

Nov. 6, 1956

W. F. BETH

2,769,286

PULPSTONE

Filed Sept. 30, 1955

2 Sheets-Sheet 1

Fig. 1

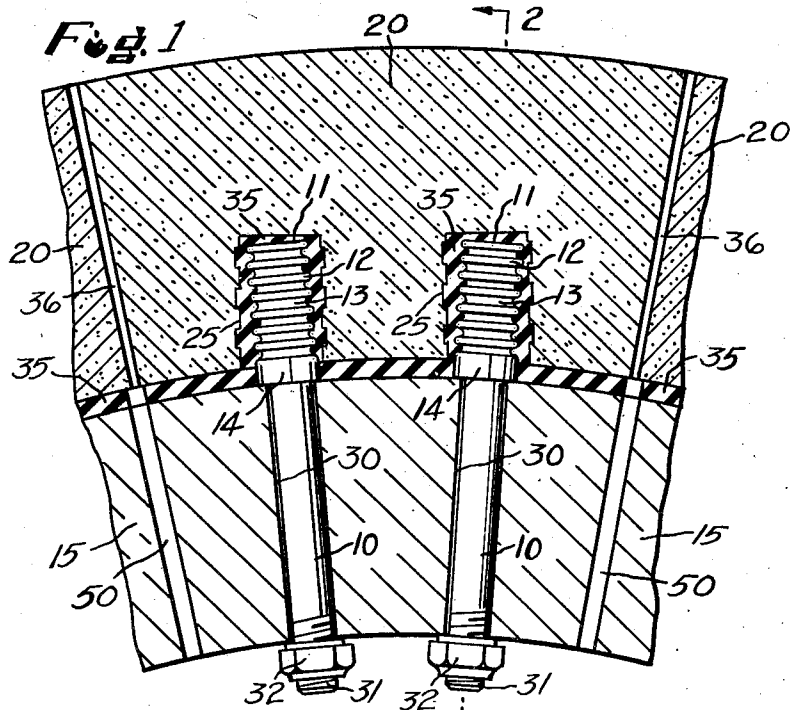
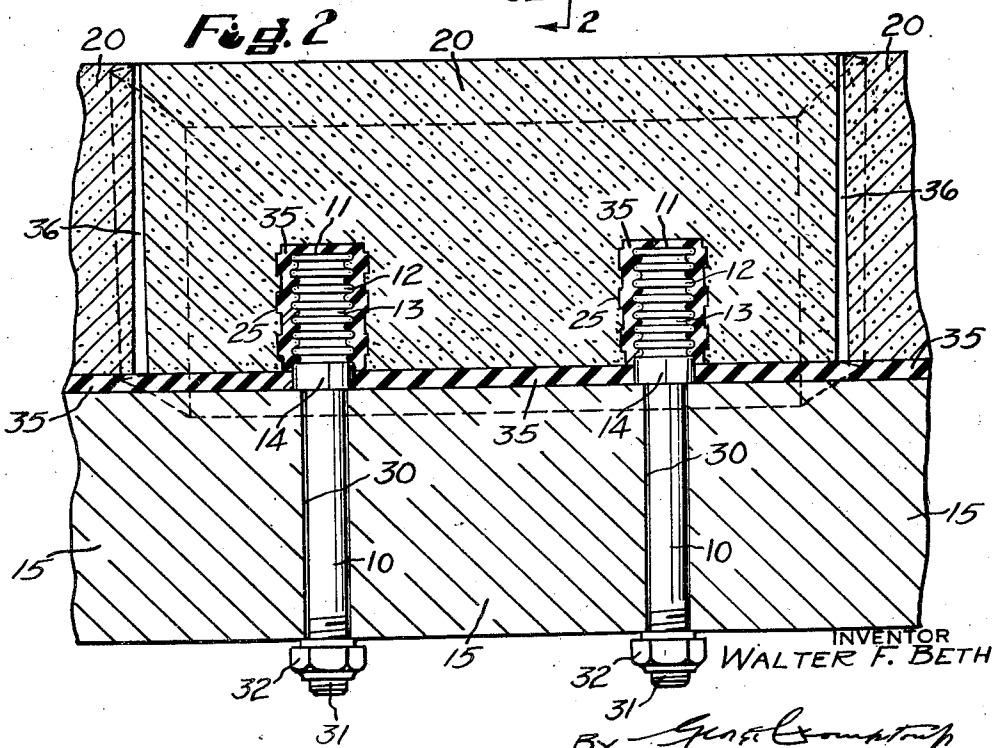


Fig. 2



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Fig. 7

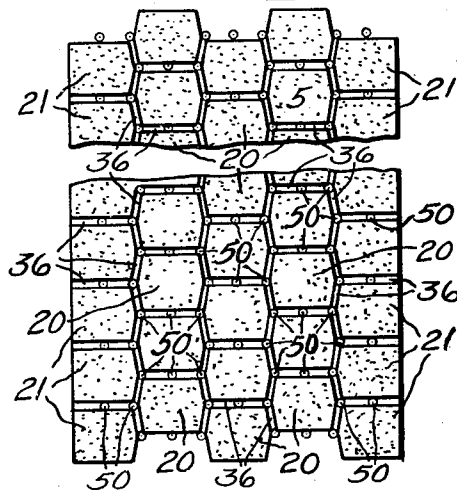


Fig. 5

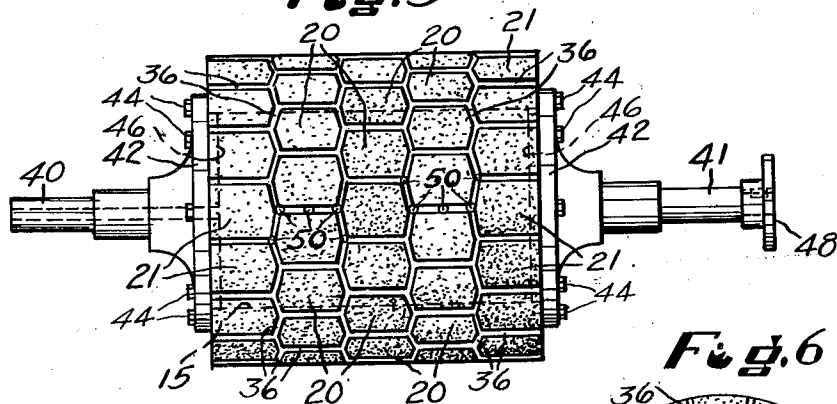


Fig. 6

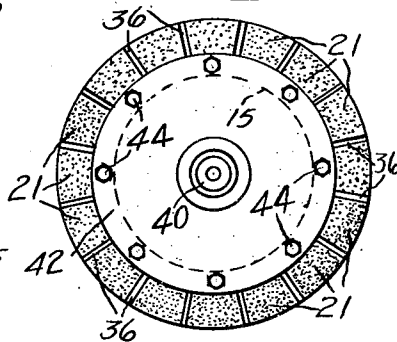


Fig. 3

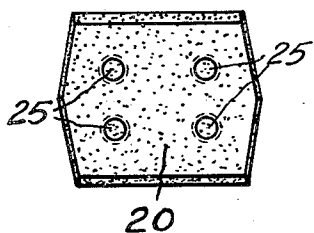
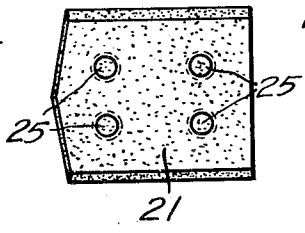


Fig. 4



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2,769,286

PULPSTONE

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Application September 30, 1955, Serial No. 537,641

10 Claims. (Cl. 51—206.4)

The invention relates to pulpstones.

One object of the invention is to provide a pulpstone of such construction that it is easy to build in the first place. Another object is to provide a pulpstone that can be easily repaired when one or a few of the blocks break. Another object is to provide a pulpstone of such construction that it can be readily reconstructed using the original center. Another object of the invention is completely to eliminate curing of the pulpstone or any of its components in an oven. Another object is to provide a pulpstone the blocks of which are firmly held in place but not under any initial tension, as I believe that initial tension on the blocks is the cause of many failures, and at the same time to provide a pulpstone having one or more of the advantages set forth in the preceding objects. Another object is to provide a pulpstone with provisions for keeping it cool for the manufacture of high grade pulp and to minimize fracturing of the blocks.

Other objects will be in part obvious or in part pointed out hereinafter.

In the accompanying drawings illustrating the invention, Figure 1 is a fragmentary cross sectional view of a pulpstone constructed in accordance with the invention,

Figure 2 is a fragmentary axial sectional view of the pulpstone, taken along the line 2—2 of Figure 1,

Figure 3 is a bottom view of one of the inner blocks used in making the pulpstone,

Figure 4 is a bottom view of one of the marginal blocks used in making the pulpstone,

Figure 5 is a side elevation of the pulpstone and its mounting,

Figure 6 is an end elevation of the pulpstone and its mounting,

Figure 7 is a developed view of the pulpstone.

As conducive to a clearer understanding of the present invention, it is noted that many pulpstones were manufactured, sold and used, and patents illustrating and describing them were issued, in which the blocks also called segments, were secured to a steel drum by bolts of various kinds. As the performance demanded of these pulpstones increased, by the use of driving motors in the pulp grinders of greater horsepower, breakage of the blocks became serious. To meet this situation the concrete center pulpstones were developed and, in many different forms, were manufactured, sold, used and patented. An excellent example of a concrete center pulpstone is illustrated and described in U. S. Patent No. 2,421,885 to Howe and Washburn.

In the case of the steel or iron drum center stones, so far as I am aware the bolts holding the blocks to the center were always tightened to exert initial pressure or tension on the blocks. In the Howe and Washburn patent pulpstone the bolts exert no initial tension on the blocks and are themselves under no initial tension or strain. I have discovered that a superior pulpstone for use in grinders of more than average horsepower can be produced by the utilization of a steel or iron drum center,

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bolts under initial tension and blocks not under initial tension.

Referring now to Figures 1 and 2, the bolts are designated by the reference character 10. Each bolt 10 has a convoluted head 11 comprising ridges 12 separated by grooves 13 and a base 14, and the base 14 might be of the same shape as the ridges 12 but is shown as flattened on the bottom. The base 14 might be shaped exactly to fit the surface of a metal drum center 15 but not a great deal is gained by so doing.

The ridges 12 are shown as rounded and so are the grooves 13 and this facilitates manufacture and allows the cement to fill the spaces and to set firmly, but many other shapes could be adopted. The distance between the centers of the ridges 12 in this illustrative embodiment of the invention is .25 inch but may be from .125 inch to .5 inch and the distance between grooves is the same with preferably the same limits.

Broadly speaking the drum 15 is a metal drum and any suitable steel or cast iron could be used or other metals such as bronze could be used. However, for manufacturing reasons I prefer to use a cast iron of the kind known as semi-steel. Strength is, of course, important and so is manufacturing cost. Any suitable mounting apparatus can be used for the drum 15 which is shown as a hollow metal cylinder and many such apparatus are known. If desired the drum 15 can have spokes, or flanges can be used removably to secure it to the shaft of the pulp grinder.

I provide blocks 20 and 21 which are made of vitrified bonded abrasive material the nature of which is now fully understood in the art. For pulpstone blocks both fused aluminum oxide and silicon carbide have been used and each is used today. The desired abrasive is mixed with ceramic bonding material usually involving a major portion of clay, the blocks are molded from the mixture of abrasive and ceramic material and are then vitrified in a kiln. Such manufacture being well known it need not be further described herein.

The blocks 20 and 21 can be of any desired contour in development, rectangles, squares and hexagons being common. However, as shown in Figures 3, 4, 5 and 7, the blocks 20 inwardly of the stone are hexagonal blocks while the marginal blocks 21 are five sided as shown. By this construction the ends of the pulpstone can be plane surfaces or other surfaces of revolution. The outer surfaces of the blocks will be at least eventually cylindrical and preferably the inner surfaces will also be cylindrical.

Referring now to Figures 1, 2, 3 and 4, I form one or more holes 25 in each block 20 and 21. These holes 25 are preferably grooved as illustrated. The clearance between the heads 11 and the grooved holes 25 is such that the blocks 20 and 21 can be placed on the heads 11. As shown in Figure 1, the bolts 10 are set radially as other arrangements would be expensive, while the holes 25 are made perpendicular to the chords of the blocks as this is the easiest way and the canting of the bolts relative to the holes is in no wise detrimental. Clearance enough is provided so that the blocks can readily be set onto the bolt heads.

These grooved holes 25 can be made by shaving the blocks when they are green, that is to say before they are vitrified. This materially simplifies manufacture as compared with molding the holes or boring them after the blocks are vitrified. Shaving can be done by rotary tools in a manner which will be well understood by those skilled in the art.

Having procured a metal drum 15 of the desired size with radial holes 30 therethrough at spaced intervals to match the holes 25 in the blocks 20 and 21, I insert a bolt 10 in each of the holes 30 with threaded ends 31

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of the bolts 30 projecting from the inside of the drum 15 and with the convoluted heads 11 on the outside of the drum 15 with the bases 14 engaging the drum. I then screw elastic stop nuts 32 onto the threaded ends 31 and tighten the nuts to place the bolts 10 under a tension of at least 3,000 pounds. The tension usually should be greater than 3,000 pounds but the amount of tension to produce depends upon the size of the drum 15 and of the pulpstone as a whole and also upon the size of the bolts and of the threads 31. With a pulpstone 62 inches in diameter and with a drum 51 inches in diameter and with bolts .625 inch in diameter and 7 inches long, a satisfactory tension is 6,000 pounds. There is no upper limit other than breaking the bolts or stripping the threads and the latter will usually occur first.

I provide a suitable cement and I now prefer Portland cement mixed with iron hardener, in proportions of one part by weight of the Portland cement and one part by weight of the hardener. Iron hardener is well known and usually consists of iron filings with a small amount of salammoniac to promote reaction. An area of the outside of the drum 15 the size of the bottom of a block 20 or 21 is coated with this cement, and the convoluted heads 11 of four adjacent bolts 10, if there are four per block, are thoroughly coated with this cement. Then a block is set in place on the heads 11 contacting the cement 35 on the outside of the drum 15 with more cement 35 in the holes 25. This job is repeated over and over again until the pulpstone is built to the required plan such as shown in Figures 5 and 6. As shown in Figure 5 there are spaces or clearances 36 all around each block separating the blocks and these spaces may be filled with filler material, many such being known in the art, but I prefer to leave these spaces open. The pulp does not fill them. A practical clearance 36 between blocks is one-sixteenth of an inch and it is not to be expected that all of the clearances 36 will be the same nor is it required that they be. While I prefer Portland base cements, especially with an iron filler, other room temperature mineral cements might also be used. I may also use room temperature setting organic cements.

Figures 5 and 6 show an illustrative manner of mounting the pulpstone of the invention. Shafts 40 and 41 having flanges 42 are bolted by bolts 44 to the drum 15 at the end thereof. Preferably the flanges 42 have inwardly projecting cylindrical portions 46 nicely fitting the inside of the drum 15 to locate it accurately. The shafts 40 and 41 are mounted in bearings in the pulpstone grinder. One of these shafts such as the shaft 41 is a driving shaft and has a driving flange 48 secured thereto as by means of a key and the flange 48 is coupled to the motor of the pulp grinder. These features are given only by way of illustration and may be varied at will. One shaft, for example the shaft 40, is a hollow shaft open at both ends.

While as stated pulpstone blocks of other shapes can be used within the broad features of my invention, there is an advantage in using hexagonal blocks 20 with five sided marginal interfitting blocks 21. Thereby the joints are readily broken so that the stone presents abrasive throughout its length and only two kinds of blocks need be manufactured. Using blocks elongated in the axial dimension as shown makes it possible to have four holding bolts for each block so located as well to distribute the stresses and to avoid breaking strains. In some cases, however, I may provide only two bolts per block, and then I would arrange them diagonally opposite by providing two diagonally opposite holes of the four illustrated in each of Figures 3 and 4. Another desirable shape for the blocks 20 is that of regular hexagons in which case if they are small only a single holding bolt need be provided for each block. However, because of danger of torsional forces loosening the blocks on the heads 11 a plurality of bolts for each block is preferred and the best number appears to be four and the next

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best arrangement is two diagonally arranged. In the claims the inner blocks 20 are stated to be hexagons or that they are hexagonal which means that they are such in plan and in development. In stating that the marginal interfitting blocks are five sided blocks, the linear sides are referred to as the blocks are seen in development.

An inner block for the pulpstone of the invention with its four holes in a preferred form of the invention may be described as consisting of an elongated hexagonal block of vitrified bonding abrasive material having a convex cylindrical surface having six plane surfaces extending from said convex cylindrical surface two of them being parallel and opposite and forming a dihedral angle whose apex is on the concave side of said convex cylindrical surface, said block having an eighth surface truncating said dihedral angle, and said block having a pair of grooved holes which extend from the eighth surface and are located on opposite sides of a plane bisecting said dihedral angle.

An outer or marginal block for the pulpstone of the invention with its four holes in a preferred form of the invention may be described as consisting of a block of vitrified bonded abrasive material having a convex cylindrical surface with five sides four of which are sides of a hexagon and the fifth of which is a straight side, said block having starting from the two sides adjacent the straight side two plane surfaces extending from said convex cylindrical surface forming a dihedral angle whose apex is on the concave side of said convex cylindrical surface, said block having two other plane surfaces starting from the cylindrical surface from the remaining sides of the hexagon, said block having a plane side starting from the straight side of the convex cylindrical surface, said block having a seventh surface truncating the dihedral angle, and said block having a pair of grooved holes that extend from the seventh surface and are located on opposite sides of a plane bisecting said dihedral angle.

It is highly desirable to keep the drum 15 cool as this assists in keeping the blocks 20 and 21 from overheating. To this end I connect a supply of water to the hollow shaft 40. As the end of the shaft 40 is on the outside of the grinder, the smallest diameter portion of the shaft 40 being a journal which fits in the bearing of the grinder, a simple expedient is to mount a stationary nozzle coaxial with the shaft 40 and closely adjacent to it thus directing a jet of water into the bore in the shaft 40 and the water by reason of its momentum will travel the entire length of the shaft 40 and spill into the rotating hollow pulpstone. The water would heat up if fresh water could not be continually supplied so I provide holes 50 radially through the drum 15 and through the cement 35 and these holes 50 may be many in number as shown in Figure 7 and will serve directly to cool the blocks 20 and 21. Centrifugal force will, of course, cause the water to form a hollow cylinder inside of the drum 15 and the centrifugal force likewise produces enough pressure to drive the water out of the holes 50. With a drum 15 having an inside diameter of four feet and the pulpstone rotating at 200 R. P. M., the pressure, assuming the layer of water in the drum to be three inches thick, will be roughly five pounds per square inch. In many cases the water layer will be thicker than that.

In an illustrative embodiment of the invention the drum 15 will be 51 inches outside diameter, 43 inches inside diameter, 54 inches long, the blocks will be 5 inches thick radially, the ridges 12 will be one inch maximum outside diameter and the holes 25 will be 1.25 inches minimum inside diameter. The other dimensions can be in proportion as shown. These dimensions are given merely by way of illustration and can be varied widely as they will be varied for grinders of different sizes and the blocks can be smaller or larger relative to the drum 15.

Especial advantages of the pulpstone construction of

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this invention are that the stone may be of any size, limited only by the size of the drum which can be manufactured. The blocks may be of any size or shape and with the bases 14 taking the tension, there is no initial stress on the blocks. But the initial tension on the bolts prevents them from moving. The mounting of the blocks does not introduce any initial tension on the blocks. The blocks may be manufactured without holes ensuring a uniform abrasive structure and simplifying molding procedures. It is also a great advantage of the construction of the present invention that the blocks can be readily removed merely by unscrewing the nuts 32 and then driving the bolts outwardly from the inside. Reconstruction of the pulpstone is then a simple matter and can be done in the mill without returning the drum 15 to the manufacturer. When one or a small number of blocks break they can be readily replaced in the manner indicated.

It will thus be seen that there has been provided by this invention a pulpstone in which the various objects hereinabove set forth together with many thoroughly practical advantages are successfully achieved. As many possible embodiments may be made of the above invention and as many changes might be made in the embodiments above set forth, it is to be understood that all matter hereinbefore set forth or shown in the accompanying drawings is to be interpreted as illustrative and not in a limiting sense.

I claim:

1. A pulpstone comprising a hollow cylindrical metallic drum having holes therethrough located in a regular pattern, metal bolts extending through said holes and projecting therebeyond into the inside of said drum and from the outside of said drum, the bolts having threaded ends where they project inside of said drum and the bolts having convoluted heads where they project outside of said drum and having base portions under said convoluted heads which contact the exterior of said drum and hold the heads free of tension, nuts on the threaded ends of said bolts said nuts being tightened to produce a tension of at least 3,000 pounds on said bolts, pulpstone blocks having holes into which said convoluted heads project said pulpstone blocks being made of bonded abrasive material and having holes to receive the convoluted heads, and room temperature set cement between the blocks and the outer surface of said drum and in the holes in the blocks and on the convoluted heads said cement securing said blocks in place on the convoluted heads and on the outside of the drum.

2. A pulpstone according to claim 1 in which the hollow cylindrical metal drum has additional holes therethrough and through the cement with their outer ends located between blocks for the exhaustion of water from inside of the drum by centrifugal force.

3. A pulpstone according to claim 2 having marginal blocks and inner blocks, said marginal blocks being five sided blocks and said inner blocks being hexagonal blocks covering the area of the drum between the marginal blocks.

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4. A pulpstone according to claim 3 in which there are at least two bolts for each block with their convoluted heads located in holes in the blocks that are entirely located on opposite sides of radial planes of the pulpstone through the centers of the blocks with said two bolts entirely located on opposite sides of said radial planes.

5. A pulpstone according to claim 1 having marginal blocks and inner blocks, said marginal blocks being five sided blocks and said inner blocks being hexagonal blocks covering the area of the drum between the marginal blocks.

6. A pulpstone according to claim 5 in which there are at least two bolts for each block with their convoluted heads located in holes in the blocks that are entirely located on opposite sides of radial planes of the pulpstone through the centers of the blocks with said two bolts entirely located on opposite sides of said radial planes.

7. A pulpstone according to claim 1 in which there are at least two bolts for each block with their convoluted heads located in holes in the blocks that are entirely located on opposite sides of radial planes of the pulpstone through the centers of the blocks with said two bolts entirely located on opposite sides of said radial planes.

8. A pulpstone according to claim 7 in which the hollow cylindrical metal drum has additional holes therethrough and through the cement with their outer ends located between blocks for the exhaustion of water from inside of the drum by centrifugal force.

9. A pulpstone according to claim 1 having marginal blocks and inner blocks with each of the inner blocks being an elongated hexagonal block of vitrified bonded abrasive material having a convex cylindrical surface having six plane surfaces extending from said convex cylindrical surface two of them being parallel and opposite and forming a dihedral angle whose apex is on the concave side of said convex cylindrical surface, said block having an eighth surface truncating said dihedral angle, and said block having a pair of grooved holes which extend from the eighth surface and are located on opposite sides of a plane bisecting said dihedral angle.

10. A pulpstone according to claim 9 in which each of the marginal blocks is a block of vitrified bonded abrasive material having a convex cylindrical surface with five sides four of which are sides of a hexagon and the fifth of which is a straight side, said block having starting from the two sides adjacent the straight side two plane surfaces extending from said convex cylindrical surface forming a dihedral angle whose apex is on the concave side of said convex cylindrical surface, said block having two other plane surfaces starting from the cylindrical surface from the remaining sides of the hexagon, said block having a plane side starting from the straight side of the convex cylindrical surface, said block having a seventh surface truncating the dihedral angle, and said block having a pair of grooved holes that extend from the seventh surface and are located on opposite sides of a plane bisecting said dihedral angle.

No references cited.