Aug. 18, 1931. H. HARDINGE 1,819,093

JOINT SEAL

Filed Aug. 31, 1929 3 Sheets-Sheet 1

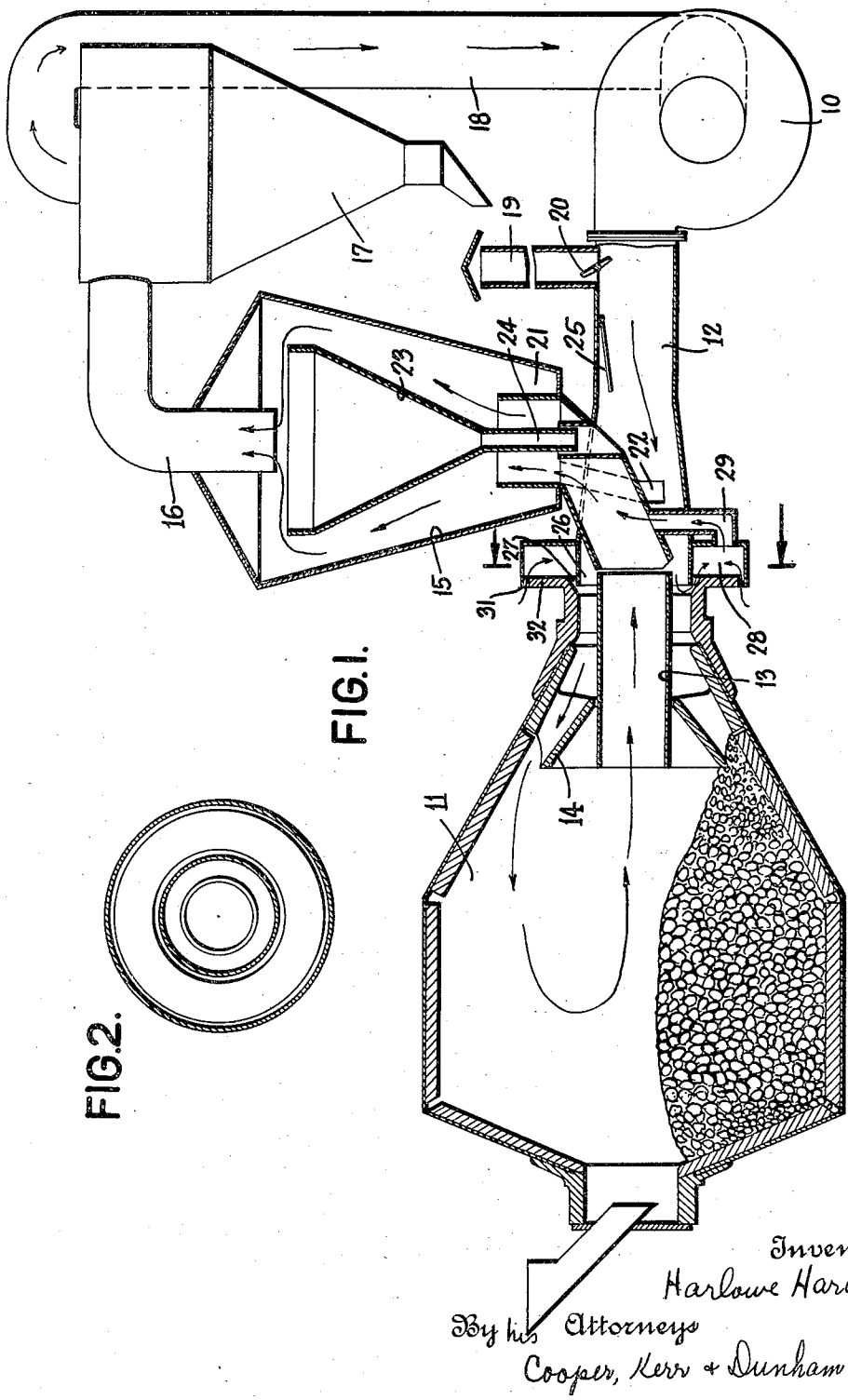


FIG. 1.

FIG. 2.

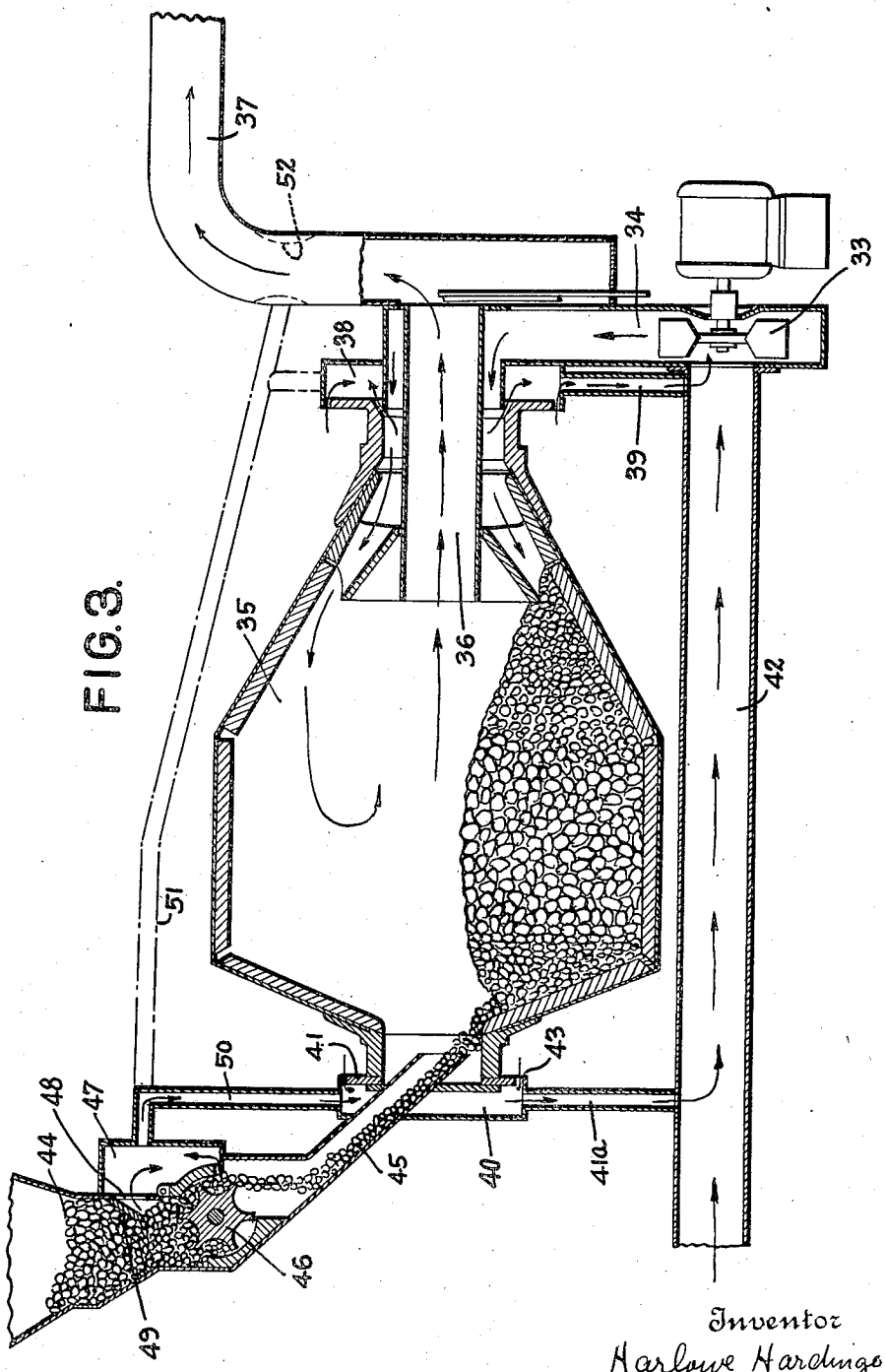
Inventor
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FIG. 3.



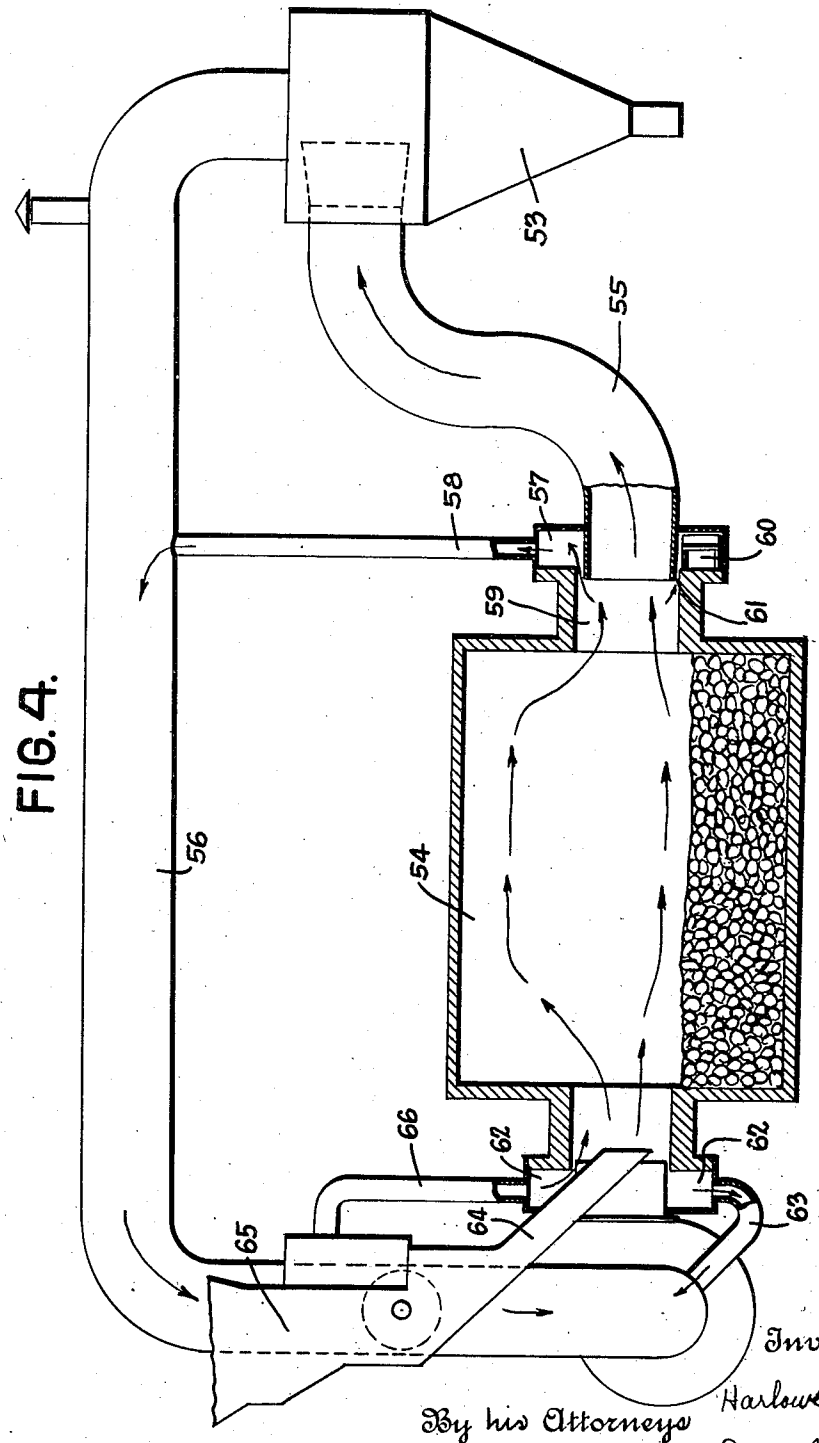
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FIG. 4.



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Patented Aug. 18, 1931 1,819,093

UNITED STATES PATENT OFFICE

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JOINT SEAL

Application filed August 31, 1929. Serial No. 389,705.

This invention relates to seals for joints between rotary and non-rotary connections through which elastic fluids are passed under pressure conditions differing from prevailing pressures at the outside of the connections, and, more particularly, to seals for preventing the loss of fine material likely to escape with air or other elastic fluid at the joints between a rotary pulverizing mill and cooperatively connected stationary conduits through which the air is passed as it enters and leaves the pulverizing mill.

Among the objects of the invention is to provide means whereby the joints of a pulverizing mill may be sealed so as to prevent the escape of air or other elastic fluid which is used for conveying product from the pulverizing mill.

Other objects and advantages will be pointed out hereinafter in the description and claims and illustrated in the drawings in which:

Fig. 1 is an elevation, partly in section, of a classification system for pulverized materials.

Fig. 2 is a section on line 2—2 of Fig. 1.

Fig. 3 is a sectional elevation of a pulverizing mill connected for use for pulverizing coal for delivery to a furnace.

Fig. 4 illustrates a classifying system for pulverized material in which the fluid medium enters at one end of the pulverizer and leaves at its other end.

In Fig. 1 I have shown my invention associated with a classification system for pulverized material similar to that disclosed and claimed in United States Patent No. 1,721,594. This system is one in which air or other elastic fluid which conveys the fine product is caused to circulate continuously through the system by blower 10 which discharges directly into the discharge end of a pulverizing mill 11 through a conduit 12. The pulverizing mill illustrated in Fig. 1 has an annular passage confined by conduit 13 and conical wall 14 through which air from conduit 12 passes as it enters the mill. Within the mill the direction of the current of air is reversed and in passing through the mill the current of air picks up fine particles which are desired to be collected. The air ladened with material leaves the mill through outlet conduit 13 and enters the outer chamber of classifier 15 from whence it passes from the classifier through conduit 16. Conduit 16 is connected with a cyclone dust collector 17 in which the material is relieved from the air by the action taking place within the collector. The air is drawn from the collector through conduit 18 by means of blower 10 whose suction side is connected with conduit 18. Vent 19 and butterfly valve 20 comprise means by which variations in pressure within the system may be controlled, vent 19 normally permitting excess air to leave the system.

When the material laden air flowing through conduit 13 enters the outer chamber of the classifier 15 its velocity is lessened and its carrying capacity is reduced with the result that material of undesired coarseness drops to the lower portion 21 of the classifier. Material collecting in this lower portion 21 finds its way through conduit 22 to the air conduit 12 and is blown back into the pulverizing mill 11 where it may be subjected to further pulverization. Also, any coarse material which drops into the inner cone 23 of the classifier descends through conduit 24 into the stream of air passing through conduit 12 and is thereby returned to the pulverizer. Damper 25 is conveniently positioned within conduit 12 for the purpose of controlling the velocity and course of air in the vicinity of the lower end of conduit 24.

In systems of this kind there is at least one joint between rotary and non-rotary members because of the fact that the pulverizing mill is rotated when in operation. It has heretofore been the practice to make as tight a fitting joint as possible between such members and in the type of system hereinabove described these members consist of the end of the pulverizing mill and the end 26 of conduit 12. From a practical point of view it is impossible to create a joint of this character sufficiently tight to prevent the loss of some air and the loss of whatever fine material the escaping air may carry with it.

The result is that the room which is occupied by the pulverizing mill 11 is likely to become dusty and consequently cause all kinds of disagreeable and sometimes injurious effects which are desired to be avoided in an efficient plant. Only by the use of very expensive means is it possible to seal such a joint sufficiently to prevent material laden air from passing into the room.

To obviate disadvantages heretofore prevailing, some of which have just been mentioned, I provide a chamber surrounding each joint. This chamber may take the form of an annular box 28 from which air is evacuated through a conduit 29 which may be connected, with convenience, to conduit 13 in which the operating pressure is less than on the inner side of the joint. The joint at 27 is closed as tightly as is practical and the area through which air may pass into annular box 28 is relatively small. The evacuation of air through conduit 29 causes the chamber within annular box 28 to be maintained at a pressure lower than the pressure of the air delivered from the blower through conduit 12 and lower than atmospheric pressure outside of conduit 13. Since the difference in pressures on both sides of the joint at 31 between the edge of annular box 28 and the flange 32 on the pulverizing mill is in favor of permitting air to enter box 28, there is no escape of the material laden air from the mill or from the chamber within annular box 28.

In Fig. 3 I have illustrated my invention in connection with a system for pulverizing and feeding coal to a furnace. In this system a blower 33 delivers air through conduit 34 into the mill 35 from which material laden air is blown through conduit 36 and conduit 37, the latter of which leads to the burners at the furnace (not shown). As in the system disclosed in Fig. 1 the discharge end of the mill is sealed by a chamber formed by an annular box 38 from which the air and fine material likely to enter therein is exhausted through conduit 39 having connection with the suction side of blower 33. When pulverized fuel is delivered directly to a furnace from a pulverizing mill the pulverizing mill must be operated under a pressure exceeding that of the atmosphere. The invention is, therefore, particularly useful in such a system. However, because the pressure within the mill exceeds that of the atmosphere it is necessary to provide sealing means at the feed end of the mill. For this purpose I provide a box 40, the edge of which terminates close to the flange 41 of the feed end of the mill. Box 40 is connected by conduit 41*a* with the main air supply conduit 42 which furnishes air to blower 33. The pressure within box 40 is less than that of the atmosphere and the tendency of flow is through joint 43 into box 40 with the result that there is no escape of air at joint 43.

It is usual to feed coal or other fuel into pulverizing mills automatically. The coal descends from a bin into a hopper 44 and is permitted to pass into a chute 45 by means of a rotary valve gate 46. Since chute 45 is subject to the pressure conditions within the mill, there is a tendency for air to flow upward through chute 45 and through the coal about valve-gate 46 and in hopper 44. In order to prevent loss of pressure and loss of any dust because of such tendency, a box 47 is affixed to the hopper 44 and communicates therewith through opening 48. Fuel is kept away from opening 48 by means of a deflector 49. Any air or dust which is likely to pass up through chute 45 and through the coal in hopper 44 is caused to enter box 47 from whence it is drawn through conduit 50 which is connected to box 40 and conduit 41.

An alternative manner of lowering the pressure in boxes 38, 40, 47 is to connect each of the boxes with another conduit 51 passing above the mill and entering conduit 37. For connecting such a conduit, a Venturi restriction 52 may be constructed in conduit 37 so as to lower the pressure in conduit 37 at the point of connection.

In Fig. 4 I have illustrated an installation in which a blower 53 blows air through a mill 54 and sweeps the mill from end to end without reversing. The air is then blown through conduit 55 into a collector 53 where it is relieved of material and from whence it is drawn through conduit 56 back to the blower 53. In this system the annular box 57 at the discharge end of the mill is connected by conduit 58 with conduit 56. Since the outlet in this type of mill is walled by the walls of the discharge area 59 it is possible that grinding media or large sizes of material may overflow into conduit 55 under overload conditions. In order to not make it necessary to provide a hand hole to enable removal of such material from box 57, a bucket 60 is provided. Bucket 60 is connected to the flange at the discharge end of the mill and is carried around in a rotary path as the mill rotates. Any material which is small enough to pass through the joint at 61 to enter box 57 will be carried up by bucket 60 and permitted to drop in the rising current of air which is leaving box 57 through conduit 58. By this means all of such material may be returned through conduit 56 to the pulverizing mill for further grinding.

The feed end of the mill is provided with another annular box 62 which has a conduit 63 leading therefrom directly to the suction side of the blower 53. This conduit enters box 62 at its lowermost portion so that it is not necessary to provide any me-

chanical means for raising dust. The upper end of chute 64 and hopper 65 has connected thereto a conduit 66 which opens into box 62. As described in connection with the installation of Fig. 3, no air or fine material may be forced upwardly and out of the system through chute 64. As in the instance previously described in order to prevent positive pressure from being carried on up into the hopper an air-lock type of feeder 68 can be used to advantage, although any type of feeder which would choke off the air from entering the hopper will do satisfactorily.

While I have described by invention in connection with pulverizing mills for various uses, I wish it to be understood that it has utility for use in apparatus where rotary and non-rotary elements are connected together and in which gases under pressure are caused to enter the rotary elements through the connection. For example, in certain types of rotary dryers hot gases are introduced by pressure at the feed end and there exists a tendency to blow out unless a balanced draft or a reduced pressure is maintained at the discharge end. Use of my invention would eliminate the necessity of having a balanced draft or reduced pressure at the discharge end.

The invention is capable of wide variation and relationship of parts without departure from the nature and principle thereof. I do not restrict myself unessentially in the foregoing or other particulars, but contemplate such alterations and modifications within the scope of the appended claims as may be found advisable.

What I claim is:

1. The combination with a rotary unit having a chamber, a relatively non-rotatable conduit opening into said chamber and blower means controlling pressure within said chamber through said conduit, of means having a chamber disposed about the joint of said rotary unit with said conduit, and means to reduce the pressure within the last named chamber below that on the side of the joint within said conduit.

2. In combination, a rotary unit, relatively stationary blower means having connection with said rotary unit for creating pressure in said rotary unit, means enclosing the joint of said rotary unit and blower means, and means for evacuating air from said enclosing means.

3. In combination, a rotary unit, relatively stationary blower means having connection with said rotary unit for creating pressure in said rotary unit, means enclosing the joint of said rotary unit and blower means, and means connecting said enclosing means with the suction side of said blower means.

4. In combination, a rotary pulverizing mill having an air inlet conduit and outlet conduit at one end, said outlet conduit being within said inlet, blower means maintaining pressure in said mill through said inlet conduit, means having a chamber disposed about the joint of the mill and the inlet, and means maintaining said chamber at a pressure below that within the mill.

5. In combination, a rotary pulverizing mill having inlet and outlet openings at one end of the mill, means for introducing elastic fluid into the mill through said inlet, said means including a blower with its pressure end having connection with said inlet through a conduit opening into the inlet of the mill and forming a joint therewith, means forming a chamber about said joint, and means for removing elastic fluid and material entering said chamber.

6. In combination, a rotary pulverizing mill having inlet and outlet openings at one end of the mill, means for introducing elastic fluid into the mill through said inlet and for removing it through said outlet, said means including a blower with its pressure end connected to said inlet and its suction end having connection with its outlet, means having a chamber contiguous to the joint of said first named means and mill, and conduit means connecting said chamber with said connection.

7. In combination, a rotary pulverizing mill having an inlet through which elastic fluid is introduced to the mill under pressure, a relatively fixed conduit cooperatively connected with said inlet, means having a chamber separating the joint of the inlet and said fixed conduit from the atmosphere, and suction means for removing elastic fluid and material entering said chamber.

8. In combination, a rotary unit, conduits having connection with the interior of said rotary unit, means for coursing fluid currents through said conduits and rotary unit, a chamber enclosing the joint between said connection and rotary unit, and means for maintaining the pressure within said chamber less than the pressure that exists on the other side of the enclosed joint.

9. In combination, a rotary pulverizing mill having one end open, means having connection wi' the open end of said mill including conduits for conducting fluid currents to and from the interior of said mill, means enclosing the joint of said first named means and the mill, and means maintaining the pressure within the space enclosed by said last named means at a pressure below that existing on the other side of the joint.

10. In combination, a rotary pulverizing mill having one end open, means having connection with the open end of said mill including conduits for conducting fluid currents to and from the interior of said mill, said conduits comprising an outlet conduit

and an inlet conduit surrounding said outlet conduit, means enclosing the joint of said first named means and the mill, and means for evacuating the space enclosed by said last named means whereby dust carried through said outlet conduit is gathered.

11. In combination, a rotary pulverizing mill having one end open, means having connection with the open end of said mill including conduits for conducting fluid currents to and from the interior of said mill, means enclosing the joint of the mill and the conduit conducting fluid currents to the mill and means for removing the dust which passes through the joint into the space enclosed by said last named means.

12. In combination, a rotary pulverizing mill, conduits having connection with the interior of said mill, means for coursing fluid currents through said mill and said conduits, a chamber enclosing the joint between at least one of said conduits and said mill, and means for removing the dust which passes through the joint of said conduit into the chamber.

13. The combination set forth in claim 12 in which said last named means comprises exhauster means for evacuating elastic fluid and dust from said chamber.

14. In combination, a rotary pulverizing mill, conduits having connection with the interior of said mill, means for coursing fluid currents through said mill and said conduits, a relatively fixed chamber surrounding at least one of said conduits opposite its joint with the rotary mill, and pneumatic means maintaining the pressure in said chamber below atmospheric pressure.

15. In combination, a rotary pulverizing mill, conduits having connection with the interior of said mill, said conduits including an inlet conduit surrounding an outlet conduit, means for introducing fluid currents into said inlet conduit at a pressure exceeding the pressure outside of the mill, a chamber enclosing the joint between said mill and said inlet conduit, and means for maintaining the pressure in said chamber below the pressure outside of said mill.

16. In combination, a rotary pulverizing mill, conduits having connection with the interior of said mill, said conduits including an inlet conduit surrounding an outlet conduit, blower means for coursing fluid currents through said mill at a pressure greater than the pressure outside of the mill, a chamber surrounding the joint of the mill and the inlet conduit, and a conduit connecting said chamber with the suction side of said blower means.

17. In combination, a rotary receptacle, conduits having connection with the interior of said receptacle at one end thereof, one of said conduits being a fluid current inlet and the other being a fluid current outlet, stationary means closing the other end of said receptacle, a chamber enclosing the joint of said stationary means and said receptacle, and means for removing the dust which passes into said chamber through said joint.

18. In combination, a rotary receptacle, conduits having connection with the interior of said receptacle at one end thereof, one of said conduits being a fluid current inlet and the other being a fluid current outlet, stationary means closing the other end of said receptacle, a hopper having a chute extending through said stationary means, means maintaining the pressure within said receptacle exceeding the pressure outside of said receptacle, and means withdrawing elastic fluid from the feed end of said chute at a rate in excess of the leakage of elastic fluid from the receptacle through the chute.

19. In combination, a pulverizing mill, conduits having connection with the interior of said mill, means coursing elastic fluid through said conduits and mill, stationary means closing one end of said mill, a feeder including a chute passing through said stationary means, and means comprising an exhauster and connections therefrom to said feeder for maintaining the pressure in said feeder from exceeding that within the mill and chute.

20. In combination, a pulverizing mill, conduits having connection with the interior of said mill, means coursing elastic fluid through said conduits and mill, stationary means closing one end of said mill, a feeder including a chute passing through said stationary means, a chamber surrounding the joint of said stationary means and mill, a conduit connecting the feeder with said chamber, and means for maintaining the pressure within said chamber below that outside of the mill.

21. In combination, a rotating drum, a feeder connected thereto through a conduit for feeding said drum, means for removing material from said drum, means for maintaining a pressure within said drum above that outside of said drum, a stationary chamber adjacent to the rotating inlet and outlet portions of said drum, and means for withdrawing from said chamber elastic fluid and material leaking into said chamber from the drum and from without the system.

22. In combination, a rotating drum, a feeder connected thereto through a conduit for feeding said drum, means for removing material from said drum, means for maintaining a pressure within said drum above that outside of said drum, a stationary chamber adjacent to the rotating inlet and outlet portions of said drum, a chamber around portions of said feeder exposed to leakage, and means for withdrawing from said chamber elastic fluid and material leak-

ing therein from the drum and from without the system.

23. In combination, a rotating drum, means for maintaining said drum under pressure above that outside of said drum, stationary connections including means for introducing and discharging elastic fluid therefrom and for feeding solid material to said drum, means for preventing leakage of elastic fluid and material from the connections between the rotating drum and stationary connections, said means comprising a housing one portion of which is exposed to the zone of high pressure within the drum with a relatively close connection between the rotary drum and housing, another portion of said housing being exposed to the zone of pressure substantially equal to that on the outside of the drum with relatively close connection between the rotating drum and housing, and means for lowering the pressure within the housing below that inside the drum for removing the elastic fluid and material leaking past said connections into the housing.

24. In combination, a system comprising a rotary pulverizing mill, a relatively stationary classifier, connections therebetween, means for maintaining the elastic fluid entering the mill at a pressure greater than that surrounding the mill, means adjacent to the joint between the mill and connections whereby elastic fluid leaking outwardly is returned back to the system at a point where the pressure is below the pressure of the elastic fluid surrounding the mill.

25. In combination, a rotary pulverizing mill, a relatively stationary classifier, connections therebetween whereby elastic fluid leaving the mill and entering the classifier is at a pressure below that entering the mill or surrounding the mill, and means whereby any leakages of elastic fluid between the moving and relatively stationary connections adjacent to the mill are drawn into said connections.

26. The combination set forth in claim 25 in which the means whereby leakage of elastic fluid is drawn into the connections comprises a chamber surrounding each of said connections and a duct leading from said chamber to the connections.

In testimony whereof I hereto affix my signature.

HARLOWE HARDINGE.