Aug. 10, 1926. 1,595,258

A. H. STEBBINS

CYCLONE CLASSIFIER

Filed Oct. 3, 1925 2 Sheets-Sheet 1

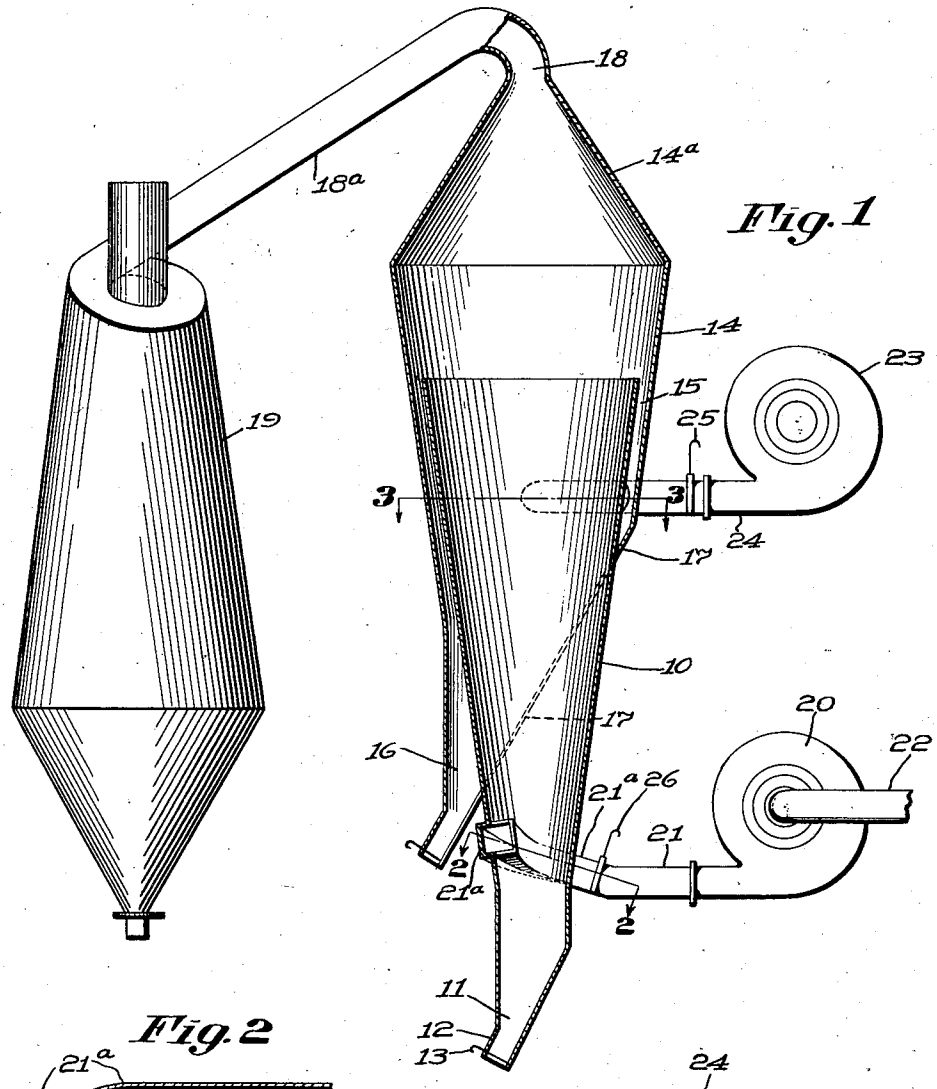


Fig. 1

Fig. 2

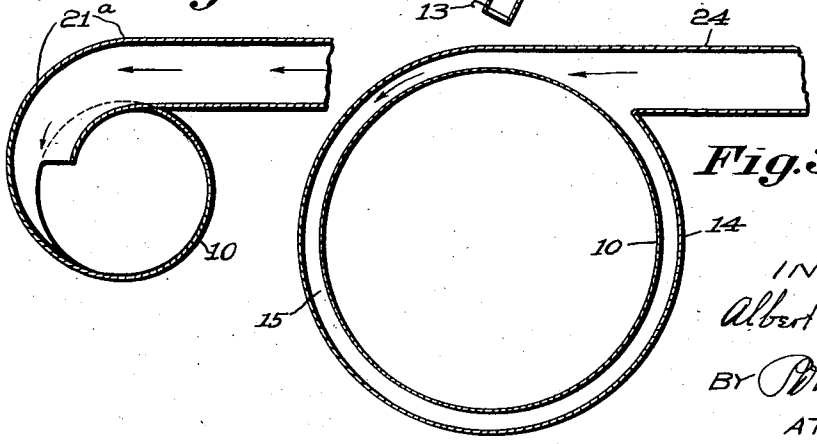


Fig. 3

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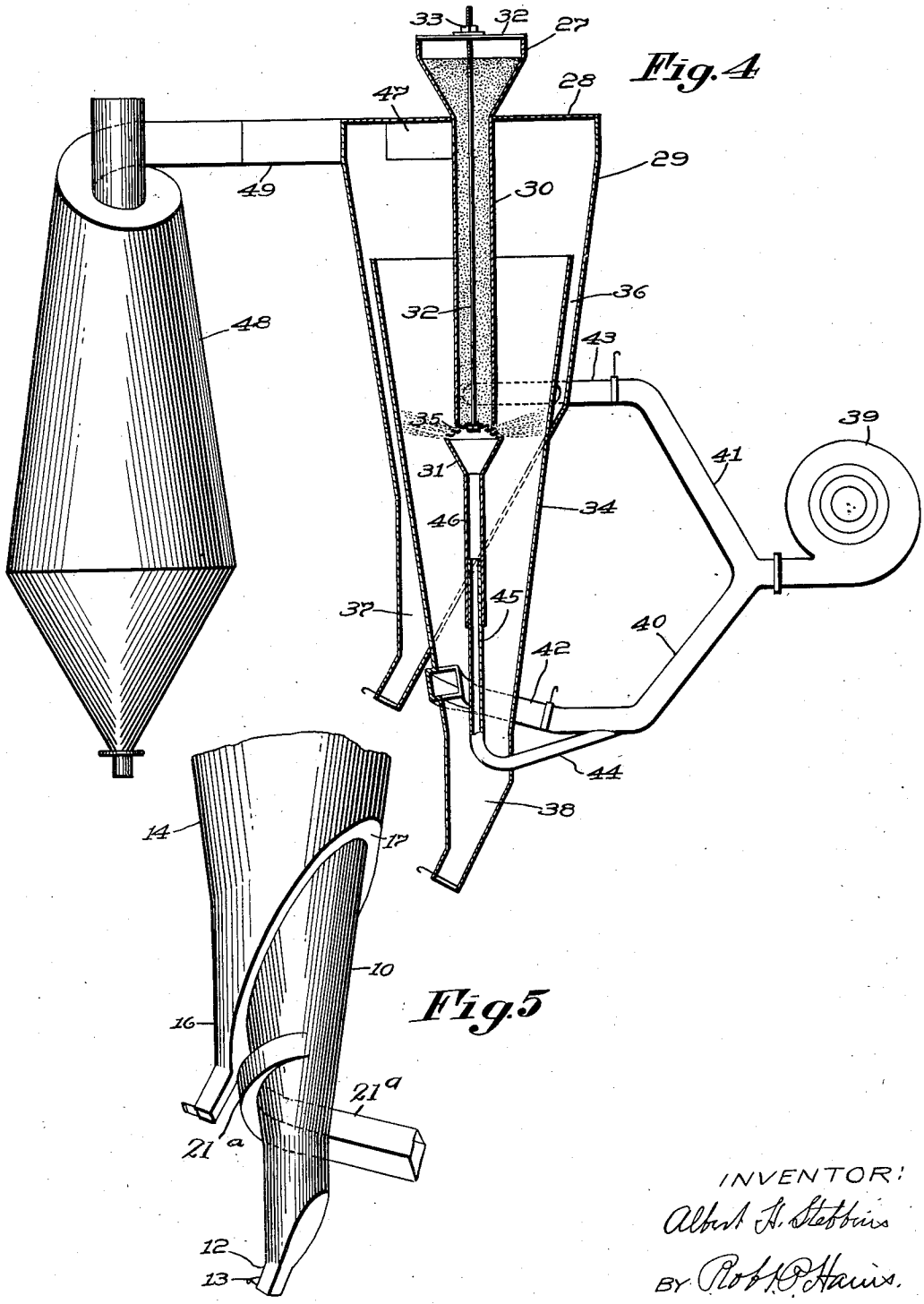


Fig. 4

Fig. 5

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UNITED STATES PATENT OFFICE.

ALBERT H. STEBBINS, OF LOS ANGELES, CALIFORNIA.

CYCLONE CLASSIFIER.

Application filed October 3, 1925. Serial No. 60,208.

This invention relates to air classifiers of the type in which the materials to be treated are carried upward and outward by a rising blast of air to promote the settling of the heavier particles out of the air.

It has been proposed heretofore to separate finely divided materials by subjecting them to the action of a rising blast of air that carries the heavier particles upward and outward so that such heavier particles may settle in an annular space designed to receive them.

In these classifiers, as proposed heretofore, it is found that as the heavier particles move downward into said annular space they tend to carry with them some of the lighter particles, and an important feature of the present invention therefore resides in a construction whereby rising currents of air are produced within said annular space to carry out of the same the fine particles that tend to settle therein.

Another feature of the invention resides in the construction whereby the blast of air rising within the classifier is given a spiral whirling movement that serves to throw the heavier particles outward by centrifugal force to promote the settling of these heavier particles into the annular chamber.

Other features of the invention and novel combination of parts in addition to the above will be hereinafter described in connection with the accompanying drawings which illustrate good practical forms of the invention.

In the drawings:—

Fig. 1 is a vertical sectional view thru a cyclone classifier constructed in accordance with the present invention, and a dust collector associated with the classifier is shown in front elevation.

Fig. 2 is an enlarged sectional view taken on the line 2—2 of Fig. 1.

Fig. 3 is an enlarged sectional view taken on the line 3—3 of Fig. 1.

Fig. 4 is a sectional view similar to Fig. 1, showing a modification of the invention; and

Fig. 5 is a perspective view of the lower portion of the classifier shown in either Figs. 1 or 4.

In the embodiment of the invention shown in the drawing, the lower portion of the classifier comprises a receptacle 10 which is preferably conical in shape and is constructed so that its walls flare outwards in an upward direction, and the lower end of this receptacle is provided with a discharge hopper 11 adapted to receive the heavy particles which settle therein, and these particles may be discharged from time to time thru the discharge spout 12 the opening of which is controlled by the gate 13.

A casing 14, which is preferably substantially conical in shape, as shown, surrounds the upper portion of the receptacle 10 and is supported in spaced relation to the upper walls of the receptacle to form the material receiving passage 15 between the receptacle and casing, and the heavier materials which are thrown outwardly by the air, in a manner to be described, will move downwards in the space 15 towards the discharge hopper 16 at the lower end of the casing 14. The materials entering the space 15 at the left-hand side of the classifier, viewing Fig. 1, will move downwards into the hopper 16, while the materials that settle in this space at other portions thereof than the left-hand side of the classifier, as shown in Fig. 1, will settle upon the inclined floor 17 and will slide downwardly upon this floor into the hopper 16 to be discharged therefrom thru the discharge spout controlled by the gate shown.

The receptacle 10 and casing 14 may conveniently be formed of sheet metal, in which case the weight of the classifier will not be very great and the inclined floor 17 which encircles the receptacle 10 and is rigidly secured thereto, will serve to support the casing 14 in spaced relation to the upper portion of the receptacle 10, as shown. The upper portion of the casing 14 is shown in Fig. 1 as provided with a cone-shaped hood 14^a and the upper end of the hood 14^a is provided with an air discharge opening 18 thru which the dust laden air may be discharged into the atmosphere. It may be desirable, however, that this dust laden air be conducted to a dust collector for further treatment, and a pipe or conduit 18^a is therefore shown as leading from the upper end of the classifier to a dust collector 19 of any well known or preferred construction.

In order to effect the desired separation of the materials, air is delivered into the lower portion of the receptacle 10 with an upward whirling movement which carries the materials to be treated upwardly within the classifier and throws the heavier par-

ticles outward by centrifugal force. The heaviest materials thrown outwardly by the whirling air will settle within the receptacle 10 and will move downwardly into the discharge hopper 11, while the lighter materials will be thrown outwards within the casing 14 and will move downwardly into the annular space 15 to pass downwards therein into the hopper 16.

The means shown for delivering air into the lower portion of the receptacle 10 with an upward whirling movement consists of the fan 20, the discharge portion of which is provided with a pipe 21, and the portion 21ª of this pipe that lies adjacent the receptacle 10 extends upwards in an inclined direction, as shown; the arrangement is such that the portion 21ª of this pipe enters thru an opening in a side wall of the receptacle 10 and extends upward around the receptacle in a spiral manner, as will be apparent from the drawings, and the upper curved end of the pipe 21ª blends into the curve of the wall of the receptacle, as will be apparent from Fig. 5. From the construction just described it will be seen that the upward inclination given to the portion 21ª of the inlet pipe serves to direct the air upwards with a whirling movement, and, since the discharge opening 18 is in the upper end of the classifier, this promotes the movement of the air in an upward direction, as does also the upward flaring construction of the walls of the receptacle 10.

The materials to be treated may be carried into the classifier with the air delivered to the receptacle by the pipe 21, or they may be otherwise introduced into the receptacle 10, and in Fig. 1 it is assumed that the pipe 22 connected to the intake side of the fan leads from some dust producing machine so that the materials to be treated are carried into the receptacle with the air.

As above stated, the heavier materials that are thrown outward by the whirling air against the walls of the casing 14 of the classifier move downward within the material receiving space 15. These materials may tend to carry downwards with them some of the fine, light materials which it is desired to remove from the heavier materials. These fine materials are prevented from being carried downward into the space 15, in accordance with the present invention, by producing rising air currents within this space which are of sufficient strength to carry upwards out of this space the very fine materials, without preventing the heavier materials from setting therein. Various means might be provided for producing the rising air currents within the annular space 15, and in the construction shown in Fig. 1, a fan 23 is provided for supplying air which is free from dust to the air space 15, and this fan has a discharge pipe 24 which directs air tangentially into the annular space 15, as will be apparent from Fig. 3. The strength of the air passing into this space thru the pipe 24 may be controlled by adjusting the gate 25, and the strength of the air delivered into the lower portion of the receptacle 10 may be controlled by adjusting the gate 26. As a result of the construction just described, such fine dust-like particles as may tend to settle within the space 15 will be carried upwards out of the space by the rising air currents produced by the fan 23.

As above stated the materials to be treated may be led into the receptacle 10 with the blast of air delivered into the lower portion of this receptacle, or may be otherwise introduced into the receptacle, and Fig. 4 shows a modified construction in which the materials to be treated are not carried into the receptacle with the air, but are delivered thereto by a hopper 27 which may be supported by the cover plate 28 that is secured to the upper end of the casing 29. The hopper 27 is provided with a pipe 30 thru which the materials pass downward within the classifiers to the air discharge head 31, and the head 31 is supported in close proximity to the lower end of the pipe 30 and may be adjusted relatively to the lower end of this pipe to control the flow of materials therefrom. In the construction shown a rod 32, the head of which is mounted within the head 31, extends upwards within the pipe 30, and thru a bridge bar 32 supported by the hopper 27. The arrangement is such that the distance between the lower end of the pipe 30 and the head 31 may be adjusted as desired by adjusting the nut 33 at the upper end of the rod 32. It is desirable that as the materials leave the discharge head 31 they be thrown outwards in all directions towards the walls of the receptacle 34, and to this end the head 31 is made hollow and is provided with a number of air apertures 35 thru which air is forced outward in more or less of a horizontal direction, to carry outward the materials being delivered by the discharge pipe 30.

The construction of the receptacle 34 of Fig. 4 and the casing 29 of this figure is substantially the same as in Fig. 1, and, as will be apparent, the material receiving space 36 is provided between the upper end of the receptacle 34 and the inner wall of the casing 29, so that the heavier materials that settle therein will pass downwards into the discharge hopper 37, while the still heavier materials which are not carried upwards by the rising air currents out of the receptacle 34 will move downwards therein into the discharge hopper 38.

Since in the construction shown in Fig.

4 the materials to be treated are not carried into the receptacle 34 by the air blast introduced into the lower portion of this receptacle, a single fan 39 may be employed to deliver air that is free from the materials to be treated into the lower portion of the receptacle 34 and also into the annular space 36, and to this end the fan 39 is provided with the branch pipes 40 and 41. The pipe 40 is connected to the pipe 42 which is similar in construction to the pipe 21[a] of Fig. 1, and the upwardly extending branch pipe 41 is connected to a pipe 43 which directs air tangentially into the space 36 the same as in Fig. 1.

A branch pipe 44 leading from the air supply pipe 40 and having an upward extending portion 45 serves to force air into the head 31 to cause it to issue therefrom in the form of jets thru the openings 35. A tube 46 extending downwardly from the head 31 telescopically engages the upward extending pipe 45 to permit the vertical adjustment described of the head 31. The air which reaches the upper portion of the classifier of Fig. 4 carrying the fine dust which remains suspended therein is discharged from the classifier thru an opening 47 and this dust laden air may be conducted to a dust extractor 48 by the conduit 49. The operation of the construction shown in Fig. 4 is substantially the same as the operation of the device shown in Fig. 1, except for the different construction shown for introducing the materials to be treated into the receptacle.

In both constructions shown the air rising within the lower conical receptacle with a spiral whirling movement serves to carry the materials to be treated upwards and to throw the heavier particles outwards by centrifugal force to separate the heavier materials out of the rising air, and the air currents rising within the annular material receiving space serve to carry upwards the fine dust-like particles that might otherwise be carried down into this space by the heavier particles.

What is claimed is:—

1. A cyclone classifier, comprising in combination, an upstanding receptacle, a casing surrounding the upper part of the receptacle to provide a material receiving space therebetween, means for directing a blast of air bearing the materials to be treated into the lower portion of the receptacle to move upwards therein with a spiral whirling movement to cause the heavier particles to be thrown outwards by centrifugal force so that they will fall into said material receiving space, and means for producing rising currents of air within said material receiving space to carry upwardly out of the same the lighter material that approaches the entrance to said space.

2. A cyclone classifier, comprising in combination, an upstanding receptacle, a casing surrounding the upper part of the receptacle to provide a material-receiving annular space between them, means for introducing air and the materials to be separated into the receptacle so that the air moves upward within the receptacle with a spiral movement that throws the heavier materials outwards by centrifugal force to move downward within said space, and means for producing rising currents of air within said space to carry upward the lighter materials that approach the entrance to said space.

3. A cyclone classifier, comprising in combination, an upstanding receptacle, a casing surrounding the upper part of the receptacle to form a material receiving space between the receptacle and casing, means for introducing a blast of air and the materials to be separated into the receptacle so that the air moves upward within the receptacle with a spiral movement that throws the heavier materials outward by centrifugal force to move downward into said space, and means for forcing air into said space to rise therein to carry upward the lighter materials that approach the entrance to said space.

4. A cyclone classifier, comprising in combination, a cone-shaped receptacle that flares outward in an upward direction, a cone shaped casing that also flares outward in an upward direction surrounding the upper part of the receptacle and spaced therefrom to form an annular air space between them, means for introducing a blast of air and the materials to be separated into the receptacle so that the air moves upward within the receptacle with a whirling movement that throws the heavier particles outward to move downward into said space, and means for producing rising currents of air within said space to carry upward the lighter materials that approach the entrance to said space.

5. A cyclone classifier, comprising in combination, an upstanding receptacle, a casing surrounding the upper portion of the receptacle and forming an annular space between them, means for introducing the materials to be treated into the receptacles, and means for delivering air under pressure into the receptacle and into said space with an upward whirling movement to throw the heavier particles within the receptacle outwards by centrifugal force so that they may enter said space while the lighter particles that tend to enter said space are carried upward out of the space by the air currents rising therein.

6. A cyclone classifier, comprising in combination, an upstanding receptacle, a casing surrounding the upper part of the recepta-

cle to provide a material-receiving, annular space therebetween, means for introducing air and the materials to be separated into the receptacle so that the air moves upward within the receptacle with a spiral movement that throws the heavier materials outward into position to enter said annular space, and means for directing a blast of air tangentially into said annular space to rise therein with a whirling movement that serves to carry upward the lighter materials that approach the entrance to said space.

7. An air classifier, comprising in combination, an upstanding receptacle, a casing surrounding the upper part of the receptacle to provide a material-receiving annular space therebetween, means for introducing a blast of air and the materials to be separated into the receptacle so that the air rises in the receptacle and carries the heavier particles upward and outward that they may settle in said annular space, and means for forcing air upwards within said annular space to carry upwards the lighter materials that approach the entrance to said space.

8. A cyclone classifier, comprising in combination, an upstanding receptacle, a casing surrounding the upper part of the receptacle to form a material receiving space between the receptacle and casing, means for introducing the materials to be separated into the classifier and for imparting a whirling outward movement to the materials to throw them outward by centrifugal force into position to enter the material receiving space, and means for producing rising currents of air within said space to carry upward away from the space the lighter particles that approach the entrance thereto.

In testimony whereof, I have signed my name to this specification.

ALBERT H. STEBBINS.