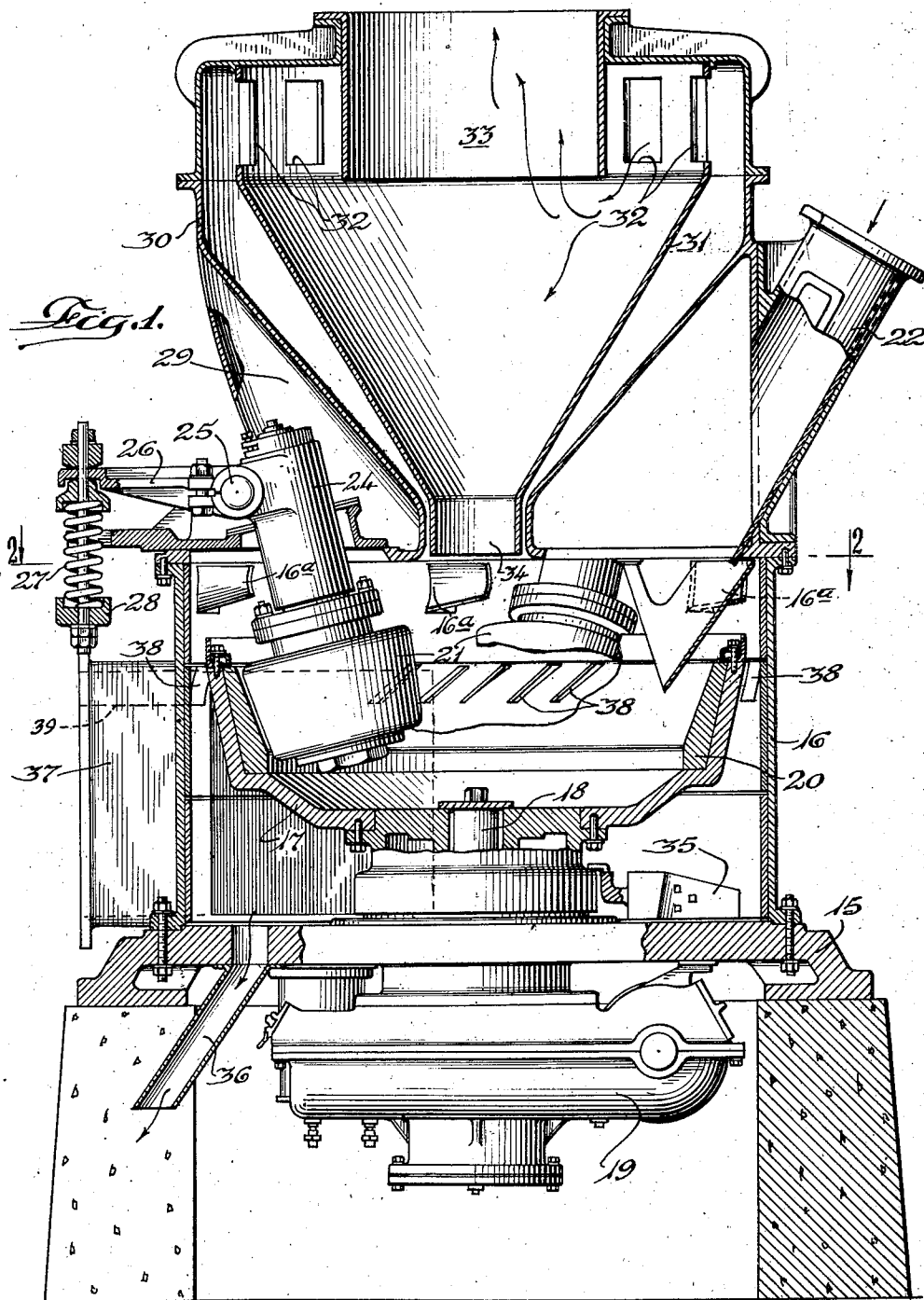


Dec. 2, 1947.

G. H. FRANGQUIST
BOWL MILL WITH VANE MEANS PROVIDING UNIFORM
VELOCITY UPWARDLY SWIRLING AIR CURRENTS
Filed Aug. 25, 1944

2,431,746

3 Sheets-Sheet 1



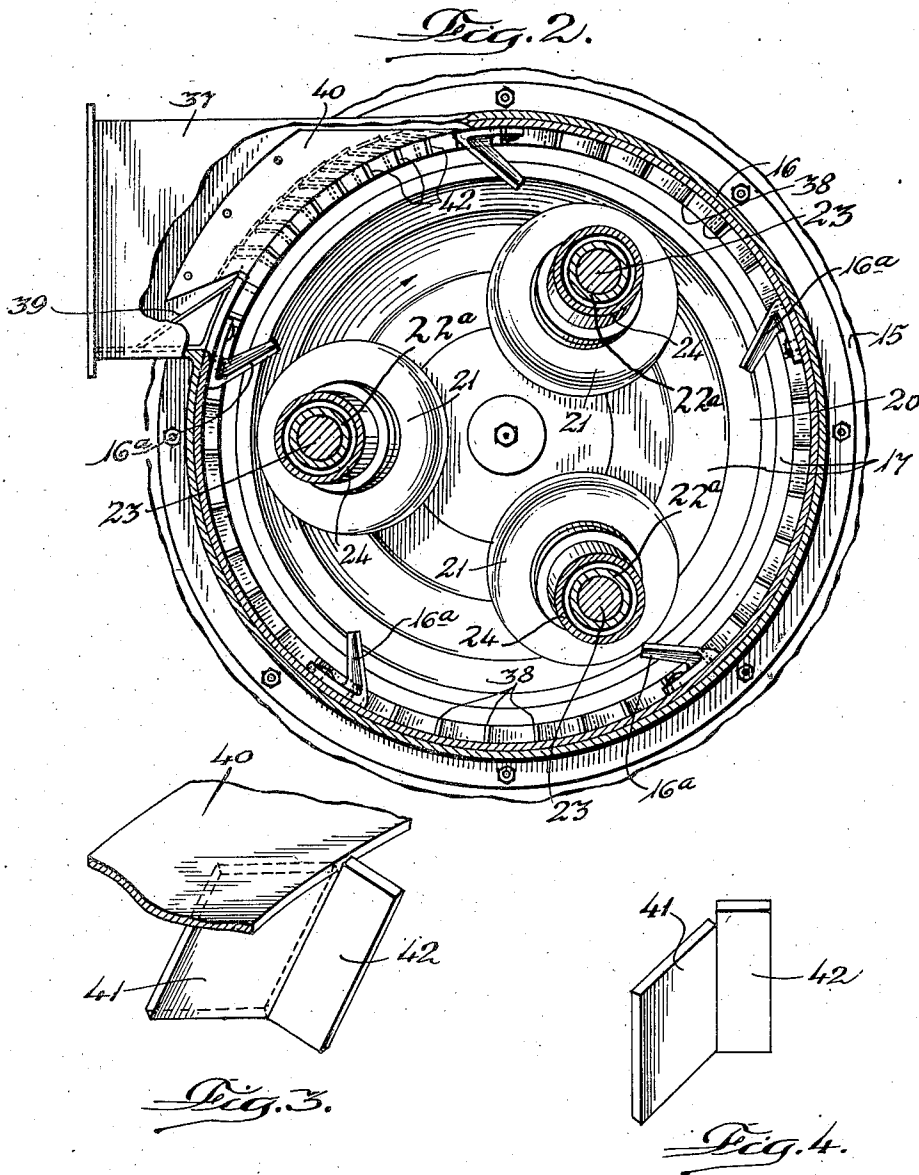
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Fig. 5.

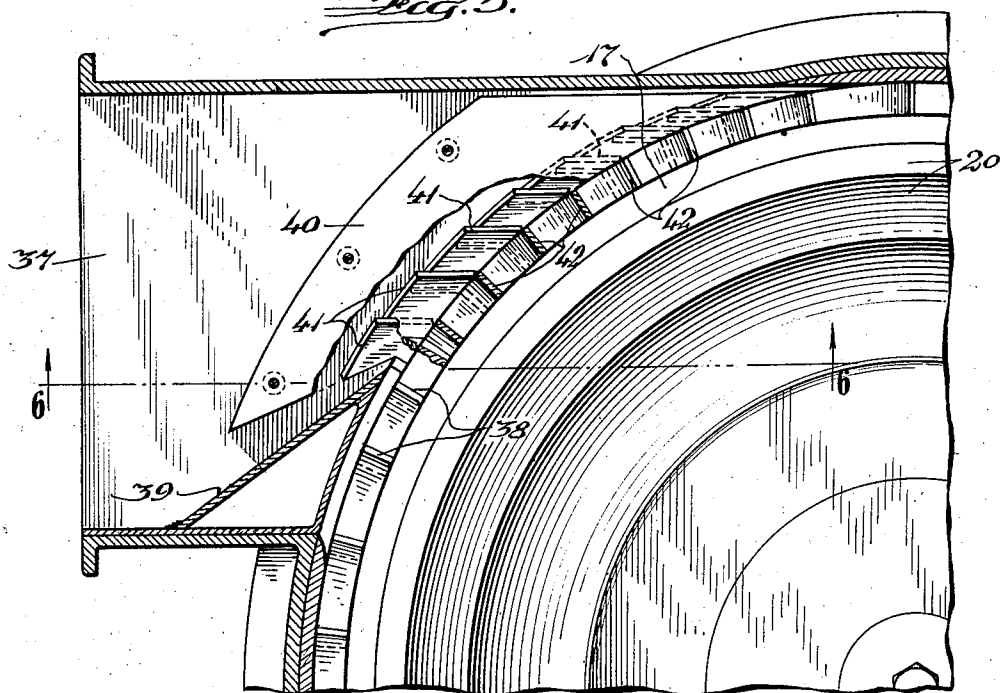
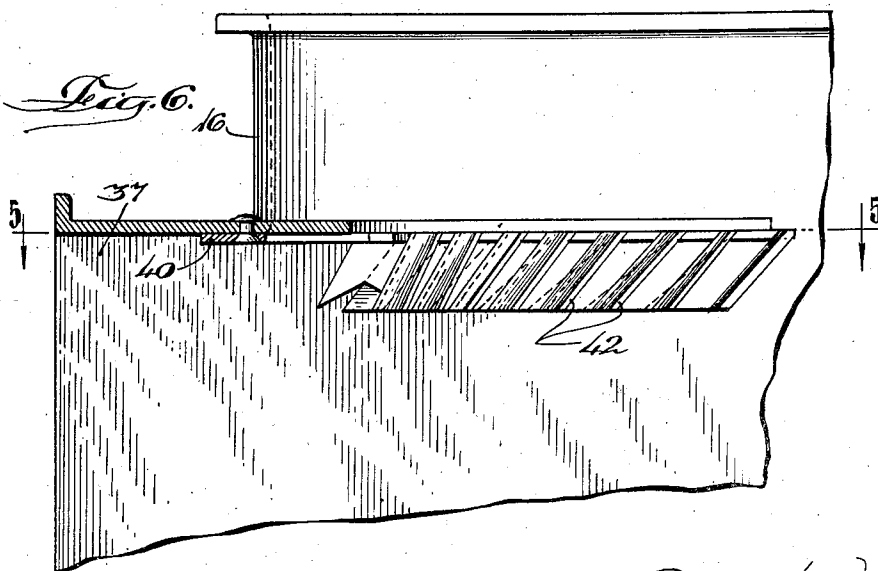


Fig. 6.



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UNITED STATES PATENT OFFICE

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ING AIR CURRENTSGustav H. Frangquist, Chicago, Ill., assignor to
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4 Claims. (Cl. 241—53)

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This invention relates to pulverizing apparatus and has for its principal object the provision of a new and improved form and arrangement of parts whereby the air currents, utilized for carrying the pulverized material out of the apparatus, may be maintained at uniform velocity at all locations within the apparatus whereby the material, when sufficiently pulverized, will be discharged without undue suspension and consequent circulation of the heavier particles of material in the air current.

The invention as herein illustrated is designed particularly for use in connection with bowl mills, such as are illustrated in the Crites United States Patent No. 2,112,359, granted March 29, 1938, although the invention is not to be restricted to use in connection with such apparatus, except so far as the claims may be so limited.

In a pulverizing apparatus of the general class herein shown, a comparatively shallow bowl is given rotary movement about a vertical axis within a closed casing or housing. Two or more rollers are rotatably mounted and extend into the bowl so as to have a crushing effect on particles carried around on the upwardly and outwardly inclined face of the bowl. The parts are arranged so that there is an annular opening between the outer wall of the bowl and the inner wall of the housing through which air introduced in the space below the bowl moves upwardly so as to pick up and float away pulverized material forced over the edge of the bowl.

One object of the invention is to provide an improved arrangement whereby the air introduced into the housing will be so distributed about the periphery of the bowl as to avoid the formation of high and low velocity zones in the air and thereby prevent substantial quantities of insufficiently pulverized material from being suspended in the higher velocity air zones and carried upwardly through the apparatus. This result has been accomplished in the preferred construction by the use of an arrangement comprising a series of vanes in spaced relation to each other about the bowl, such vanes being in substantially radial position but disposed obliquely at a suitable angle from the horizontal, with the upper ends of the vanes in the lead with respect to the direction of rotation of the bowl. The size of the annular opening between the bowl and the wall of the casing or housing is such with respect to the size of the stream of air introduced into the housing that the distribution of the air about the entire periphery of the bowl is assured, and the angular positions of the

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vanes insure that the several portions of the stream of air between successive vanes shall be directed forwardly and upwardly with respect to the direction of rotation of the bowl and that oversized material, finding entrance between the vanes will be deflected upwardly thereby and carried in the air stream back into the bowl of the mill.

Another object of the invention is to include the provision of the improved constructions and arrangements herein shown and described in connection with one approved form of apparatus.

Fig. 1 is a central vertical sectional view through one preferred form of bowl mill, showing the improvement of the present invention incorporated therein.

Fig. 2 is a horizontal sectional view taken substantially at the line 2—2 of Fig. 1.

Fig. 3 is a perspective view of a fragmentary portion of a horizontal plate mounted at the upper face of a duct through which air is delivered into the apparatus, showing in position one of the vanes of that portion of the series of vanes.

Fig. 4 is a perspective view of the vane structure of Fig. 3.

Fig. 5 is an enlarged detail view substantially similar to a portion of Fig. 2, being substantially a horizontal sectional view taken at the line 5—5 of Fig. 6, and

Fig. 6 is a vertical sectional view taken substantially at the line 6—6 of Fig. 5.

Referring now to the several figures of the drawings, in which corresponding parts are indicated by the same reference characters, 15 indicates a base plate suitably secured in position, upon which a housing or casing 16 is fixedly mounted. Within the housing 16, a bowl 17 of approved type is rotatably mounted so as to be driven through the medium of a vertical shaft 18 which in turn is driven by suitable driving mechanism in the gear housing 19 below the base plate 15 so as to cause the bowl to rotate in clockwise direction in Fig. 2.

In the arrangement shown, the bowl 17 is provided with a grinding ring 20, with which three rollers 21 cooperate for crushing and pulverizing material fed into the bowl through a chute 22. Each of the rollers 21 is rotatably mounted in position by means comprising a sleeve assembly 22^a engaging the roller and freely rotatable on a shaft 23. The shaft is fixed in an outer sleeve 24 which is pivotally mounted on a horizontal axis at 25. An arm 26 fixedly mounted on the sleeve 24 has an effective bear-

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ing on the upper end of a coiled spring 27, the lower end of which bears against a bracket 28 held rigidly in position with respect to the housing 16. The arrangement is such that the springs 27 press the rollers 21 yieldingly toward the grinding ring 20. As is best shown in Fig. 1, each of the sleeves 24 extends upwardly through a suitable opening at the top face of the housing 16 into a deep inwardly pressed groove 29 in the outer face of an extension casing member 30 secured above the casing member 16, means being provided preferably about the sleeves 24 for preventing the escape of air.

As is best shown in Fig. 1, the bowl 17 is spaced a short distance from the inner face of the housing 16 so as to provide an annular opening between the bowl and the housing, the arrangement being such that a stream of air introduced either by suction or pressure into the housing 16 below the bowl is caused to rise through the annular opening so as to pick up and float away particles of material which have been sufficiently pulverized in the bowl of the mill and forced upwardly and outwardly therefrom during the grinding operation. The suspended particles which are insufficiently pulverized are deflected inwardly by angular deflectors 16^a, secured to the inner wall of the housing, and thereby returned to the bowl 17 for further reduction. It is the principal object of the present invention to provide an improved arrangement by which a stream of air fed into the housing 16 is caused to be distributed as desired about the periphery of the bowl, it being the object in many instances to make the distribution of the air substantially uniform throughout the entire circumference of the bowl.

The air rising through the annular opening between the bowl and the housing passes upwardly along opposite sides of the inwardly pressed portions 29 of the housing and is carried upwardly along the upwardly flared shell 31, thence through a series of openings 32 through the upper edge portion of the shell 31. The air is then deflected downwardly a short distance in order to gain access to the delivery pipe 33 through which the air and the particles held suspended therein are discharged from the apparatus. The force of the air is such as to hold in suspension particles of the material being pulverized which approximate a predetermined size and weight. Any particles of material of excessive size carried by the air stream above the deflectors 16^a will be caused to pass on downwardly when the direction of the air changes at the lower end portion of the pipe 33, such oversize particles being delivered through an opening at 34 through the shell 31 again into the bowl 17 directly below for further pulverizing action.

The means for causing the desired distribution of the air stream about the periphery of the bowl 17 will now be described. Preferably the size of the air stream fed into the housing 16 is such with relation to the size of the annular opening between the bowl and the housing as to cause necessarily more or less distribution of the air about the bowl. The air is fed into the housing 16 through a duct 37. In the embodiment shown, the said duct 37 is located at one side of the center of the chamber and consequently causes the air to follow a circular path corresponding to the direction of rotation of the bowl 17 and to the general path of travel of the material discharged from the bowl.

As is best shown in Fig. 1, where a portion

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of the bowl 17 and grinding ring 20 are broken away for clearness of illustration, a series of vanes 38 are fixedly mounted in the annular openings between the inner face of the wall of the housing 16 and the outer face of the bowl. The said vanes may be secured in position in any suitable manner, for example, welded directly to the wall of the housing. These vanes are in oblique position at an angle of about 45 degrees from the horizontal, and are of such length as to overlap vertically, the upper ends of the vanes being in advance in the direction of rotation of the bowl and in the direction of the rotational movement of the air stream. The said vanes 38, as will be seen by inspection of Fig. 1, are arranged in radial position, so as to divide the annular opening between the bowl and the wall of the housing 16 into a series of sections between the successive vanes. The vanes 38 are mounted in spaced relation to each other as described about the entire periphery of the bowl except for a short distance opposite to the duct 37 where an alternative arrangement is provided. This alternative construction includes an arrangement of vanes for stratifying the air in the upper portion of duct 37 adjacent the annular passage surrounding the bowl 17.

A baffle plate 39, having a height equal to the adjacent vanes 38, is provided within the duct 37 for deflecting the entering air, such baffle plate constituting in effect a portion of the wall of the housing 16 and having a plurality of vanes 38 mounted thereon.

Across the top face of the duct 37, a transversely positioned plate 40 is provided, having its inner edge curved in substantially concentric relation to the periphery of the bowl. Secured to the bottom face of the transverse plate 40 are a plurality of air stratifying plates 41 in oblique position at an angle of approximately 45 degrees from the horizontal and extending in substantially parallel relation with respect to each other and with respect to the duct 37. These plates 41 carry vanes 42 corresponding in size and shape with the vanes 38, and extending like the vanes 38 into close proximity to the periphery of the bowl 17. The vanes 42 are in radial position with respect to the bowl, and are obliquely disposed with each vane at an angle of about 45 degrees from the horizontal. The arrangement is such that the vanes 42 complete the series of vanes 38 so as to provide similarly functioning vanes about the entire periphery of the bowl.

With a stream of air entering the housing 16 through the duct 37, and with such stream of air moving in clockwise direction about the chamber of said housing 16 as seen in Fig. 2, such air finds its way readily between the vanes which are disposed so as to receive the air with a minimum of change of direction. The arrangement is such that the air is distributed quite evenly among the comparatively large number of openings between successive vanes, so as to be caused to rise close to the periphery of the bowl in position to pick up pulverized particles as they are forced upwardly and outwardly from the bowl.

The spaces between the several vanes 38 and between the several vanes 42 are such as to permit large pieces of waste material, for example tramp iron which may be present in the material being pulverized but which is not readily pulverized by the rollers 23, to pass downwardly between adjacent vanes and into the space beneath the bowl. This waste material is swept

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from the bottom of the chamber beneath the bowl 17, by means of one or more scrapers 35, into a discharge chute 36. The oversize particles of coal, or other material being pulverized, which are relatively light in weight in relation to the trap iron waste material and which may find entrance in the spaces between the inclined vanes will be blown upwardly into the bowl, the inclined vanes serving as deflectors which co-operate with the force of the air stream to return such particles to the bowl of the mill. However, the heavier particles of foreign material will pass downwardly between the vanes into the lower chamber of the casing.

By the use of the improved construction, an effective control of the air current is assured so as to provide good results by the use of a minimum strength of air current and so as to enable the use of the pulverizing apparatus to advantage for pulverizing coal for feed directly to a furnace. With the air moving under control smoothly along the faces of the walls or at a sharp angle with respect thereto rather than moving with a high degree of turbulence directly toward the walls, the effectiveness of the air current for carrying away the pulverized particles by a flotation effect is greatly increased, and the efficiency of the apparatus is correspondingly increased.

While the form and arrangement of the parts as shown in the drawings and as above described are preferred, it is to be understood that the invention is not to be limited to such arrangement except so far as the claims may be so limited, changes being well made in the arrangement without departing from the spirit of the invention.

I claim:

1. A pulverizing apparatus, comprising in combination a housing, a bowl rotatably mounted in said housing with an annular opening between the bowl and the wall of the housing, means for rotating the bowl in said housing about a vertical axis, means operative in said bowl for pulverizing material fed to the bowl, a conduit for directing a stream of air into said housing in a path substantially tangent to the inner wall thereof so as to move upwardly through said annular opening and at the same time to move about the outer face of the bowl in the same direction as that in which the bowl is rotating, and vanes extending below the upper portion of said conduit and arranged in substantially radial position in said housing in spaced relation to each other at the inner face of the housing with their inner ends in close relation to the outer surface of the bowl so that the vanes divide the stream of air into a plurality of sections between successive vanes for obtaining a predetermined distribution of the air about the bowl.

2. A pulverizing apparatus, comprising in combination a housing, a bowl rotatably mounted in said housing with an annular opening between the bowl and the wall of the housing, means operative in said bowl for pulverizing material fed to the bowl, means for rotating the bowl in said housing about a vertical axis whereby the material pulverized therein is thrown outwardly therefrom and carried in a general circular path adjacent the wall of the housing, a conduit for directing a stream of air into said housing in a path substantially tangent to the inner wall thereof

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so as to move upwardly through said annular opening and at the same time to move about the outer face of the bowl in the same direction as that in which the bowl and said discharged material is moving, and vanes between said bowl and said housing arranged to extend below the upper portion of said conduit and in oblique position with their upper ends in advance with respect to the direction of rotation of said bowl so as to function as deflectors for returning oversize particles of material to the bowl.

3. A pulverizing apparatus, comprising in combination a housing, a bowl rotatably mounted in said housing with an annular opening between the receptacle and the wall of the housing means for rotating the bowl in said housing about a vertical axis, means operative in said bowl for pulverizing a material fed to the bowl, a duct leading into said housing opposite to said bowl for the introduction of a stream of air into the housing so as to rise through said annular opening, vanes mounted on the inner face of the housing in oblique position at a substantial angle from the horizontal in spaced relation to each other about the major portion of the housing, a transverse plate extending across the upper face portion of the duct adjacent to said bowl, and vanes mounted on said transverse plate to extend below the upper limits of the duct and arranged in oblique position corresponding to the position of said first-named vanes and serving with said first-named vanes to complete a series of vanes substantially about the periphery of the bowl.

4. A pulverizing apparatus, comprising in combination a housing, a bowl rotatably mounted in said housing with an annular opening between the bowl and the wall of the housing, means for rotating the bowl in said housing about a vertical axis, means operative in said bowl for pulverizing a material fed to the bowl, a duct leading into said housing opposite to said bowl for the introduction of a stream of air into the housing so as to rise through said annular opening, vanes mounted on the inner face of the housing in oblique position at a substantial angle from the horizontal in spaced relation to each other about the major portion of the housing, a transverse plate extending across the upper face portion of the duct adjacent to said bowl, a series of spaced apart supporting plates depending from said transverse plate opposite to said bowl, and vanes mounted on said supporting plates in oblique position corresponding to the position of said first-named vanes and serving with said first-named vanes to complete a series of vanes substantially about the periphery of the bowl.

GUSTAV H. FRANGQUIST.

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