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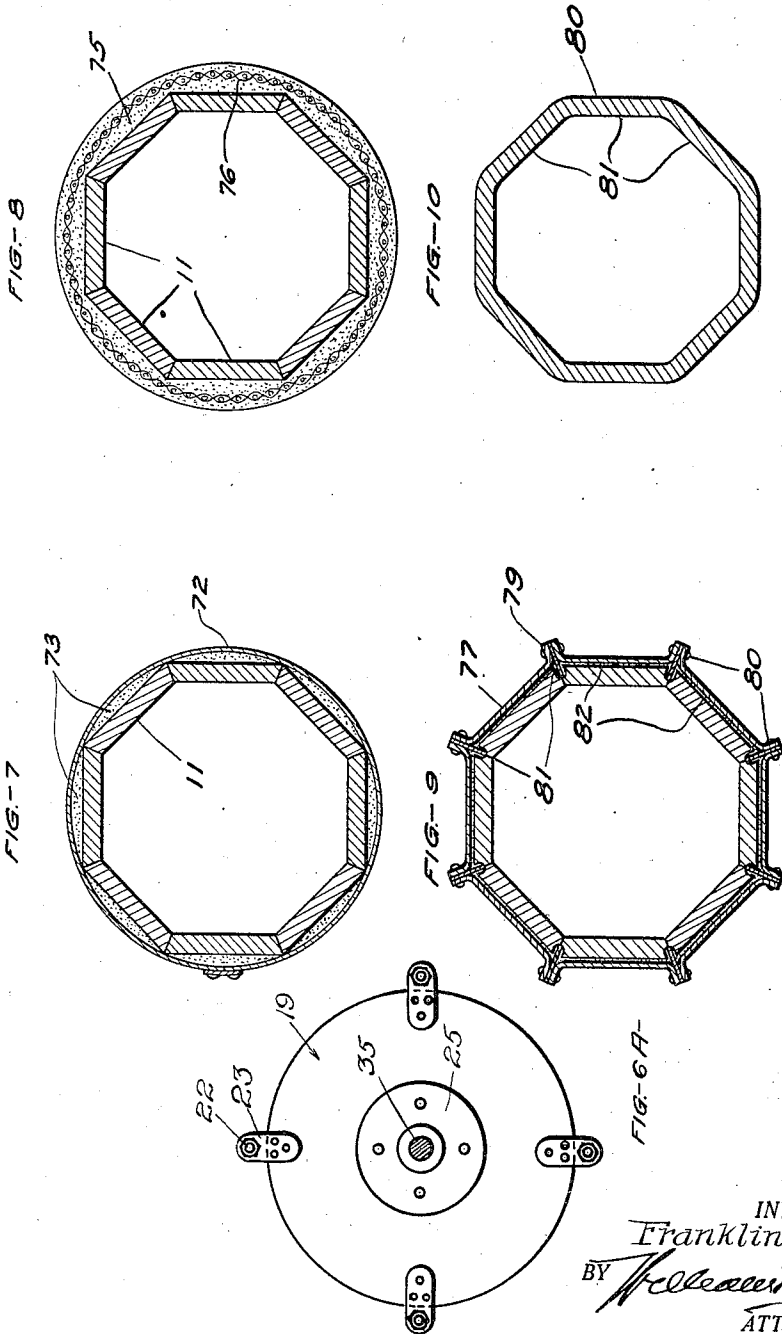
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PULVERIZING MILL

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UNITED STATES PATENT OFFICE.

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PULVERIZING MILL.

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To all whom it may concern:

Be it known that I, FRANKLIN H. WOLEVER, a citizen of the United States, and a resident of Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Pulverizing Mills; and I do hereby declare that the following is a full, clear, and exact description thereof, reference being had to the accompanying drawings, and to the characters of reference marked thereon, which form a part of this specification.

This invention relates to improvements in crushing or pulverizing mills of that character in which granular materials, such as vitreous enamels and like materials are enclosed in a barrel, together with crushing elements, such as balls or weights, so as to grind the material to a powder by the constant tumbling and impact action of the balls or elements against each other and against the side of the barrel when the barrel is rotated on its axis. While the mill is primarily designed to be used in the crushing of enamels in the ceramic and iron and steel enameling art, and has been designed especially for such art, it may be used for crushing and pulverizing other like materials.

Among the objects of the invention is to produce a rotating barrel mill, the inner wall of which comprises planes of vitreous materials, as porcelain, that are so arranged with respect to each other that the inner wall of the barrel takes the form of a polygonal cross section, with the wall segments spaced at desired angles, as from 90 to 135 degrees, so as to produce angle breaks between the segments of such extent that the crushing elements will, upon impact against the wall sections, bound across the angles instead of tending to roll around the wall of the barrel as if it be made cylindric or nearly so.

Another object of the invention is to provide a novel multiple section, inner, vitreous wall of a mill barrel, the sections of which are reliably supported by means which avoid the use of interiorly exposed cement joints or other joints by which deleterious material will be exposed to the crushed or ground material.

A further object of the invention is to provide a novel means of exteriorly binding together the vitreous segments, slabs or staves and end walls of such a barrel partly

through the medium of yielding elements so as to hold and support them reliably in place, while at the same time avoiding crushing pressure on the relative frangible elements of the barrel due to temperature changes, and also affording means for removing a broken stave or slab and the replacement of another.

A still further object of the invention is to provide a crushing or pulverizing mill barrel which is made throughout with solid vitreous segments disposed at angles to mutually support each other and to produce a polygonal cross section and of such thickness as to readily withstand the impact of the crushing elements, and which elements are made of such dimensions, that said elements continue throughout the distance of the dimension of the barrel for which the elements are intended, thereby avoiding the use of inner small tile or brick and the consequent inconvenience of installing them and removing injured wall parts.

There is shown in the drawings a number of modifications illustrating the structure set forth, said drawings being more or less diagrammatic to indicate the essential elements of the inventions, and are not intended to be limiting with respect to the scope of the invention.

As shown in the drawings;

Figure 1 is a side view of a crushing mill embodying my invention with parts in section.

Figure 2 is a cross section on the line 2—2 of Figure 1.

Figure 3 is a detail of one of the joints between adjacent staves or slabs of the crushing barrel.

Figure 4 is a detail showing one of the perforated discharge doors of the barrel.

Figure 5 is a cross section on the line 5—5 of Figure 1.

Figure 6 is a detail illustrating the screen door through which the contents of the barrel of the sample mill are discharged.

Figure 6^a is an end view of the mill barrel.

Figures 7, 8, 9, and 10 are cross sections of modified grinding barrels.

As shown in Figures 1 to 6^a, inclusive, of the drawings, 10 designates the barrel of the pulverizing mill made up of a plurality of solid slabs or staves 11 of vitreous porcelain which extend from end to end of the barrel and are disposed at such transverse angles to each other as to give to the assembled structure the polygonal interior forma-

tion set forth. 12 designates a solid or grinding door to cover the charging and discharging opening of the barrel, and there will be a number of doors to correspond to the number of compartments of the barrel. 13, Figure 4, designates a form of perforated or screen door which is adapted to fit over the door opening of a compartment, and through the perforations of which the crushed material is discharged while avoiding discharge of the crushing elements therewith. These doors will be made of the same material as the staves 11.

14, 14 designate the end walls or heads of the barrel made of vitreous porcelain or the like. They are fitted at their peripheries in rebates or recesses on the inner sides of the slabs or staves 11, as shown at 15 (Figure 1). Resilient members 16 are interposed between the ends of said slabs 11 and the margins of metal plates 19 fitted outside of the vitreous porcelain heads 14. Said heads 14 and the resilient member 16 may extend between the end walls 14 and metal heads 19 towards the center of the latter. The peripheries of the metal plate 19 are turned inwardly to form annular flanges 18 which extend radially beyond the staves, as shown in Figure 1, to constitute confining members which cooperate with confining hoops, hereinafter described to exteriorly support the barrel parts. The spaces between said flanges 18 and the staves or slabs may be filled with cement 20 to further exteriorly bond the barrel elements.

The barrel structure is held together by tie rods 22 exterior to the barrel which extend through lugs 23 riveted to the peripheral portions of the metal heads or end plates 19, the parts being clamped together by nuts on the threaded ends of the tie rods. The gaskets 16 provide equalizing means on the slabs or staves and the barrel ends due to temperature changes. The construction shown provides a very compact, relatively light, economical and very rigid end supports for the barrel.

25 designates hubs fixed to or forming parts of the metal plates or heads 19. They are formed with annular flanges 26 that extend into the larger central openings in the porcelain heads 14 and are bonded thereto at 27 by cement. Said hubs are hollow and are fastened to the central portions of the heads 14 by flanged keys 28 which enter the bores of the hubs and are bonded thereto at 30 by cement; the flanged portions 31 of said keys overlapping the inner faces of the heads 14 and constituting at once means to lock the metal hubs to said heads and means to cover the metal flanges of the hubs to prevent contact of the material being ground with the metal of said hubs.

Keyed or otherwise secured to the hubs 25 of the plates 19 are shafts 35 which are ro-

tatively mounted in bearings 36 carried by the upper ends of standards 37 at the ends of the barrel. One of said shafts 35 carries tight and loose pulleys 36' and 37', respectively, whereby the barrel may be rotated. Alternatively a motor or a counter shaft may be geared to said shaft 35. In this manner the barrel is supported on said standards and is free to be rotated in the bearings carried thereby.

The slabs or staves of the barrel are formed at their side edges with oblique or mitered meeting faces 40 arranged at such angles to the longitudinal planes thereof as to bring the inner side faces of the slabs at their proper angles relatively to each other for the purpose set forth. Said slabs or staves are locked together at their meeting side edges by key members 41 which are contained in registering elongating recesses 42, nearer the outer than the inner sides of the slabs, as best shown in Figure 3. Said recesses are larger than the key members and are bonded to the adjacent slabs by cement 43 poured into said recesses after the key members have been fitted in place.

The construction shown and thus described permits the mitered or oblique edges of the slabs to be brought flatwise together, so that said slabs thereby mutually support each other, but the principal advantage of this arrangement is that the slabs are bound together by dry joints 46 inwardly beyond the recesses 42, so that thereby bonding cement is not exposed at the joints inside said barrel and liability of injurious contact of cement with the material being ground is avoided.

The said staves or slabs 11 are shown in Figures 1 and 2 as exteriorly bound together intermediate their ends by a plurality of metal hoops 48 of such diameter as to engage the corners of said slabs at their outer angles. Said hoops are each made of a single length of strap material that is provided at its adjacent ends with out-turned lugs 49 which are connected by a clamping bolt 50, the hoop extending continuously about the barrel from one of said lugs to the other.

The grinding and discharge doors 12, 13 are angled at their edges to fit the angled edges of the slabs or staves, as shown in Figures 2 and 4. They are removably mounted on the barrel by being clamped to transverse exterior frame members 52 which extend between and are riveted to adjacent hoops at the sides of the door opening (Figures 1 and 2). Formed on or fixed to said frame members are lugs 54 that are threaded at their outer ends to receive nuts 55. Cross or clamping bars 56 of T cross section are fitted over the outer faces of the doors and are formed at their ends with eyes to fit over the threaded ends of the lugs,

being clamped against the doors by the nuts 55. The doors are provided with handles 58 by which they may be handled.

As will be noted by an inspection of Figure 2, the grinding doors are solid porcelain plates, while in Figure 4, the discharging doors are also made of like material and are perforated to permit the crushed material to fall therethrough when the doors are lowermost in the barrel. It will thus be seen that the door frames and doors are so constructed and applied to the barrel that the crushed material has no contact with metal parts, except that which might intercept the discharging material by the presence of the clamping bars 56 and handles 58, the injurious tendency of which is negligible.

As shown in Figure 2, said hoop members 48 are spaced from the flat outer faces of the slabs or staves between the outer angles of meeting staves or slabs by elongated wooden lagging 60, and the spaces between lagging and the points where the hoops engage with the staves or slabs may be filled with bonding bodies 61 of cement.

When the barrel is assembled, it will be charged by moving the same to bring the grinding doors 12 at the top of the barrel, whereupon by releasing of the nuts 55 the doors may be removed and the barrel charged through the door openings, whereupon the grinding doors are replaced. The discharging doors may be fitted to the door openings when the latter are at the top of the barrel, so that when the barrel is rotated one half around, the crushed material may fall through the perforations of the discharging doors, while retaining the crushing balls or elements in the barrel.

When the cylinder or drum has been charged with the material to be treated, together with a sufficient number of balls or impact elements, the doors are fitted in place and the barrel rotated so as to cause the balls to float through the mass of the material being treated, and said material is reduced or crushed to a desired mesh both by the intergrinding of the particles of the material upon themselves and the balls and because also of the impact effect of the balls or crushing elements against the inner wall of the barrel, the material being caught between moving crushing elements and between the latter and the interior polygonal wall of the barrel.

By reason of the fact that the segments or facets of the inner wall are disposed at angles to each other, the said crushing balls or elements are caused to be deflected from one substantially plain faced stave or slab to a neighboring stave or segment disposed across an intermediate juncture angle, so that thereby the said balls or crushing elements move largely in straight lines from contact with one segment of the inner face

of the barrel to another segment; and by reason of the momentum acquired in this straight path movement effectively crushes the material caught between the said balls or crushing elements and said segments or faces. This inner configuration of the drum greatly hastens the reduction of the material.

As shown in Figure 1, the barrel is divided into two chambers 65, 66 by an imperforate partition 67 so that two grades or colors of material, or wet and dry material may be operated upon at the same time. The said partition 67 (or there may be a number of them) may fit within the barrel in any suitable manner. As shown, the staves or slabs are interiorly grooved to receive the edges of the polygonal partition, and the partition may be removed to form a larger barrel compartment by breaking or crushing the partition, as by a sledge hammer.

At one end of one of the shafts 35 is provided and thereby supported a smaller barrel 65 which is similar in its interior configuration to the larger barrel shown, with the exception that, as herein shown, the several angularly disposed faces 66 of the inner wall are made parts of an integral shell, and the door 67 is held in place by means of a clamping screw 68 that is threaded through a yoke 69 fixed to end castings 70 between which the barrel is confined. The said smaller barrel may be used as a sample mill, and it is actuated simultaneously with the larger mill and is disposed in axial alignment therewith. In the present instance, the sample mill barrel has the form of a jar, whose axis is horizontal, one end wall 65' of which is integral with the surrounding wall, and the other end wall 65² being made a part separate from and fitted in the rebated open end of said jar. The parts are held together between the metal heads or spiders and tie bolts shown, and the hubbed head or spider may be readily removed from the shaft 35.

In the construction shown in Figure 7, the slabs or staves 11 are confined by a solid cylindric metal shell 72; that is to say, a shell which extends from end to end of the barrel, as distinguished from spaced hoops, and the voids between said shell and the outer faces of the slabs or staves intermediate the outer angles of the staves or slabs are filled with bonding bodies 73 of cement or the like to thereby firmly hold the barrel structure together.

In the construction shown in Figure 8, the said slabs or staves 11 are held together by a surrounding reinforced concrete structure 75 made in any known or preferred way of producing reinforced concrete structures, the reinforcing element thereof comprising the enmeshed screen cylinder 76.

In the construction shown in Figure 9, the slabs or staves 11 are held together by a plurality of plates 77 which extend lengthwise of the staves and are coextensive in width therewith.

They are formed at their side margins with flanges 79 which meet in planes parallel to the meeting faces of the side edges of said slabs or staves, and the plates are joined together by clamping bolts or rivets 80 that pierce said flanges. In this latter construction the key elements 81 which enter registering grooves in and lock the said staves or slabs together at their juncture may be fastened to these flanged plates by the bolts or rivets 80. The plates 77 are spaced from the slabs or staves and the voids are filled with bonding bodies 82 of cement or the like.

In the construction shown in Figures 7 and 9, the staves or slabs may be assembled upright and held together by any suitable means while the cylinder 72 of the barrel shown in Figure 7 is placed thereover, or while the plates 77 of the construction shown in Figure 9 are bolted around the assembled staves or slabs or placed over the assembled slabs in one assembled polygonal barrel form and the cementitious bonding bodies may be run between the slabs or staves and their shells, while the barrel parts remain standing upright.

The said hoops 48 of Figures 1 and 2 of the shell 72 of Figure 7 and the fabricated enclosing shell plates 77 of Figure 9 serve not only to hold the slabs or staves together but serve also to relieve said slabs or staves of bending stresses when at the lower side of the barrel due to the load of the barrel and contents and the span of the slabs or staves, the top staves offering an arched support for the lower staves and the contained load of the barrel.

In Figure 10 the barrel 80 is made of a single or integral part, the inner angularly disposed faces 81 of which produce a wall that is polygonal in cross section.

In all the constructions shown in Figures 7 to 10, inclusive, any suitable form of charging and discharging doors may be employed, preferably following along the general arrangement shown in Figures 1 to 6, inclusive. For sake of clearness, however, the door structures have been omitted from said Figures 7 to 10, inclusive.

I claim as my invention:

1. A mill for pulverizing enamel stock and the like comprising a rotative barrel formed with end walls and a circumferential wall of internal polygonal cross section, with the segments meeting at angles of from 90 to 135 degrees, all made of vitreous porcelain, the circumferential wall being continuous from end to end and joined

to the end wall by internal dry joints, said circumferential wall being made of solid vitreous porcelain staves and being joined along integral beveled edges by internal dry joints to produce the angle specified and means exterior to the internal faces of the joints between the beveled edges of said staves and between the end walls to hold the barrel members rigidly together.

2. A crushing or pulverizing mill for enamel stock and the like comprising a barrel having end walls and an enclosing wall each composed of solid vitreous porcelain, the enclosing wall being made of solid vitreous porcelain staves extending from end wall to end wall and there joined to the end walls by interior dry joints and the staves being joined along beveled edges to produce internal dry joints and angularly disposed crushing faces in cross section, said enclosing wall being provided with a door opening, a solid vitreous porcelain door closing said opening and having inwardly beveled edges to fit corresponding edges of the solid staves, and confining means wholly exterior to the inner side of the barrel to hold the door in place and the staves assembled to form the enclosing wall and to confine said wall on the end walls.

3. A crushing or pulverizing mill for enamel stock and the like comprising a rotative barrel having solid vitreous porcelain enclosing and end walls, with the end walls fitted to and interlocked with the ends of the enclosing wall to present vitreous porcelain walls only to the interior of the barrel, metal plates fitted outside of said end walls, means outside the barrel for drawing said plates together and against said barrel end walls to thereby hold the barrel parts assembled, and supporting and driving trunnions fixedly connected to said end metal plates.

4. A crushing or pulverizing mill for enamel stock and the like comprising a rotative barrel having solid vitreous porcelain enclosing and end walls, with the end walls fitted within rebated portion of and interlocked to the ends of the enclosing wall, and with the enclosing wall made of solid staves joined along interior dry joints and at angles to each other, metal plates fitted outside said end walls, tie rods exterior to the barrel and extending between said end plates for clamping said plates on said end walls and the latter on the ends of the enclosing walls, and supporting and driving trunnions fixed to said metal end plates.

5. A crushing or pulverizing mill for enamel stock and the like comprising a barrel having solid vitreous porcelain enclosing and end walls and fitted into and interlocked with the ends of the enclosing wall to present vitreous porcelain walls only to the interior of the barrel, metal plates fitted

against said end walls, means extending between said plates to clamp said end walls on the enclosing wall, and cushioning means between said plate and said end walls, said end walls each having a central opening, and the metal plates having driving hubs which extend within said openings and are bonded to said end walls and vitreous porcelain means to interlock said hubs to said end walls and to cover said hubs from contact with the contents of the barrel.

6. A crushing or pulverizing mill for enamel stock and the like comprising a barrel having solid vitreous porcelain enclosing and end walls and fitted into and interlocked with the ends of the enclosing wall to present vitreous porcelain walls only to the interior of the barrel, metal plates fitted against said end walls, means extending between said plates to clamp said end walls on the enclosing wall, said end walls having central openings, and the metal plates having driving hubs which extend within said openings and are bonded to said end walls, and vitreous porcelain means to interlock said hubs to said end walls and to cover said hubs from contact with the contents of the barrel.

7. A crushing or pulverizing mill for enamel stock and the like comprising a barrel having solid vitreous porcelain enclosing and end walls and fitted into and interlocked with the ends of the enclosing wall, metal plates fitted against said end walls, means extending between said plates to clamp said end walls on the enclosing wall, and cushioning means between said plates and said end walls, said end walls having central openings, and the metal plates having hollow hubs which extend within said central openings and are bonded to said end walls, and vitreous porcelain plugs fitted within said hollow hubs from within the barrel and bonded to said hubs and provided with flanges which overlap said central openings radially exterior to said hubs.

8. A crushing or pulverizing mill for enamel stock and the like comprising a barrel having vitreous porcelain circumferential shell and end walls, the latter fitted to and interlocked with the ends of the circumferential shell, metal plates fitted outside said end walls, with means exterior to the barrel for clamping said plates together to thereby hold the barrel parts assembled, said vitreous porcelain end walls having central openings, and the metallic end plates having hubs which extend within said openings and are bonded to said end walls, means to interlock said hubs to said vitreous porcelain end walls and to cover the inner ends of said hubs so that they will not be exposed to the material within the barrel, and driving and supporting shafts connected to said end plates.

9. In a crushing or pulverizing mill for enamel and like stock, a barrel having its circumferential wall composed wholly of vitreous porcelain and its end walls made of like material, metallic plates fitted to said end walls, with means exterior to said circumferential wall for clamping said plates thereon, and resilient cushions between said plates and the said end walls to accommodate the structure to temperature changes.

10. A crushing or pulverizing mill for enamel stock and the like comprising a barrel having a vitreous porcelain circumferential shell and end walls made of like material and fitted and interlocked to the ends of the circumferential wall to produce continuous inwardly facing surfaces neutral to the enamel, metal plates fitted outside said end walls, with means for clamping said plates together to thereby hold the barrel parts assembled, said metal plates having hollow hubs that extend into said openings and are exteriorly bonded to said end walls, and flanged porcelain plugs inserted into the hollow hubs from within said barrels, with the flanges thereof overlapping the inner faces of the end walls radially beyond said central holes so as to avoid contact of the barrel contents with said hubs and the bonding material.

11. A pulverizing mill for enamel stock and the like comprising vitreous porcelain end walls and a circumferential wall, the latter composed wholly of longitudinally and laterally continuous vitreous porcelain staves fitted together at angles in matched self supporting relation to produce at the inner surface of the wall dry joints, and means in the angles of said staves exterior to said joints and inwardly beyond the outer side of the mill to lock said staves together.

12. A crushing mill for enamel stock and the like comprising a barrel having its circumferential and end walls made wholly of solid vitreous porcelain, said circumferential wall composed of a plurality of mutually supporting, solid longitudinal staves disposed at angles to each other to constitute an interior polygonal cross section barrel with the interior joints between the staves dry.

13. A crushing mill for enamel stock and the like comprising a horizontally rotative barrel having interlocked solid vitreous porcelain end and circumferential walls, the latter comprising longitudinal staves which meet along their side edges at angles to self support each other and to produce a barrel of interior polygonal cross section, the ends of said staves being inset or rebated to receive the end walls, plates applied to said end walls, exterior clamping means applied to the plates to hold the staves and end walls assembled, cushioning means between said metal plates and said end walls,

staves and hubs on said plates interlocked to said end walls.

14. A crushing mill for enamel stock and the like comprising a horizontally rotative barrel having interlocked solid vitreous porcelain end and circumferential walls, the latter comprising longitudinal staves which meet along their side edges at angles to produce a barrel of interior polygonal cross section, the edge faces of said staves being joined at the inner side of the barrel by dry joints, and locking means between said stave edges radially exterior to said dry joints.

15. A crushing mill for enamel stock and the like comprising a horizontally rotative barrel having interlocked solid vitreous porcelain end and circumferential walls, the latter comprising longitudinal staves which meet along their side edges at angles to mutually support each other and to produce a barrel of interior polygonal cross section, the edge faces of said staves being joined at the inner side of the barrel by dry joints, and said meeting faces of the staves radially exterior to said dry joints having longitudinal registering recesses, and locking members in said recesses bonded to said staves.

16. A grinding and crushing mill for

enamel stock comprising a rotative barrel comprising vitreous porcelain heads and an enclosing wall made of solid staves of the same material extending continuously from head to head and joined thereto by dry joints, said staves meeting at their side margins along beveled faces to produce closed, internal, dry joints produced wholly by the material of the staves, and means between adjacent staves externally radial to said internal dry joints, and within the periphery of the barrel to lock together and bond said staves.

17. A grinding and crushing mill for enamel stock comprising a rotative barrel comprising vitreous porcelain heads and an enclosing wall made of solid staves of the same material extending continuously from head to head and joined thereto by dry joints, said staves meeting at their side margins along beveled faces to produce closed, internal, dry joints produced wholly by the material of the staves, means to confine said heads on the ends of the staves and circumferential binding means to hold the staves together along their beveled faces.

In witness whereof I claim the foregoing as my invention, I hereunto append my signature this 20th day of January, 1920.

FRANKLIN H. WOLEVER.