W. K. LIGGETT.

SEPARATOR.

APPLICATION FILED FEB. 18, 1907.

1,135,594.

Patented Apr. 13, 1915.

2 SHEETS—SHEET 1.

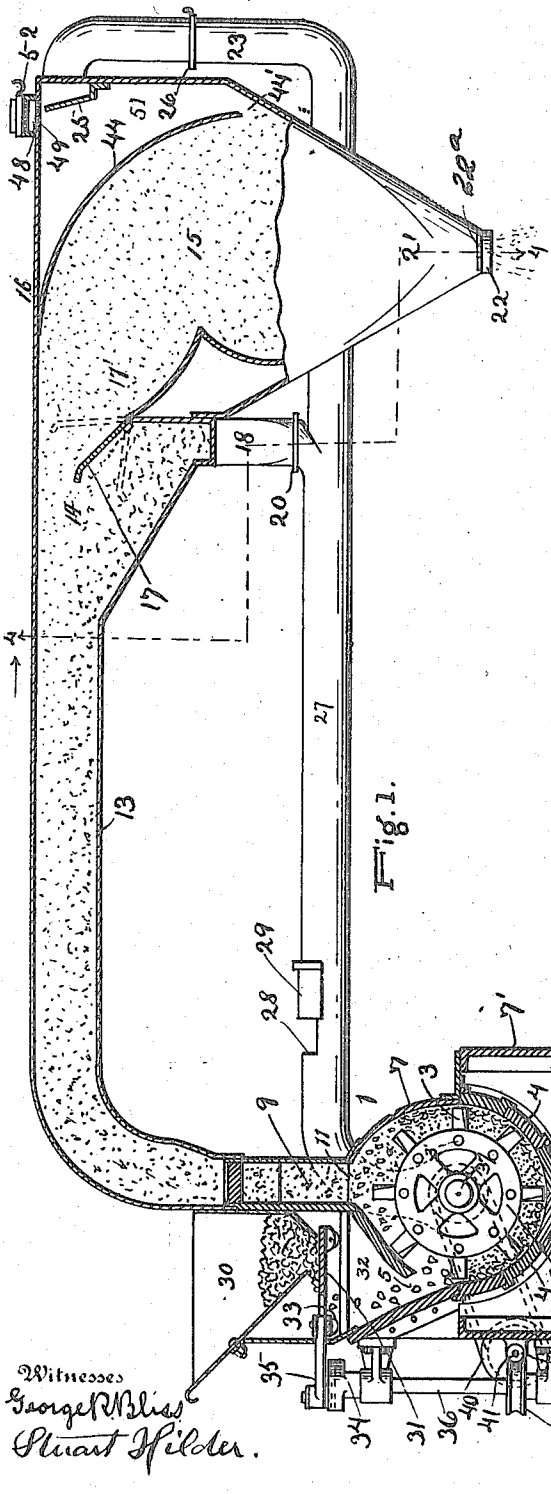


Fig. 1.

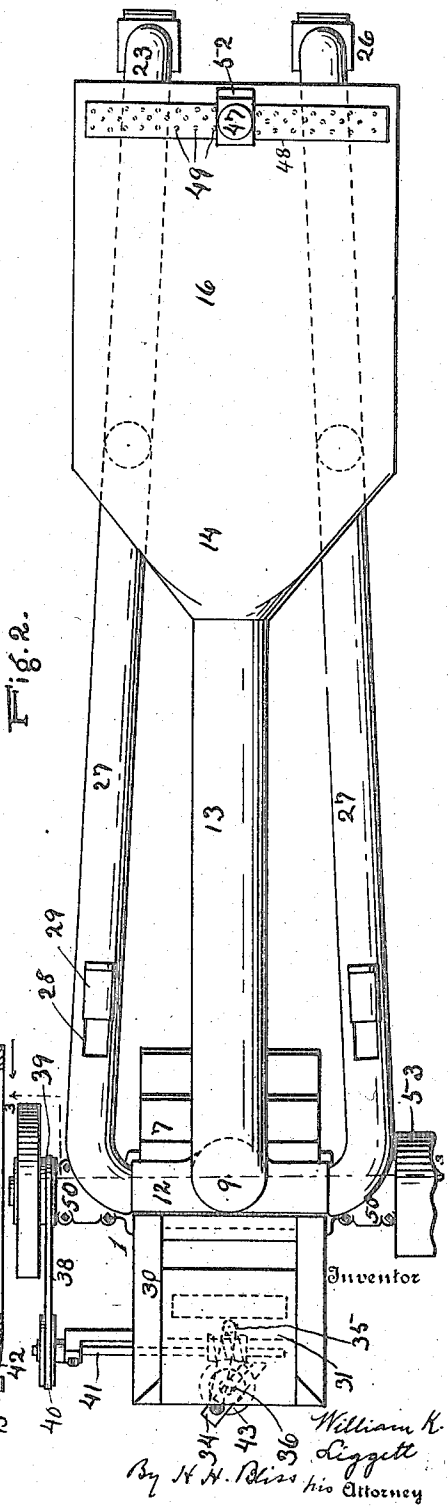


Fig. 2.

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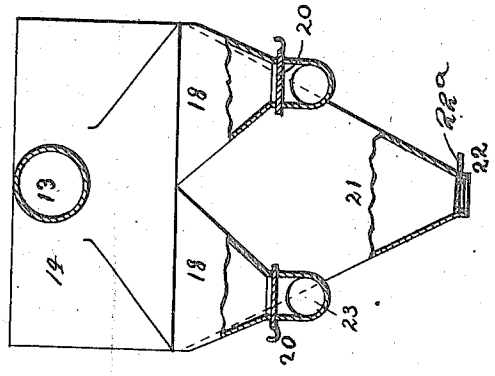


Fig. 4.

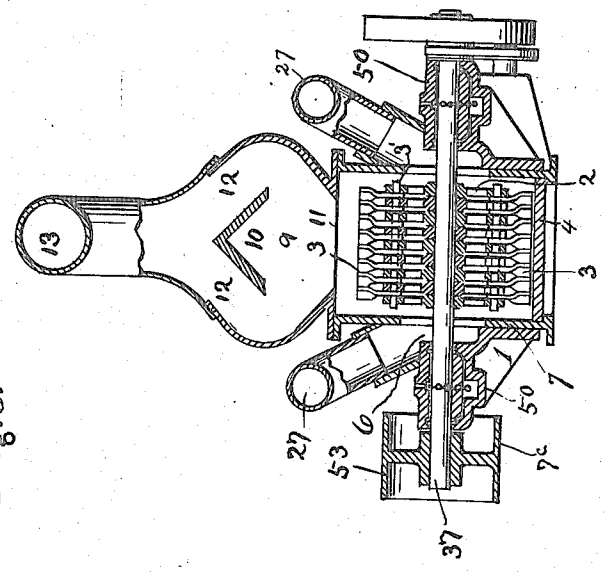


Fig. 3.

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UNITED STATES PATENT OFFICE.

WILLIAM K. LIGGETT, OF COLUMBUS, OHIO, ASSIGNOR, BY MESNE ASSIGNMENTS, TO THE JEFFREY MANUFACTURING COMPANY, A CORPORATION OF OHIO.

SEPARATOR.

1,135,594. Specification of Letters Patent. Patented Apr. 13, 1915.

Application filed February 18, 1907. Serial No. 357,914.

To all whom it may concern:

Be it known that I, WILLIAM K. LIGGETT, a citizen of the United States, residing at Columbus, in the county of Franklin and State of Ohio, have invented certain new and useful Improvements in Separators, of which the following is a specification, reference being had therein to the accompanying drawing.

My invention relates to apparatus for pulverizing material, particularly material to be used as fuel, by impact and attrition between the particles.

Its object is to produce an apparatus that will pulverize the material, carry it away from the pulverizing mill and grade it or separate it according to the size of the particles, collecting those which are of the desired degree of fineness and returning the coarser portions to be re-treated in the pulverizing mill.

Referring to the accompanying drawings—Figure 1 is a longitudinal section of an apparatus embodying my invention. Fig. 2 is a top plan view of the same. Fig. 3 is a transverse section taken on the line 3—3 of Fig. 2. Fig. 4 is a vertical sectional view taken on the line 4—4 of Fig. 1.

In the drawings, 1 indicates a pulverizing machine or mill which in its general features may be of any approved or well-known construction. As shown, it comprises a suitable casing 7 supported upon a base 7'; a shaft, mounted in bearings 50, extending longitudinally through the casing; and, mounted upon the shaft, a series of supports 2 for the beaters or hammers 3. The supports may be of any desired construction, those shown being of annular disk form secured to the shaft by spokes and hubs. The hammers or beaters are pivotally supported upon bars 3' mounted in the annular disks of the supports 2. The hammers are preferably formed of flat metal which is, intermediate its end given a twist or turn, with the result that they not only serve as hammers for reducing the material fed to the mill, but also as fan blades to cause a circulation of air through the apparatus, as will be later described. Opposed to the hammers or beaters 3 is a grinding surface consisting of sections 4—4 of suitable character and construction. The material to be pulverized is introduced into the casing through the feed opening 5.

30 indicates a hopper in which the material to be reduced or pulverized is dumped and from which it is gradually fed. I have indicated a reciprocating feeder mechanism arranged below the lower open end of the feed hopper, and adapted to deliver the material to a spout 32, leading to the feed opening. The feeding mechanism is represented as consisting of a reciprocating feed plate 31, supported by rollers 33 arranged to travel on suitable tracks provided therefor. The feed plate is reciprocated by means of a pitman 35 and a crank 34 mounted upon a shaft 36, which receives its motion through suitable gearing 42—43, and a power shaft 41. The upper portion of the casing in which the pulverizing operations take place communicates with a delivery trunk 9, through which the finely pulverized material is discharged along with the blast of air produced by the rapidly revolving fan-shaped beaters 3.

The opening 11 into the trunk 9 is of a length approximating the length of the chamber in which the reducing of the material takes place. But immediately above this opening the trunk expands transversely, as best indicated at 12, Fig. 3, and in this expanded part of the trunk there is situated a deflecting plate 10 of inverted V-shape, arranged to interrupt the passage of the larger particles of material which may be blown out of the casing 1, and, arresting their forward movement, allow them to drop back into the casing to be further reduced. Connected with the upper end of the vertical discharge trunk 9 and leading therefrom is a horizontal trunk 13, which is of such length as to permit therein some grading of the material being conveyed by the current of air, the larger and heavier particles gradually settling. The far end of the trunk is expanded to constitute a separating or grading chamber 14. The upper part of this grading chamber communicates with a bin-like collecting or settling receptacle or chamber 15 for the finely reduced material, while the lower portion communicates with ducts 18, through which the larger particles are delivered. Situated between the chambers 14 and 15 is a gate or adjustable clos-

ing plate 17, pivoted at 17′ and arranged to be adjusted from one position to another by means external to the casing 16, the latter inclosing the said chambers.

44 indicates a deflecting plate or board situated within the casing 16 and constituting the rear or far side of the chamber 15, and extending from the top thereof downward, preferably in a curved direction, as indicated in Fig. 1, leaving a comparatively narrow passage 44′ between the lower edge of the deflecting board and the rear wall of the casing. To the rear of and above the deflecting board 44 there is an air space 51 with the upper portions of which communicate the air trunks or conduits 23—23. A guard plate or deflector 25 is preferably situated in front of the openings into the trunks 23, this serving to arrest any particles of material that may have been carried by the air current beyond the deflecting board 44 and into the air space 51. The air trunks or conduits 23 lead forward and connect with air pipes or conduits 27—27, with which also communicate the ducts 18 opening into the separating chamber 14. A cut-off or slide valve 26 is arranged in each of the air pipes or ducts 23.

48 is an air box situated on the top of the casing 16 and communicating through perforated plate or screen 49 with the air space 51. There is an opening from the air trunk 48 into the external atmosphere at 47 controlled by a valve 52.

A valve 20 is situated in each of the ducts 18 and controls the communication between such duct and the return air pipe or conduit 27. The latter air pipes, 27, lead forward and communicate with the casing 1 at the eyes or axial central portions thereof. In each of the pipes 27 there is formed an opening 28 adapted to be closed by a sliding plate 29.

The lower portion of the settling chamber 15 is preferably hopper-like in construction, as indicated at 21, and communicates with a discharge opening controlled by a suitable valve or closure 22^a. The fine material which settles and collects in the hopper 21 is delivered intermittently or continuously as desired, through the opening 22.

Power for driving the apparatus is received from any suitable motor, not shown, that may be belted to the pulley 53, mounted on the shaft 37. Upon this shaft 37 is a belt pulley 39, connected by a driving belt 38 with a pulley 40, on the shaft 41, through which power for operating the feed mechanism is conveyed.

The operation of the machine may now be set forth. The rapid rotation of the shaft causes the hammers to stand out approximately radially under the influence of centrifugal force, when they act as fans to cause a vigorous circulation of air through the apparatus, the air taking the following path: from the casing 1, through the trunks 9 and 13 to the settling mechanism in the casing 16, and thence by the return ducts 23 and 27 back to the casing, the eyes of which it enters to be again forced through the same path. Material being fed to the casing is reduced by impact and attrition in a well-known manner, and when the particles become sufficiently small they are carried out by the air blast into the trunk 13.

An apparatus constructed as shown and described is capable of delivering as its finished product material of different grades of fineness. If a relatively coarse grade of material is to be produced, the parts are arranged in the following manner: The valves 20 are closed, cutting off communication between the ducts 18 and the return air pipes 27; the valve or deflector at 17 is lowered, making a free communication between the chambers 14 and 15; the valve 52 is opened, allowing the escape of the air from the space 51 in the rear of the settling chamber 15, and the openings 28 into the air pipes 27 are uncovered. Under these conditions, whatever material is taken up by the air currents produced by the rapidly revolving beaters 3 is carried forward into the settling chamber, where it is deposited, none of the material so carried forward being returned to the reducing mill for further treatment. Under these conditions there is not a circulation of air through the whole apparatus, that is from the reducing mill to the settling chamber and back therefrom to the reducing mill, as the air, after passing the settling chamber, is allowed to escape through the opening 47. Air is supplied to the casing 1 through the pipes 27, it entering them at the openings 28. Should it happen that the settling chamber 15 cannot take care of all the material delivered with the air currents thereto, such particles as pass into the air space 51 and fail to settle there may be conveyed back to the reducing mill through the ducts 23 and 27, the valves 52 and 26 being regulated to suit the conditions, their position determining the relative amount of air that is returned from the casing 16 to the reducing mill.

If a finer grade of material is required, the valve 20 is opened to the desired extent and the deflector 17 moved upward to more or less restrict the opening between the chambers 14 and 15. At the same time the valve 26 will be opened to cause a circulation from the rear side of the casing 16 to the reducing mill, the air currents through the pipes 23 assisting to advance the coarser material delivered from the separating chamber 14 through the ducts 18. Under these conditions a greater proportion of the air, as compared with the conditions last before supposed, will be circulated through

the apparatus, and therefore the openings 28 should be correspondingly restricted.

It is thought to be unnecessary to further describe the operation of the apparatus, it being apparent to those skilled in the art that it is capable of a wide variety of adjustments to secure the desired finished products.

By constructing the rotating element of the pulverizing mill as shown and described, that is to say consisting of a series of supports of annular construction connected with the shaft 37 by spokes, it will be observed that there is formed a central axial chamber in the rotating element into which the air, and the particles of material which it may be carrying are drawn by the hammer blades acting as fans, the air being discharged radially from said axial chamber throughout the entire longitudinal extent of the said rotating element and directly into the paths of the hammers. Each hammer 3 is formed of a flat bar of metal, to which is given a partial twist between its ends. The inner ends, which are pivoted to the carriers 2, lie parallel with each other and between the carriers being mounted upon the shaft 3'.

It will be understood that the separator embodying my invention is not necessarily limited to use with a pulverizing apparatus, such as I have shown. It is equally well adapted for use without such a pulverizing apparatus, and the material to be separated may be suspended in air currents produced by a fan or by any other suitable means.

What I claim is:

1. The combination of a pulverizing apparatus, an air duct leading from the pulverizing apparatus through which material may be carried along by the action of air currents, a casing inclosing a settling chember into which the said air duct leads and an air space separate from the settling chamber but communicating therewith at points out of alinement with the air duct, the said casing having a single opening arranged for the gravity discharge of materials both from the settling chamber and from the air space, and a return air duct from the said air space to the pulverizing apparatus.

2. The combination of a pulverizing apparatus, a duct leading from the pulverizing apparatus to which the pulverized material may be carried by means of air currents, a settling chamber into which the said duct leads, an air chamber into which the air passes after leaving the settling chamber, the air chamber being provided with a valve controlled passage communicating with the external air, a screen positioned across the said passage, a return air conduit from the said air chamber to the pulverizing apparatus, the said conduit being independent of the said passage, and a controlling valve in the said conduit, substantially as set forth.

3. The combination of a pulverizing apparatus, a duct leading from the apparatus through which the pulverized material may be carried by means of air currents, a settling chamber into which the said duct leads, a passageway additional to the said duct being provided between the said chamber and the external air, and a screen positioned across the said passageway.

4. The combination of a pulverizing apparatus, a conduit through which the pulverized material is delivered from the pulverizing apparatus by means of air currents, two settling and grading chambers arranged to effect a separation of the pulverized material according to the size of its particles, a duct leading from one of the settling chambers back to the pulverizing apparatus and arranged to return the air therefrom after it has been separated from the pulverized material, a duct leading from the other settling chamber, arranged to permit the free flow of air and the material that settles in the said chamber back to the pulverizing apparatus, and means for controlling the passage of air through the said ducts, substantially as set forth.

5. In a pulverizing apparatus, the combination of a pulverizing mill, a delivery duct through which the pulverized material is passed from the mill by means of air currents, a casing to which said duct leads devided into two settling chambers, a return air duct leading to the pulverizing mill, such return air duct being connected with the lower part of the settling chamber for the coarser grades of material, and being also connected with the settling chamber for the finer grades of material at a point to take the air therefrom after the pulverized material has been separated, substantially as set forth.

6. In a separator, the combination of a means for producing air currents and suspending pulverized material therein, a horizontal air trunk through which the material-laden air passes, a grading chamber connected to the said air trunk and in horizontal alinement therewith, and a baffle plate arranged to separate the upper stratum of air in the said duct and chamber from the lower stratum, the separating edge of said baffle plate being adjustable to different horizontal planes, substantially as set forth.

7. In a separator, the combination of a horizontal air duct through which the dust-laden air may pass, and a device at the end of said duct whereby the upper stratum of air in the duct may be separated from the lower stratum, the said device being adjustable to change the line of separation between the two strata, substantially as set forth.

8. In a separator, the combination of a horizontal air duct through which dust-laden air may pass, a grading chamber and

a settling chamber connected to the end of said duct and in horizontal alinement therewith a baffle plate between said chambers by means of which the dust may be separated according to the stratum of air in which it is suspended, the separating edge of said baffle plate being adjustable to different horizontal planes, and means for removing the dust from the said chambers, substantially as set forth.

In testimony whereof I affix my signature, in presence of two witnesses.

WILLIAM K. LIGGETT.

Witnesses:

CHARLES W. MELLER,

H. B. ALEXANDER.