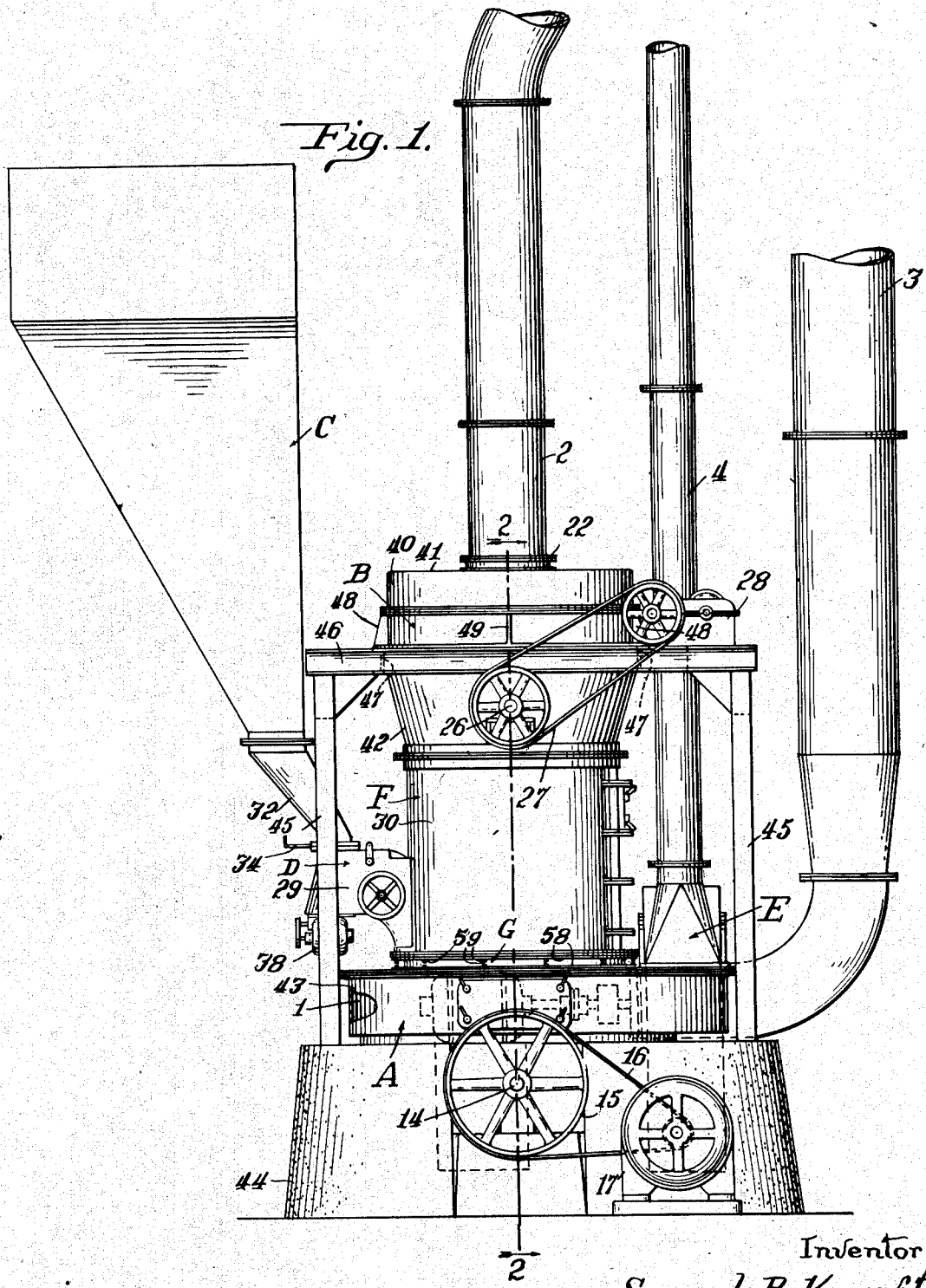
April 21, 1942. S. B. KANOWITZ 2,280,238

COMBINED MILL AND SEPARATOR

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Fig. 1.



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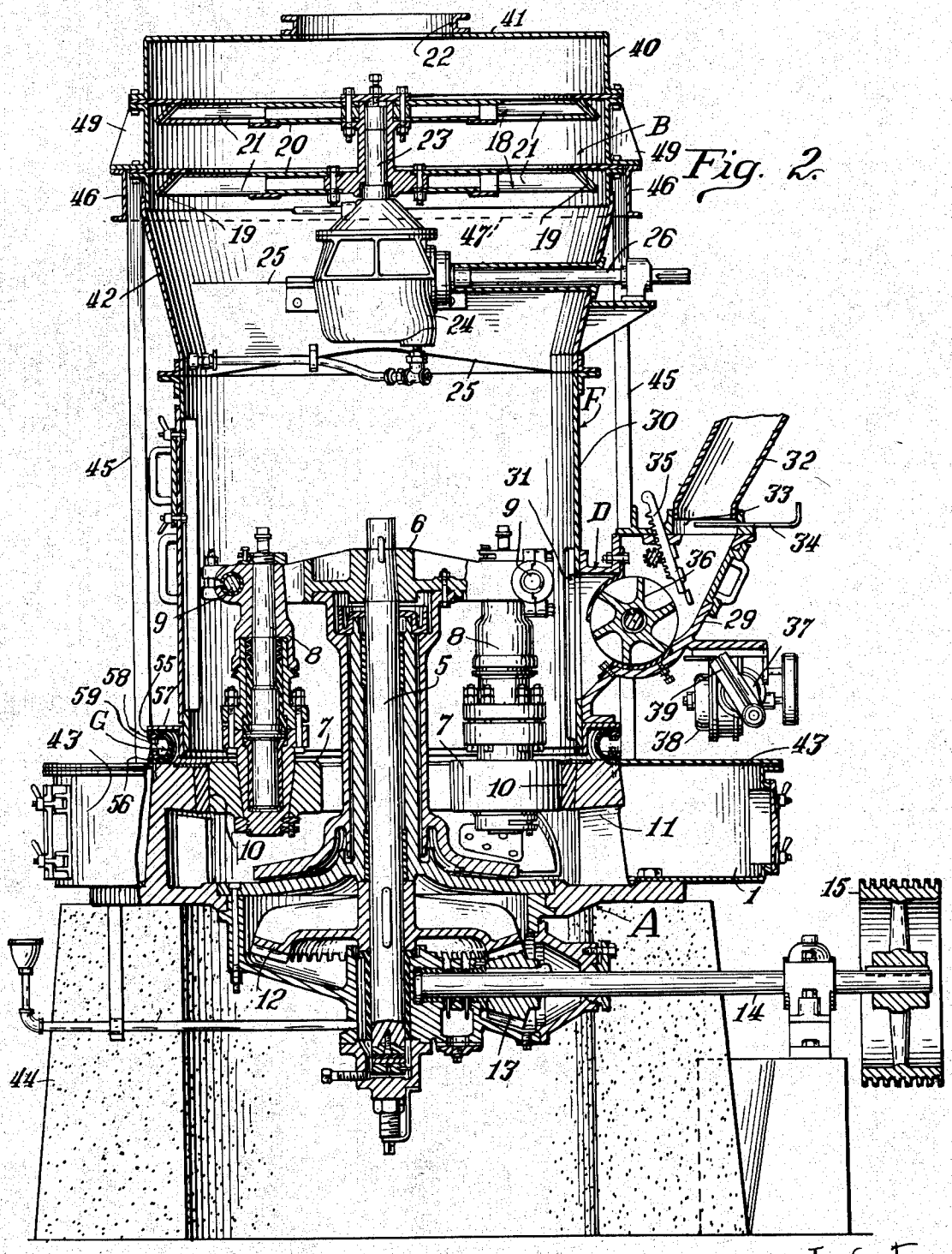


Fig. 2.

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Fig. 3.

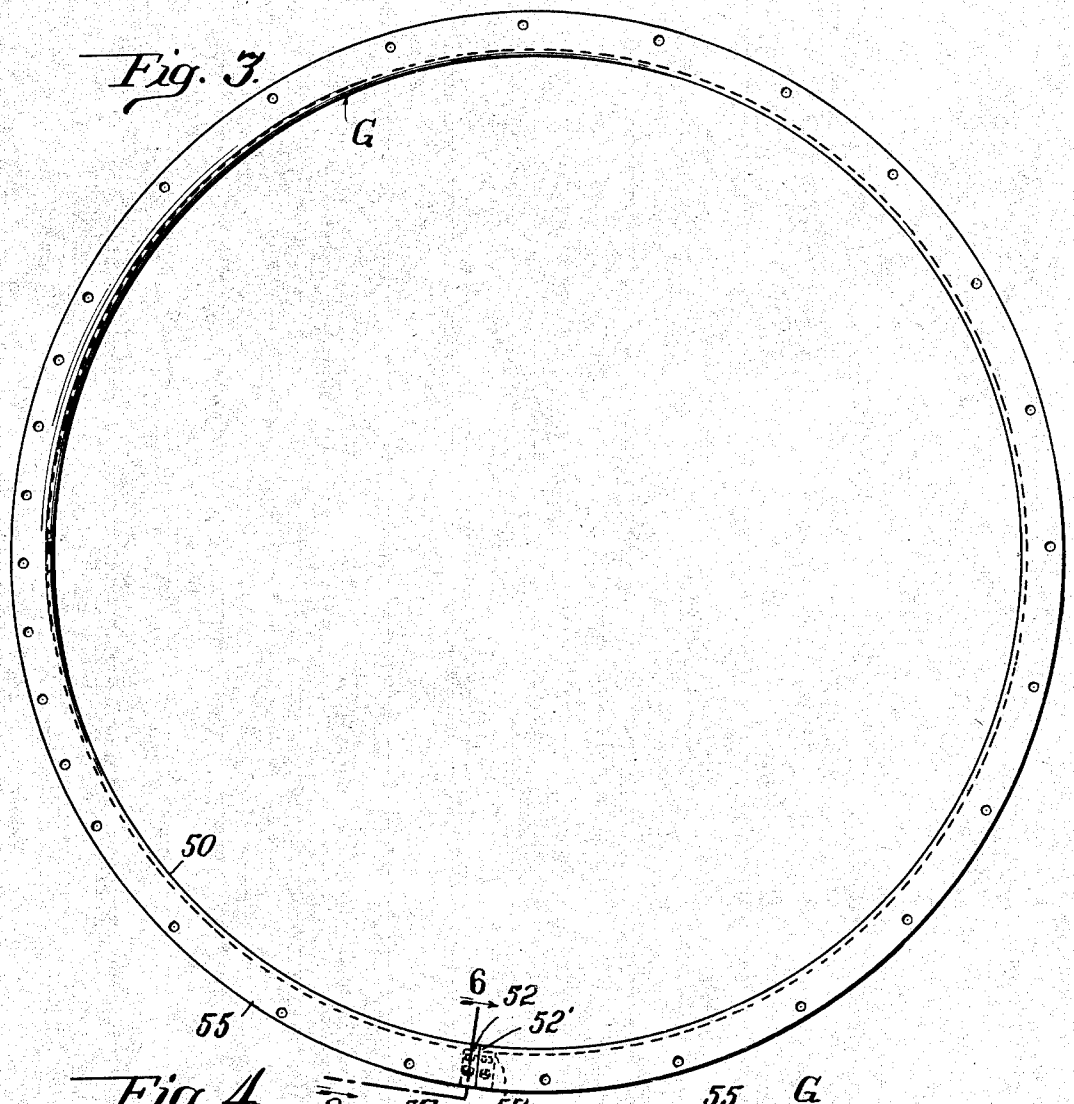


Fig. 4

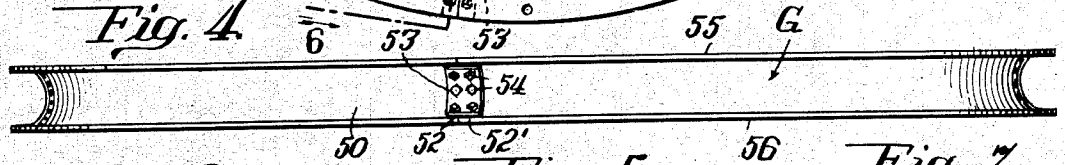


Fig. 6

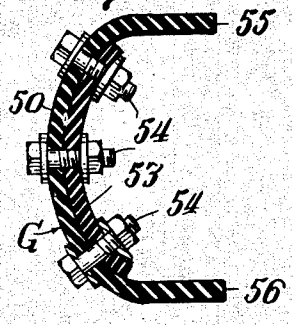


Fig. 5.

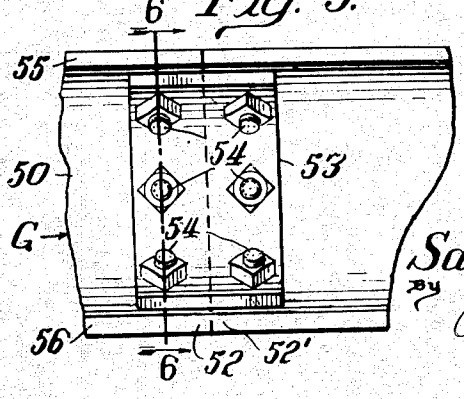
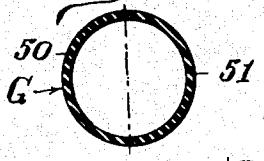


Fig. 7.



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UNITED STATES PATENT OFFICE

2,280,238

COMBINED MILL AND SEPARATOR

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Application December 31, 1938, Serial No. 248,769

5 Claims. (Cl. 83—45)

This invention relates to certain new and useful improvements in a combined mill and separator apparatus in which the separator, as well as the means for feeding new material to the mill to be ground, are supported entirely independent of the mill although remaining in their normal close operating positions relative to the mill, so that the effect of mill vibrations on the separator and feeder will be minimized.

It is customary in certain mill installations, particularly roller mills, to position a separating apparatus directly above the mill and enclosed in the same housing so that the ground material carried upwardly from the mill in an air stream will pass directly into the separator. Insufficiently ground material will be rejected by the separator and will fall back into the mill for further treatment, only the sufficiently pulverized material being carried upwardly in suspension in the air stream from the combined apparatus. Mechanically actuated feeding apparatus is also provided to introduce the new material to be ground into the mill at a controlled and uniform rate. Usually the separator and the feeding apparatus are supported directly from the mill through the single continuous housing. Consequently the rather violent vibrations of the mill assembly due to the movement of the heavy mill parts, and the shocks incident to crushing the material, will be transmitted through the housing to the separator and feeder mechanisms carried by this housing. Under certain conditions these vibrations may adversely affect the proper operation of the separator, and even cause injury to or breakage of certain of the relatively light parts of the separator. Furthermore, these vibrations will cause the material to pack in the feeder so that the feeding apparatus may not function properly.

According to the present invention the housing enclosing the mill and separator is divided into a lower mill housing and an upper separator housing. The mill assembly comprising the mill housing is supported on a fixed foundation. The separator assembly, comprising the separator housing, and also supporting the feeding apparatus, is suspended by separate supporting means in proper position over the mill assembly but entirely independently of the mill, and a flexible sealing means is utilized to join the two housing sections, so that one section may move or vibrate independently of the other. As a consequence the separator and feeding mechanisms will remain comparatively steady, except for the minor vibrations caused by the moving parts of these particular mechanisms.

The principal object of this invention is to provide an improved mill and separator combination such as briefly described hereinabove and disclosed more in detail in the specifications which follow.

Another object is to provide improved means for supporting the separator entirely independently of the mill with which the separator is directly associated.

Another object is to provide improved means for supporting the feeding mechanism entirely independently of the mill with which it is associated.

Another object is to provide an improved flexible means for connecting the separate housing sections which enclose the mill and separator.

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

In the accompanying drawing:

Fig. 1 is an elevation of a portion of the mill and separator installation.

Fig. 2 is a central vertical section taken substantially on the line 2—2 of Fig. 1. It may here be noted that the feeding mechanism shown at the left of Fig. 1 has been shifted through an angle of 90° in Fig. 2 so as to facilitate the disclosure. This feeding mechanism can be mounted at any convenient side of the mill-separator apparatus.

Fig. 3 is a plan view of the flexible sealing ring.

Fig. 4 is a side view of the sealing ring, looking upwardly from the bottom as shown in Fig. 3.

Fig. 5 is an enlarged detail of that portion of the sealing ring where the ends are joined.

Fig. 6 is a vertical section taken substantially on the lines 6—6 of Figs. 3 or 5.

Fig. 7 is a transverse section through a length of rubber hose, indicating how the sealing ring may be formed therefrom.

Referring first to Fig. 1, the mill assembly indicated generally at A is positioned below and in direct communication with the separator assembly indicated generally at B. The material to be ground (for example coal) is introduced into the mill from bin C by means of the automatic feeding mechanism indicated generally at D. The blower or exhauster E introduces an air stream tangentially into the air manifold I of the mill, the air stream flowing upwardly from the mill and carrying ground material up into

the separator B. This separator rejects insufficiently pulverized material which falls back into the mill for further treatment. The sufficiently pulverized material is carried upwardly by the air stream through conduit 2 into a cyclone separator (not here shown) which collects the pulverized material, the air flowing back through conduit 3 to the exhauster E. A suitably valved air vent pipe 4 is connected with a portion of this air circulating system, preferably between the exhauster E and the mill.

Referring now to Fig. 2, the mill is shown as of the roller type, although other suitable types of mills might be substituted. The mill comprises the central vertical drive shaft 5, rotatable about the central vertical axis of the mill and separator combination, and carrying at its upper end the spider 6 from which a circular series of grinding rollers is suspended. Each grinding roller 7 is freely rotatable about its own axis in a carriage 8 pivoted at 9 in spider 6 so that the roller will swing outwardly by centrifugal force against the stationary bull-ring 10. The material introduced by feeding mechanism D is ground between the rollers 7 and bull-ring 10, and the air stream which flows inwardly from air manifold 1 through openings 11 in the mill frame carries ground material in suspension upwardly through housing F to the separator B. The central vertical mill-shaft 5 is driven through beveled gears 12 and 13 from horizontal shaft 14 which carries at its outer end the belt pulley 15. This pulley is rotated through belt gearing 16 (Fig. 1) from the motor 17.

The separator B, which is supported in the upper portion of housing F, is of a known type comprising one or more rotary deflectors or whizzers 18 which cooperate with stationary annular deflectors 19. Each whizzer comprises a closed central disk portion 20 and a plurality of radially projecting vanes 21 which extend at their outer ends into proximity to the stationary deflectors 19. Only the very finely pulverized material will be carried through these rotary whizzers by the air stream and thence carried out through the upper outlet opening 22 and through conduit 2 (Fig. 1) to the cyclone separator. The larger particles of material will be rejected by the separator and will fall back into the mill for further grinding treatment. The rotary deflectors or whizzers are carried by a vertical shaft 23 centered about the central vertical axis of the mill and separator, shaft 23 being supported by central gear casing 24 carried by radially extending arms or braces 25 mounted on the walls of housing F. Shaft 23 is driven by gearing in casing 24 from the horizontal shaft 26 extending out through one side of housing F. Shaft 26 is driven through belt gearing 27 from a motor 28 (see Fig. 1). While the specific type of separator here shown and briefly described by way of example is preferred, other forms of separators could be used as far as the general features of the present invention are concerned.

The feeder mechanism D is of known type comprising a main casing 29 carried by the intermediate hollow cylindrical vertically extending portion 30 of the mill and separator housing F about an inlet opening 31 in the side of said housing section 30. The material to be ground is delivered from the spout 32 leading from bin C into the inlet opening 33 at the top of feeder casing 29. Adjustable valves 34 and 35 control the flow of material through casing 29 to the rotary pocketed feed wheel 36. A crank 37 actuated through suitable reduction gearing from motor 38 reciprocates a pitman 39 which (through ratchet mechanism not here shown) intermittently rotates the pocketed feeder 36 at a selected rate. In this way the material to be ground is introduced into the mill at a substantially uniform and controlled rate.

The mill and separator housing which has been designated as a whole by the reference character F comprises an upper cylindrical portion 40, closed at the top by wall 41 except for the central outlet opening 22, and an inwardly and downwardly tapering portion 42 extending to the top of the intermediate cylindrical portion 30 already referred to. The separator mechanism is enclosed and supported by these upper housing sections 40 and 42. The lowermost portion 43 of housing F encloses the air manifold 1 on the lower portion of the mill mechanism, this lower portion of the housing having a central upper opening of substantially the same diameter as the intermediate portion 30 of housing F. In the example here shown this intermediate portion 30 of the housing extends down so as to enclose the upper portion of the mill assembly and register at its lower end with the opening in the top of the lower housing section 43.

The mill assembly, comprising the lower portion 43 of the housing which is directly connected with the mill, is as usual supported on a fixed foundation comprising the concrete pedestals 44. The motor 17 which drives the mill is also mounted on a portion of this fixed foundation. In former installations of this general type the upper portion of the assembly comprising the upper housing sections and the separator and feeder mechanisms carried thereby have been attached to and directly supported by the lower mill assembly. There are rather heavy vibrations and shocks developed in the mill due to the movements of the heavy grinding elements and the crushing and grinding operations. These vibrations are transmitted through the housing to the separator and feeder mechanisms supported thereby. Consequently loosening of the connecting bolts and breakage of the lighter metal parts of the casing may develop and the moving elements of the mechanisms may become mis-aligned and unstable and further damage may result. Also these vibrations cause the material to pack in the feeder so that it does not function properly.

According to the present invention all of this upper assembly comprising the upper portion of the housing and the separator and feeder mechanisms is suspended in proper position above the mill assembly but quite independent of the mill assembly. The upper and lower portions of the complete housing are joined by a flexible connection which minimizes the transmission therethrough of the vibrations in the mill assembly. A supporting frame for the upper portion of the assembly comprises four posts or uprights 45 supported at their lower ends on foundation pedestals 44 and connected at their upper ends by cross beams 46 and transversely extending cross beams 47 (Fig. 1). Brackets 48 secured to diametrically opposite sides of the upper housing section 40 rest on the cross beams 47, and similar brackets 49 at 90° to the brackets 48 rest on the other cross beams 46. In this way all of the separator mechanisms comprising the three upper sections 40, 42 and 30 of the housing F are

suspended from this supporting frame and are not carried in any way by the mill assembly. The separator motor 28 is also conveniently mounted on this supporting frame as shown in Fig. 1. The feeder mechanism D is also suspended from the supporting frame since it is carried by the intermediate portion 30 of the housing. It may here be noted that, as far as the separator is concerned, the housing F may be divided at a higher point in the assembly. That is, part or all of the intermediate housing section 30 might be supported from the mill and form a part of the mill-housing. However, it is preferable to divide the housing at a lower level, as in the example here shown, in order that the feeder mechanism D may be carried by the separator assembly and still be positioned low enough to feed directly into the mill. In this description, and in the claims which follow, all of the housing sections which form a portion of the separator assembly and are supported independently of the mill assembly are considered as forming a part of the separator housing, although as a matter of fact the intermediate housing section 30 in the example here shown actually encloses an upwardly extending portion of the mill elements. That portion of the housing which forms a part of the mill assembly and is supported directly from the foundation 44 is considered as being the mill housing.

The flexible connection between the mill and separator housings, here designated as a whole by the reference character G, is shown more in detail in Figs. 3 to 7 inclusive. This flexible sealing member may be conveniently formed from a length of rubber hose of sufficiently large inside diameter, for example six inches. This hose is split longitudinally, as indicated in Fig. 7, into two half sections 50 and 51. Each of these sections will make one of the sealing rings. This hose section 50 or 51 is looped with the concave side outermost to form a continuous ring. The abutting ends 52 and 52' are secured together by a flexible arcuate strap member 53 which is preferably cemented to the two end portions of the ring and then additionally secured thereto by a plurality of bolts 54. The ring is flattened down to a somewhat smaller diameter than the original hose, for example four inches, thus providing upper and lower edge portions 55 and 56 which are respectively attached to the adjacent end portions of the separator and mill housings. As shown in Fig. 2, an annular angle collar 57 is secured to the lower outer end portion of the separator housing and the upper flange 55 of the flexible sealing member G is secured to the outwardly extending flange of this collar by means of a clamping ring 58 held in place by a circular series of spaced apart bolts 59. The lower flange 56 of the sealing member is secured in a similar manner to the mill housing 43 or a portion of the mill assembly adjacent the upper outlet opening of the mill. It will be apparent that this flexible sealing ring will close the joint between the relatively movable sections of the housing F, while at the same time this flexible member will absorb the greater portion of the vibrations that would otherwise be transmitted to the upper housing sections and the separating and feeding mechanisms.

I claim:

1. A grinding and separating unit comprising a mill, a separator positioned above and in direct communication with the mill, and an upright housing for enclosing both the mill and separator, said housing forming an enclosure through which material is carried upwardly in suspension in an air stream from the mill to the separator, and through which material rejected by the separator gravitates toward the mill, the housing being divided intermediate its top and bottom into an upper separator housing having an open lower end and a lower mill housing having an open upper end, a fixed foundation on which the mill assembly comprising the mill housing is supported, means for supporting the separator assembly comprising the separator housing in position above the mill assembly, said latter means comprising uprights supported on the foundation independently of the mill assembly and cross-beams carried by the uprights, means for suspending the separator housing from the cross-beams, and means for sealing the connection between the adjacent ends of the mill and separator housings, said sealing means permitting relative movements of the housings.

2. A grinding and separating unit comprising a mill including rotary grinding elements, a separator positioned above and in direct communication with the mill, said separator including a rotary deflecting member, and an upright housing enclosing both the mill and separator, said housing forming an enclosure through which material is carried upwardly in suspension in an air stream from the mill to the separator, and through which material rejected by the separator gravitates toward the mill, the housing being divided intermediate its top and bottom into an upper separator housing having an open lower end and a lower mill housing having an open upper end, a motor means for actuating the mill elements, a motor means for actuating the rotary element of the separator, a fixed foundation on which the mill assembly comprising the mill housing is mounted, a structure for supporting the separator assembly comprising the separator housing in position above the mill assembly, said supporting structure comprising uprights mounted on the foundation independently of the mill assembly and cross-beams carried by the uprights, means for suspending the separator housing from the cross-beams, the second motor means also being carried by the supporting structure, and means for sealing the connection between the adjacent ends of the mill and separator housings, said sealing means permitting relative movements of the housings.

3. A grinding and separating unit comprising a mill including rotary grinding elements, a separator positioned above and in direct communication with the mill, said separator including a rotary deflecting member, and an upright housing enclosing both the mill and separator, said housing forming an enclosure through which material is carried upwardly in suspension in an air stream from the mill to the separator, and through which material rejected by the separator gravitates toward the mill, the housing being divided intermediate its top and bottom into an upper separator housing having an open lower end and a lower mill housing having an open upper end, a motor means for actuating the mill elements, a motor means for actuating the rotary element of the separator, a fixed foundation on which the mill assembly comprising the mill housing is mounted, a structure for supporting the separator assembly comprising the separator housing in position above the mill assembly, said

supporting structure comprising uprights mounted on the foundation independently of the mill assembly and cross-beams carried by the uprights, means for suspending the separator housing from the cross-beams, the second motor means also being carried by the supporting structure, and a flexible endless sealing member positioned between and attached to the adjacent open end portions of the mill and separator housings.

4. A grinding and separating unit comprising a mill and a separator positioned above and in direct communication with the mill, the mill assembly comprising a housing having a substantially circular upper opening, the separator assembly comprising a housing having a substantially cylindrical lower portion open at its lower end and having a diameter sufficient to enclose a portion of the mill assembly and register with the upper opening of the mill housing so as to form a continuous enclosure for the mill and separator through which enclosure material flows in both directions between the mill and separator, a fixed foundation on which the mill assembly is supported, means for supporting the separator assembly in position above the mill assembly, said latter means comprising uprights supported on the foundation independently of the mill assembly and cross-beams carried by the uprights, means for suspending the separator assembly from the cross-beams, and a flexible sealing ring positioned between and attached adjacent its upper and lower edges respectively to the open end portions of the mill and separator housings.

5. In combination, a mill assembly and an apparatus for feeding material at a controlled rate into the mill, the mill assembly comprising a lower housing having an upper opening, a fixed foundation on which the mill assembly is supported, an upper housing having a lower open end portion adapted to register with the upper opening of the lower housing so as to form with the lower housing a continuous conduit through which material in suspension in air flows upwardly from the mill and through which material to be ground passes downwardly to the mill, the feeding apparatus being supported entirely by the upper housing independently of the mill assembly, and means for suspending the upper housing and feeding apparatus comprising uprights supported on the foundation independently of the mill assembly and cross-beams carried by the uprights, means for suspending the upper housing from the cross-beams, and a flexible sealing ring positioned between and attached adjacent its upper and lower edges respectively to the upper and lower housings.

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