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Gotthard

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[54] **APPARATUS FOR COOLING AND CLASSIFYING GROUND MATERIAL**

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[52] **U.S. Cl.** ..... **209/11,** 209/139 A

[51] **Int. Cl.** **B07b 7/10**

[58] **Field of Search** ..... 209/3, 11, 139 A, 139 R, 209/133, 134, 136; 34/77; 241/23

[56] **References Cited**

UNITED STATES PATENTS

2,657,797	11/1953	Ledgett	209/11
2,658,615	11/1953	Ebersole	209/11
3,175,686	3/1965	Rietn	209/3
3,095,369	6/1963	Jager	209/139
3,219,185	11/1965	Doyle	209/139

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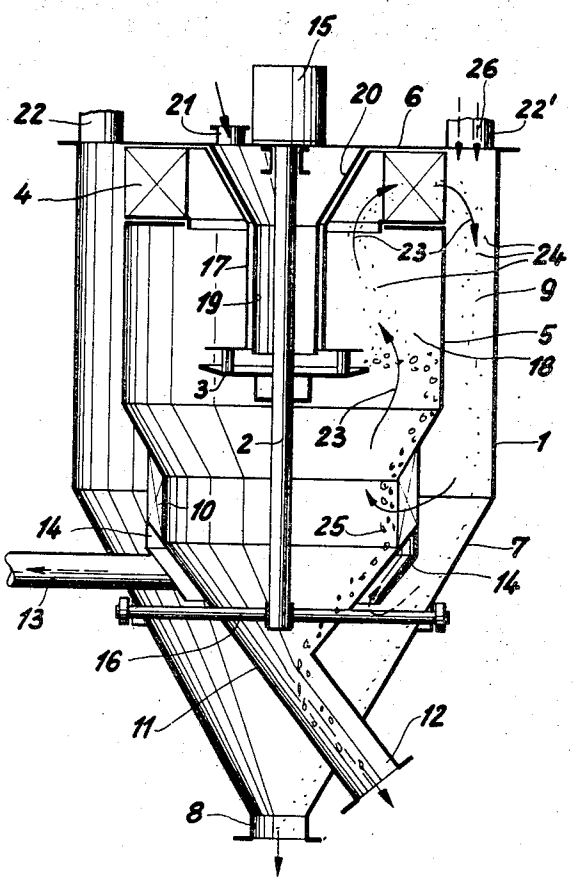
[57] **ABSTRACT**

An air separator is provided with an inlet for blowing cooling air into a circulating stream containing separated fines leaving a primary separating chamber and entering a secondary separating chamber. An excess of warm air is extracted through a pipe to maintain the quality of air flowing through the primary chamber constant.

3 Claims, 5 Drawing Figures



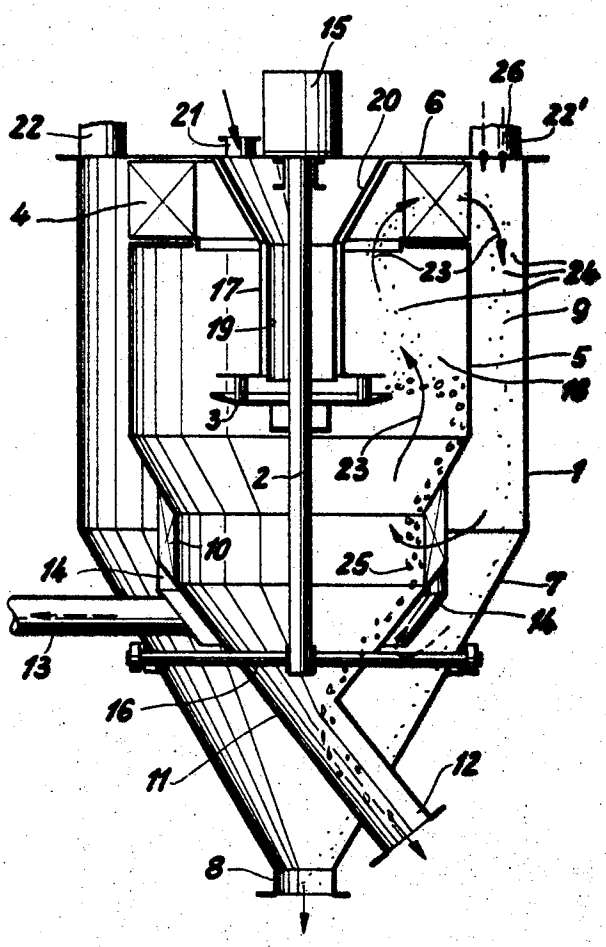
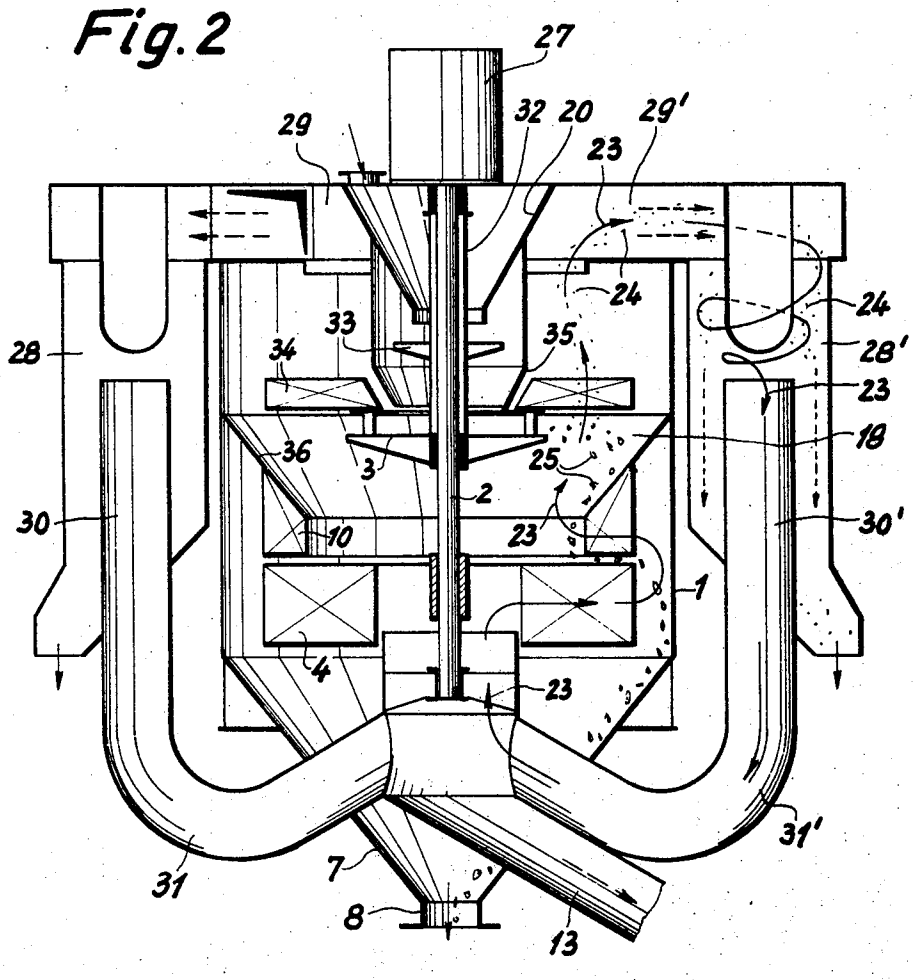


Fig. 1

Fig. 2


27
29
32
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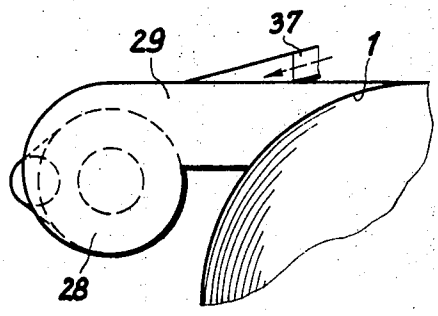
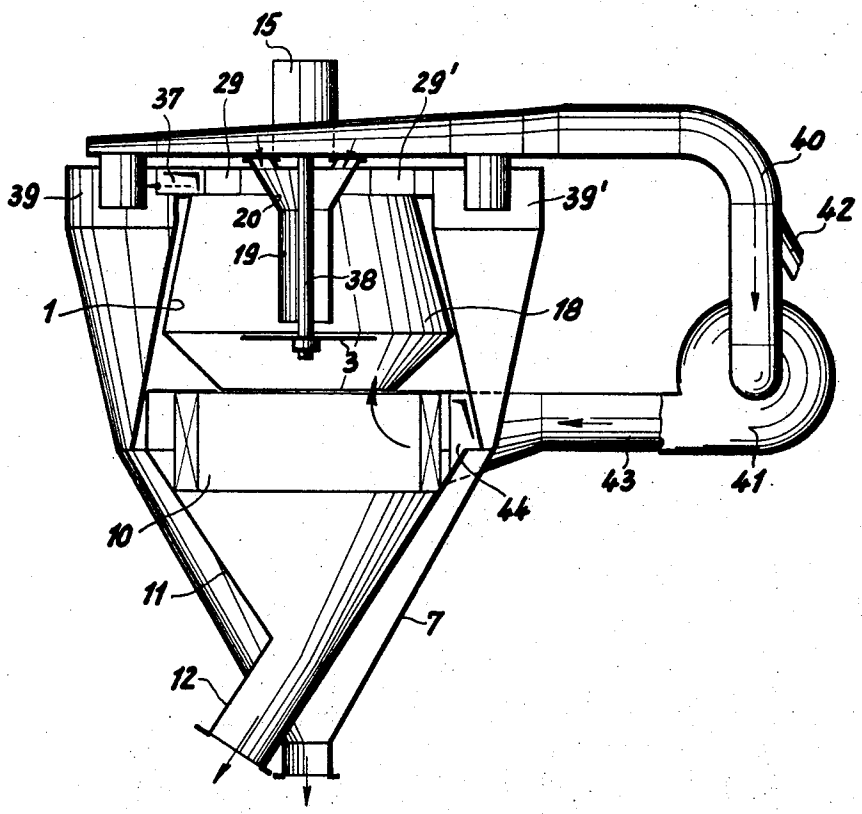

37
29
1
28

Fig. 3

Fig. 4



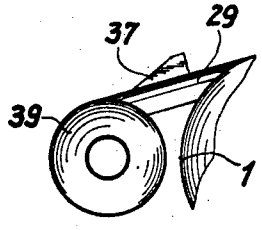


Fig. 5

APPARATUS FOR COOLING AND CLASSIFYING GROUND MATERIAL

BACKGROUND OF THE INVENTION

This invention relates to an apparatus for cooling and classifying fine material in an air separator by feeding cool air into the separator and removing warm air from the separator.

Since ground material is often produced at a considerably higher temperature than is required for the finished material, the material must generally be cooled in an air separator.

Methods are known wherein the cool air is in general introduced from the bottom into the actual separating chamber, and the warm air is removed from a ring of screens disposed in the lower part of the separator. It is also known to add cool air to the circulating stream of air extracted from the separator and freed of fine material in dust separators, before the stream of air enters the separator again. The main disadvantage of these methods is that cool air introduced reaches the actual separating chamber with the stream of separating air, and all the ground material, i.e., the coarse and the fine, is cooled in the chamber. The cool air is consequently used unnecessarily in cooling the coarse material, which is subsequently returned from the separator to the grinding plant. The optimum cooling of the fine material for a given quantity of cool air is not therefore attained.

SUMMARY OF THE INVENTION

The object of the invention is to provide an apparatus for the type described wherein the maximum possible cooling of the fine material is achieved for a given quantity of cool air at a specific temperature.

According to the invention this object is achieved in that the cool air is fed into the separating air stream at a position where at least the majority of the coarse material has already been separated from the separating air stream, which in general is now only laden with fine material.

Since with the apparatus for carrying out the invention the cool air is only introduced after the separation of coarse material, i.e., into the separating air stream now in general only laden with fine material, optimum cooling of the fine material is achieved for a given quantity of cool air.

In a device for practicing the invention, with a fan disposed in the separator to produce a circulation of separating air, an effective embodiment of the invention is provided by using at least one cool air conduit which enters the separating air flow space on the pressure side of the fan. The fan is consequently not burdened with cooling air, and is fully utilized in circulating the main stream of air. In contrast with known devices, the air passing through the fan thus makes a full contribution to the separating effect; in this manner a greater quantity of separating air than previously is now available, especially for the subsequent separation taking place in the lower part of the separator adjacent the zone where the circulating air re-enters the separating chamber.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a schematically shown vertical section through a first air separator embodying the invention;

FIGS. **2** and **3** are a vertical section and a fragmentary plan view of a further embodiment of an air separator;

FIGS. **4** and **5** are a vertical section and a fragmentary plan view of a third embodiment.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

The air sifter shown in FIG. **1** has an outer separator housing **1** containing a vertical shaft **2** carrying a scatter plate **3** and a fan **4** connected thereto and rotating with the shaft and the scatter plate, and has an inner separator housing **5.**

The outer housing **1** has a circular cross-section and is closed at the top by a cover **6.** At the bottom this housing becomes a collector hopper **7** having an exit pipe **8** for the fine material. The inner housing **5** is disposed coaxially with the outer separator housing **1.** A flow space **9** is formed between the two housings. Adjacent the conically shaped lower part of housing **5** is a ring of screens **10** connected to the upper edge of a coarse material collector hopper **11.** The outlet pipe **12** of hopper **11** leads downwardly and passes through the wall of collector hopper **7.** This collector hopper **7** also has passing through it an air conduit **13,** which emanates from a skirt **14** disposed below the ring of screens **10.**

The shaft **2** is centrally disposed in the air separator. It extends from a drive **15** mounted on the housing cover **6** down into the separator, and is supported in the lower part thereof by radially adjustable struts **16.** The scatter plate **3** affixed to shaft **2** is drivingly connected with fan **4** by a hollow shaft **17.** The fan is located above the inner housing **5** which contains the actual separating chamber **18.** The hollow shaft **17** of the fan **4** concentrically surrounds the ground material feed pipe **19** which runs coaxially with shaft **2** and ends some distance above scatter plate **3.** The feed pipe **19** is connected to a material supply hopper **20** which is adjacent the housing cover **6** and is filled from an inlet pipe **21.** On the housing cover **6** are also disposed a number of peripherally distributed cool air inlets **22, 22'** which enter the flow space **9** on the pressure side of the fan **4.**

The air separator shown in FIG. **1** operates as follows:

The air separator is supplied through inlet pipe **21** with ground material, coming for instance from a tube mill, which is to be separated into coarse and fine material. This ground material passes through supply hopper **20** and feed pipe **19** onto scatter plate **3.** The latter is set in rotation by drive **15** and shaft **2,** and spins the ground material off into the separator chamber **18.**

The air stream **23** drawn by the fan passes through the ground material flung off by scatter plate **3** and entrains the fine material **24,** causing a first separation of the coarse and fine materials. While the coarse material **25** slides along the inner wall of housing **5** and the screen ring **10** into the collector hopper **11** and is then removed from the separator through outlet pipe **12,** the fine material **24** travels with the separating air stream **23** through the fan into the flow space **9.** Cool air **26**

is blown into this flow space 9 through inlets 22 and 22', and is mixed with the separating air stream 23 and the fine material 24, which ensures optimum cooling of the fine material. The fine material separated from the air stream in the flow space 9 leaves finally as a well-cooled final product through the collector hopper 7 and the exit pipe 8. The coarse material 25 having the separator can however be returned to the grinding plant.

In order to keep the quantity of separating air flowing through the separating chamber 18 substantially constant, part of the warm air is extracted through pipe 13. The latter is preferably attached to a skirt 14 about which the warm air stream to be removed is deflected, so that the fine material falling along the wall of hopper 7 cannot be entrained.

The separating air left in the separator flows, under suction effect of fan 4, back into the separating chamber 18 through the screen ring 10. Thus the separating air stream 23 must again pass through the coarse material moving downwards on the inside of the screen ring 10, which causes a further separation of the coarse material. In this manner the air stream supplied by the fan makes a full contribution to the further separation.

In the embodiment shown in FIGS. 2 and 3, the housing 1 again has a centrally disposed shaft 2 which extends from a drive 27 mounted on the separator and is supported in the lower part of the separator. In this case the shaft 2 carries a fan 4 which is disposed beneath the separating chamber 18, and is directly connected to the fan. Around the housing 1 are disposed several fine material separators 28, 28' whose inlet apertures are connected to the separating chamber 18 by inlet pipes 29, 29', while their dip pipes 30, 30' extending downwardly from the separators 28, 28' are joined by pipes 31, 31' to the suction side of fan 4.

In addition to the shaft 2, a further hollow shaft 32 coaxially supported thereon is driven by the drive 27. On the central part of this hollow shaft 32 is mounted a pre-distributor plate 33, and at its lower end is secured the scatter plate 3, which supports a counter-blade system 34. A hood is disposed above the scatter plate 3 and around the pre-distributor plate 33. This hood 35 is supported by the supply hopper 20 located beneath the drive 27.

The separating chamber 18 is mainly formed by the housing 1 and a cone 36 connected to the housing 1. At the bottom end of the cone 36 is the ring of screens 10, which are spaced directly above the fan 4.

The pipes 31, 31' brought together on the suction side of fan 4 and passing through the collector hopper 7 are connected to a common warm air outlet conduit 13. A cool air inlet conduit 37 opens into each inlet pipe 29, 29' (see FIG. 3).

Ground material is also supplied to the air separator shown in FIGS. 2 and 3 through the supply hopper 20. The material is spread by the pre-distributor plate 33 in the hood 35, and reaches the scatter plate 3, which scatters it radially in the separating chamber 18. The coarse material 25 with any fine material still adhering thereto then falls along the inner side of cone 36 to the top of fan 4 and is again scattered outwardly thereby. The coarse material is finally removed through the hopper 7. In this way the ground material is traversed three times by the circulating air stream (arrows 23). The fine material 24 thus entrained by the separating air stream is separated out in the fine material separators 28, 28'. In order to subject the fine material to particularly effective cooling, cool air is supplied through pipes 37 to the pipes 29, 29' forming the inlets from the separating chamber 18 into the fine material separators 28, 28' (see FIG. 3), and the fine material is thus cooled intensively before its separation. The air feed of fine material is returned to the separator through the pipes 31, 31' which lead from the fine material separators 28, 28' to the fan 4; but a certain amount of warm air is first removed via the conduit 13, so that a largely constant amount of separating air can be fed to fan 4.

Finally, FIGS. 4 and 5 show a third air separator construction embodying the invention.

Here again the housing 1 encloses a sifting chamber 18 into which extend a material supply hopper 20 and a ground material feed pipe 19. These enclose a shaft 38 driven by the drive 15. On the lower end of this shaft 38 the scatter plate 3 is secured. Housing 1 ends in a ring of screens 10, adjacent the upper part of the coarse material collector hopper 11.

In an arrangement similar to that of FIGS. 2 and 3, a large number of fine material separators 39, 39' are disposed at the edge of the air separator and are connected to the separating chamber 18 by inlet pipes 29, 29'. A cool air supply conduit 37 also opens into each of these inlet pipes. In contrast to the preceding embodiment, the fine material separators 39, 39' are connected via a pipe 40 to a fan 41 lying outside of the housing 1. A warm air exit pipe 42 is connected to the pipe 40. The pressure side of the fan 41 is connected by a pipe 43 to a space 44 surrounding the screen ring 10.

The fine material separators 39, 39' with their material outlets are mounted on the edge of the hopper 7 surrounding the coarse material collector hopper 11.

The ground material passes through the supply hopper 20 and the material feed pipe 19 to the scatter plate 3 which distributes it uniformly in the separating chamber 18. The coarse material then passes downwards on the inner wall of the housing, and is removed via the coarse material collector hopper 11 and the outlet pipe 12.

The circulating stream of separator air entering from space 44 through the screen ring 10 thus passes twice through the ground material, entraining the fine material, which is separated in the fine material separators 39, 39'. Cool air is fed into the mixture of fine material and air as it passes through the pipes 29, 29', so that the fine material emerging from the separators 39, 39' and the hopper 7 leaves the air separator as well-cooled finished material.

The excess warm air is removed through the pipe 42. Because of this removal of excess warm air before the fan (see also FIGS. 1 and 2), the latter in general need only be designed for the amount of air needed for separating. The air separators of the last two embodiments also have the special advantage that only clean air impinges on their fans, so that wear effects are largely avoided.

A common feature of all the embodiments is that only the fine material, and not the coarse material, is cooled.

If the warm air is to be fed to another unit, e.g., to the mill, it can be extracted beyond the fan, so that no blower is needed to overcome the pressure difference.

I claim:

1. Apparatus for cooling and classifying ground material, comprising means defining a primary chamber for separating coarse material from an air stream; means defining a secondary chamber for separating fine material from an air stream, which has an inlet connection leading from the upper portion of the primary chamber into the secondary chamber and an outlet connection leading from the secondary chamber into the lower portion of the primary chamber; an inlet for ground material leading into the upper portion of the primary chamber; a fan arranged to recirculate an air stream upward through the primary chamber into contact with the incoming ground material, through the secondary chamber and back into the lower portion of the primary chamber, causing coarse material to separate by gravity in the primary chamber, and causing fine material to be carried by the air stream into the secondary chamber and there separated from the air stream; wherein the improvement comprises means for introducing, into the recirculating air stream entering the secondary chamber, air which is cooler than such entering air stream; and means for withdrawing air from the recirculating air stream leaving the secondary chamber before such air stream again contacts said incoming ground material.

2. Apparatus according to claim 1 wherein the means for withdrawing air is arranged to withdraw air from the air stream leaving the secondary chamber before such air stream enters the fan.

3. Apparatus for cooling and classifying ground material, comprising means defining a primary separating chamber, means defining a secondary separating chamber, an inlet connection leading from the upper portion of the primary chamber into the secondary chamber and an outlet connection leading from the secondary chamber into the lower portion of the primary chamber, an inlet for said ground material leading into the upper portion of the primary chamber, a fan constructed and arranged to circulate an air stream upwardly through the primary chamber into contact with the incoming ground material, through the secondary chamber and back into the lower portion of the primary chamber, causing coarse material to separate by gravity in the primary chamber, and causing fine material to be carried by the air stream into the secondary chamber and there separated from the air stream, wherein the improvement comprises means for introducing cooling air into the circulating air stream leaving the primary chamber and entering the secondary chamber, and means for withdrawing an excess of air from said circulating air stream leaving the secondary chamber before such air stream again contacts said incoming ground material to maintain a substantially constant quantity of air flowing through said primary chamber.

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