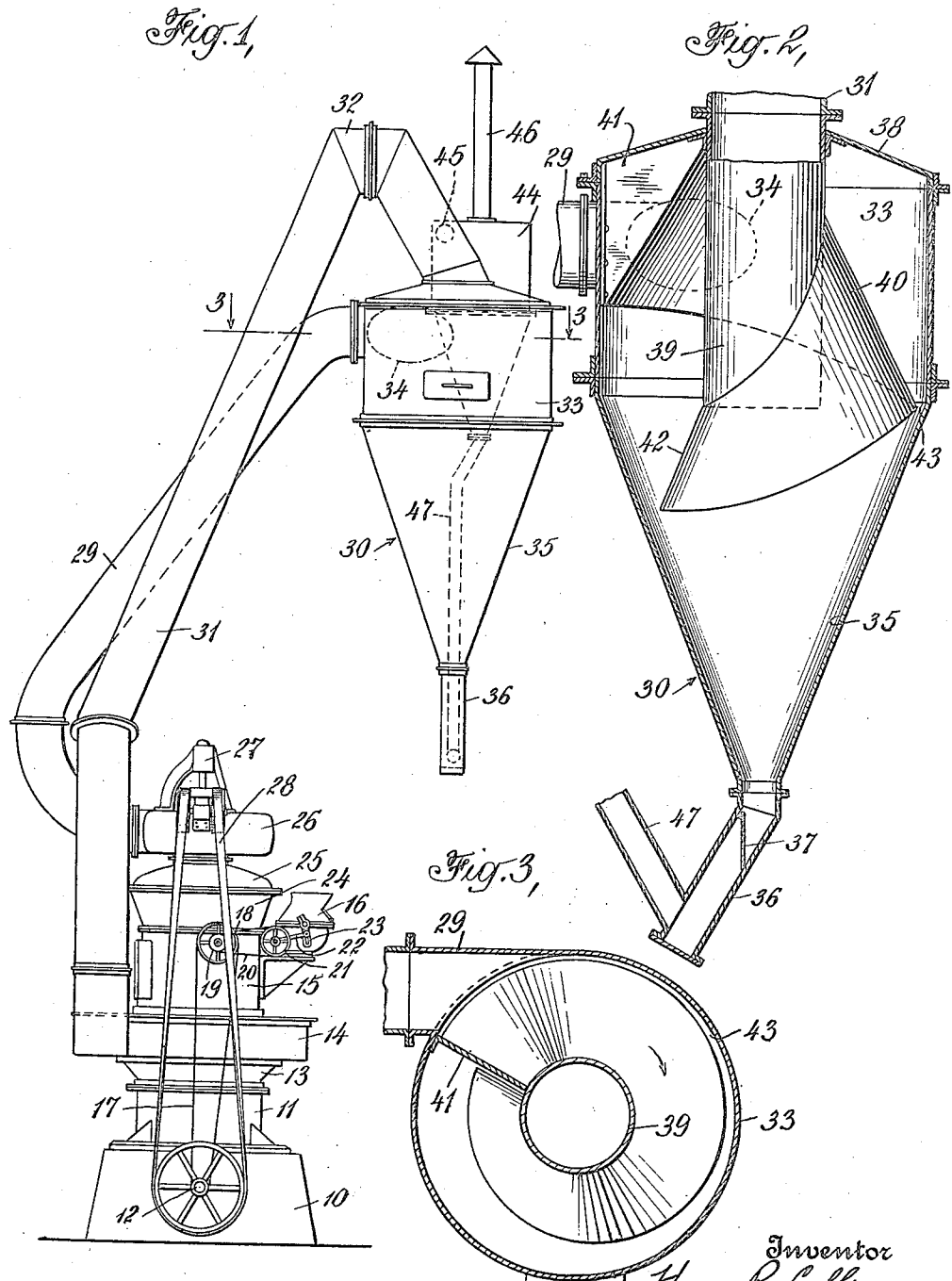


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SEPARATOR.
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UNITED STATES PATENT OFFICE.

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Original application filed November 8, 1919, Serial No. 336,571. Divided and this application filed June 21, 1920. Serial No. 390,435.

To all whom it may concern:

Be it known that I, HARRY R. COLLINS, a citizen of the United States, residing at Allentown, in the county of Lehigh, State of Pennsylvania, have invented certain new and useful Improvements in Separators; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

This invention relates to a separator for removing finely divided material from a moving column of air in which the material is held in suspension.

In accordance with the invention the separator comprises a casing, preferably of cylindrical shape, provided near its top with a port through which a current of air laden with pulverized material may enter the separator. A discharge chute of any suitable form is connected to the bottom of the casing, preferably by means of a tapering section. The top of the casing is provided with a cover which serves to support a relief pipe extending through the casing and carrying a spiral member or ribbon. The spiral member is downwardly inclined, that is to say, the projection of its outer edge upon the relief pipe does not coincide with the intersection of the inner edge of the member and the relief pipe. Thus, the member is so arranged with respect to the pipe and the surrounding casing as to provide above the member a spiral chamber of gradually increasing volume to permit expansion of the dust laden air as it passes through the separator, whereby its velocity will be reduced and material will be separated therefrom by centrifugal force.

The increasing volume of the spiral chamber is obtained by attaching the member to the relief pipe along a spiral line of progressively increasing pitch, or by progressively varying the inclination of the member as it passes around the pipe, or by a combination of these two arrangements. Preferably the member makes but one turn about the relief pipe, and its lower end projects below the bottom of the pipe and terminates in an edge which lies in a vertical plane passing through the center line of the pipe, which plane also includes the upper

edge of the member. A vertical partition is arranged adjacent to the last named edge to prevent air from passing over this end of the member and entering the relief pipe over a short path. The air is thus forced to make at least a complete revolution within the separator before it can pass over the depending lower edge of the member and escape through the relief pipe, and since the latter is of cylindrical form there is no obstruction to the passage of air from the chamber into the pipe.

During the passage of the air through the separator, the material will be separated therefrom by centrifugal force, and the preferred arrangement of the parts produces a maximum separation of material without requiring that the column of air be carried around the relief pipe a number of times during its passage through the separator. There is thus effected a considerable saving in the time required for separating the material, and the power necessary to move the column of air through the separator is correspondingly reduced.

In order to permit the material deposited upon the inner face of the casing to pass to the bottom of the separator, the ribbon is spaced a slight distance from this face. By supporting the ribbon entirely upon the relief pipe it is not necessary to provide any other arrangements for supporting the outer edge of the ribbon, which might tend to cause the material to accumulate and prevent its free discharge from the separator.

The high efficiency of the separator renders it particularly suitable for use in systems in which the material is pulverized in a mill and then conveyed in suspension in a column of moving air through the separator, where it is freed from the air, which then returns to the mill to take up a new supply of material. Owing to the large amount of material which is removed from the air by means of the separator, the fan or other mechanism which propels the air through the system may be run at a lower speed and with less expenditure of power, since there is less residue from the separating operation which must be carried through the system a second time. There results therefore a corresponding reduction in the cost of operating the mill, and the time re-

quired for the pulverizing and separating of a given quantity of material is correspondingly lessened.

The separator of the invention is of general utility, but for purposes of illustration it is shown in the accompanying drawing in combination with a pulverizing mill of the type shown in my copending application, Serial No. 336,571, filed November 8, 1919, of which this application is a division. In this drawing—

Fig. 1 is a view of an entire unit comprising a pulverizing mill and a separator having an auxiliary separator connected therewith;

Fig. 2 is a vertical sectional view of the separator; and

Fig. 3 is a horizontal sectional view of the separator taken along the line 3—3 of Fig. 1.

The pulverizing mill which is shown and described in detail in my copending application referred to above, comprises a foundation 10 upon which is mounted a base section 11, within which is located the pulverizing mechanism consisting of a fixed ring within which grinding balls are propelled by means of a vertical shaft driven from a counter shaft 12 adapted to be driven from any suitable source of power exterior to the mill. Attached to the top of the base section 11 is an intermediate section 13 surrounded by a casing 14 into which the air returns from the separator and from which it is directed into the mill by tangential blades forming part of the section 13. On top of this last named section is a second intermediate section 15 carrying upon its exterior a feeder 16 by which the pulverized material is supplied in controllable quantities to the mill. The feeder is driven from the same shaft 12 that drives the grinding balls, by means of a belt 17 passing over a pulley 18 with which is associated a second pulley 19 connected by means of a belt 20 to a pulley 21, which by means of an eccentric and adjustable connection 22 oscillates a rocker arm 23 by which the mechanism of the feeder is actuated, as described in detail in my copending application.

The intermediate section 15 is surmounted by other sections 24 and 25, and on the top of the latter section is a casing 26 within which is a fan for producing circulation of air through the mill and the separator and the conduits therebetween. The fan is suspended from a suitable bearing 27 on top of the fan casing, and driven from the shaft 12 by means of a belt 28.

Connected to the fan casing 26 is a conduit 29 which leads to the separator 30 which is mounted at some distance above the mill so that the conduit 29, as well as the return conduit 31, are inclined, thus eliminating any flats therein which would permit mate-

rial to accumulate and gradually fill up the conduits. The return conduit 31 is provided above the separator with an abrupt bend 32, so that any material tending to collect at this region will fall into the downwardly extending branches and thus be prevented from accumulating in the bend of the conduit, as would be the case if the usual curved bend were used.

The separator 30 comprises an upper cylindrical casing 33 provided near its top with a port 34 through which air laden with pulverized material enters the separator from conduit 29. Attached to the bottom of casing 33 is a tapering casing 35 to the bottom of which is connected a chute 36 through which the material is discharged after being separated from the air. The chute should preferably be provided with a check valve 37 of any suitable construction.

At the top of casing 33 is a cover 38 provided with a relief pipe 39 extending into the separator and to the top of which the return conduit 31 is connected. Surrounding the relief pipe and carried upon the latter is an inclined, spiral ribbon 40 at the upper end of which is a vertical partition 41, which as shown most clearly in Fig. 3, occupies such a position with respect to the port 34 as to prevent any air from passing over the upper end of the ribbon and entering the relief pipe over a short path. The air entering the separator is thus directed by the ribbon in a spiral path around the relief pipe and cannot escape through the latter until it has passed over the lower end 42 of the ribbon, which extends downwardly from the bottom of the pipe, and as shown most clearly in Fig. 3 lies directly below the upper end of the ribbon. The free edge of the ribbon is spaced a slight distance from the adjacent casing wall, as at 43 in order to permit the material that is deposited upon the inner surface of the separator to fall to the bottom of the casing 35 and be discharged through the chute 36.

The ribbon may be attached to the relief pipe along a spiral line of progressively increasing pitch or the inclination of the member may be progressively varied as it passes around the pipe, or a combination of these two arrangements may be used as in the case of the separator illustrated in the drawing. In any case the free space above the ribbon which may be occupied by the incoming air increases progressively so that the air as it passes through the separator may expand with consequent reduction of its velocity. As the upper and lower ends of the ribbon lie substantially in the same vertical plane, the air in its passage through the separator is forced to make a complete turn about the relief pipe before it can escape through the latter, and by carrying the lower end of the ribbon below the bottom of

the pipe, a maximum length of path through the separator is obtained so that centrifugal force will exert its greatest effect in separating the material from the air without requiring that the air be carried around the pipe more than once. On account of this increased efficiency of the separator the fan located in the casing 26 of the mill may be run at lower speed and with less expenditure of power, since there is less material which must be carried through the fan and conduits a second time, in addition to the freshly ground material which is taken up by the air entering the casing of the mill through the return conduit 31. The cost of operating the unit pulverizer and air separator is thus correspondingly reduced and the time required for the pulverizing of a given quantity of material is correspondingly lessened.

In designing any particular separator the relief pipe should be made of sufficient size to permit unrestricted egress of the air at the velocity which it will have as it passes over the lower end of the ribbon. If the relief pipe should be made too small it will impede the progress of air through the separator and interfere with the most efficient operation of the apparatus.

An auxiliary separator 44 is preferably associated with the main separator, although such auxiliary separator may be omitted if desired. This auxiliary separator, which may be of the improved construction of the main separator, or of any other suitable construction, is connected to the return conduit 31 by a pipe 45, and the relief pipe 46 of this auxiliary separator opens into the atmosphere. Material deposited in the auxiliary separator is discharged through a conduit 47 connected to the chute 36 of the main separator.

While a preferred embodiment of the invention has been shown and described, it will be understood that various changes in the details of construction may be made without departing from the principle of the invention as defined in the appended claims.

I claim:

1. A separator comprising a cylindrical casing provided near its upper end with a port through which a current of air laden with material may enter the separator and at its lower end with a discharge chute, a cylindrical relief pipe within the casing, and a downwardly flaring spiral member attached to the relief pipe along a line of progressively varying pitch to provide a spiral chamber of gradually increasing volume above the member.

2. A separator comprising a cylindrical casing provided near its upper end with a port through which a current of air laden with material may enter the separator and at its lower end with a discharge chute, a

relief pipe within the casing, and an inclined member attached to the relief pipe along a line passing spirally around the pipe with the inclination of the member varying progressively whereby a spiral chamber of increasing volume above the member is provided.

3. A separator comprising a cylindrical casing provided near its upper end with a port through which a current of air laden with material may enter the separator and at its lower end with a discharge chute, a relief pipe within the casing, and a member attached to the relief pipe along a line of progressively varying pitch with the inclination of the member varying progressively as it passes around the pipe, whereby a spiral chamber of increasing volume above the member is provided.

4. A separator comprising a cylindrical casing provided with a port near its upper edge through which a current of air laden with material may enter the separator, a discharge chute connected to the bottom of the casing, a cover for the casing, a cylindrical relief pipe suspended from the cover, and a downwardly flaring member attached to the relief pipe and passing downwardly and once around the same so that the free space above the member increases progressively to reduce the velocity of the air as it passes through the separator.

5. A separator comprising a casing provided near its upper end with a port through which a current of air laden with material may enter the separator and at its lower end with a port through which the material may be discharged, a relief pipe within the casing, and a downwardly flaring spiral member attached to the relief pipe along a line of progressively varying pitch to provide a spiral chamber of gradually increasing volume above the member.

6. A separator comprising a casing provided near its upper end with a port through which a current of air laden with material may enter the separator and at its lower end with a discharge chute, a relief pipe within the casing, and an inclined member attached to the relief pipe along a line passing spirally around the pipe with the inclination of the member varying progressively, the member extending from the bottom of the relief pipe and terminating in an end lying in a vertical plane passing through the axis of the relief pipe, whereby a spiral chamber of increasing volume is provided.

7. A separator comprising a casing provided near its upper end with a port through which a current of air laden with material may enter the separator and at its lower end with a discharge chute, a relief pipe within the casing, and a member attached to the relief pipe along a line of progressively varying pitch with the inclination of the

member varying progressively as it passes around the pipe, a member extending from the bottom of the relief pipe terminating in an end lying in a vertical plane passing through the axis of the relief pipe whereby a spiral chamber of increasing volume is provided.

8. A separator comprising a casing provided near its upper end with a port through which a current of air laden with material may enter the separator and at its lower end with a discharge chute, a relief pipe within the casing, and an inclined member attached to the relief pipe along a line passing spirally around the pipe with the inclination of the member varying progressively, the member extending from the bottom of the relief pipe and terminating in an end lying in a vertical plane passing through the axis of the relief pipe, the free edge of said member being spaced from the inner face of the casing to permit material deposited thereon to fall into the casing and be discharged therefrom, whereby a spiral chamber of increasing volume is provided.

9. A separator comprising a casing provided near its upper end with a port through which a current of air laden with material may enter the separator and at its lower end with a discharge chute, a relief pipe within the casing, and a member attached to the relief pipe along a line of progressively varying pitch with the inclination of the member varying progressively as it passes

around the pipe, a member extending from the bottom of the relief pipe terminating in an end lying in a vertical plane passing through the axis of the relief pipe, the free edge of said member being spaced from the inner face of the casing to permit material deposited thereon to fall into the casing and be discharged therefrom, whereby a spiral chamber of increasing volume is provided.

10. A separator comprising a cylindrical casing provided with a port near its upper edge through which a current of air laden with material may enter the separator, a tapering casing connected to the lower edge of the cylindrical casing, a discharge chute connected to the bottom of the tapering casing, a cover for the cylindrical casing, a cylindrical relief pipe suspended from the cover and terminating substantially at the bottom of the cylindrical casing, and a member attached to the exterior of the relief pipe along a line of progressively varying pitch with the inclination of the member varying progressively as it passes around the pipe with its lower end extending into the tapering casing below the bottom of the relief pipe, the free edge of said member being spaced from the inner face of the casings to permit material deposited thereon to fall into the cylindrical casing and be discharged therefrom.

In testimony whereof I affix my signature.

HARRY RAYMOND COLLINS.