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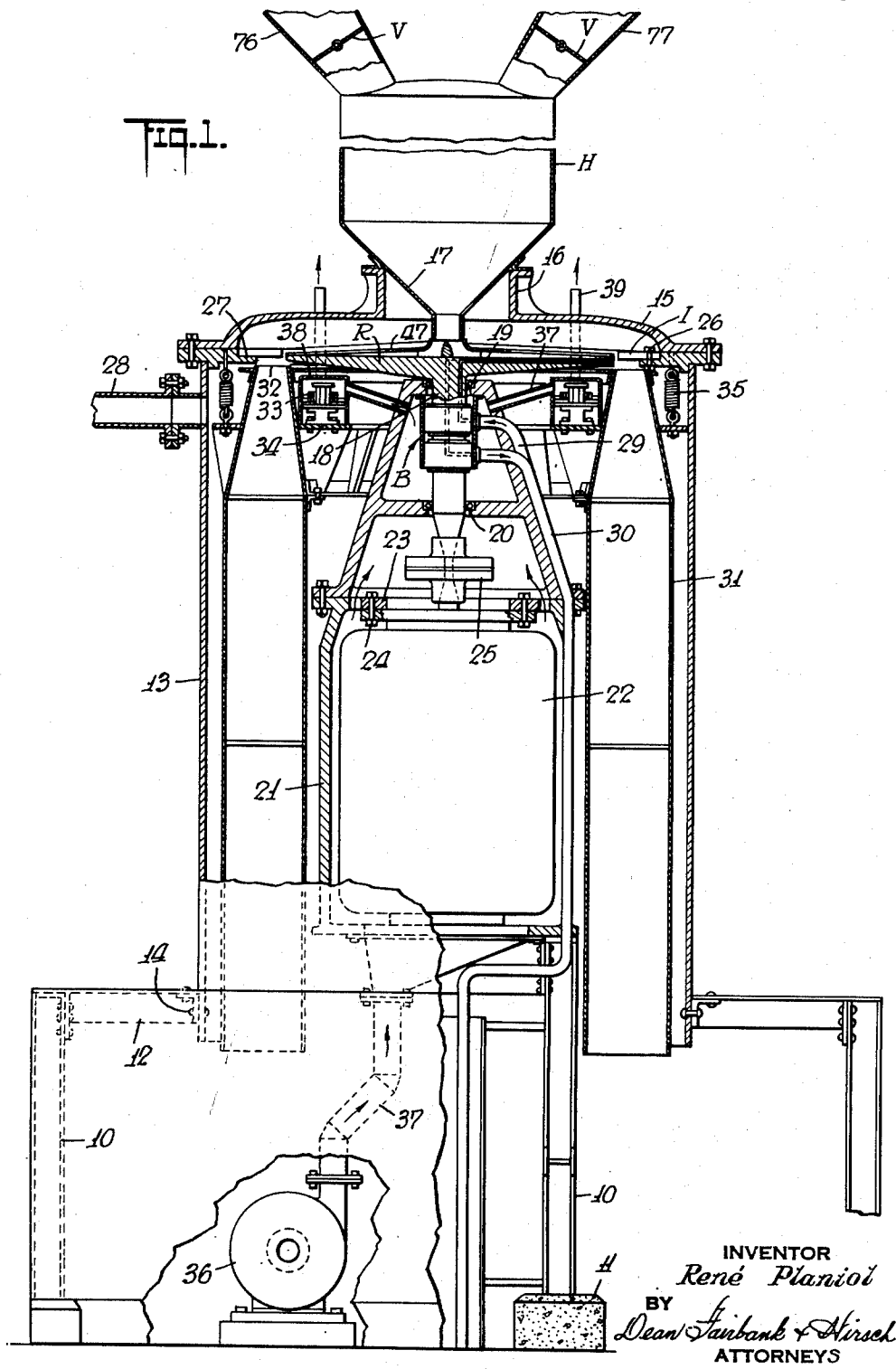
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IMPACT PULVERIZING MILL, INCLUDING BOTH COOLING AND VACUUM MEANS

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3 Sheets-Sheet 1

FIG. 1.



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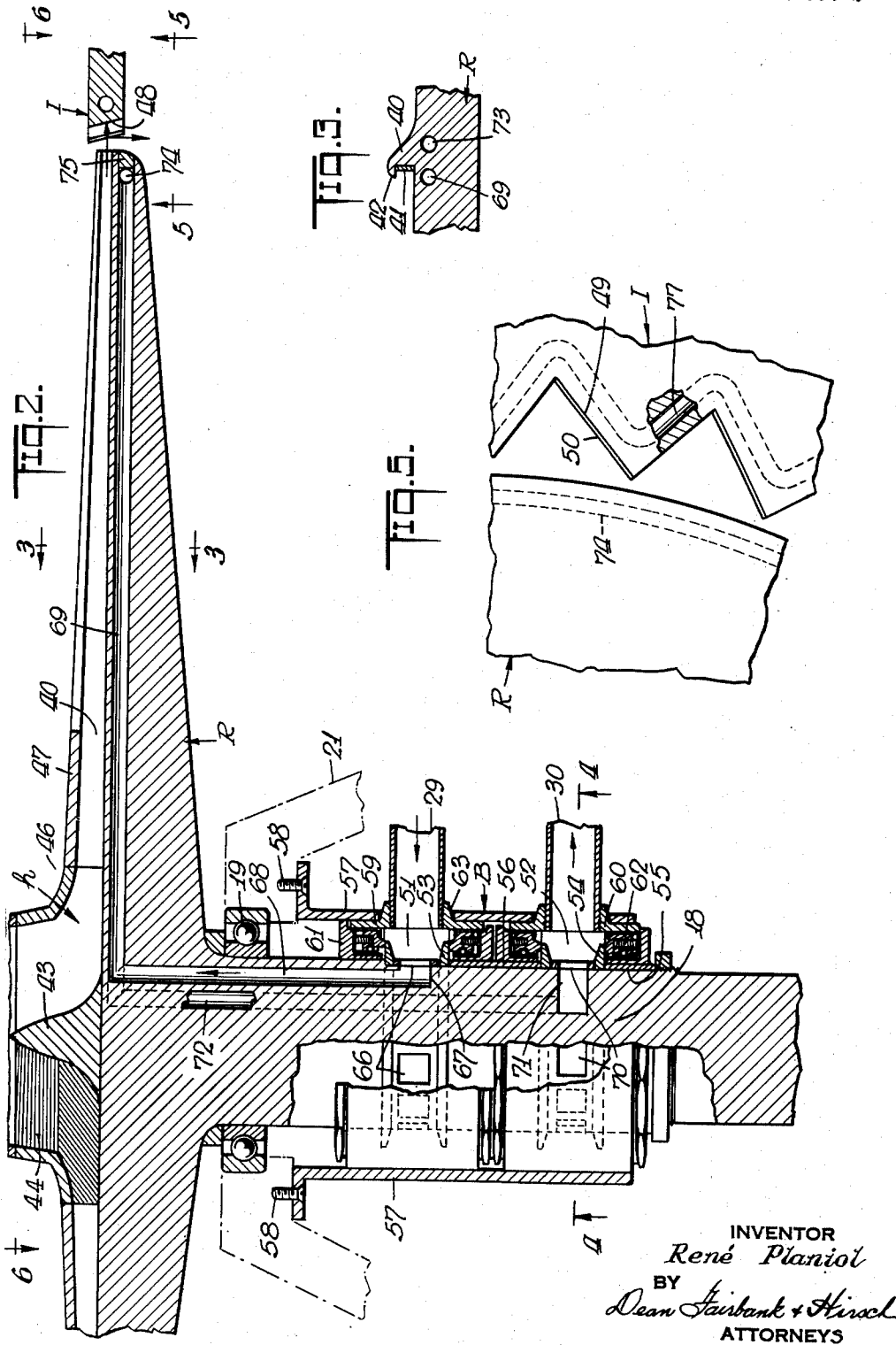
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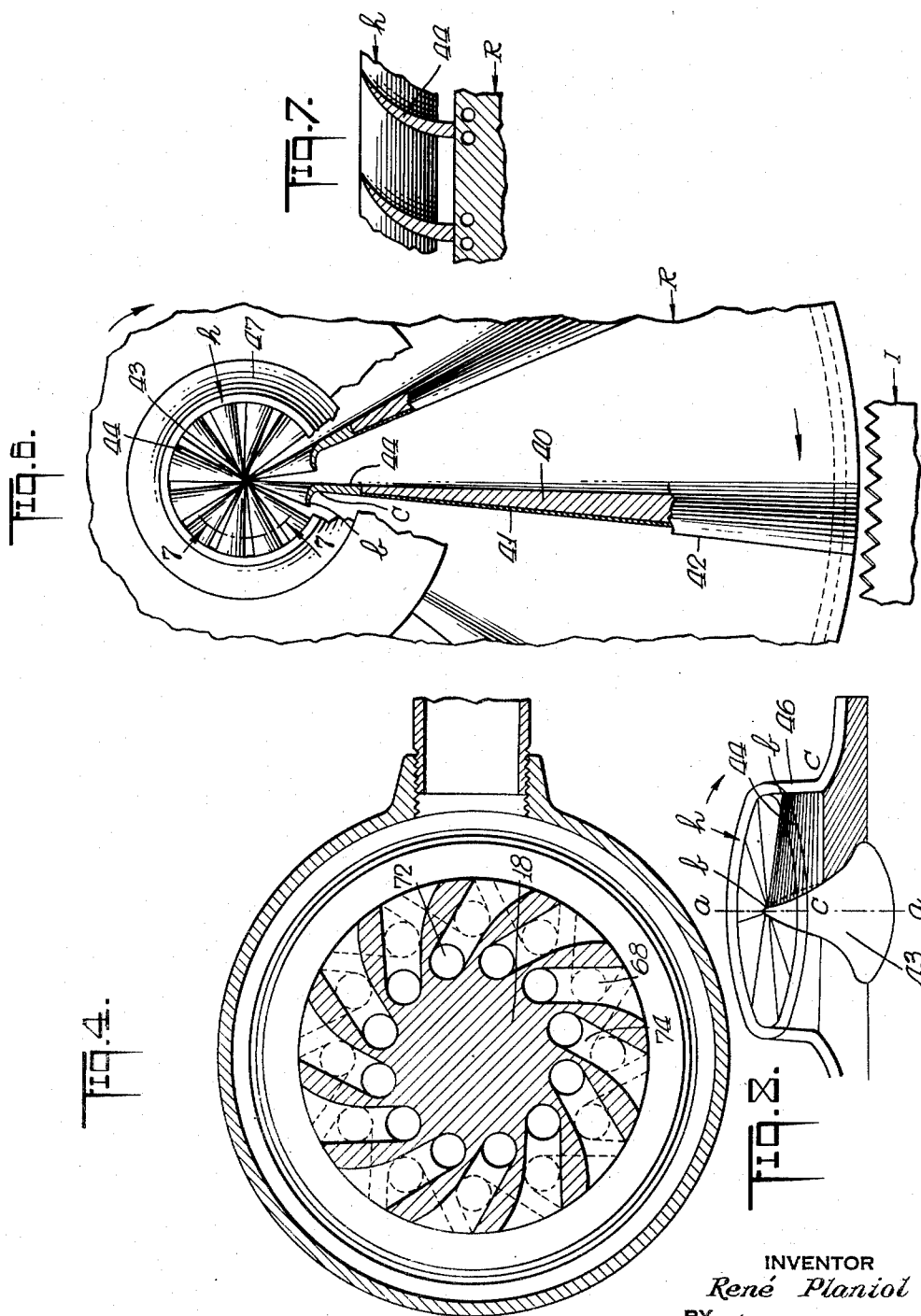
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IMPACT PULVERIZING MILL, INCLUDING
BOTH COOLING AND VACUUM MEANSRené Planiol, New York, N. Y., assignor, by mesne
assignments, to Plaroc, Inc., New York, N. Y., a
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4 Claims. (Cl. 241-67)

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The present invention relates to attrition methods and mills.

It is among the objects of the invention to provide a method and a mill of the above type which can be operated without resort to steam or other high pressure fluids for a high output of finely comminuted material for a given bulk of machine and a given power consumption and which shall be effective for adequately comminuting even relatively recalcitrant materials.

Another object is to provide a method and mill of the above type by which the comminution is effected without much evolution of heat so that the comminution may be effected to any desired degree of fineness without impairing or altering the physical or chemical state even of heat sensitive organic materials being comminuted.

In the accompanying drawings, in which is shown one of various possible embodiments of the invention,

Fig. 1 is a view of the mill in longitudinal cross section,

Fig. 2 is a fragmentary view on a larger scale radially through the rotor, its bearing and the impact ring, and showing only one of the guide vanes,

Fig. 3 is a detailed view in transverse cross section, taken on line 3-3 of Fig. 2,

Fig. 4 is a view in transverse cross section on a larger scale, taken on line 4-4 of Fig. 2,

Fig. 5 is a fragmentary detail view on a greatly enlarged scale, taken on line 5-5 of Fig. 2 and with parts broken away,

Fig. 6 is a fragmentary view with parts broken away, taken on line 6-6 of Fig. 2,

Fig. 7 is a transverse cross section on a larger scale, taken on line 7-7 of Fig. 6, and

Fig. 8 is a perspective view of the hub, showing one of the guide vanes in detail.

Referring now to the drawings, the mill comprises a base having supporting columns 10 on suitable foundation 11 and carrying a system of beams 12 bolted thereto and in turn carrying the cylindrical housing 13 rising therefrom, bolted thereto at 14 and enclosing the operating parts of the mill.

The housing has a cover 15 upon the neck 16 of which rests the conical bottom 17 of the hopper H, the mouth of which delivers the granules, flakes or other small particles to be comminuted or pulverized to the center of a rotor plate R coaxial therewith.

The rotor plate has an axle 18 integral therewith, rotatable in ball bearings 19 and 20 in a support structure 21 therefor mounted upon the

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base structure. The axle also has a bearing B thereabout between said ball bearings. Desirably the rotor mounting structure is itself a casing which encloses the electric driving motor 22 that is bolted at 24 against the lower face of a flange plate 23 and connected by a coupling 25 to the lower end of the upright rotor axle 18.

The rotor plate is encompassed by an impact ring I affixed as by bolts 26 to a flange 27 rigid with and desirably welded to the cover 15. Against this impact ring, the material is centrifugally hurled and thereby comminuted.

The housing 13 is hermetically sealed and maintained under a substantial vacuum by suction applied through pipe 28 from a suitable vacuum pump (not shown), thereby to eliminate the retardation of the atmosphere and to cause the material to be hurled with greater force for greater impact against the impact ring.

To avoid overheating of the parts under the high speed of movement therealong or thereagainst of the material being comminuted, means is preferably provided to circulate cooling fluid through the rotor and desirably also through the impact ring. To this end a pump (not shown) preferably below the structure forces cooling fluid, such as oil, through the upright pipe 29 and transversely of the bearing B into the rotor axle 18, and then through the rotor and out through another part of the bearing B by way of pipe 30 back to the source of cooling fluid supply.

The comminuted material is dropped through a discharge conduit 31, preferably of sheet metal which is desirably of annular cross section and which as shown, encompasses the rotor supporting casing 21 and is in turn encompassed by the housing 13. Annular conduit 31 has an inlet or mouth 32 directly under the impact ring I, as shown. To avoid sticking of the fine particles to the wall of the discharge conduit 31, one or more separately encased electromagnetic vibrators 33 are desirably mounted on a transverse plate 34 affixed to said conduit 31, said plate and with it said conduit being suspended from the flange 27 by coil springs 35.

To avoid excessive overheating of the encased motor 22 and the encased electromagnetic vibrators 33, said parts are hermetically sealed and air is forced through the motor casing 21 from a blower 36 by way of duct 37 and desirably also by way of ducts 37' through the upper end of casing 21 to the cases 38 of the vibrators 33, whence the air escapes through vent pipes 39.

The foregoing description indicates the general relationship of parts. A more detailed descrip-

tion of a preferred construction of some of the elements follows:

The rotor plate R is provided with radiating vanes 40 extending from the periphery of hub h outward to the periphery of the rotor. These vanes are preferably integral with the rotor plate and rise from the upper face thereof. Wear-strips 41 of hard metal, desirably a composition of tungsten and carbon known as "Carboloy," are welded against the upstanding ribs 40, and an integral overhanging lip 42 extends forward from the upper edge of each rib over the upper edge of the corresponding wear-strip 41.

The hub h of the rotor is provided preferably with an upstanding guide knob 43, desirably integral with the rotor plate upon which the material to be comminuted drops from the hopper H. Guide vanes 44 preferably rise from the hub area of the rotor plate about the central knob 43 and their roots are aligned with the respective hurling vanes 40, as best shown in Fig. 6. The guide vanes are curved longitudinally upward and forward, that is, to lead in rotation in advance of the associated hurling vanes 40. Each guide vane thus has its forward and upper edge b-b peripherally, but, little behind the neighboring guide vane. Thus it will be seen that the material to be comminuted, as it drops from the hopper, falls around knob 43 upon and between the successive curved guide vanes 44 and the linear speed thereof is progressively accelerated as it moves radially outward along the hub by centrifugal force. Thus no excessive shock is incurred as the material drops upon the hub of the rotor and as it accelerates in moving outward.

The guide vanes may be and preferably are designed to effect admission substantially without any shock whatsoever, of the particles that drop by gravity from the hopper, and the acceleration thereof is effected smoothly with a minimum of wear of the machine. The ideal condition would be so to form the vanes that the component of the acceleration which is normal to the surface of the vane is a constant.

Results satisfactory in practice are attained if the parts are designed, as best shown in the various fragmentary views of Figs. 6, 7 and 8. Each of the vanes 44 is a straight line surface, specifically a conoid. The axis a-a of the machine is one directrix of the conoid and the curve b-b is the other directrix thereof. The radial upper edge b-b of the vane surface leads the lower edge c-c thereof by a fixed angle, as shown. That curve is so conformed that at its upper edge b-b, the dropping particles scooped by the vane are followed closely by the under surface thereof for an instant, without pushing the particles downward. At its lower end c, the tangent of the curve b-c is upright or parallel to the axis a-a.

While the guide vanes could, if desired, be conoidal clear to the roots of the hurling vanes 40, it is sufficient and in general preferred to conform each guide vane as a conoid only at the upper part thereof, as shown, the lower or outermost area of the vane being plane, as shown, and tangential to the lower end of the conoidal surface and constituting a rectilinear extension of the corresponding hurling vane 40.

Preferably a hub ring 45 covers the hub from the mouth of the hopper H and has a peripheral rim plate 47 resting upon the inner ends of the hurling vanes 40 and desirably welded thereto. The hub ring 46 thus aids in confining the particles to be comminuted until they have been

hurled past the rim 47, at which time they have acquired so tremendous a centrifugal speed, especially under the vacuum operation set forth, that they will not escape from the rotor, even though the vanes 40 are uncovered beyond the rim 47, as shown, the small lip 42 serving to confine the particles that are hurled along the wear-strips 41.

The impact ring I which encompasses the rim of the rotor is preferably beveled downward and outward as at 48, so that as the particles are hurled against the impact ring, they will be reflected generally downward as suggested by arrows in Fig. 2. Preferably the impact ring is serrated or formed with a surface that is toothed about its entire periphery, as best shown in Fig. 5. Since the particles are centrifugally hurled from the periphery of the rotor R only toward one face of each of the serrations, the forward face 49 only of each serration need be covered with a plate 50, preferably of the same hard wear-resistant material as that at 41 on the hurling vanes 40.

The cooling arrangement generally described above is preferably of the following specific construction:

The rotor bearing B is provided with a pair of peripheral grooves 51 and 52, the upper of said grooves being desirably for inlet of cooling fluid to the rotor, and the lower for return thereof. These grooves are preferably determined each by a ring 53 and 54, respectively, shrunk upon the rotor axle 18 and rotating therewith, each being channel shaped in cross section. The bearing B has an outer sleeve 57 of considerably larger diameter than rings 53 and 54, affixed at 58 to casing 21 which encompasses two bearing collars 59, 60 with sockets 63 protruding outward through corresponding openings in said sleeve. Pairs of bearing bushings 61 are threaded into said bearing collars at opposite ends thereof to flank the respective shrunk rings 53, 54. The ends of the shrunk rings 53, 54 ride in the rotation on the rotor axle 18 upon oil seals 62 of conventional construction which are confined between the respective bushings 61 and the end faces of the intervening shrunk rings 53, 54, and are encompassed by the bearing collars 59, 60. Inlet and outlet pipes 29 and 30, respectively, are affixed in the sockets 63 of bearing collars 59, 60.

The shrunk inlet ring 53 has a multiplicity of apertures 66 therethrough, each registering with the outturned lower end 67 of a corresponding bore 68 rising therefrom longitudinally of the rotor axle. Bore 68 are at uniform distance from the axis of axle 18 near the periphery thereof, as shown in Figs. 2 and 4. The upper ends of bores 68 feed into bores 69 radially of the rotor plate R and extending outward to the rotor periphery. Similarly, shrunk outlet ring 54 has a multiplicity of apertures 70 therethrough, each registering with the outturned lower end 71 of a corresponding bore 72 rising therefrom longitudinally of the rotor axle. Bore 72 are at uniform distance from, but nearer the axis of axle 18 than are bores 68. The upper ends of bores 72 feed into bores 73 radially of the rotor plate R and extending outward to the periphery thereof in contiguity to the companion bores 69.

Near the periphery of the rotor plate, the associated feed and return bore lengths 69 and 73, respectively, communicate by a short cross bore 74 and plugs 75 seal the outer ends of the associated rotor bores.

The hopper H preferably has two inlet pipes

76 and 77 from which the material to be comminuted is delivered therinto and each of said inlets is provided with a valve V, both valves being normally closed as shown, so that the vacuum applied through conduit 28 will be sustained. Vacuum is also desirably applied through a conduit (not shown) above the valve V. The hopper H may be refilled through either valve V without seriously interfering with the vacuum.

The operation proceeds as follows:

From the motor 22, the rotor shaft 18 and rotor R are driven at high speed while the material from the hopper H slowly drops upon the hub *h* and is directed by knob 43 to the various guide vanes 44 which gradually accelerate the particles without shock as they move outward, until they escape from below the rim 47 of the hub ring 46 and are moved with ever increasing linear speed and high periphery speed to slide along the wear strips 41 lengthwise of hurling vanes 40. Air resistance is eliminated by reason of the vacuum maintained in housing 13, so that the particles are hurled off the periphery of the rotor at tremendous speed and with correspondingly tremendous impact against the impact ring I, where the particles are shattered by striking the wear plates 50. The particles thus hurled are reflected, as shown by arrows in Fig. 2, from the serrated impact ring I, the bevel of which is shown at 48, and move downward through the annular discharge conduit 31 to a suitable collector (not shown). The constant action of the electromagnetic vibrators 33 agitates the conduit 31 and prevents the particles from adhering to the walls thereof in the course of escape from the machine.

The moving parts are kept from excessive heating by the cooling system. The cooling oil is propelled by a pump (not shown) from inlet pipe 29 to the peripheral groove 51 of shrunk ring 53, thence into the various bores 68 upwardly in parallel through the axle 18 and thence radially outward along the bores 69 of the rotor plate R to the periphery thereof, and thence by way of cross bores 74 radially inward in parallel through bores 73, and finally axially downward through the return bores 72 in the axle to return to the pump by way of outlet groove 52 of shrunk ring 54 through outlet pipe 30. In this operation no leakage occurs as the joint 62 is maintained tight at the horizontal faces of the rings 53, 54 that are shrunk onto the axle. From a similar source the cooling fluid passes through the length of the impact ring I by way of conduit 77 which extends in a zigzag path along the serrations and the impact faces thereof.

Accordingly, excessive heating both in the rotor plate and the impact ring is avoided. Nor are the particles heated to such extent as to result in rendering them plastic or promoting coalescence or sintering. Indeed, even biological material, such as grain or seeds may be comminuted by use of the present attrition mill without carbonization or other degeneration.

As many changes could be made in the above construction and method and many apparently widely different embodiments of this invention could be made without departing from the scope of the claims, it is intended that all matter contained in the above description or shown in the accompanying drawings shall be interpreted as illustrative and not in a limiting sense.

Having thus described my invention, what I

claim as new and desire to secure by Letters Patent of the United States is:

1. An impact pulverizer comprising a hopper, a rotor plate having a vertical axle therebelow, means for rotating the axle, inlet and outlet passageways longitudinally of said axle, said plate having radiating hurling vanes, a stationary impact ring about said plate, said plate having radiating passageways therein near the respective vanes, each including (1) a run extending outward to near the periphery thereof and directly connected with the upper end of the corresponding inlet passageway in said axle and (2) a return run extending inward near and substantially parallel to said first run and directly connected with the upper end of the corresponding outlet passageway in said axle and means for circulating cooling liquid by pressure propulsion in parallel through the several paths, each of which paths consists of an inlet passageway in the axle, an outward run on the rotor, a return run on the rotor and an outlet passageway in the axle, means for circulating cooling fluid through said ring, a housing enclosing said rotor and said impact ring, and means for maintaining the interior of said housing under vacuum.

2. An impact pulverizer comprising a base, a cylindrical housing rising therefrom, an inner casing coaxial therewith, a rotor at the upper end of said inner casing, having an axle, a bearing therefor, rotor driving means within said inner casing, an impact ring about said rotor affixed in said housing, a collector in said base, a discharge conduit intervening between said ring and said collector, and cooling means for said rotor, said cooling means comprising a pressure propulsion circulating system for cooling fluid having an inlet at said rotor bearing, associated inlet and outlet annular chambers about said rotor axle and within said bearing, and a multiplicity of longitudinal duct pairs through said rotor axle, one duct of each pair communicating with the inlet chamber and the other with the outlet chamber, said rotor having radiating ducts arranged in pairs substantially under the respective vanes extending to near the periphery of the rotor, the ducts of each pair communicating with the respective axle ducts, the companion radiating ducts of each pair being directly connected together within and near the periphery of the rotor.

3. In an impact pulverizer, the combination of a rotor plate having an axle, a bearing for said axle, said rotor having radiating upstanding hardened metal ribs, and means for cooling said ribs during operation, said means comprising a pair of annular grooves in said bearing about said axle, one constituting an inlet and the other an outlet for cooling fluid, cooling circuits connected in parallel between said annular grooves and comprising a multiplicity of duct pairs for such cooling fluid, each duct pair comprising a length from the associated groove longitudinally of the axle, thence radially of the rotor plate, each duct pair in the rotor plate being connected together near the periphery of the latter and means exteriorly of said annular grooves and communicating therewith for circulating cooling fluid under pressure through said circuits in parallel.

4. An impact pulverizer comprising a horizontal rotor, an upright driving axle thereunder, an impact ring encompassing the periphery of said rotor and adjacent thereto, an annular discharge conduit under the rotor and impact plate and

having its inlet across the gap between the adjacent peripheries of the rotor and impact ring, a casing for said pulverizer, means communicating with said casing below the top of said annular discharge conduit for maintaining a vacuum in said casing, passageways through the rotor, each having a radially outward and a return run adjacent the respective vanes, riser passageways through the axle communicating with the respective runs, a liquid conveying bearing for said axle, and means for forcing the liquid into the axle through one set of riser passageways thereof through the outward and return runs of the passageways of the rotor in series and thence downward through the other set of riser passageways for cooling the stock being comminuted.

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