June 19, 1928. 1,673,849

A. H. STEBBINS

CONCENTRATOR

Filed May 6, 1927 2 Sheets-Sheet 1

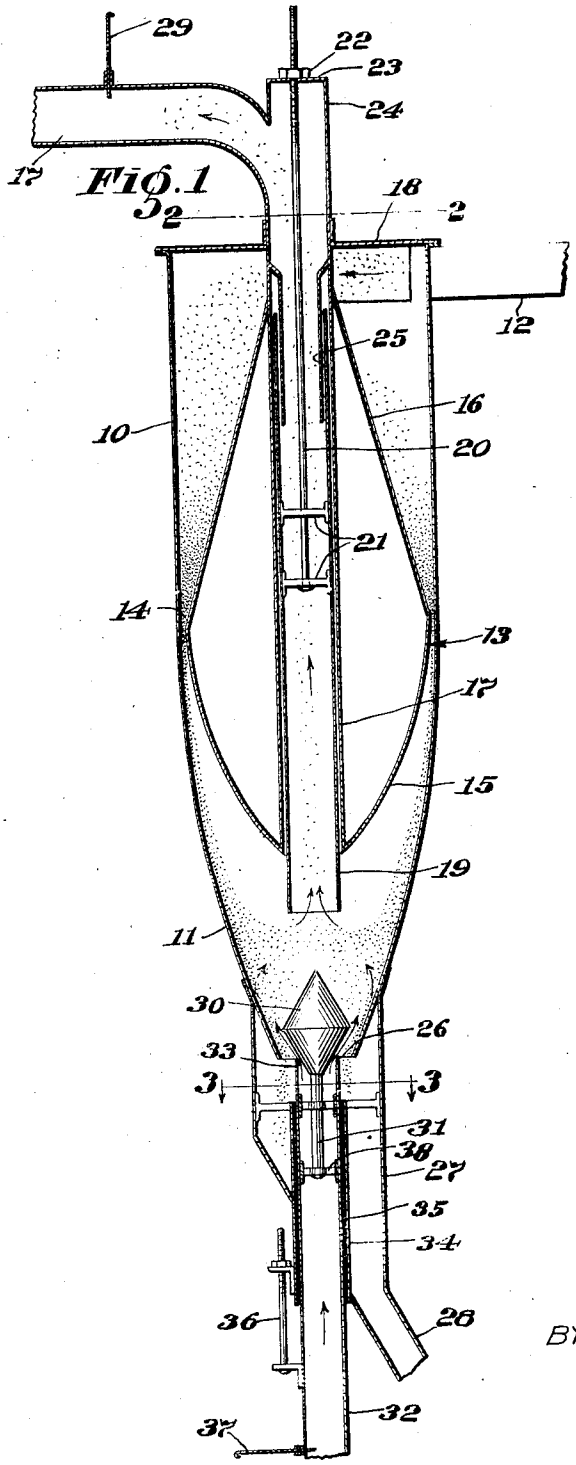


Fig. 1

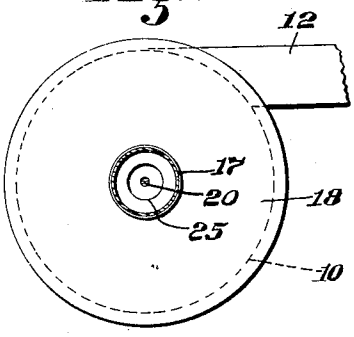


Fig. 2

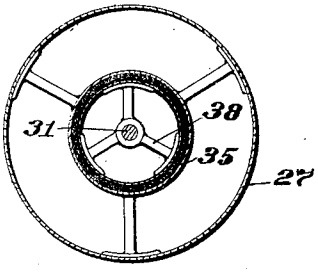


Fig. 3

INVENTOR:
Albert H. Stebbins
BY Robt. D. Harris
ATTORNEY

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Filed May 6, 1927 2 Sheets-Sheet 2

Fig. 4

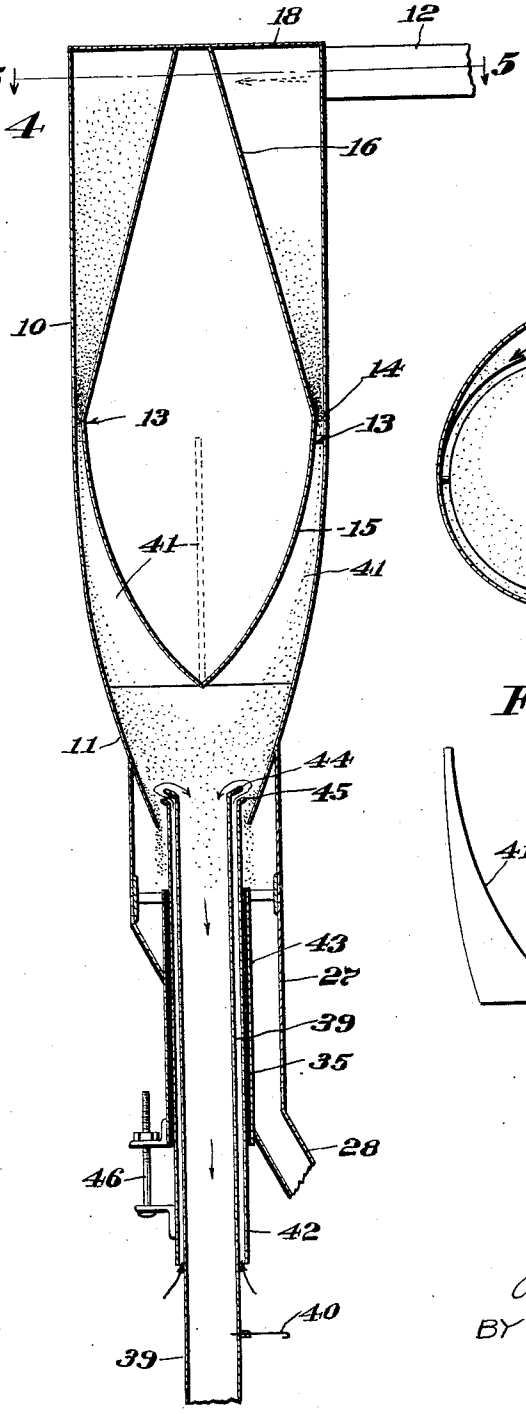


Fig. 5

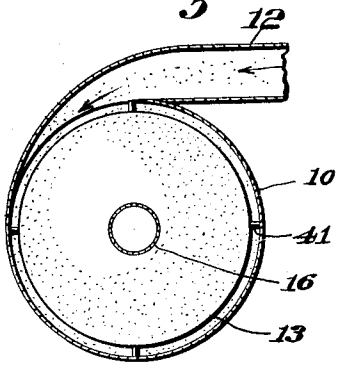
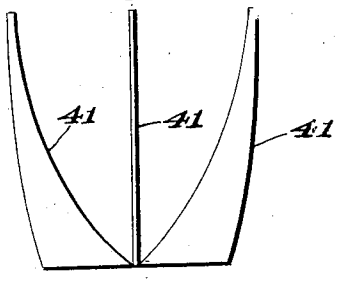


Fig. 6



INVENTOR:
Albert H. Stebbins
BY Robt. O. Harris,
ATTORNEY

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UNITED STATES PATENT OFFICE.

ALBERT H. STEBBINS, OF LOS ANGELES, CALIFORNIA.

CONCENTRATOR.

Application filed May 6, 1927. Serial No. 189,381.

This invention relates to concentrators constructed to effect separation of the materials by forcing air bearing the materials to be treated through a discharge nozzle so that the light particles will be deflected from a straight path to a greater degree than the heavy particles.

In carrying out the present invention air bearing the materials to be separated is forced through an annular discharge slot into the bowl-shaped lower end of a receptacle, and the arrangement is such that as the air bearing the materials travels downwardly along the inwardly converging side walls of the receptacle the heavy particles will be deflected from their straight path of travel to a less degree than the fine particles.

The lighter particles that are deflected or crowded inwardly from the side walls of the receptacle to a greater degree than the heavy particles may be removed from the heavy particles by exhausting air from the receptacle near its central axis while the heavier particles escape from the lower end of the receptacle adjacent its side walls, and the separation of the materials may be further promoted by introducing currents of air into the lower portion of the receptacle so that they pass upwardly through the materials to carry off the lighter particles.

The present invention therefore pertains to a concentrator comprising a receptacle having inwardly converging side walls and an annular throat or nozzle for directing air bearing the materials to be treated downwardly into the receptacle so that the lighter particles will be deflected inwardly more than the heavy particles, and also to means for directing currents of air through the separated materials to carry off the lighter particles.

The various features of the invention and novel combination of parts will be best understood from the following description when read in connection with the accompanying drawings illustrating good practical forms of the invention.

In the drawings:—

Fig. 1 is a vertical sectional view through a concentrator constructed in accordance with the present invention;

Fig. 2 is a sectional view taken on the line 2—2 of Fig. 1;

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

Fig. 4 is a vertical sectional view through a modified form of concentrator;

Fig. 5 is a sectional view taken on the line 5—5 of Fig. 4; and

Fig. 6 is a side elevation of means employed in the construction of Fig. 4 to support the central core.

In the embodiment of the invention shown in Figs. 1, 2 and 3, separation of the materials is effected in a tubular receptacle 10, which receptacle is provided near its lower end with the downwardly converging side walls 11 so that the receptacle has a bowl-shaped construction near its lower end as shown. Air bearing the materials to be separated is introduced into the upper portion of the receptacle 10 through the pipe 12, which pipe may lead from a blast fan not shown, or other means adapted to force the material laden air into the receptacle 10 under pressure. The feed pipe 12 preferably extends tangentially into the receptacle as shown, so that a sufficient whirling movement will be imparted to the air and materials delivered to the receptacle to keep the materials evenly distributed throughout the air within the upper part of the receptable.

As stated, an important feature of the present invention resides in the construction whereby air bearing the materials to be treated is forced downwardly into the contracted lower end of the receptacle through a restricted annular throat, and to this end, in the construction shown, a core 13 is mounted within the receptacle. This core is of sufficient size to provide a narrow throat 14 between the outer wall of the core and the inner wall of the receptacle 10, and the core preferably tapers towards its opposite ends, as indicated by 15 and 16. This construction helps to direct the compressed air in the upper portion of the receptacle towards the throat 14 and will serve to define a passage for the jet of air discharged from the throat 14 into the lower portion of the receptacle.

Various means might be provided for supporting the core 13 centrally within the receptacle 10 and in the construction shown this is accomplished by securing the core to the air exhaust pipe 17 which extends downwardly into the receptacle through the upper cover plate 18. The exhaust pipe 17 is preferably provided with an inner tube 19

which is slidably mounted in the pipe 17 so that it may be raised and lowered to vary the position of the lower or intake end of the tube 19. This tube may be supported in its desired position of adjustment by a rod 20, the lower end portion of which is connected to the tube 19 by the spiders 21, and the upper portion of the rod 20 is threaded to receive the nut 22 which rests upon the end wall 23 of the extension 24 provided at the upper end of the exhaust pipe 17. If desired, an inner tube 25 may be mounted within the pipe 17 to telescopically receive the upper end of the sliding tube 19.

The construction so far described will serve to force the material laden air downwardly through the annular throat 14 in the form of an annular jet and as this jet moves downwardly within the bowl-shaped end portion of the receptacle 10 the air will be crowded inwardly towards the central axis of the receptacle. The heavy particles within the air jet will be deflected from their straight path of travel to a less degree than the light particles and as a result the heavy particles will travel downwardly in close proximity to the converging side walls 11, while the lighter particles will be deflected or crowded inwardly towards the central axis of the receptacle. The heavy particles lying close to the side walls 11 will escape through the lower end 26 of the receptacle into the concentrate receiving hopper 27 and air is preferably exhausted from this hopper by providing the pipe 28 which leads from the lower end of the hopper to any preferred form of exhaust means. The lighter particles which remain suspended within the air in the lower portion of the receptacle 10 will be removed from the receptacle by the exhaust pipe 17 which may lead to a suction separator or dust collector not shown. The amount of air carried upwardly through the exhaust pipe 17 may be controlled as desired by adjusting the gate or valve 29.

Some of the fine particles may tend to cling to the heavier particles so that they will be carried downwardly into the hopper 27, and in order to reduce this tendency a deflector head 30 is mounted within the lower portion of the receptacle 10. This head 30 has an enlarged central portion and tapers towards its opposite ends as shown, and may be supported within the lower portion of the receptacle by the shaft 31. The arrangement is such that the lighter particles which might tend to move downwardly through the central portion of the discharge opening 26 are deflected by the head 30 towards the side walls 11, and in order to prevent the fine particles from passing downwardly through the annular passage lying between the lower portion of the head 30 and the side walls 11, air is caused to pass upwardly through this annular passage. This air in the construction shown passes upwardly through the air supply pipe 32 which is slidably mounted within a tube 34 located within the central portion of the discharge hopper 27. The air supplied by the pipe 32 may be introduced from the atmosphere and drawn upwardly into the receptacle 10 by the suction produced by the exhaust pipe 17, or, if desired, the pipe 32 may be connected to a blast fan or other means for forcing air upwardly through this pipe. The air supplied by the pipe 32 escapes through the restricted throat 33 provided between the upper end of the pipe 32 and the head 30 and passes upwardly into the receptacle 10 through the materials, as clearly indicated by the arrows in Fig. 1. The size of the throat 33 may be varied as desired by raising and lowering the pipe 32 which is slidably mounted within the fixed tube 34, and packing 35 may be provided between these two pipes to form a tight joint. Adjustable bolts 36 are provided for holding the pipe 32 in its desired position of adjustment, and the amount of air introduced into the lower portion of the receptacle through the pipe 32 may be controlled by adjusting the gate or valve 37. The head supporting shaft 31 is secured to the spiders 38 mounted within the tube 32.

From the foregoing description, when read in connection with the drawings, it will be understood that since the heavy particles moving downwardly within the lower portion of the receptacle 10 are more difficult to deflect from their straight path of travel than the light particles, the heavy particles will strike against and will slide down the inwardly converging walls 11 into the hopper 27, while the lighter particles which are deflected or crowded inwardly away from the side walls 11 will be carried upwardly by the air removed from the receptacle by the exhaust pipe 17. The air delivered to the lower end of the receptacle by the pipe 32 will pass upwardly through the materials to air-sweep or extract the lighter particles which tend to cling to the heavier particles approaching the discharge end of the receptacle 10. The air introduced through the pipe 32 will serve also to aid the suction means in drawing the tailings or lighter particles upwardly through the suction pipe 17.

In the modified construction shown in Figs. 4, 5 and 6 the construction and operation is substantially the same as that above described, except that the air exhausted from the lower portion of the receptacle 10 passes downwardly through the suction pipe 39 which pipe leads to a suction separator or dust collector, and the volume of air passing

downwardly through the pipe 39 may be controlled by adjusting the gate or valve 40.

The core 13 mounted centrally within the receptacle 10 in the construction shown in Fig. 4 has its upper end attached to the cover plate 18 and this core is held centrally within the receptacle 10 by the spacing plates 41 best shown in Fig. 6. Since the air discharged through the annular throat 14 passes downwardly within the lower portion of the receptacle without rotating about the core 13 the supporting plates 41 will not appreciably interfere with the air blast passing downwardly from the throat 14.

In the construction of Fig. 4 air from the atmosphere is introduced into the lower portion of the receptacle by drawing air upwardly through the air inlet pipe 42 which is slidably mounted within a tube 43 mounted centrally within the discharge hopper 27. The upper end of the suction pipe 39 flares outwardly as indicated by 44 and the upper end of the air supply pipe 42 is also flared outwardly as at 45, the construction being such that the air introduced through the pipe 42 is directed outwardly towards the side walls 11 of the receptacle to remove the lighter particles from the heavier particles sliding down the inclined walls 11 towards the discharge opening of the receptacle. The suction produced in the lower portion of the receptacle 10 by the suction pipe 39 will serve to draw air upwardly through the pipe 42 and into the lower portion of the receptacle, as indicated by the arrows in Fig. 4, and the size of the annular discharge slot provided at the upper end of the pipe 42 may be varied as desired by raising and lowering this pipe, which may be supported in the desired position of adjustment by the threaded bolts 46. As a result of the modified construction of Fig. 4 it will be seen that the lighter particles which are deflected inwardly towards the central axis of the receptacle will pass downwardly directly into the tailing discharge pipe 39 and that the finer particles which tend to enter the receptacle 27 with the heavier particles will be picked up by the air currents supplied by the air inlet pipe 42.

What is claimed is:—

1. A concentrator comprising in combination, a receptacle provided near its lower end with downwardly converging side walls, a core supported centrally within the receptacle and having a bulging portion intermediate its ends and adapted to form a narrow annulus or throat between its bulging portion and the inner wall of the receptacle and shaped to direct an annular jet of fluid downwardly within the receptacle along its converging side walls, means for forcing a fluid bearing the materials to be treated downwardly through said throat so that the heavier particles will travel adjacent said walls while the lighter particles will be deflected inwardly away from the walls, and a fluid discharge pipe extending into the lower portion of said receptacle to remove therefrom the lighter particles that work inwardly away from said side walls.

2. A concentrator comprising in combination, a receptacle provided near its lower end with downwardly converging side walls, a core supported centrally within the receptacle and having a bulging portion adapted to form a narrow annulus or throat between said bulging portion and inner wall of the receptacle and shaped to direct an annular jet of fluid downwardly within the receptacle along its converging side walls, means for forcing a fluid bearing the materials to be treated downwardly through said throat so that the heavier particles will travel adjacent said walls while the lighter particles will be deflected inwardly away from the walls, and a conduit for removing from the lower portion of the receptacle the fluid and lighter particles that are crowded inwardly from said side walls.

3. A concentrator comprising in combination, a receptacle provided near its lower end with downwardly converging side walls, a core supported centrally within the receptacle and having a bulging portion adapted to form a narrow annulus or throat between said bulging portion and inner wall of the receptacle and shaped to direct an annular jet of fluid downwardly within the receptacle along its converging side walls, means for forcing a fluid bearing the materials to be treated downwardly through said throat so that the heavier particles will travel adjacent said walls while the lighter particles will be deflected inwardly away from the walls, a conduit for removing from the lower portion of the receptacle the fluid and lighter particles that are crowded inwardly from said side walls, and means adjacent the lower portion of the receptacle for directing a fluid against the path of material moving downwardly within the receptacle to extract the fine particles.

4. A concentrator comprising in combination, a receptacle provided near its lower end with downwardly converging side walls, a core supported centrally within the receptacle and having a bulging portion adapted to form a narrow annulus or throat between said bulging portion and inner wall of the receptacle and shaped to direct an annular jet of fluid downwardly within the receptacle along its converging side walls, means for forcing a fluid bearing the materials to be treated downwardly through said throat so that the heavier particles will travel adjacent said walls while the lighter particles will be deflected inwardly away from the walls, a conduit for removing from the lower portion of the receptacle the fluid and lighter

particles that are crowded inwardly from said side walls, and means adjacent the lower portion of the receptacle for directing jets of fluid outwardly away from the central axis of the receptacle against the materials carried downwardly by the air blast.

5. A concentrator comprising in combination, a receptacle provided with a bowl-shaped lower end having inwardly converging side walls, a core supported centrally within the receptacle to form a narrow annulus or throat between the outer face of the core and inner wall of the receptacle and shaped to direct an annular jet of air downwardly along the curved bowl-forming walls, means for forcing air bearing the materials to be treated downwardly through said throat so that the heavier particles will travel along said curved walls while the lighter particles will be deflected inwardly away from the walls, and a conduit for removing from the lower portion of the receptacle the air and lighter particles crowded inwardly from said curved walls.

6. A concentrator comprising in combination a tubular receptacle provided near its lower end with downwardly converging side walls and having an opening at its lower end through which the heavier particles are discharged, a core supported centrally within the receptacle to form a narrow annulus or throat between the outer face of the core and inner wall of the receptacle and shaped to direct an annular jet of air downwardly along the converging wall, means for forcing air bearing the materials to be treated downwardly through said throat so that the heavier particles will travel along said converging walls while the lighter particles will be deflected inwardly away from the walls, means for removing from the central portion of the receptacle the air in which the lighter particles are suspended, and means for directing currents of air against the materials approaching said discharge opening to direct the lighter particles away from the discharge opening.

7. A concentrator comprising in combination a tubular receptacle provided near its lower end with downwardly converging side walls and having an opening at its lower end through which the heavier particles are discharged, a core supported centrally within the receptacle to form a narrow annulus or throat between the outer face of the core and inner wall of the receptacle and shaped to direct an annular jet of air downwardly along the converging wall, means for forcing air bearing the materials to be treated downwardly through said throat so that the heavier particles will travel along said converging walls while the lighter particles will be deflected inwardly away from the walls, means for removing from the central portion of the receptacle the air in which the lighter particles are suspended, and means for introducing a fresh supply of air into the lower portion of the receptacle and for directing it against the heavier particles approaching said discharge opening to direct the lighter particles away from the discharge opening.

8. A concentrator comprising in combination a tubular receptacle provided near its lower end with downwardly converging side walls and having an opening at its lower end through which the heavier particles are discharged, a core supported centrally within the receptacle to form a narrow annulus or throat between the outer face of the core and inner wall of the receptacle and shaped to direct an annular jet of air downwardly along the converging wall, means for forcing air bearing the materials to be treated downwardly through said throat so that the heavier particles will travel along said converging walls while the lighter particles will be deflected inwardly away from the walls, means for removing from the central portion of the receptacle the air in which the lighter particles are suspended, means forming an annular air inlet slot in the lower portion of the receptacle through which air is introduced to pass through the downwardly moving heavier materials, and adjustable means for varying the size of said slot.

9. A concentrator comprising in combination, a receptacle provided near its lower end with downwardly converging side walls, a core supported centrally within the receptacle and constructed to form a narrow annulus or throat between its outer surface and the inner wall of the receptacle and having a tapering portion above the throat for directing the air through the throat and a tapering portion below the throat for directing the jet of air issuing from the throat downwardly along said converging walls, means for forcing air bearing the materials to be treated downwardly through the throat so that the heavier particles will travel adjacent said walls while the lighter particles will be deflected inwardly away from the walls, and a discharge pipe for removing from the lower portion of the receptacle the air and lighter particles crowded inwardly from said side walls.

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

ALBERT H. STEBBINS.