

April 2, 1940.

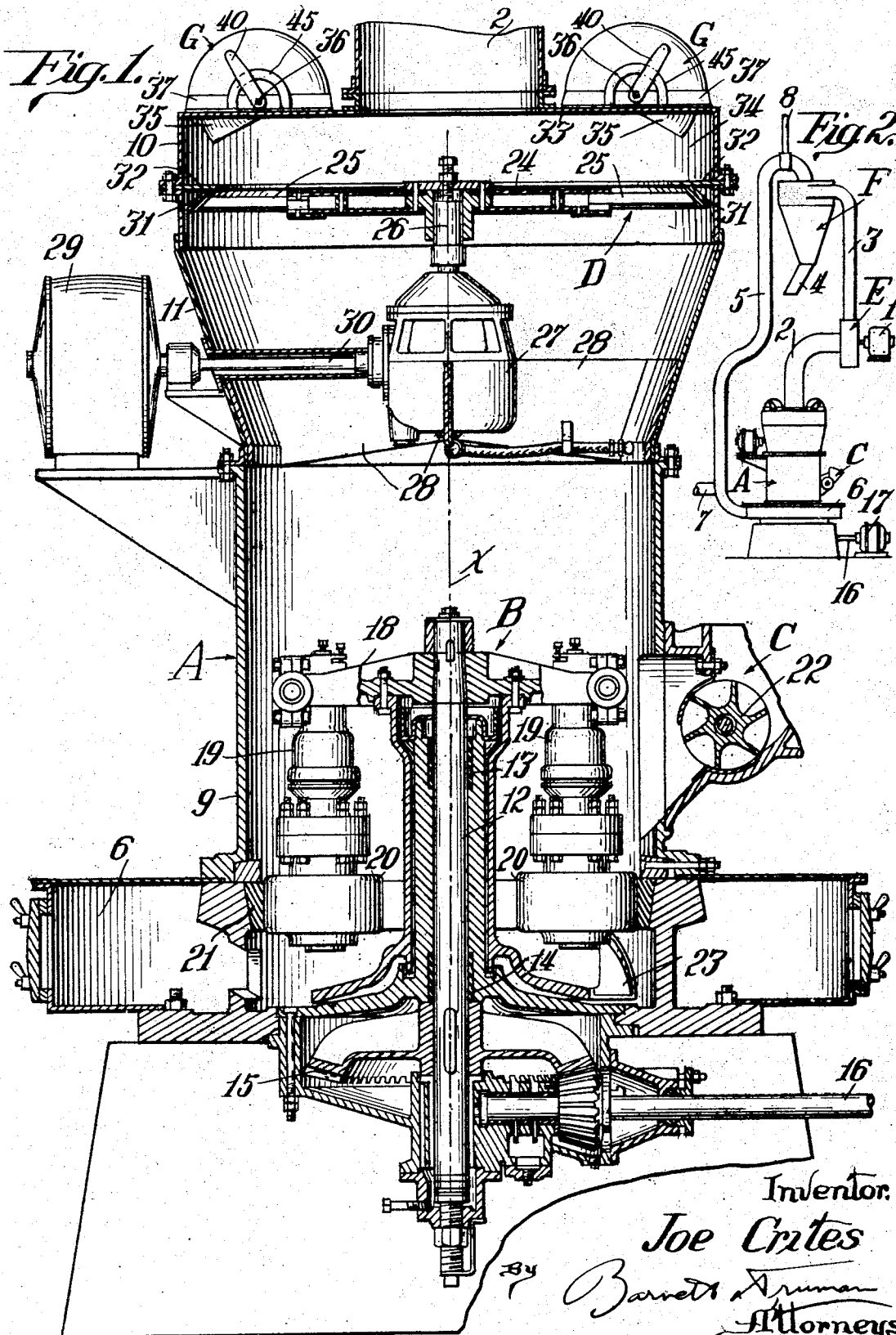
J. CRITES

2,195,618

ADJUSTABLE SEPARATOR

Filed June 4, 1937

2 Sheets-Sheet 1



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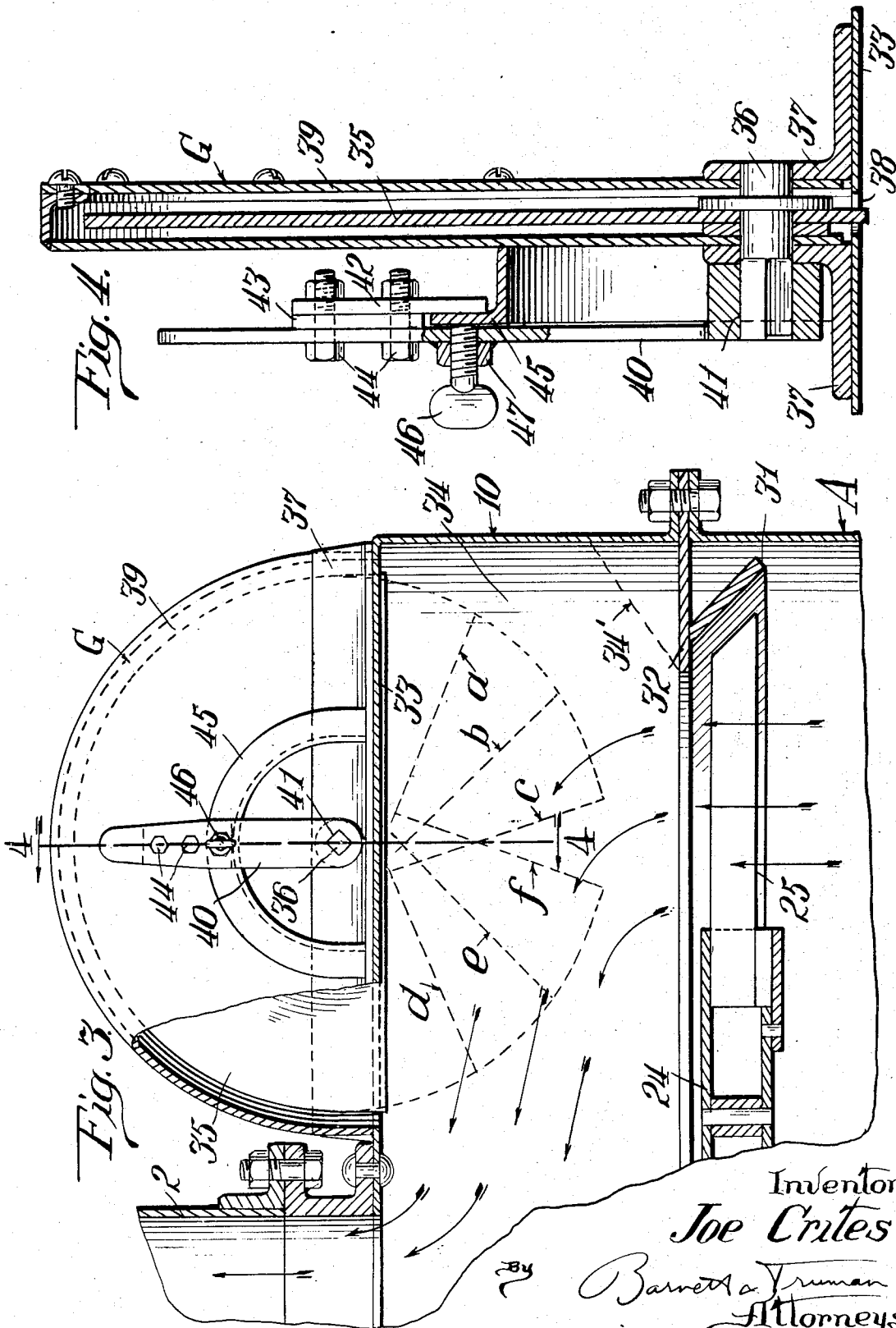
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2 Sheets-Sheet 2



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UNITED STATES PATENT OFFICE

2,195,618

ADJUSTABLE SEPARATOR

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Application June 4, 1937, Serial No. 146,434

4 Claims. (Cl. 209—139)

This invention relates to certain new and useful improvements in adjustable mechanical separators, and more particularly to improved means for grading or determining, within certain limits, the fineness of the material that is delivered from the separator.

The form of separator to which these improvements are preferably applied is of the general type disclosed in the patent to Cook, 1,783,357, granted December 2, 1930. In this type of separator an air stream is caused to flow upwardly through a closed casing, and a rotary deflecting member is mounted on a central vertical axis within the casing. This rotary deflector or "whizzer" preferably comprises a central closed disc portion from the periphery of which projects an annular series of radial blades or vanes. These vanes extend in proximity to the outer wall of the casing and a stationary conical deflecting member carried by the casing wall extends inwardly so as to overlap the outer ends of the vanes. The rotating vanes throw the heavier particles of material in the air stream outwardly against the inclined lower surface of the deflecting ring from which they carom downwardly within the casing or chamber. The separator here shown by way of example is used in direct connection with a grinding mill, the air stream drawing the finely divided material upwardly from the mill, and the heavier material rejected by the separator settles back into the mill for further grinding. The air stream is forced to flow upwardly between the rapidly rotating blades of the whizzer, and the only material that can rise above the whizzer is sufficiently fine to be carried in suspension in this rising air stream without being thrown out by the whizzer vanes or blades and the stationary deflecting member.

The casing is partially closed by an annular top wall that extends inwardly to a centrally positioned outlet through which the air stream is directed. The whizzer and cooperating stationary deflector are spaced downwardly from this top wall so as to provide an inwardly open annular separating or classifying space in which a final separation process takes place. The air stream whirls in this space about the central axis due to the motion imparted thereto by the whizzer and the heavier portion of the material that finds its way above the deflectors is carried outwardly by centrifugal force and settles out upon the upper surface of the fixed deflector, from which these heavier particles of material gradually drift back through the whizzer openings and

then gravitate down through the casing along with the material originally rejected by the whizzer.

According to the present improvements, suitable damper means are provided which may be projected to selected positions within this separating space above the whizzer. These vanes tend to break up or impede the whirling motion of the air stream in this separating space and create eddy currents which tend to prevent the repositing of the heavier material in the outer portion of this space. In general, the further these vanes are projected into the separating space the greater the percentage of heavy material that will remain in suspension in the air stream and be carried out from the separator. Conversely, as these vanes are withdrawn from the separating space the fineness of the delivered material will be increased. More specifically, these dampers are of substantially semi-circular form pivoted about horizontal axes above the top wall of the casing and adapted to be swung downwardly to selected positions within the separating space. Means is provided for adjusting the dampers and holding them in adjusted position.

The general object of this invention is to provide an improved separator of the type briefly described hereinabove and disclosed more in detail in the specification which follows.

Another object is to provide an improved damper or valve means for grading the fineness of the separated material delivered from the separator.

Another object is to provide an improved adjustable separator adapted for use in direct connection with a grinding mill.

Another object is to provide an improved form of adjustably rotatable damper means.

Other objects and advantages of this invention will be more apparent from the following detailed description of one approved form of apparatus constructed and operating according to the principles of this invention.

In the accompanying drawings:

Fig. 1 is a central vertical section through the combined grinding and separating apparatus.

Fig. 2 is a small diagrammatic elevation illustrating how this improved grinding and separating apparatus may be assembled with means for enforcing the air circulation and means for removing the pulverized material from the air stream.

Fig. 3 is an enlarged detail section, corresponding generally to the upper right-hand portion of Fig. 1.

Fig. 4 is a vertical section taken substantially on the line 4—4 of Fig. 3.

Referring first to Figs. 1 and 2, the apparatus comprises generally the upright, substantially closed casing A in the lower portion of which is positioned the grinding mechanism B to which the material to be ground or pulverized is delivered by the mechanism indicated generally at C mounted in one side of casing A. The improved separating mechanism D is mounted in the upper portion of casing A. The fan or blower E (Fig. 2) driven by motor 1, draws the air stream with finely divided material in suspension from casing A through conduit 2 and delivers this air stream through conduit 3 into the cyclone separator F in which the solid material is deposited and discharged through spout 4. The air stream, relieved of the solid material, flows out from separator F through conduit 5 back into the annular air manifold 6 surrounding the lower portion of casing A and from which the air stream is delivered into the grinding chamber to again pick up pulverized material. New air (heated if desired) can be drawn into the circulating air stream through conduit 7, and a portion of the air stream may be vented through outlet 8. It will be understood that the complete circulatory system just described and shown in Fig. 2 is merely disclosed by way of example.

As far as the grinding and separating assembly hereinafter disclosed in detail is concerned it is only necessary that some suitable means be provided for continuously providing the upwardly flowing air stream through the casing A.

Referring now more particularly to Fig. 1, the enclosing housing or casing A, which is preferably centered about the central vertical axis x , comprises a lower cylindrical portion 9, an upper cylindrical portion 10 of somewhat larger diameter, and an intermediate upwardly extending conical portion 11.

The mill B is here shown as of the well known roller type and comprises the central vertical shaft 12 journaled in bearings 13 and 14 and rotated through bevel gearing 15 from the shaft 16 driven by motor 17 (Fig. 2). The spider 18 carried at the upper end of shaft 12 supports a circular series of roller carriers 19 each pivoted in the spider so that the grinding rollers 20 supported by carriers 19 for free rotation about their own central axes may swing radially outward from the central axis x under the influence of centrifugal force as the spider is rotated. As the rollers swing outwardly they will engage the stationary bull-ring 21 and roll thereon, or against material to be ground that may be interposed between the rollers and bull-ring. The material to be ground is delivered into the mill housing by the means C which may comprise the rotary pocketed feed wheel 22, this material falling downwardly between the grinding rollers and bull-ring so as to be crushed or pulverized therebetween. The plows 23, also carried by the rotating assembly, pick up material that falls into the bottom of the casing and deliver it back between the grinding elements. The air stream entering the lower portion of housing A from manifold 6 flows upwardly through the grinding chamber and casing A carrying in suspension the material pulverized by the mill.

The separator D is preferably of the general type disclosed in the patent to Cook hereinabove referred to. The central rotary element of this separator is journaled for rotation about the central axis x and comprises a central disc or de-

flector 24 from which project a circular series of radially extending vanes 25, these vanes having their greatest width positioned vertically so as to present a minimum of obstruction to the upwardly flowing air stream. This rotary deflector or "whizzer" is carried by vertical shaft 26 journaled in gear casing 27 supported from the outer casing 11 by a plurality of radially extending plates 28. The whizzer is rotated by any suitable means, preferably a motor 29 operatively connected with shaft 26 through horizontal shaft 30 and suitable gearing in the casing 27. Preferably a variable speed motor is used, or speed change gearing may be interposed between this motor and shaft 30. The outer ends of vanes 25 are beveled inwardly and upwardly and rotate in close proximity to the lower surface of the downwardly and outwardly projecting annular conical deflector 31 carried by the inner surface of casing 10. The supporting means comprises an annular plate 32 which projects over the upper outer end portions of vanes 25. The upper end of outer casing 10 is closed by a top or cover plate 33 from the central portion of which the outlet conduit 2 leads upwardly.

Referring now also to Figs. 3 and 4, as well as Fig. 1, it will be noted that the only path through separator D for this upwardly flowing air stream is through the annular space between the central disc or deflector 24 and the outer stationary deflector 31, and between the rapidly rotating vanes 25 which cut across this annular space. Only finely divided particles of material held in suspension in the air stream will find their way upwardly between these vanes. The greater portion of the material above a certain size will be thrown outwardly against the stationary deflector 31 and thence directed downwardly through casing A.

There is an additional classifying zone 34 above the rotary whizzer in which a further separation process takes place. The air in this zone is whirling rapidly due to the motion imparted thereto by the rotating whizzer, and the heavier particles of the material that have passed the whizzer will be thrown by centrifugal force to the outer portion of this zone and will settle down on the annular shelf 32, as indicated in broken lines at 34' in Fig. 3. This material will eventually drop back between the rotating vanes 25 and settle downwardly, together with the other rejected material through casing A so as to be returned to the grinding process. Only the very finely divided material will eventually be carried out in suspension in the air stream through outlet conduit 2. The general path of this air stream is indicated by the arrows in Fig. 3, although it will be understood that the whirling motion of this air stream in separating space 34 is not indicated. The fineness of this delivered material will depend, within certain limits, on the speed of rotation of the rotary whizzer, but additional grading or classification is obtained by the adjustable damper means hereinafter described, which embody the principal improvements of this invention.

A plurality of these improved damper means G are supported at spaced intervals in a circular series on the annular top wall 33 of the casing A. In the present example four of these dampers are used, spaced at 90° intervals. Each of these assemblies G comprises a substantially semi-circular damper 35 positioned in a vertical plane and secured on a short horizontal shaft 36 journaled in brackets 37 positioned radially on top

5 wall 33. When in the normal position shown in Figs. 3 and 4, this damper is positioned entirely outside of separating space 34, but as shaft 36 is rotated this damper 35 will be moved downwardly into the separating space 34 through slot 38 in top wall 33. The damper 35 is enclosed by a housing 39 outside of the casing and also supported by brackets 37. This housing not only protects the damper but also prevents the flow of air or suspended materials through slot 38. An adjusting crank arm 40 is secured at 41 on one end of horizontal shaft 36. A short auxiliary arm 42 and a spacing block 43 are secured on the rear of crank arm 40, at a position intermediate the length thereof by securing bolts 44. The arm 42 engages against the rear face of the guiding and clamping segment 45 mounted on the front face of housing 39. A clamping screw 46 threaded through a boss 47 on arm 40 is adapted to be adjustably engaged with the front face of segment 45 and thus clamp this segment between screw 46 and auxiliary arm 42 to lock the adjusting arm in any selected position. By loosening the thumb screw 46 the arm 40 and damper 35 may be swung in either direction through an angle of approximately 90°, and then locked in any selected position by tightening the thumb screw 46.

Let it first be assumed that each of these dampers is swung to the position indicated in solid lines in Fig. 1, or in broken lines at *a* in Fig. 3. When in this position the damper will interfere with, or impede to some extent, the free whirling motion of the air stream in separating space 34. Eddy currents will be set up in the outer portion of this separating space which will tend to prevent the settling out of heavy material as indicated at 34'. As a result, more of this heavier or larger material will be carried out in suspension in the air stream through outlet conduit 2. This effect will be accentuated as the damper is successively swung downward to such positions as indicated at *b* and *c* in Fig. 3, the maximum effect being attained when the damper is swung to the extreme position *c*. A much smaller impeding effect is produced when the damper is swung in the opposite direction to the positions indicated at *d*, *e*, and *f*, the least effect being at *d* and the greatest at *f*.

The maximum fineness of the material delivered from the separator is obtained when the damper is entirely removed from the separating space to the normal position shown in Figs. 3 and 4. A minimum effect, that is to only slightly increase the coarseness of the delivered material, is obtained when the damper is swung down in a counter-clockwise direction, this effect being increased as the damper approaches the position *f*. A much greater effect is obtained when the damper is swung in the opposite direction to the positions *a*, *b* and *c*, a maximum coarseness being obtained when the damper is in the position *c*. It will be understood that the several positions hereinabove described are merely illustrative, and that intermediate positions can be selected.

Alternatively, the operating handle 40 may be removed and replaced at a position substantially 90° from the position here shown when the damper is in withdrawn position. It may be replaced in either of two positions so that the damper can be adjusted in either a clockwise or counter-clockwise direction through arcs of substantially 180°. In this way the damper may be

adjusted to a great variety of positions within the separating space, and in each of these positions there will be a different variation in the grade or fineness of the material delivered from the separator. As a general rule, the greater the portion of the damper that is positioned within the separating space, the coarser will be the delivered material. As already noted, the least effect is obtained when the damper is rotated in a counter-clockwise direction, and the maximum effect is obtained when the damper is turned in a clockwise direction. All of this is with reference to the particular damper disclosed in Fig. 3. It will be understood that each of the individual dampers is adjusted in a similar manner, the best effect being obtained when all of the dampers are adjusted to similar positions. Any suitable number of these dampers may be used, satisfactory results having been obtained with four dampers, as herein disclosed.

I claim:

1. In combination, an upright casing, means for causing an air stream to flow upwardly through the casing carrying finely divided solid material in suspension, said casing having an annular top wall surrounding a centrally positioned outlet for the air stream, a rotary whizzer pivoted about the central vertical axis of the casing and projecting at its periphery into proximity to the casing wall, the whizzer being formed with openings in its outer portion for the passage of the air stream, means for rotating the whizzer, a non-rotary annular member carried by the casing wall and spaced downwardly from the top wall of the casing to provide, with the whizzer, the lower wall of an inwardly open annular separating space in which the air stream whirls, an annular series of dampers positioned to be projected to selected positions in the separating space, each damper comprising a substantially semi-circular plate centrally pivoted about a horizontal axis adjacent the casing wall and adapted to be rotated in a vertical plane through a slot in the wall to selected positions within the separating space, and means for rotating the plate and holding it in adjusted position.

2. In combination, an upright casing, means for causing an air stream to flow upwardly through the casing carrying finely divided solid material in suspension, said casing having an annular top wall surrounding a centrally positioned outlet for the air stream, a rotary whizzer pivoted about the central vertical axis of the casing and projecting at its periphery into proximity to the casing wall, the whizzer being formed with openings in its outer portion for the passage of the air stream, means for rotating the whizzer, a non-rotary annular member carried by the casing wall and spaced downwardly from the top wall of the casing to provide, with the whizzer, the lower wall of an inwardly open annular separating space in which the air stream whirls, an annular series of dampers positioned to be projected to selected positions in the separating space, each damper comprising a substantially semi-circular plate centrally pivoted about a horizontal axis adjacent the casing wall and adapted to be rotated in a vertical plane through a slot in the wall to selected positions within the separating space, means for rotating the plate and holding it in adjusted position, and an enclosing housing for the plate and slot mounted on the exterior of the casing wall.

3. In combination, an upright casing, means for causing an air stream to flow upwardly

through the casing carrying the finely divided solid material in suspension, said casing having an annular top wall surrounding a centrally positioned outlet for the air stream, a rotary whizzer pivoted about the central vertical axis of the casing and projecting at its periphery into proximity to the casing wall, the whizzer being formed with openings in its outer portion for the passage of the air stream, means for rotating the whizzer, a non-rotary annular member carried by the casing wall and spaced downwardly from the top wall of the casing to provide, with the whizzer, the lower wall of an inwardly open annular separating space in which the air stream whirls, an annular series of dampers positioned to be projected to selected positions in the separating space, each damper comprising a substantially semi-circular plate centrally pivoted about a horizontal axis adjacent the casing wall and adapted to be rotated in a vertical plane through a slot in the top wall of the casing to selected positions within the separating space, and means for rotating the plate and holding it in adjusted position.

4. In combination, an upright casing, means for causing an air stream to flow upwardly through the casing carrying the finely divided

solid material in suspension, said casing having an annular top wall surrounding a centrally positioned outlet for the air stream, a rotary whizzer pivoted about the central vertical axis of the casing and projecting at its periphery into proximity to the casing wall, the whizzer being formed with openings in its outer portion for the passage of the air stream, means for rotating the whizzer, a non-rotary annular member carried by the casing wall and spaced downwardly from the top wall of the casing to provide, with the whizzer, the lower wall of an inwardly open annular separating space in which the air stream whirls, an annular series of dampers positioned to be projected to selected positions in the separating space, each damper comprising a substantially semi-circular plate centrally pivoted about a horizontal axis adjacent the casing wall and adapted to be rotated in a vertical plane through a slot in the top wall of the casing to selected positions within the separating space, means for rotating the plate and holding it in adjusted position, and an enclosing housing for the plate and slot mounted on the exterior of the top casing wall.

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