Feb. 16, 1932. A. H. STEBBINS 1,845,358

SEPARATOR FOR TREATING MATERIAL LADEN AIR

Filed Oct. 29, 1929 4 Sheets-Sheet 1

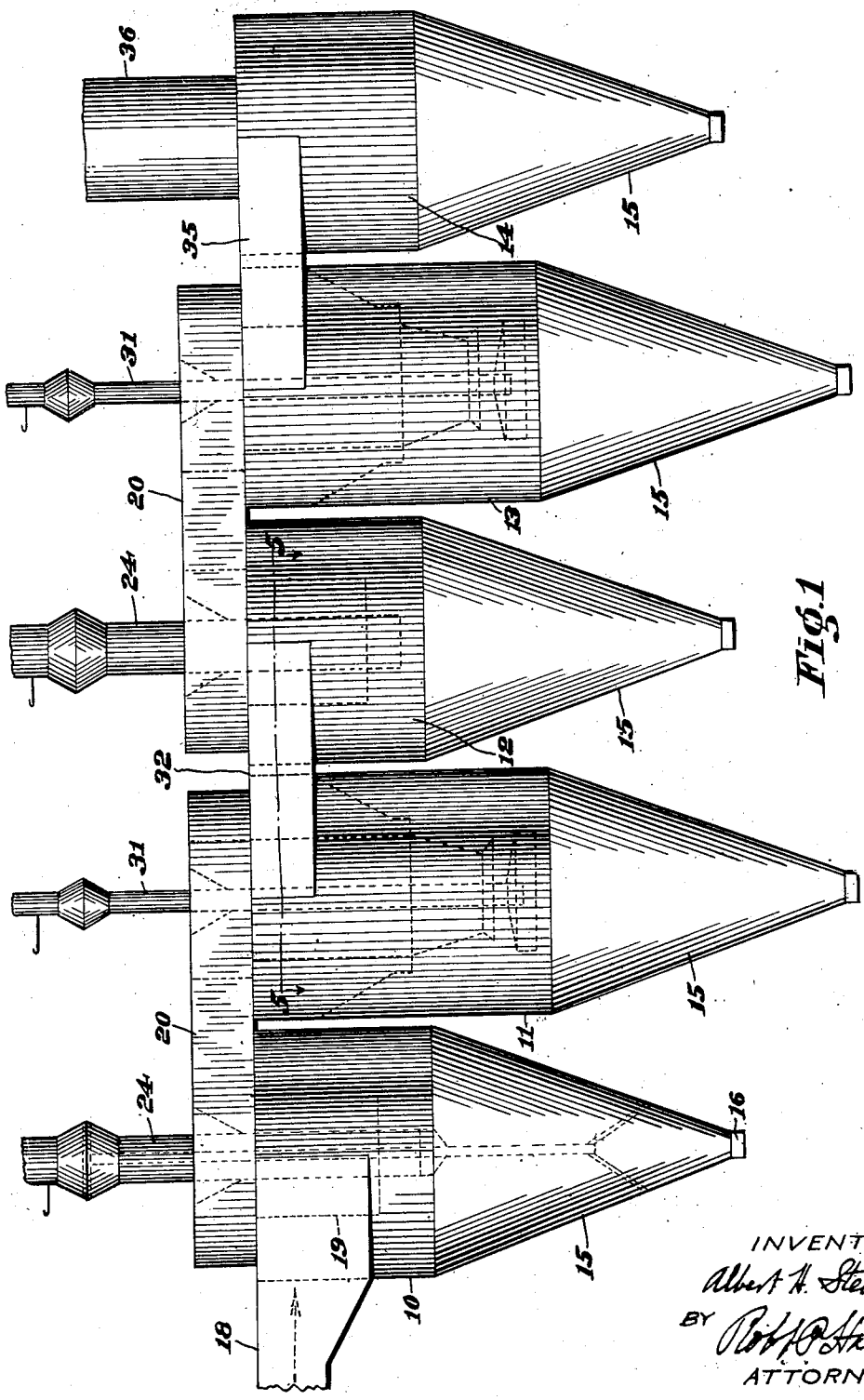


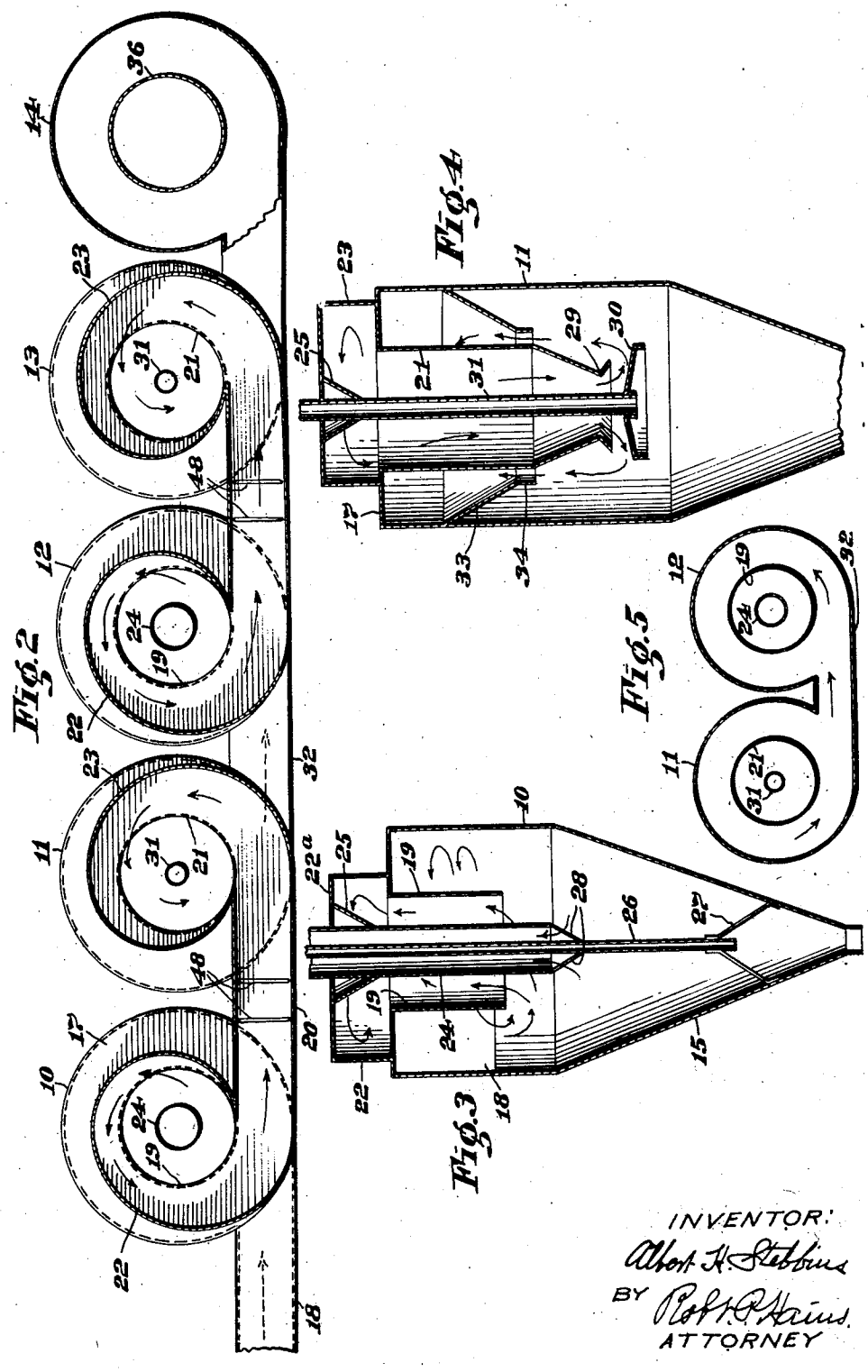
Fig. 1

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SEPARATOR FOR TREATING MATERIAL LADEN AIR

Filed Oct. 29, 1929 4 Sheets-Sheet 2



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SEPARATOR FOR TREATING MATERIAL LADEN AIR

Filed Oct. 29, 1929 4 Sheets-Sheet 3

Fig. 6

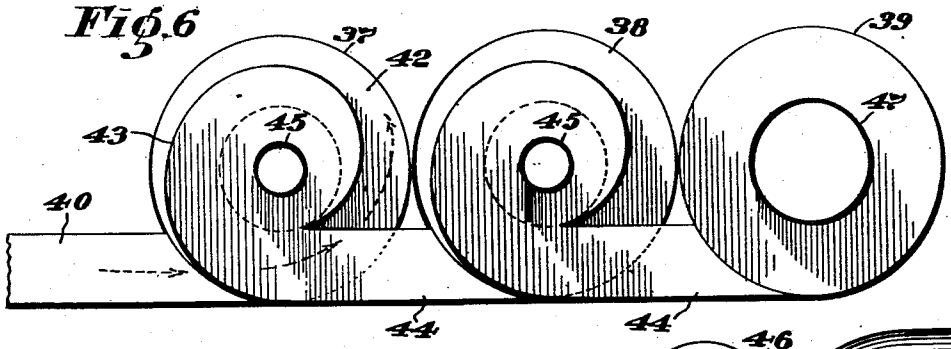
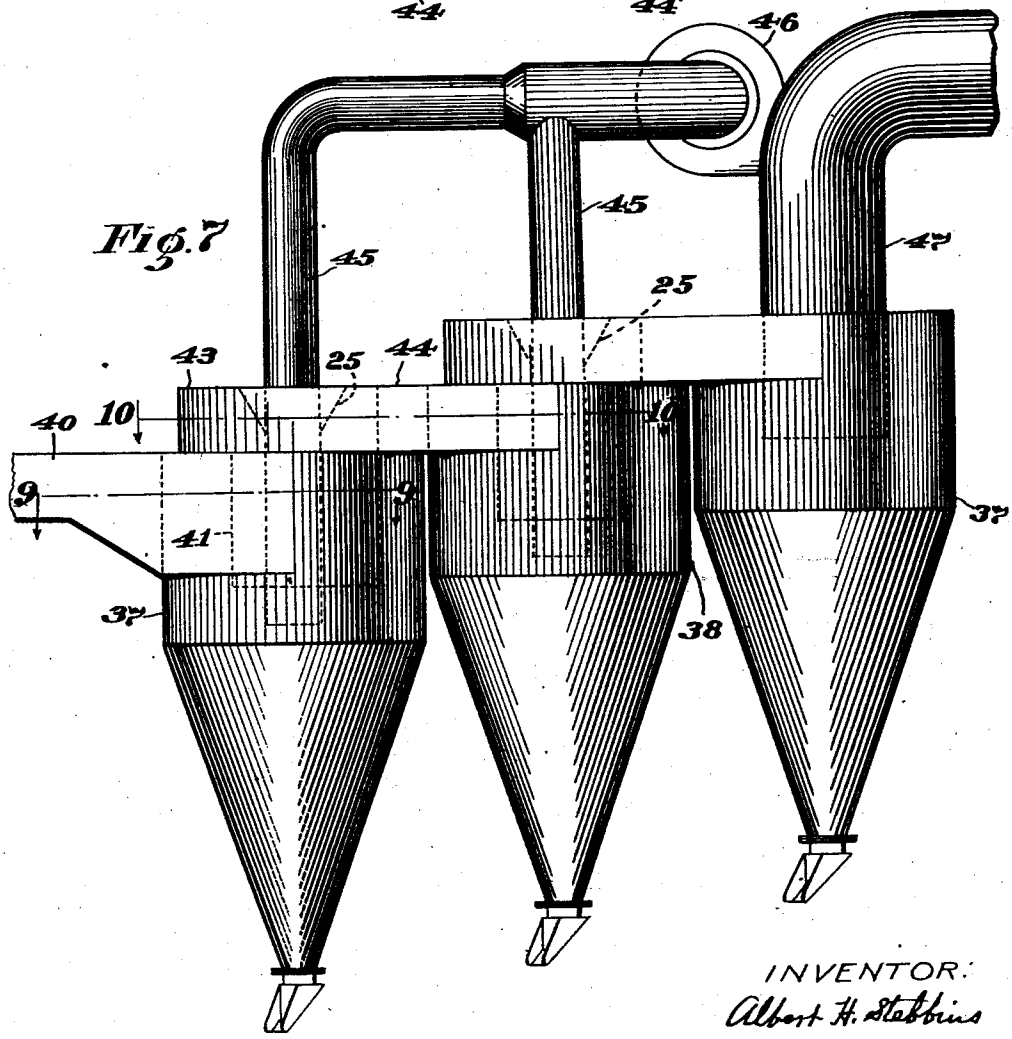


Fig. 7



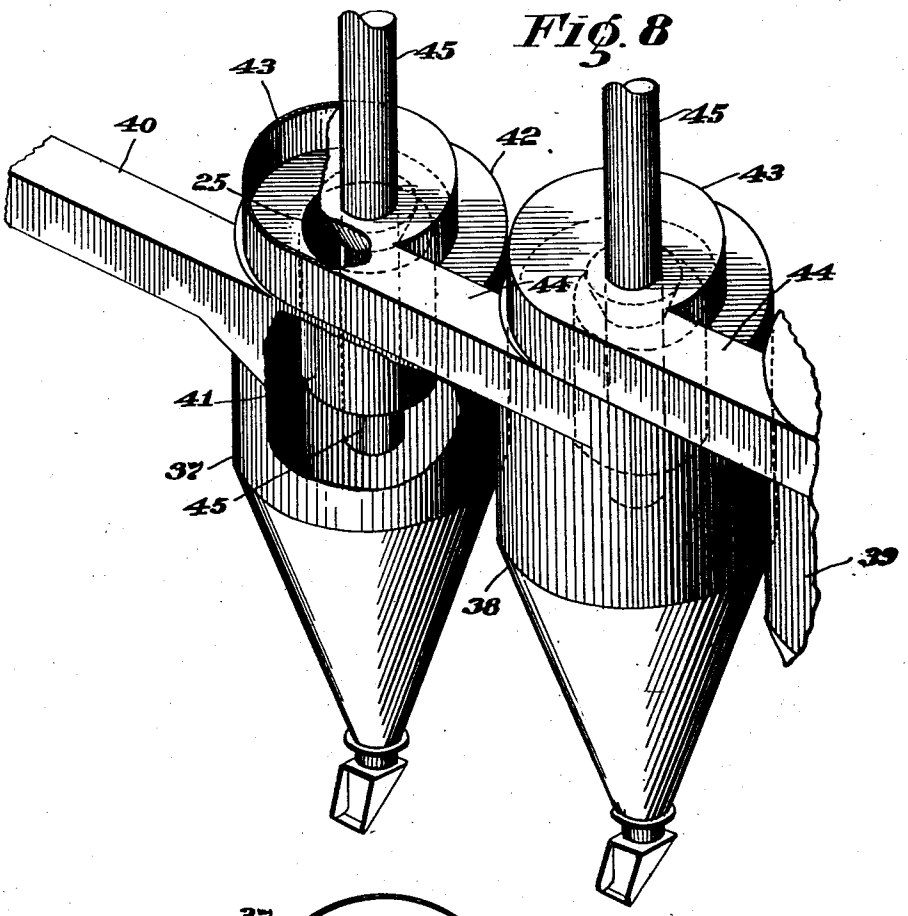
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SEPARATOR FOR TREATING MATERIAL LADEN AIR

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Fig. 8



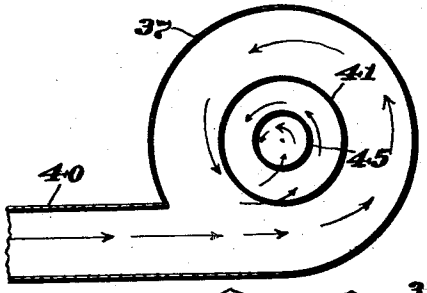


Fig. 9

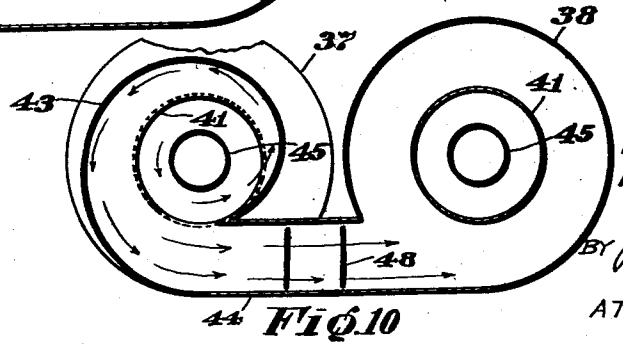


Fig. 10

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Patented Feb. 16, 1932 1,845,358

UNITED STATES PATENT OFFICE

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SEPARATOR FOR TREATING MATERIAL LADEN AIR

Application filed October 29, 1929. Serial No. 403,157.

This invention relates to separators for treating material laden air to classify and collect the materials, and more particularly to separators of the type in which centrifugal force is employed to remove the coarser particles from the air stream.

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 side walls of the receptacle to move downwardly adjacent the walls under the influence of gravity out of the path of the air.

One important feature of the present invention resides in novel means for introducing material laden air into a receptacle to promote the desired whirling movement of the air therein.

Another feature of the invention resides in a novel construction for removing the air from a receptacle so as to promote the whirl movement of the air in that receptacle.

Another feature of the invention resides in a group of separators connected in series and in novel means for delivering the material bearing air from one receptacle to another so as to promote a pronounced whirling or rotative movement of the air in each receptacle.

A more specific feature of the invention resides in an air stream transformer consisting of an air pipe provided at one end with a transposing or transforming chamber having a conduit leading tangentially from the pipe, the arrangement being such that if air is passed in either direction through this transformer a rotating or whirling movement will be imparted to the air within the pipe. This result is secured by providing an involute-curve connection between the pipe and conduit to facilitate the passage of the whirling air smoothly from the pipe into the tangentially disposed conduit to transform the whirling air in the pipe into a straightened stream as it enters the conduit, or vice versa transforming the straight stream of air in the conduit into a whirling or rotating stream within the pipe.

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 side elevation of a group of separators connected in series for the successive treatment of material laden air;

Fig. 2 is a top plan view of Fig. 1 with parts in section;

Fig. 3 is a vertical sectional view through the first receptacle of Fig. 1;

Fig. 4 is a vertical sectional view through the second receptacle of Fig. 1;

Fig. 5 is a horizontal sectional view taken on the line 5—5 of Fig. 1;

Fig. 6 is a top plan view of a modified construction showing a group of separators connected in series;

Fig. 7 is a side elevation of the separators of Fig. 6;

Fig. 8 is a perspective view with parts in section of the first and second separator of Fig. 6;

Fig. 9 is a sectional view taken on the line 9—9 of Fig. 7, and

Fig. 10 is a sectional view taken on the line 10—10 of Fig. 7.

The separator of the present invention for treating material laden air may be employed as a classifier for treating comparatively coarse materials, but is designed more particularly for use as a dust collector for removing fine dust-like particles from a stream of air, and this separator is well adapted for use in connection with other types of air treatment machines as well as in a group or series of similar separators as shown.

In the embodiment of the invention shown in Figs. 1 to 5 inclusive the separating receptacles 10, 11, 12, 13 and 14 are connected in series for effecting the successive treatment of a stream of material laden air, and the connections between these receptacles are so constructed that a pronounced whirling or rotative movement will be imparted to the air in each receptacle.

Each of the receptacles is preferably given

a cylindrical or approximate cylindrical construction as shown to facilitate the rotation of the air therein and each receptacle is provided at its lower end with a downwardly converging hopper 15 for receiving the materials that settle out of the path of the air. The materials may accumulate in the hoppers 15 and be discharged therefrom from time to time or may be otherwise disposed of but in any event air should be prevented from entering the receptacle through the discharge pipe 16 at the lower end of each hopper.

Each of the classifiers 10 to 14 inclusive is provided at its upper end with an end plate or closure 17 as shown and the material laden air delivered to the first receptacle 10, is supplied by the pipe 18 which is adapted to deliver its stream of air tangentially into the receptacle 10. The pipe 18 may lead from any dust producing machine or other source furnishing material laden air which it is desired to treat or unload.

The separators or dust collectors of the present invention may be operated either by blast or suction, and where a number of these receptacles are connected in series it may be desirable to employ both blast and suction means to promote the travel of the air stream through the entire series of receptacles.

The material bearing air supplied to the receptacle 10 by the pipe 18 is caused to flow through this pipe, either by blast or suction with sufficient force to impart a pronounced whirling or rotating movement to the air within the receptacle 10. This will serve to throw the heavier particles within the air outwardly against the side walls of receptacle 10 to move downwardly adjacent these walls under the influence of gravity into the collecting hopper 15.

When the separate receptacles are connected in series it is desirable to convey the air from one receptacle the other in such a manner that a pronounced whirling movement will be imparted to the air in each receptacle. An important feature of the present invention therefore resides in the means for conducting the air from one receptacle to another to promote the rotative movement of the air in each receptacle. In carrying out this feature of the invention novel means is employed for removing the air from the first receptacle and delivering it to the second receptacle to rotate in the latter and this means in the construction shown consists of a relatively large pipe 19 extending downwardly through the cover 17 of the receptacle 10 for a substantial distance into the receptacle as will be apparent from Fig. 3, the arrangement being such that the air whirling within the central portion of the receptacle 10 may readily enter the lower end of the pipe 19 and continue its rotative movement while passing upwardly within this pipe.

In order to conduct this stream of whirling air from one receptacle to another it is necessary to straighten out the stream or transform it from a rotating stream to a straight flow stream, and it is desirable to do this with a minimum loss of energy due to friction and other causes.

This is accomplished in accordance with the present invention by providing a conduit 20 leading from the upper end of the air discharge pipe 19 of one receptacle to the upper end of a somewhat similar air inlet pipe 21 mounted in the second receptacle 11 and extending downwardly from the cover plate 17 thereof as best shown in Fig. 4 to supply air to this second receptacle.

The conduit 20 is provided at its intake end with a portion 22 having the form of an involute curve as best shown in Fig. 2, the construction being such that this involute curve constitutes a transforming chamber adapted to direct the whirling air moving upwardly within the pipe 19 smoothly into the conduit 20 to be carried by this conduit to the next receptacle.

The discharge end of the conduit 20 is provided with a similar involute curved portion 23 constituting a transforming chamber adapted to direct the stream of air from the conduit 20 into the inlet pipe 21 to rotate therein. It will be seen from the construction best shown in Fig. 2 that as the stream of air passes from the conduit 20 into the transformer or involute curved portion 23 it will be smoothly directed downwardly into the pipe 21 with a pronounced rotative movement which serves to rotate the volume of air within the receptacle 11.

As the air rotating within the receptacle 10 flows towards the discharge pipe 19 it will produce more or less of a vortex and below this vortex will be produced a relatively calm area which will contain comparatively clean air. It may be desirable to remove this relatively clean air from the receptacle thereby reducing the volume of air to be treated. This is accomplished in the construction shown by providing the air discharge pipe 24. This pipe extends downwardly within the receptacle 10 centrally through the pipe 19 to a point well below the intake end of the pipe 19, so that it will remove the air from the relatively calm area just mentioned. The pipe 24 may lead to any suitable form of suction means not shown.

A cone or annular deflecting plate 25 is preferably provided within the transforming chamber 22 and serves as a brace between the pipe 24 and the upper wall 22^a of the transforming chamber. This cone also serves to deflect the air outwardly into the involute curved portion of the conduit 20 as the stream of air moves upwardly in the pipe 19.

In some cases it may be desirable to provide means for removing air from the collecting

hopper 15 so that the air which is forced downwardly into this hopper will not rise therein to disturb the particles settling within this hopper. This may be accomplished by providing the air exhaust pipe 26 which extends downwardly well into the collecting hopper 15 as shown in Fig. 3 and which may lead to any desired suction producing means.

Strengthening braces 27 may be provided between the lower end of the pipe 26 and the side walls of the hopper 15 and similar braces 28 may be provided between the pipe 26 and the lower end of the pipe 24.

It is desirable to utilize as far as possible rotation of the air within the inlet pipe 21 of the receptacle 11 to promote rotation of the volume of air within the receptacle 11, and in the construction shown the lower end of the pipe 21 is reduced as at 29 in the form of a nozzle and as the whirling air passes downwardly through this nozzle, as indicated by the arrows, it is directed outwardly by an annular apron 30 which is disposed below and in spaced relation to the discharge end of the nozzle 29. As a result of this construction the rotating stream of air supplied by the inlet pipe 21 is directed outwardly in a horizontal plane into the receptacle 11 to rotate the volume of air therein. The apron 30 in the construction shown is supported by a pipe 31 extending downwardly into the receptacle and adapted to remove air from below this apron.

The receptacles 10 and 11 when connected in the manner just described constitute a pair of cooperating separators which operate in an extremely satisfactory manner to effect a centrifugal separation of the heavier particles out of the air in each receptacle.

If desired two or more of such pairs of separators may be connected in series as shown in Figs. 1 and 2 in which case receptacles 10 and 11 constitute one pair of cooperating separators, and receptacles 12 and 13 constitute a second pair of cooperating separators; when so arranged receptacle 12 will or may be similar in construction and operation to receptacle 10, and receptacle 13 will or may be similar in construction and operation to receptacle 11.

Since the inlet pipe 21 and the means associated therewith serves to produce the desired whirling movement of the air within the receptacle 11, the air to be discharged from this receptacle may be removed therefrom through a side wall of the receptacle.

This is accomplished in the construction shown by providing the conduit 32 leading tangentially from the receptacle 11 and discharging tangentially into the receptacle 12 as best shown in Fig. 5. The means for removing the air from the receptacle 11 should not unduly interfere with the rotation of the air in this receptacle and it is therefore desirable to provide an annular partition or apron 33 within the receptacle 11 about the inlet pipe 21, which apron is provided with the reducing neck 34 through which air may travel upwardly about the pipe 21 as indicated by the arrows into the upper portion of the receptacle and escape therefrom through the discharge conduit 32 to be delivered by this conduit tangentially into the third receptacle 12.

The conduit 32 will serve to deliver the material bearing air into the receptacle 12 in a manner similar to the inlet pipe 18 for the receptacle 10, and the construction and operation of the receptacles 12 and 13 will be the same as that just described in connection with receptacles 10 and 11. The air within the upper portion of the receptacle 13 may be discharged therefrom tangentially through the conduit 35 which delivers its air tangentially into the receptacle 14 to whirl therein and the air is removed in a vertical direction through the upper end of the receptacle 14 by the conduit 36 which may lead to any suitable form of suction producing means.

As the material laden air passes from one receptacle to another it will expand and this increase of volume of the air may be taken care of by successively increasing the size of the receptacles, but in the present construction this is taken care of by providing the exhaust pipes 24, 31 adapted to remove some of the air from each receptacle. As the air expands in passing from one receptacle to another and its velocity decreases, this change in the condition of the air will promote the settling of the fine particles out of the air in each receptacle.

It will be apparent from the foregoing that the stream of air is discharged axially from the first receptacle and introduced axially into the second receptacle of a pair, and that through the employment of the involute curve or transformer 22 the rotating air within the pipe 19 is directed smoothly into the conduit 20, and through the employment of the involute curve or transformer 23 the stream of air from the conduit 20 is directed into the pipe 21 to rotate therein. As a result of this construction the material laden air is so removed from one receptacle and introduced into the next that the rotation of the air in each of the receptacles is promoted.

In the embodiment of the invention illustrated in Figs. 6 to 10 inclusive three receptacles 37, 38 and 39 are shown as connected in series so that a rotative movement is imparted to the air in each receptacle to promote a separation of the heavier particles out of the air stream. The first receptacle 37 is similar in construction and operation to the receptacle 10 above described in that the material laden air is supplied to the receptacle 37 tangentially by an inlet pipe 40 to impart a whirling or rotative movement to

the air within the receptacle 37 and the air is removed from the central portion of the receptacle 37 by the discharge pipe 41 that extends downwardly through the cover plate 42 at the upper end of the receptacle 37. The air passes from the pipe 41 into a transforming chamber 43 which is similar in construction and operation to the transforming chamber 22 above described and has an involute curved portion that serves to direct the rotating air smoothly into the conduit 44 which in this modified construction serves to direct the air tangentially into the second receptacle 38.

It will be noted that in this modified construction the receptacles are arranged one slightly above the other in stepped relation as best shown in Fig. 7, this being desirable so that the laterally extending conduit 44 leading from the upper end of one receptacle will deliver its air stream tangentially into the next receptacle through a side wall thereof.

The relatively clean air within the quiet zone below the discharge pipe 41 of the receptacles 37 and 38 may be removed from the receptacles through the exhaust pipes 45 that may lead to a fan 46 or other suction producing means.

It will be apparent from the modified construction just described that air is delivered tangentially through a side wall into each of the receptacles 37, 38 and 39 and is removed axially through the upper end of these receptacles, the construction being such that the whirling air within a receptacle may continue its whirling movement while moving upward into the exhaust pipes 41, 47. As the air passes from the upper end of each exhaust pipe 41 into the transformer 43 it is converted into a straight flow stream and delivered by the conduit 44 into the next receptacle to whirl therein.

While air has been described herein as the carrying medium for the materials to be treated it is to be understood that water or other fluids might be employed to this end.

In some cases it may be found that the materials carried by the air tend to settle upon the lower wall of the conduits 20 and 44 leading from one receptacle to another, such settling of the air may readily be prevented by providing apertures 48 within the lower wall of these pipes to admit jets of air from the atmosphere into the pipes to promote the carrying action of the air.

What is claimed is:—

1. A pair of separators for treating material laden air connected in series and comprising, a separating receptacle having a discharge pipe extending into the receptacle from its upper end, means for delivering material laden air into the receptacle to rotate therein and effect a centrifugal separation of the materials, a second separating receptacle having an inlet pipe extending into the receptacle from its upper end, a conduit connected to said pipes exteriorly of the receptacles for conducting air bearing the lighter materials from one receptacle to the other through said pipes and provided at each end with an involute curved portion adapted to promote rotation of the air in each of said pipes, and the cooperating pipes and conduit being constructed and arranged to remove the air axially from the first receptacle and to discharge the air axially into the second receptacle so as to promote the whirling movement of the air in each receptacle.

2. A pair of separators for treating material laden air connected in series for successive treatment of the materials, comprising a separating receptacle having a discharge opening in its upper end, means for delivering material laden air into the receptacle to rotate therein and effect a centrifugal separation of the materials, a second separating receptacle having an inlet opening in its upper end, and a conduit for conducting the material laden air bearing the lighter materials from one receptacle to the other axially through said openings and provided at each end with an involute curved portion adapted to promote rotation of the air passing through each of said openings to thereby impart rotative whirling movement to the air within the receptacles.

3. A pair of separators for treating material laden air connected in series for successive treatment of the materials, comprising a pair of separating receptacles each constructed for a centrifugal separation of the materials therein, means for supplying material laden air to the first receptacle, and means for conducting the air carrying the finer materials axially from the first receptacle and delivering it axially into the second receptacle, including a connecting conduit provided at each end with an involute curved portion for promoting rotation of the air as it approaches the discharge opening of the first receptacle and as it enters the second receptacle.

4. A pair of separators for treating material laden air connected in series for successive treatment of the materials, comprising a pair of separating receptacles each constructed for a centrifugal separation of the materials therein, means for supplying material laden air to the first receptacle, and means for conducting the air carrying the finer materials axially from the first receptacle and for delivering it into the second receptacle, including a central pipe that extends downwardly a substantial distance within the first receptacle from the upper end thereof and a conduit provided at its intake end with an involute curved portion connected to said pipe for promoting rotation of the air within the receptacle as it approaches the intake end of said pipe.

5. A pair of separators for treating material laden air connected in series for successive treatment of the materials, comprising a pair of separating receptacles each constructed for a centrifugal separation of the materials therein, means for supplying material laden air to the first receptacle to rotate therein, and means for conducting the air carrying the finer materials from the first receptacle and delivering it axially into the second receptacle, including a connecting conduit provided at its discharge end with an involute curved portion for promoting rotation of the air as it passed from the conduit axially into the receptacle.

6. A separator for treating material laden air comprising, a separating receptacle constructed for the rotation of air therein, means for delivering material laden air into the receptacle, and means for conducting the air carrying the finer materials axially from the receptacle, including a conduit leading from the receptacle and having an involute curved portion for promoting rotation of the air as it approaches the axial discharge opening.

7. A separator for treating material laden air comprising, a separating receptacle constructed for the rotation of air therein, means for delivering material laden air into the receptacle in an axial direction through an end thereof, including a central pipe extending downwardly a substantial distance within the receptacle and a conduit leading to said pipe and provided at its discharge end with an involute curved portion developed about and opening into said pipe for imparting a rotative movement to the material laden air as it passes axially into the receptacle through said central pipe.

8. A separator for treating material laden air comprising, a separating receptacle constructed for the rotation of air therein and having a discharge pipe extending a substantial distance into the receptacle from its upper end, means for delivering material laden air into the receptacle, and a conduit leading from said pipe and having an involute curved portion connected to the upper end of said pipe and adapted to promote rotation of the air in said pipe as it approaches the discharge conduit.

9. A separator for treating material laden air comprising, a separating receptacle constructed for the rotation of air therein and having a centrally disposed inlet pipe extending a substantial distance into the receptacle from its upper end, means for delivering material laden air into the receptacle to rotate therein, including a conduit provided at its discharge end with an involute curved portion developed about and opening into said pipe and adapted to impart a rotating movement to the air within this pipe to cause the same to rotate within the receptacle as it discharges from the lower end of the pipe.

10. A pair of separators for treating material laden air connected in series for successive treatment of the materials, comprising, a separating receptacle having a central discharge opening in its upper end, means for delivering material laden air into the receptacle to rotate therein and effect a centrifugal separation of the materials, a second separating receptacle having a central inlet opening in its upper end, a conduit for conducting the material laden air bearing the lighter materials from one receptacle to the other through said openings and provided at each end with an involute curved portion adapted to promote rotation of the air passing through each of said openings, and means for admitting jets of air into said conduit to promote the carrying action of the air therein.

11. A group of separators for treating material laden air connected in series for promoting a centrifugal separation of the materials in each receptacle, comprising a pair of separating receptacles each having a central opening in its upper end, means for delivering material laden air into the first receptacle, a conduit leading from the opening of the first receptacle to the opening of the second receptacle and provided at each end with an involute curved portion adapted to promote rotation of the air in each receptacle, and means for discharging the air and lighter materials suspended therein through a side wall of the second receptacle.

12. A separator for treating material laden air comprising, a separating receptacle constructed for the rotation of air therein, an air inlet pipe at the upper end of said receptacle and extending centrally within the receptacle, a conduit for delivering material laden air to the receptacle through said pipe and provided at its discharge end with an involute curved portion that opens into and is developed about said pipe to impart a rotating movement to the air entering the receptacle through said pipe so that this air will move outwardly into the receptacle from the lower end of the pipe with a rotative movement that promotes the rotation of the air within the receptacle.

13. A pair of separators for treating material laden air connected in series for successive treatment of the materials comprising, a pair of separating receptacles each constructed for a centrifugal separation of the materials therein, means for supplying material laden air to the first receptacle, a centrally disposed discharge pipe leading from the upper end of the first receptacle and centrally disposed inlet pipe at the upper end of the second receptacle, and a conduit extending tangentially from one pipe to the other and adapted to promote rotation of the air in each of said pipes to thereby promote rotative movement of the air in each receptacle.

14. A separator for treating material lade-

air comprising, an annular separating receptacle having a collecting hopper at its lower end, an inlet pipe extending downwardly a substantial distance centrally within the receptacle from the upper end thereof, means for delivering material laden air into said pipe to cause it to rotate therein and impart its rotative movement to the air in the receptacle as it is discharged from the lower end of said pipe, and a deflector at the lower end of said pipe for directing the rotating air outwardly in a lateral direction.

15. In the art of separating materials, in combination, a material treatment receptacle, an inlet pipe extending centrally within the receptacle through an end thereof and arranged so that rotative movement may be imparted to the air in the receptacle by rotating the air in said pipe, and an air conduit leading to said pipe and provided with an involute curved portion that is developed about and which opens into the pipe and adapted to impart a rotative movement to the air as it passes from the conduit into the pipe to cause this air to be discharged from the pipe into the receptacle with a rotative whirling movement.

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

ALBERT H. STEBBINS.