May 31, 1932. A. H. STEBBINS 1,861,247

AIR CLASSIFIER

Filed Oct. 29, 1929 2 Sheets-Sheet 1

Fig. 1

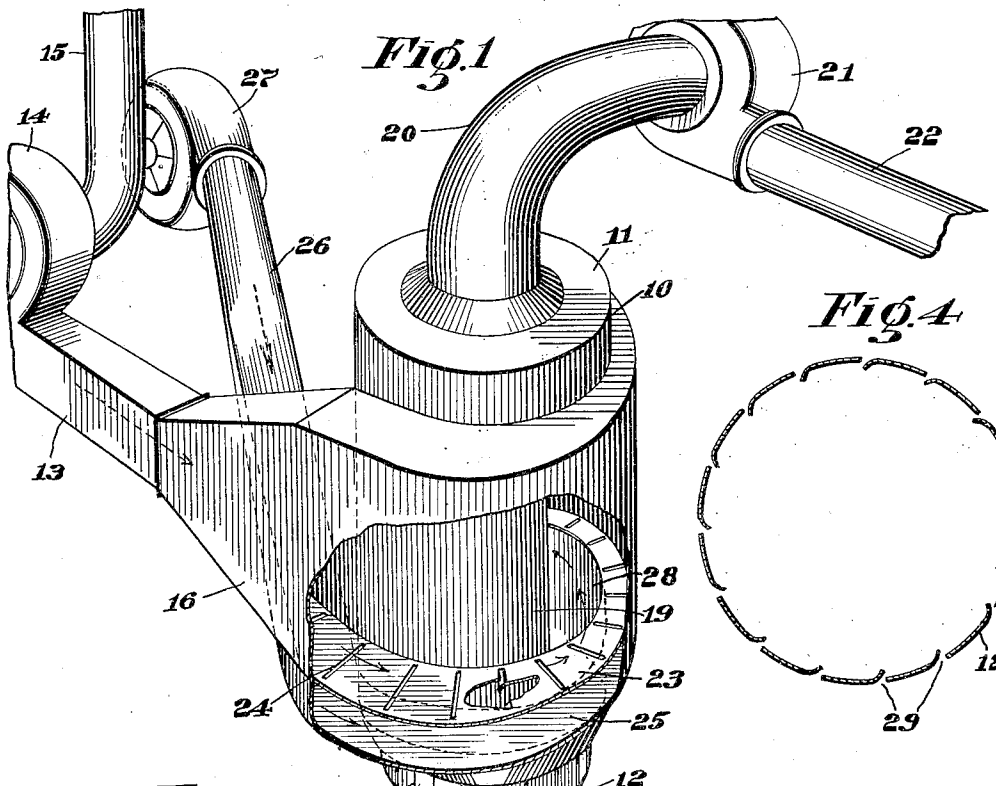


Fig. 4

Fig. 2

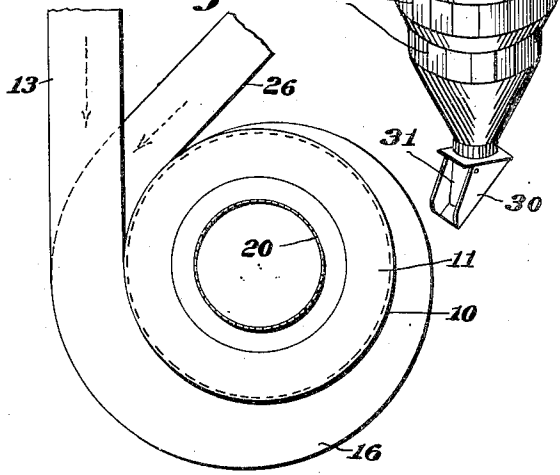
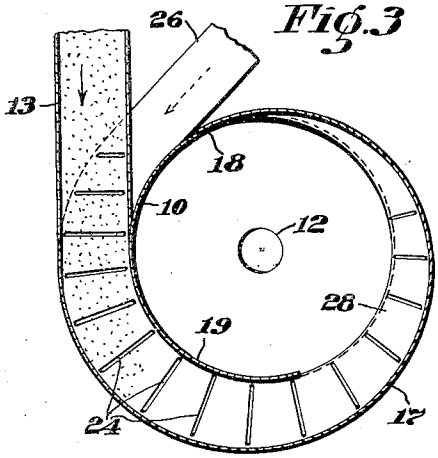


Fig. 3



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Fig. 5

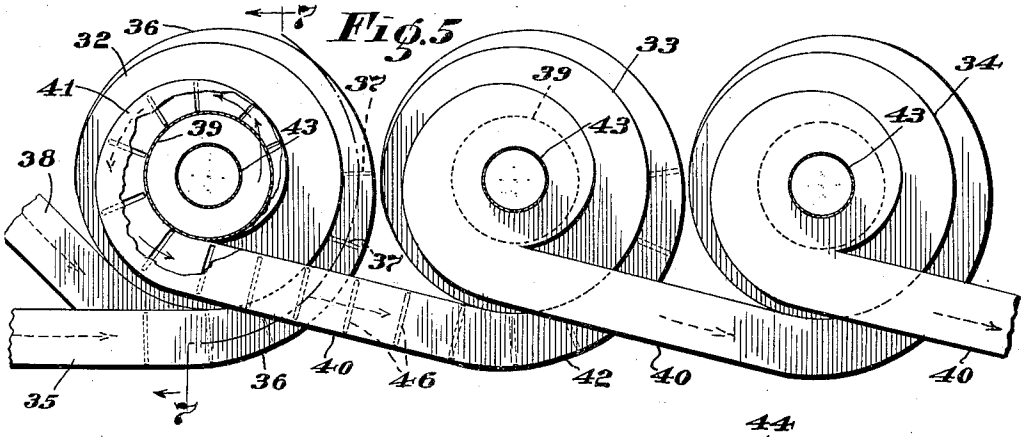


Fig. 6

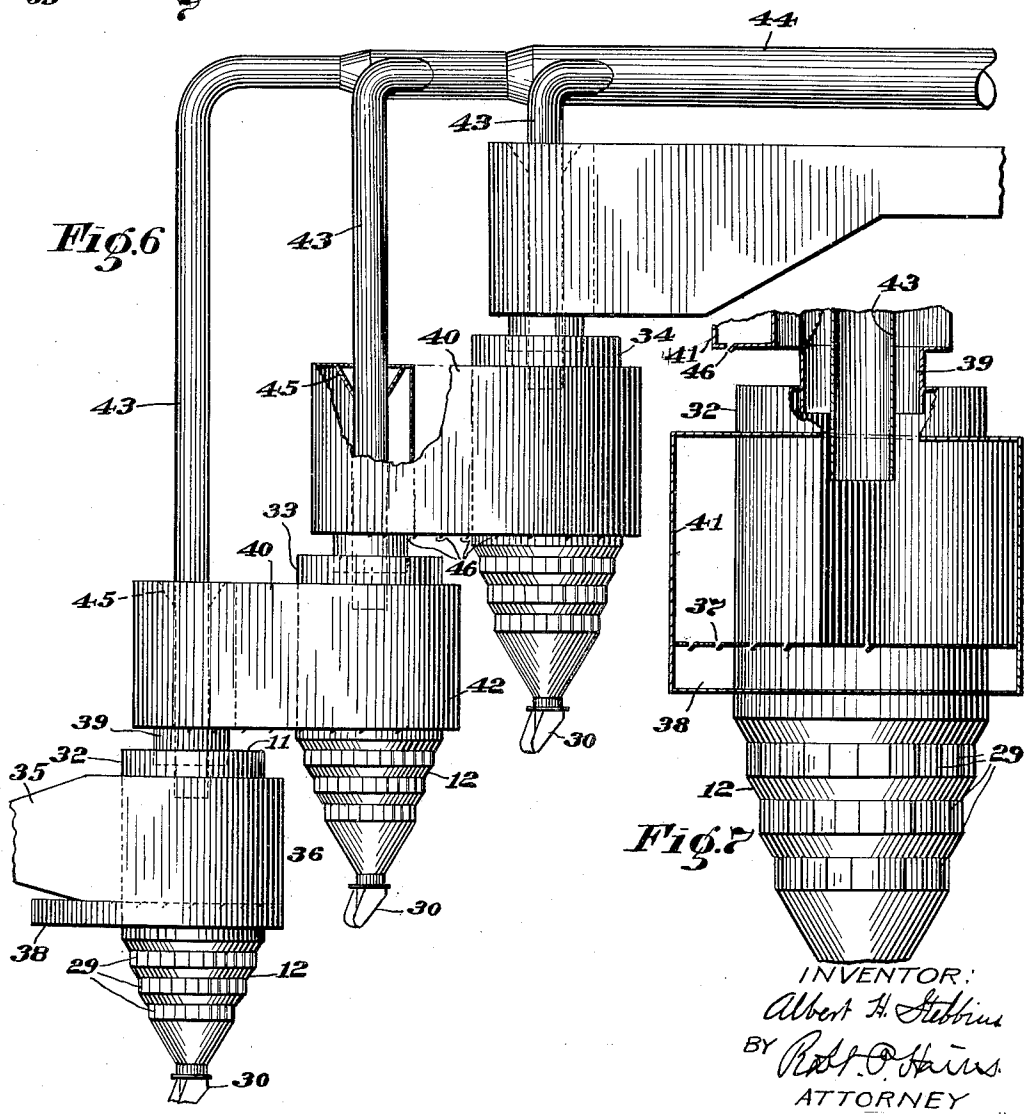


Fig. 7

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UNITED STATES PATENT OFFICE

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AIR CLASSIFIER

Application filed October 29, 1929. Serial No. 403,156.

This invention relates to air classifiers of the type in which centrifugal force is employed to promote separation of the materials.

In carrying out the present invention material laden air is caused to rotate in a receptacle so that the heavier particles will be thrown outwardly by centrifugal force against the sides of the receptacle to move downwardly adjacent the sides of the receptacle under the influence of gravity out of the path of the whirling air.

One important feature of the present invention resides in novel means for imparting a rotating or whirling movement to the air within the receptacle to effect the separation of the materials. This is accomplished in accordance with the present invention by supplying the material laden air to the receptacle through an inlet pipe that is provided with a curved portion that extends around the central or intermediate point of the receptacle. This curved portion of the pipe is so constructed that it gradually directs the stream of air inwardly through an opening in the side wall of the receptacle and imparts a rotating movement to the air in the receptacle.

Another feature of the invention resides in the construction whereby jets of air are introduced through the lower side of the air inlet pipe to increase the flow of the air therein and to prevent the materials carried by the air from settling in the pipe.

Another feature of the invention resides in means for introducing jets of air into the lower portion of the receptacle so that this additional supply of air will carry upwardly the finer particles that may tend to settle in the lower portion of the receptacle with the coarse particles.

Still another feature of the invention resides in a group of classifiers connected in series for the successive treatment of the materials, and in novel means for conveying the air from one receptacle to another so that rotative movement of the air will be produced in each receptacle to effect a centrifugal separation of the materials.

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 perspective view of an air classifier constructed in accordance with the present invention;

Fig. 2 is a top plan view of the air classifier of Fig. 1;

Fig. 3 is a horizontal sectional view taken through the central portion of the air classifier of Fig. 1;

Fig. 4 is a horizontal sectional view taken through the lower apertured portion of the receptacle of Fig. 1;

Fig. 5 is a top plan view of a modification of the invention showing three classifying receptacles connected in series;

Fig. 6 is a side elevation of the classifiers of Fig. 5 and

Fig. 7 is a sectional view taken on the line 7—7 of Fig. 5.

In accordance with the present invention air bearing the materials to be separated is delivered into a receptacle 10 which is preferably cylindrical or substantially cylindrical in shape and the upper end of this receptacle is closed by the end plate or cover 11 and the lower end of the receptacle is provided with a downwardly tapered portion 12 adapted to form a collecting hopper into which heavier particles separated out of the whirling air may settle.

The material laden air to be treated in the receptacle 10 may be supplied from a previous air operating machine or the comminuted materials may be fed by a hopper into the air stream in a well known manner. In the construction shown the material laden air is supplied by the pipe 13 illustrated as leading from a fan 14 having the inlet pipe 15. The portion of the pipe 13 adjacent the receptacle 10 has its width increased as indicated by 16 and this widened portion 16 of the pipe extends around the receptacle 10 in the form of an involute curve as will be apparent from Figs. 1, 2 and 3. The arrangement is such that the curved outer wall 17 of the inlet pipe extends around a major

portion of the receptacle 10 and curves inwardly toward the wall of the receptacle until it merges with the wall of the receptacle at 18. As a result of this construction the curved wall 17 gradually directs the stream of air inwardly through an opening in the side wall of the receptacle, which opening in the construction shown extends approximately half way around the receptacle.

The inner portion of the curved inlet pipe 16 is preferably provided with an inner wall 19 which extends around the receptacle 10 a sufficient distance to direct the stream of air within the pipe 16 outwardly against the curved outer wall 17 of this pipe; that is the length of the curved wall 19 or the distance to which it extends around the drum 10 may be varied in accordance with the size and nature of the materials to be separated, but in any case the length of the opening formed in the wall of the receptacle 10 and extending from the end of the wall 19 around the receptacle to the point 18 should be sufficient to permit the air stream to be gradually directed inwardly through this opening by the involute curve of the outer wall 17.

As a result of the construction of the air inlet pipe just described the stream of material laden air within this pipe will be gradually directed inwardly through the opening in the side wall of the receptacle 10 to cause this stream of air to merge with the air within the receptacle and impart a pronounced rotative movement to the volume of air therein. The heavier materials within the air entering the pipe 16 will be thrown outwardly by centrifugal force against the outer curved wall 17. This will help to remove these heavier particles out of the main path of the air so that they will be acted upon to a less degree by the travel of this stream of air inwardly towards the central axis of the receptacle, with the result that these heavier particles will be delivered by the curved portion 17 of the inward pipe against the inner wall of the receptacle 10. These heavier particles together with the other heavier particles which are carried outwardly by centrifugal force against the walls of the receptacle will move downwardly under the influence of gravity into the collecting chamber 12.

The air from which the heavier particles have been removed by centrifugal force is discharged from the receptacle 10, in the construction shown in Figs. 1, 2 and 3, through the pipe 20 extending upwardly from the upper end 11 of the receptacle. This pipe 20 may lead to a dust collector or other air treatment receptacle but is shown as leading to the suction side of a fan 21 having the discharge pipe 22.

The air delivered into the receptacle 10 by the curved pipe 16 will gradually work inwardly toward the central axis of the receptacle and will move upwardly into the discharge pipe 20. This movement of the air towards the centre of the receptacle carries with it the finer particles, while the larger particles, as above stated, under the influence of centrifugal force and gravity will move outwardly against the side walls of the receptacle and downwardly into the collecting chamber 12.

The air classifier of the present invention may be operated by an air blast or by suction or by the combination of these two forces as shown in Fig. 1, and while air is herein described as the carrying medium for the materials being separated it is to be understood that water or other fluids may be employed as a carrying medium within the scope of the present invention.

If the materials within the stream of air supplied to the receptacle by the pipe 13 are relatively large or heavy they may tend to settle along the lower wall 23 of the pipe 16. This may be prevented in accordance with the present invention by providing the floor plate 23 of this pipe with the inlet apertures or louvers 24. These apertures may serve to admit air from the atmosphere or may be employed to deliver jets of air under pressure into the pipe 16. In either case it is desirable to provide a closed air conduit 25 below the floor plate 23, for if air from the atmosphere is supplied to the apertures 24 the volume of air admitted through these apertures may be controlled by controlling the amount of air permitted to enter the conduit 25, and in case it is desired to supply air to the apertures 24 under pressure this may be accomplished by providing the conduit with an air supply pipe 26 which may lead from the fan 27 or other source of air pressure. It will be understood that the inner curved portion of the conduit 25 is closed by the wall 28 so that the air is confined in the conduit 25 and may escape only through the apertures 24.

The air inlet apertures 24 and means for supplying air thereto under pressure not only prevents materials from settling along the floor plate 23 of the inlet pipe but constitutes a simple means for cleaning or blowing-out the entire receptacle which may be accomplished by supplying air to the conduit 25 under abnormal pressure.

The heavier particles moving downwardly under the force of gravity into the collecting chamber 12 may tend to carry with them some of the finer particles. In order to prevent this it may be desirable to admit air into the chamber 12 at a number of points around the walls thereof for producing sufficient air streams moving upwardly within the lower portion of the receptacle to pick up the finer particles that may tend to settle therein. This is accomplished in accordance with the con-

struction shown by providing the lower portion 12 of the receptacle with any desired number of inlet apertures 29 adapted to admit air into the lower portion of the receptacle from the atmosphere.

The heavier materials collected in the lower portion 12 of the receptacle may be discharged therefrom from time to time through the discharge valve 30 having the swinging door 31.

In some cases it may be desirable to connect two or more air classifiers constructed in accordance with the present invention in series to subject the materials carried by the air from one receptacle to another to successive treatments, and means to this end is disclosed in the modified construction of Figs. 5, 6 and 7.

In this modified construction three air classifiers 32, 33 and 34 are shown as connected in series and each of these classifiers may be constructed for the most part the same as the classifier of Fig. 1.

Material laden air is supplied to the classifier 32 of Fig. 5 by an air inlet pipe 35 having a curved involute portion 36 which is similar in construction and operation to the portion 16 of Fig. 1. Air under pressure or from the atmosphere may be supplied to the apertures 37 formed in the floor of the inlet pipe 36, by the conduit 38.

Each of the receptacles 32, 33 and 34 is provided at its lower end with a downwardly converging portion 12 forming a collecting chamber for the heavier materials the same as in Fig. 1 and this portion 12 may be provided with the air inlet apertures 29 as in Fig. 1.

The means employed in the modified construction in Figs. 5, 6 and 7 for removing air from the receptacles is somewhat different from that disclosed in Fig. 1, as it is desirable to so remove the air from one receptacle and deliver it to the next that a pronounced whirling movement of the air will be produced in each of the receptacles.

This is accomplished in accordance with the present invention by providing each of the receptacles 32, 33 and 34 with an air discharge pipe 39 mounted in the upper end plate 11 of each receptacle and the pipe 39 is so arranged that it extends downwardly a short distance into its receptacle as will be apparent from Fig. 7. Each pipe 39 leads to an air discharge pipe 40 adapted to conduct the air from the upper end of one receptacle to the central or intermediate portion of the next receptacle.

The pipes 39 are so positioned within the receptacles that the air whirling within a receptacle may move upwardly into the discharge pipe 39 without having its whirling or rotating movement interrupted. It is desirable to direct this rotating air within the pipes 39 into the tangentially disposed conduits 40 with a minimum loss of energy due to friction and other causes.

The forward or air receiving portion of each conduit 40 is therefore provided with an involute curve 41 having the construction best shown in Fig. 5 and adapted to direct the whirling air in the pipe 39 smoothly into the conduit 40, and if a relatively strong suction is produced in the conduit 40 the whirling movement of the air within the pipe 39 will be increased by employing the involute curve construction just described. The whirling air upon entering the conduit 40 travels as a straight flow stream towards the next receptacle 33 to be directed around and into the next receptacle through its side wall by the involute curved portion 42.

The portion 42 at the delivery end of each supply pipe 40 is similar in construction and operation to the portion 16 of the air supply pipe above described.

It will be apparent from the construction just described that the involute curve at one end of the connecting pipe 40 tends to increase the rotating movement of the air leaving one receptacle and the involute curved portion 42 at the opposite end of this pipe serves to impart a pronounced rotative movement to the air within the next receptacle. As a result of the construction just described the air traveling from one classifier to the next to subject the materials suspended therein to succesive treatments is caused to rotate rapidly in each of the classifying receptacles to provide centrifugal separation of the heavier particles out of the air stream.

The pressure of the air will tend to decrease as it passes successively from one receptacle to another and this condition may be taken care of by successively increasing the size of the receptacles 32, 33 and 34, but in the present construction instead of increasing the size of the classifying receptacles means is provided for removing part of the air from each receptacle.

This is accomplished in the present classifier by providing each receptacle with an air discharge pipe 43 positioned to extend downwardly through the pipe 39 a substantial distance into the receptacle, the arrangement being such that the inlet end of each of these pipes will reach downwardly within its receptacle to a relatively quiet zone to remove air which is practically free from fine particles. This relatively clean air removed by the pipes 43 may be conducted to the pipe 44 leading to any desired form of suction producing means, not shown.

A conical deflecting plate 45 is preferably provided in the curved portion 41 of each discharge pipe and serves to help direct the stream of air into the tangentially extending portion 40 of the conduit and serves also to form a strengthening connection between the portions 41 and 43 as will be apparent from

the drawings. If desired one or more of the conduits 40 may be provided with the apertures 46 in its floor plate for admitting air into the conduit from the atmosphere to thereby prevent material from settling upon the floor plate of the conduit 40.

It will be seen from the foregoing that the curved inlet pipe shown and described for directing material laden air into a classifying receptacle through a side wall thereof serves to impart a pronounced whirling movement to the air within the receptacle to effect a centrifugal separation of the particles within the air, and it will also be seen that this novel means of introducing material laden air into a receptacle may be employed in connection with a single classifier as shown in Fig. 1 or in connection with a series of classifiers as disclosed in Figs. 5 and 6.

What is claimed is:—

1. An air classifier comprising in combination, a receptacle having an air discharge conduit, an inlet pipe for supplying material laden air to the receptacle and having the form of an involute curve encircling the receptacle and arranged so that its cross-sectional area gradually decreases in the direction in which the air stream travels to gradually force the stream of air inwardly through an opening in a side of the receptacle, means for advancing the material laden air rapidly along said pipe to cause it to rotate the air in the receptacle and effect a centrifugal separation of the materials, and an air confining conduit formed along the lower wall of said pipe and provided with air apertures for directing jets of air upwardly through the lower wall of the pipe to prevent materials from settling in the pipe.

2. An air classifier comprising in combination, a receptacle having an air discharge conduit, an inlet pipe for supplying material laden air to the receptacle and having the form of an involute curve encircling the receptacle and arranged so that its cross-sectional area gradually decreases in the direction in which the air stream travels to gradually force the stream of air inwardly through an opening in a side of the receptacle, means for advancing the material laden air rapidly along said pipe to cause it to rotate the air in the receptacle and effect a centrifugal separation of the materials, and said pipe having air inlet openings in its lower wall.

3. An air classifier comprising in combination, a separating receptacle, a conduit for discharging air from the receptacle, an inlet pipe for supplying material laden air to the receptacle and having the form of an involute curve encircling the receptacle and constructed to gradually force the stream of air inwardly into the receptacle through an opening in a side wall thereof, and means for forcing jets of air into said pipe to help increase the speed of the air stream to cause the stream of air to rotate the air in the receptacle and effect a centrifugal separation of the materials.

4. A plurality of air classifiers connected in series and each comprising an upright receptacle constructed for the centrifugal separation of materials therein, a central discharge pipe extending axially from the upper end of each receptacle, a conduit for conducting air and the materials suspended therein from the discharge pipe of one receptacle into the next receptacle so as to promote the whirling movement of the air in both receptacles, said conduit being provided with an involute curve at its intake end developed about and opening into the discharge pipe to impart a rotating movement to the air in this pipe and provided with an involute curve at its discharge end that is developed about and opens into the next receptacle through a side wall thereof, and means for delivering material laden air into the first receptacle with a rotative whirling movement.

5. A plurality of air classifiers connected in series and each comprising an upright receptacle constructed for the centrifugal separation of materials therein, a central discharge pipe extending axially from the upper end of each receptacle, a conduit for conducting air and the materials suspended therein from the discharge pipe of one receptacle into the next receptacle so as to promote the whirling movement of the air in both receptacles, said conduit being provided with an involute curve at its intake end developed about and opening into the discharge pipe to impart a rotating movement to the air in this pipe and provided with an involute curve at its discharge end that is developed about and opens into the next receptacle through a side wall thereof, an exhaust pipe for each receptacle extending concentrically through the discharge pipe of the receptacle, and means for delivering the materials to be treated into the first receptacle.

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

ALBERT H. STEBBINS.