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APPARATUS FOR SEPARATING DUST AND FOREIGN MATTER FROM AIR.

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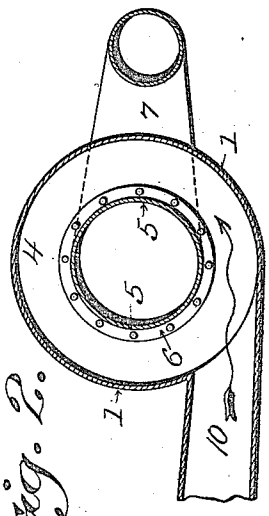

Fig. 2.

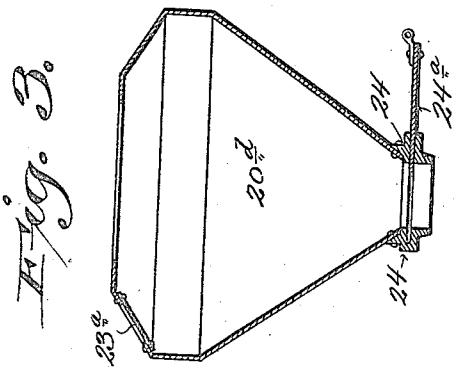

Fig. 3.

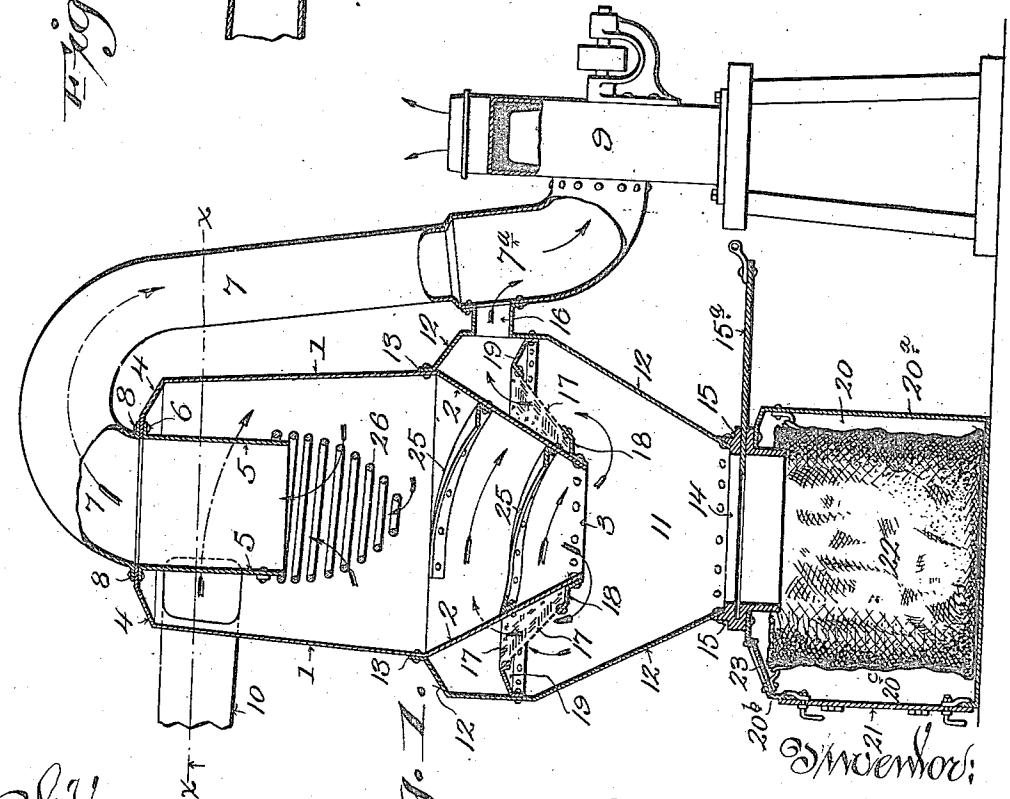

Fig. 1.

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# UNITED STATES PATENT OFFICE.

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## APPARATUS FOR SEPARATING DUST AND FOREIGN MATTER FROM AIR.

1,170,438. Specification of Letters Patent. Patented Feb. 1, 1916.

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*To all whom it may concern:*

Be it known that I, CALLO D. FAHRNEY, of the city of Milwaukee, in the county of Milwaukee and State of Wisconsin, have invented a new and useful Improvement in Apparatus for Separating Dust and Foreign Matter from Air, of which the following is a specification.

My invention involves the use and employment, combined with certain other features and devices of an auxiliary nature, of a vertically disposed drum or so-called cyclone chamber, in which the air, laden with dust and other matter carried by it, is caused to assume a whirling or gyrating motion, whereby the dust and foreign matter are driven by centrifugal force against the peripheral wall thereof and conducted into a communicating receiving chamber, leaving the purified air to pass beyond the limits of the separating and collecting apparatus, and is designed primarily to be disposed within a suction line and to be operated under suction by a current of air superinduced by a suction producing agent disposed beyond the confines of the separating and collecting device, and communicating therewith by means of one or more suction conduits.

By the employment of my invention as herein described and set forth, I am enabled to pass all, or in any event the major portion, of the air through the separating device, either on a small or large scale and either at moderate or high speed, and still accomplish the desired result of effective separation without any resistance whatever to the air current except that incident to its passage through the cyclone chamber, which is found to be unimportant.

Another feature of my present invention consists in the adaptation of means for removing or trapping out the separated and collected matter from a separating apparatus operating under suction, without interrupting the continuous flow of air through the same and without interfering with the separating function.

Proceeding now to describe my invention with respect to the accompanying drawings, Figure 1 thereof represents a sectional elevation of a separator and collector and trapping-out apparatus embodying the features of my improved device. Fig. 2 is a horizontal section in line *x x*, Fig. 1, looking in the direction indicated by the arrows. Fig. 3 is a sectional elevation showing a modified construction of the bottom chamber indicated by 20 in Fig. 1.

Like letters of reference refer to like parts in the several figures.

1 represents the peripheral wall or casing of the cylinder or upper body portion of the vertically disposed drum or separating chamber, which chamber is hereinafter mentioned as the cyclone chamber, the same being made circular in cross-section and enlarging slightly from its top downward, with a tapering or cone shaped lower extremity, of which latter 2 represents the peripheral wall and 3 an open mouth in the bottom of the said chamber.

4 represents the head or top casing of the cyclone chamber, having a round central opening therein.

5 represents the wall or casing of a vertically disposed annular shield projecting downward into the said chamber from the rim of the central opening in the said upper chamber head 4, to which latter the said shield is attached at its top by means of the flanged portion 6.

7 represents a spout or suction conduit with its adjacent end expanding and communicating with the central opening in the top head 4 of the cyclone chamber and to which it is fastened by means of the flanged portion 8, the shield with wall 5, projecting downward into the cyclone chamber forming in effect an extension of the said spout or suction conduit 7. In the construction shown, the conduit 7 at its opposite end terminates in an enlarged portion indicated by $7^a$, which latter in turn communicates with the central intake opening of the exhaust fan 9.

10 represents an inlet duct communicating with and entering the cylinder or upper body portion of the cyclone chamber near its top laterally and at a tangent.

11 represents a sub-chamber or receiving chamber disposed underneath the cyclone chamber and communicating therewith, in the construction shown, by means of the open mouth, 3, in the bottom of the said cyclone chamber. The said receiving chamber is shown circular in cross-section with its casing, 12, converging at the top to meet the casing of the cyclone chamber, to which

latter it is fastened by means of the flange 13. The casing 12 of the said receiving chamber also converges from the body portion thereof downward forming a hopper or tapering lower extremity, with a gate-controlled opening, 14, in its bottom, 15 representing a blast-gate connected with the casing 12 thereof, and 15[a], a slide operating to open and close the said blast-gate.

16 represents an auxiliary discharge spout or suction conduit, one end of which communicates with the said receiving chamber 11 and is attached to the casing 12 of the latter at a point near the top of the said chamber. The opposite end of the auxiliary suction conduit 16 forms a junction with the main suction conduit 7 the two terminating in the enlarged conduit 7[a], which latter in turn communicates with the suction producing agent 9.

In the construction shown the tapering lower extremity of the cyclone chamber projects downward into the upper central portion of the receiving chamber 11, leaving an annular space between the casing of the said receiving chamber and the cone of the cyclone chamber. Within this space is shown the disposition of a disk-shaped dust-cloth or screen 17, having a hole in its center adapted to slip over the lower end of the cyclone chamber, to which latter it is fastened by means of a flanged ring 18. The outer edge of the said dust cloth or screen 17, is attached to the casing 12 of the receiving chamber 11, by means of the flanged ring 19, the point of engagement of the latter with the casing 12 of the receiving chamber 11 being below the point where the auxiliary suction conduit 16 communicates with the said chamber, for reasons presently pointed out. This dust-cloth or screen may be attached in a manner rendering it easily removed or renewed.

20 represents another chamber disposed underneath the receiving chamber 11, and communicating therewith by means of the gate-controlled opening 14, in the bottom of the said chamber 11. In Fig. 1, the chamber 20 is shown rectangular in cross-section, 20[a], 20[b] and 20[c] representing the exposed vertical side walls thereof, respectively.

21 represents a door disposed in one of the vertical side walls of the chamber 20, to permit of the removal of separated and accumulated matter therefrom.

22 represents a bag which may be disposed and suspended within the chamber 20 with the mouth of the bag open to the gate-controlled opening 14, which opening forms a means of communication between the chamber 20 and the so-called receiving chamber 11 disposed above it. When the bag 22 is so adjusted the blast gate 15, controlling the opening 14 may be opened to permit the matter accumulated in the bottom of the chamber 11 to drop down into the said bag, the door 21 being first closed.

23 is a window disposed in the head or upper portion of the casing of the chamber 20 to permit the attendant to see when the bag 22 is full, or in case no bag or other receptacle is used, to see when the chamber itself is full of accumulated matter.

In Fig. 3 is shown a modified construction of a bottom chamber 20 as shown in Fig. 1, the same being indicated in Fig. 3 as 20[d] and having a gate controlled opening in its bottom, to permit of the removal or dumping of its contents. In Fig. 3 the chamber indicated by 20[d] is made circular in cross section with a tapering lower extremity, 24 representing a blast gate attached to the casing of the same at the bottom and 24[a] representing a slide operating to open and close the said blast-gate. In Fig. 3, 23[a] represents a window disposed in the casing of the chamber 20[d].

25 represents a deflector in the form of a spiral disposed within the lower tapering portion of the cyclone chamber and attached to the casing thereof, to conduct gyrating matter impinging against the peripheral wall of the cyclone chamber down into the communicating receiving chamber below.

26 is a hood preferably of open spiral construction disposed over the intake mouth of the shield with casing 5 which projects downward into the cyclone chamber from the rim of the central opening in the top thereof, to prevent any large article from possibly reaching the suction producing agent via the said opening in the top of the cyclone chamber and through the medium of the connecting suction conduit 7.

In operation, power being first transmitted to the fan wheel of the exhaust fan 9 shown, a current of air is created in both of the suction conduits 7 and 16 in the direction of the fan, as indicated by the arrows. The main conduit 7 takes its supply of air from the cyclone chamber through the central shielded opening in the top thereof, and the auxiliary suction conduit 16 takes its supply of air also from the cyclone chamber but through the open mouth 3 in the bottom thereof, and through the medium of the receiving chamber 11, which latter forms an air tight connection or air passage between the said conduit 16 and the said mouth in the bottom of the cyclone chamber, the gate controlled opening 14 in the bottom of the chamber 11 being first closed. The suction-producing agent thus acting upon the interior of the cyclone chamber tends to create a vacuum within the said chamber and in the communicating receiving chamber underneath, with the result that air is caused to flow into the cyclone chamber through the inlet duct, 10, which communicates with the cyclone chamber laterally and tangently near

its top. As soon as the current of air entering the cyclone chamber through the inlet duct 10 attains a reasonable velocity its inertial tendency causes it to follow the peripheral wall of the said chamber with the result that all the air contained within the cyclone chamber and while passing through it takes on a whirling or gyrating motion, the speed of which increases according to the suction exerted by the suction producing agent and the corresponding velocity with which the air enters the cyclone chamber through the said inlet duct 10, due respect being had, of course, to relative dimensions and proportions of the whole apparatus.

Foreign matter or articles carried by the air and projected together with it into the cyclone chamber through the inlet duct 10 also tend to seek the peripheral wall of the cyclone chamber and to impinge against it through centrifugal force until carried by gravity and the action of the air down into the communicating receiving chamber 11, disposed underneath, the spiral deflector, 25, expediting the operation under certain conditions and construction of the lower conical portion of the cyclone chamber. The rapidly whirling motion of the air within the cyclone chamber at the same time tends to cause dust and light matter to seek the casing of the said chamber, with the result that the air drawn out by suction through the shielded opening in the top of the cyclone chamber from the core of the whirling mass is, for all practical purposes, purified, all foreign matter, including dust, having been separated therefrom by centrifugal force alone.

The opening in the top of the cyclone chamber may be of equal, or even greater area than that of the inlet duct 10 with a correspondingly large suction conduit leading from the said opening to the suction producing agent, and all the air passing into and through the cyclone chamber may be carried to the suction producing agent via that means alone, dispensing with the auxiliary conduit 16 entirely, but in order to carry dust and light matter from the cyclone chamber down into the communicating receiving chamber and in order to minimize the length of the cyclone chamber, it is found advantageous to apply suction to the openings in both ends of the cyclone chamber and to thus cause a predetermined portion of the air to pass, together with dust and foreign matter down into the communicating receiving chamber and thence to the suction producing agent via an auxiliary suction duct. In the construction shown, that portion of the air which is caused to pass down from the cyclone chamber into the communicating receiving chamber 11 is removed from the latter by means of the auxiliary suction conduit 16, this portion of the air first passing through the dust cloth or screen 17, disposed within its path in the chamber 11 to prevent dust and floating particles of matter from being carried out of the said chamber by the suction. Where only coarse or moist matter is handled this dust cloth or screen may be dispensed with, and again by sufficient enlargement of the receiving chamber 11, to permit dust and floating matter to settle, it might not be required, but in practice it is found necessary at most to take but a small percentage of the air down through the bottom opening of the cyclone chamber to accomplish the purpose of carrying dust and light matter down into the communicating receiving chamber, and hence the resisting effects of a screening agent employed in this manner in a purely auxiliary capacity becomes a matter of no practical importance.

That portion of the air passing down into the receiving chamber 11 tends to still partake of the whirling motion of the air while passing through the cyclone chamber above, although in a reduced degree of velocity. The dust cloth 17 may therefore be disposed with its outer edge elevated, as shown. The dust and flying particles of matter following the movement of the air in this chamber, tend to seek the peripheral wall of this closure the same as in the cyclone chamber, with the result that the dust cloth is kept free from contact with dust and foreign matter by reason of the position shown.

Describing in further detail the method of trapping out and removing the separated matter from the apparatus while operating continuously under suction and without interrupting the flow of air through the separating or cyclone chamber, ordinarily the gate controlled opening 14, in the bottom of the receiving chamber 11 would be left open to permit the separated matter as it comes from the bottom opening of the cyclone chamber to drop down through the receiving chamber 11 into the bottom chamber 20, or into a bag or other receptacle disposed therein. Then when the chamber 20, or the receptacle placed therein, is full the gate controlled opening 14 connecting the two lower chambers, is closed by means of a blast gate 15 and the slide $15^a$ operating therein. This causes the separated matter coming from the cyclone chamber to accumulate temporarily in the bottom of the receiving chamber 11, while the accumulated matter is being removed from the chamber 20 through the door 21 disposed in the side thereof as shown by the construction in Fig. 1, or by means of opening the blast gate in the bottom of chamber $20^d$ in the modified construction shown in Fig. 3. When the chamber 20 has been emptied and its egress opening closed and it is again ready to receive a new supply of the sepa-

rated matter from above the blast gate in the bottom of the chamber 11 may again be opened and left open until the bottom receptacle is full.

The bag 22 employed in combination with the form of construction shown in Fig. 1 is a convenient method for removing and handling the separated matter and an important feature of my invention consists in the adaptation of means for depositing matter as it comes from a separator operating under suction into bags or other suitable receptacles automatically, and without permitting any dust to escape, which desirable result may be accomplished both by the construction shown in Fig. 1, by inserting the bag or other receptacle in the bottom chamber itself, while in the modified construction of the lower chamber shown in Fig. 3 the matter may be dropped into a bag or other receptacle attached or disposed beneath the gate controlled opening in the bottom of the chamber indicated $20^d$.

I claim:

1. A separator and dust collector comprising a vertically disposed cylindrical chamber with tangential inlet; outlet openings in the top and bottom thereof with a flange projecting downwardly from the rim of the top opening and a spirally constructed hood disposed over the mouth of the said flanged top opening to permit the escape of the whirling air without resistance and at the same time screening it.

2. A separator and dust collector comprising a vertically disposed cylindrical chamber having a tangential inlet with outlet openings in the top and bottom thereof; a cylindrical chamber disposed underneath the aforesaid chamber and partly enveloping its lower portion to receive a portion of the air from the said above chamber in whirl and to purify that portion by centrifugal action; an outlet opening for the air in the said lower chamber in the upper portion of its casing and a refuse chamber disposed underneath the said secondary chamber and connected therewith by a gate-controlled passage.

3. A separator and dust collector comprising a vertically disposed cylindrical chamber having a tangential inlet with outlet openings in the top and bottom thereof; a secondary cylindrical separating chamber disposed underneath the first mentioned chamber and enveloping its lower portion to receive a portion of the air in whirl from same; air outlet means in the upper portion of the casing of the said lower chamber; a refuse chamber with gate-controlled opening disposed under the said secondary chamber and suction means in communication with the top outlet opening of the upper chamber and also with the said air outlet of the secondary separating chamber.

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