the closed circuit type for separating a finely divided material into coarse and fine fractions including a substantially closed casing, means in said casing defining concentric inner and outer chambers spaced from the top of said casing, said inner chamber for collecting the coarse fraction and said outer chamber for collecting the fine fraction, means for maintaining an air current flowing upwardly in the inner chamber and flowing downwardly in the outer chamber, means for introducing finely divided material into the inner chamber for entrainment of the fine fractions in the air stream for transfer to the outer chamber and collection of the coarse fractions in the inner chamber, an inner chamber outlet in said casing and outer chamber outlet in said casing, the improvement in combination therewith comprising means for maintaining the distance between the top of the casing and the chamber outlets at a minimum, said means comprising an air pervious closure means for the bottom of one of the chambers inclined toward said one chamber outlet for diffusing air into the material above the closure to fluidize the material and cause it to flow over the closure to the outlet.

2. An air separator as in claim **1** wherein the closure closes the inner chamber and has a perforated extension connected to an inner chamber outlet positioned externally of said casing.

3. An air separator as in claim **2** wherein the closure is symmetrical in relation to a vertical plane passing through the axis of the separator and the upper end of the inner chamber outlet.

4. An air separator as in claim **1** wherein the closure closes the bottom of the outer chamber and is annular with the outer chamber outlet positioned externally with the casing at the low end of the annular closure.

5. An air separator as in claim **4** wherein the closure is symmetrical in relation to a vertical plane passing through the axis of the separator and the upper end of the outer chamber outlet.

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