Sept. 25, 1945. J. F. VOGT 2,385,745

CYCLONE SEPARATOR

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Fig. 1.

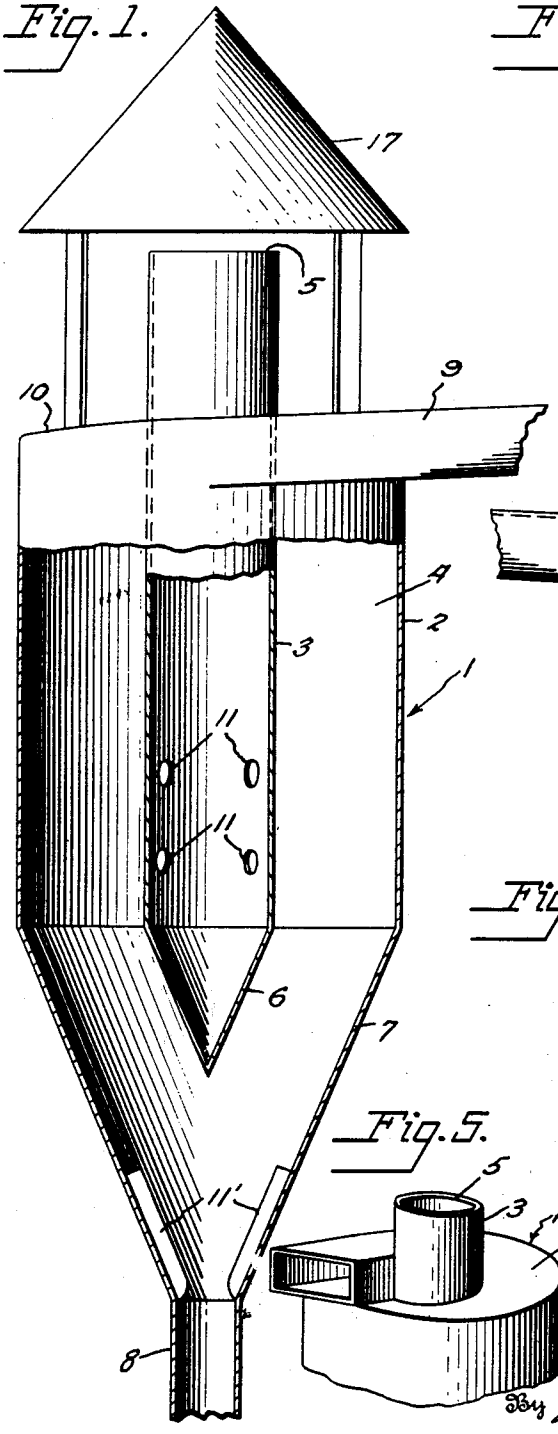

Fig. 4.

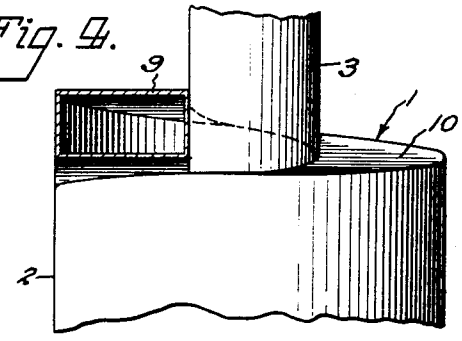

Fig. 3.

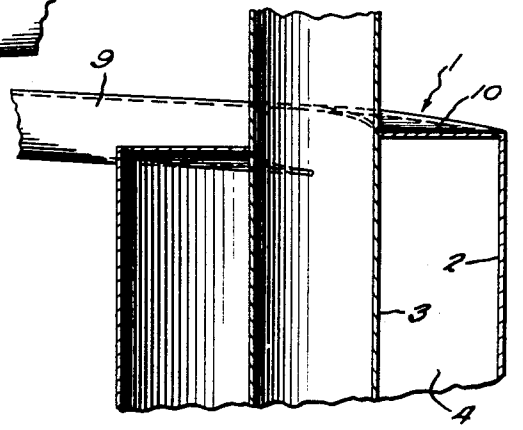

Fig. 2.

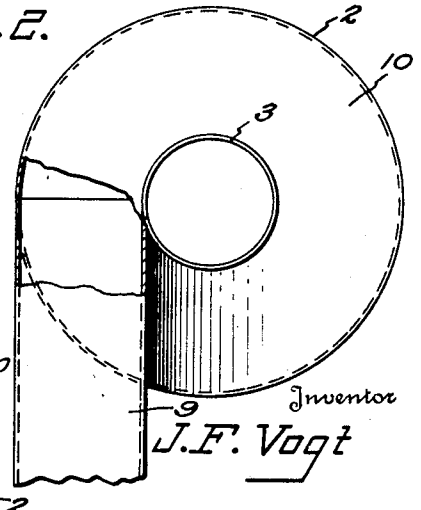

Fig. 5.

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Fig. 6.

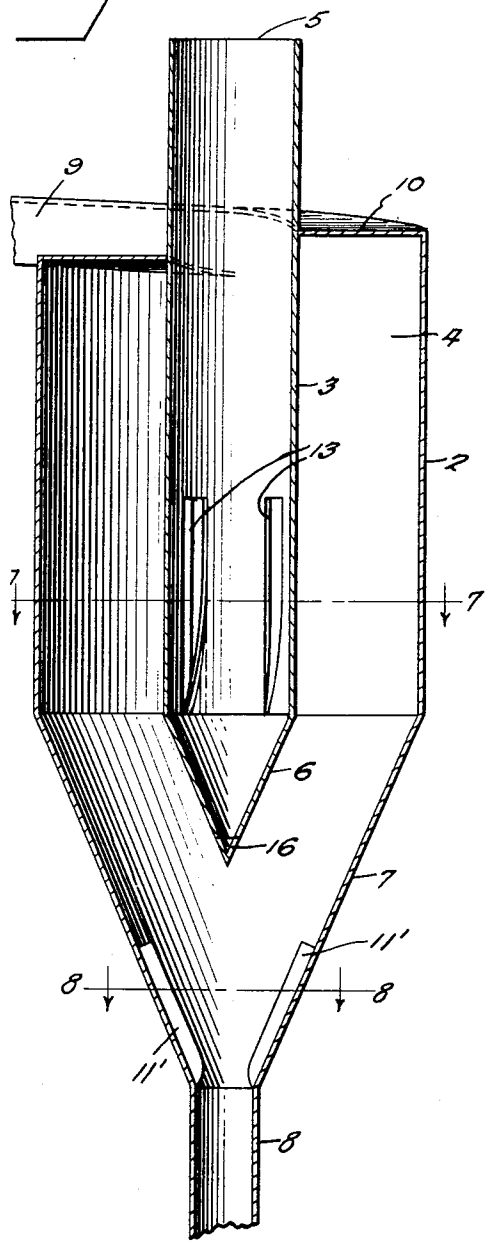


Fig. 7.

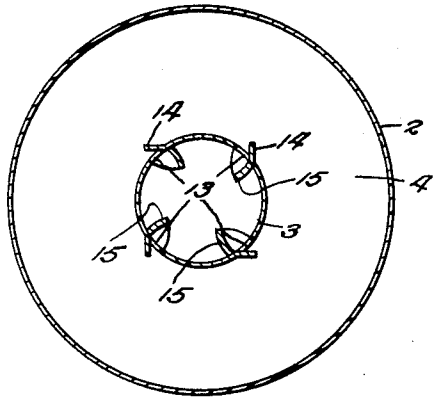
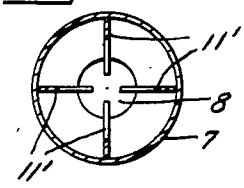


Fig. 8.



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CYCLONE SEPARATOR

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Application February 5, 1941, Serial No. 377,563

5 Claims. (Cl. 183—81)

This invention relates to a cyclone separator.

The general object of the invention is to provide apparatus which will remove fine solids or dust suspended in a mass of moving air, more completely and with less resistance to the movement of the air than will any apparatus heretofore devised.

One of the more specific objects of the invention is to provide a cyclone in which the inlet for the dust-laden air is as wide as the annular chamber in the cyclone through which the air spirally circulates, so that the cross-section of the air column in a single convolution of the helix of moving air within said annular chamber consists of air which entered the cyclone at the same time, and not of vertical laminations accreting through successive revolutions of said helix in the same plane, past the inlet.

Another object of the invention is the provision of a cyclone in which the cover of the annular chamber starts at the top of the inlet and spirals downward through 360°, terminating beneath the bottom of the inlet so that the entering air is deflected downwardly in a spiral course through 360°, after which its path of flow is immediately under the spiral convolution of incoming air, which continues to deflect it in a downward spiral at the same angle throughout the axial length of the annular cyclone chamber, so that the air travels in contiguous convolutions of uniform cross-section without either radial or axial displacement by incoming air, resulting in minimum turbulence and diffusion, and in practically undisturbed movement of the dust particles radially outward under centrifugal force.

Still another object of the invention is to provide a cyclone separator of the type described, in which the outlet pipe forming the inner wall of the annular cyclone chamber, is provided with perforations which may have deflecting edges or scoops projecting into the annular chamber, for shaving off the inner layer of clarified air from the whirling air column, reducing the back pressure in the cyclone chamber.

Still another object of the invention is to provide the perforations with nozzles or baffles in the discharge pipe, arranged to divert the air axially, whereby to further minimize the back pressure in the discharge pipe.

A further object of the invention is the provision of rotation inhibiting vanes or their equivalent, in the cone of the cyclone to nullify the vacuum that might prevent the gravitational discharge of the dust.

Other objects of the invention will appear as the following description of a preferred and practical embodiment of the invention proceeds.

In the drawings, throughout the several figures of which the same characters of reference have been employed to designate identical parts:

Figure 1 is a longitudinal diametrical section through a cyclone separator embodying the principles of the present invention;

Figure 2 is a top plan view;

Figure 3 is a vertical section taken in the same plane as Figure 1, but viewed in the opposite direction, the lower portion being broken away;

Figure 4 is an elevation of the upper portion of the cyclone separator, showing the inlet conduit in vertical section;

Figure 5 is a perspective view of the upper end of the cyclone separator;

Figure 6 is a vertical axial section through a modified form of cyclone separator;

Figure 7 is a cross-section taken along the line 7—7 of Figure 6; and

Figure 8 is a horizontal section taken along the line 8—8 of Figure 6.

Referring now in detail to the several figures, and first adverting to that form of the invention shown in Figures 1 to 5, inclusive, the numeral 1 represents as a whole, a cyclone which consists of the outer cylindrical shell or casing 2 and the inner cylindrical discharge pipe 3, said shell and said discharge pipe forming between them the annular separating chamber 4.

It is not essential to the invention that either the shell or discharge pipe be cylindrical, for these members may be frusto-conical and still perform with some degree of efficiency the functions of the invention. It is essential, however, that the inner and outer walls of the separating chamber be substantially parallel.

The discharge pipe 3 is preferably wide open at the top 5, and is provided with the conical lower end closure 6. The lower end of the shell 2 is joined to a frusto-conical member 7, the bottom of which opens into the dust discharge pipe 8.

The cyclone is provided with an inclined inlet conduit 9 for dust-laden air. Said inlet conduit communicates with the top of the annular separating chamber 4 tangentially as shown in Figure 2, and is of a width equal to the full width of said separating chamber. As shown in Figure 2, the opposite side walls of said inlet conduit are joined respectively to the shell 2 and the discharge pipe 3 and the side and bottom walls terminate in a vertical diametrical plane.

The depth or vertical dimension of the air inlet conduit 9 depends upon the volume of air to be handled, and this governs also the length of the shell 2, as it is desirable that the incoming air perform a plurality of convolutions before reaching the level of the lower end of the discharge pipe.

The separating chamber 2 is provided with a cover 10 which spirals downwardly through an angle of 360°, beginning in the plane of the upper wall of the air inlet conduit and terminating beneath the bottom wall of said air inlet conduit, so that the air after entering the separating chamber is deflected downwardly in a spiral course by said cover, through an angle of 360°, after which it flows immediately under the mass of incoming air, which continues to deflect it in a downward spiral, at a uniform angle throughout the axial length of the separating chamber. It is thus provided that the rotating air does not return in the same plane as the incoming air, and therefore, it is not displaced radially inwardly by the incoming air. In other words, the cross-section of the column of air in any one convolution within the separating chamber is air that simultaneously issued from the air inlet conduit and is not composed of laminations of air which has just entered, surrounding air which has already performed one or more revolutions.

The fact that the air after performing one complete rotation issues beneath the mouth of the air inlet assures that the air column in each convolution will be of uniform cross-section, the same as the cross-sectional shape and area of the air inlet conduit, and descending at the same angle so that there will be little or no turbulence or diffusion between the air bodies of contiguous convolutions. The effect of this is that the movement of the dust particles radially outward under the pressure of centrifugal force will be undisturbed, and with maximum efficiency.

The lateral wall of the discharge pipe 5 is provided with a plurality of apertures 11 distributed longitudinally and circumferentially thereof, and including also the conical end 6 where the latter member is employed. For clarity only, a few such apertures are shown in the drawings, but for best efficiency the aggregate areas of said apertures should be in excess of the cross-sectional area of either the inlet duct or the air discharge pipe. The upper part of the discharge pipe 5 is preferably left imperforate, and the zone at which the perforations start depends upon the nature of the dust material to be removed. The lower conical member 7 of the cyclone perform its usual function in cyclones, the whirling air in the convergent lower part of said member tending to rise by centrifugal force, and opposing the descent of the spiral column in the separating chamber 4, producing a body of relatively static air in the upper part of the conical member.

The dust which has been thrown out by centrifugal force against the inner surface of the shell 2 descends by gravity into the member 7, and slides down the wall thereof into the dust discharge pipe 8.

It may happen that the upward movement of the air body in the member 7 will produce sufficient vacuum to prevent or interfere with the proper gravitational discharge of the dust. Such a drawback is frequently encountered in cyclones, and various expedients have been devised to prevent it. The present invention proposes a circumferential series of longitudinally extending ribs 11' which interrupt, to a sufficient extent, the rotary movement of air in the apical portion of the conical member 7 and thus prevent the creating of undesirable vacuum at this point.

It will be observed that while the air inlet conduit 9 is a cylindrical pipe 12, at points remote from the cyclone its shape gradually and progressively changes to a rectangular contour by the time it joins the cyclone. This prevents turbulence of the dust-laden incoming air and reduces the necessary driving power of the fan, not shown, which forces the dust-laden air to the cyclone.

In Figures 6, 7 and 8, a form of the invention is shown, in which the plain apertures 11 of Figures 2 and 3 have been substituted by elongated longitudinally extending louvers 13, each provided with a baffle or scoop 14 on one side, projecting at an angle into the separating chamber and effective to shave off the inner layer of clarified air and to deflect it into the discharge pipe. These deflectors or baffles thus act as a pump, augmenting the discharge of clarified air from the separating chamber and reducing the back pressure in said chamber.

Figures 6, 7 and 8, also show that the louvers are provided with vanes 15, extending into the discharge pipe and so shaped as to change the direction of the clarified air entering said discharge pipe, into an axial direction, thus reducing back pressure in said discharge pipe.

The apex 16 of the conical end 6 of the discharge pipe may be removable for the purpose of emptying out any collection of solids which may accumulate in said conical end, although I have found by long use of the cyclone that this is not generally necessary. The upper open end of the discharge pipe 5 may be shielded from the weather by an umbrella-like hood 17, suitably secured.

While I have in the above description disclosed what I believe to be a preferred and practical embodiment of the invention, it will be understood to those skilled in the art that the specific details of construction and the arrangement of parts, as shown, are largely by way of example and not to be construed as limiting the scope of the invention, which is defined in the appended claims.

What I claim is my invention is:

1. Cyclone comprising a casing having a cylindrical upper portion and a coaxial inverted frusto-conical lower portion terminating in a dust discharge pipe, a clarified air discharge pipe extending coaxially through the cylindrical portion, terminating adjacent the plane of juncture of said upper and lower portions and defining with said cylindrical portion an annular centrifugal chamber, a downwardly spiralling air inlet conduit forming the top closure of said centrifugal chamber communicating tangentially therewith and being substantially the full width of said centrifugal chamber, the lower end of said clarified air discharge pipe being closed, said clarified air discharge pipe having lateral openings communicating with said centrifugal chamber, confined to the portion of said pipe within said centrifugal chamber.

2. Cyclone as claimed in claim 1, the lateral openings in said discharge pipe having an aggregate area at least equal to the cross-sectional area of said air inlet conduit.

3. Cyclone as claimed in claim 1, including a circumferential series of narrow baffles contiguous to the surface of the frusto-conical portion of said casing adjacent said dust discharge pipe,

said baffles lying in planes radial to the axis of said casing.

4. Cyclone as claimed in claim 1, including scoops on the outside of said clarified air discharge pipe communicating with said openings, said scoops facing the swirl of clarified air within said centrifugal chamber.

5. Cyclone as claimed in claim 1, including scoops on the outside of said clarified air discharge pipe communicating with said openings, said scoops facing the swirl of clarified air within said centrifugal chamber, and direction changing baffles within said clarified air discharge pipe adjacent said openings shaped to gradually change the direction of the discharging jets to an axial direction of flow through said clarified air discharge pipe.

JOSEPH F. VOGT.