June 10, 1947. W. L. HOWE ET AL 2,421,886

PULPSTONE

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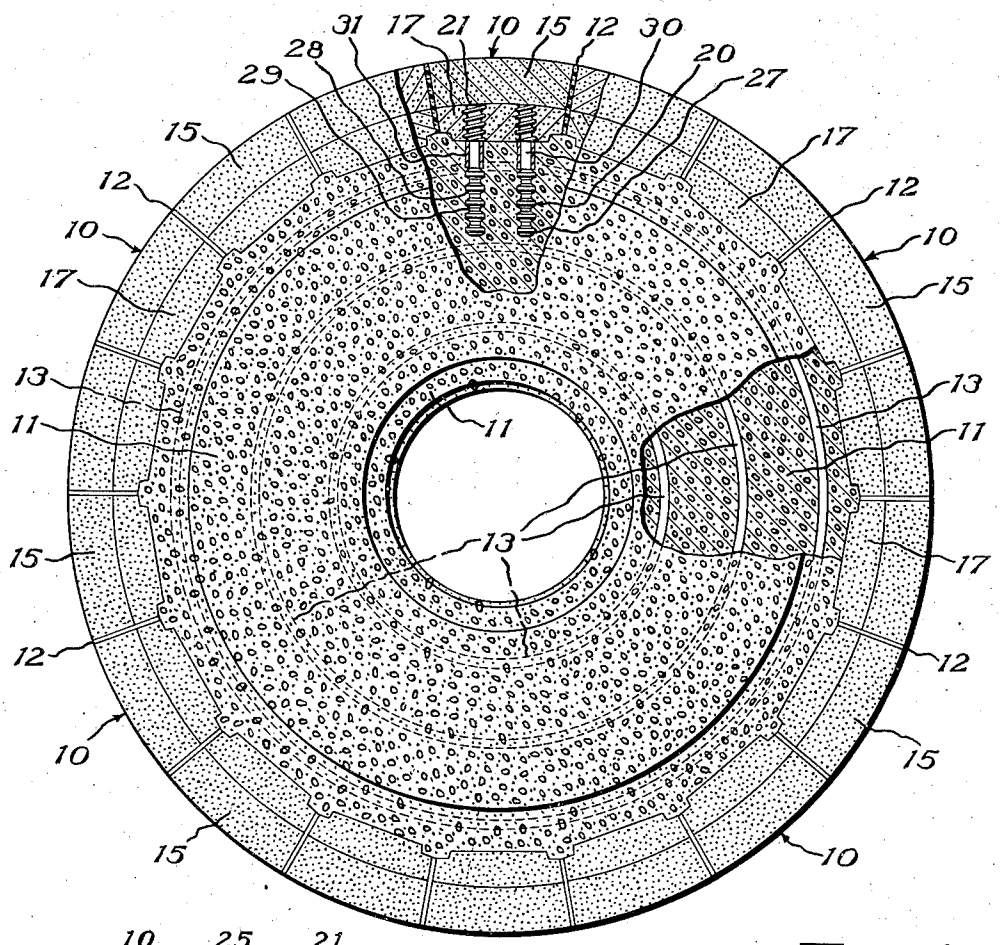


FIG. 1

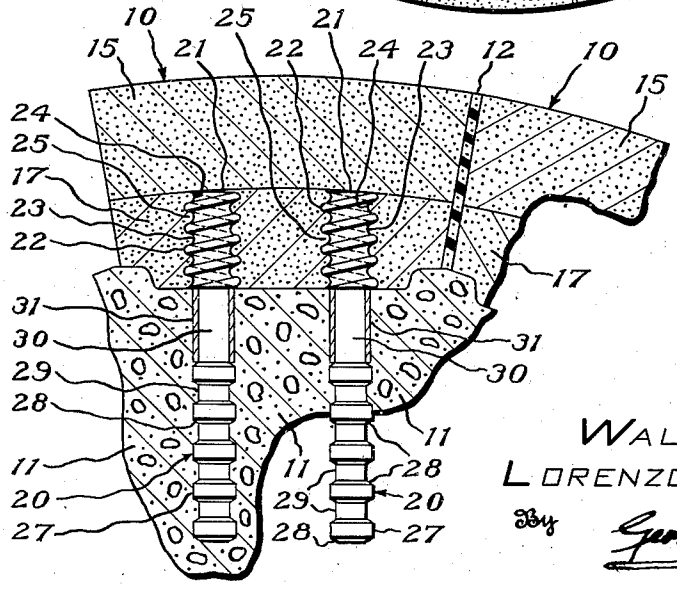


FIG. 2

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FIG. 3

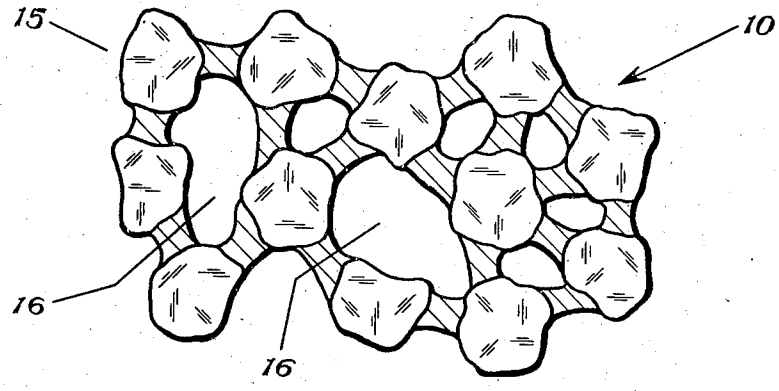
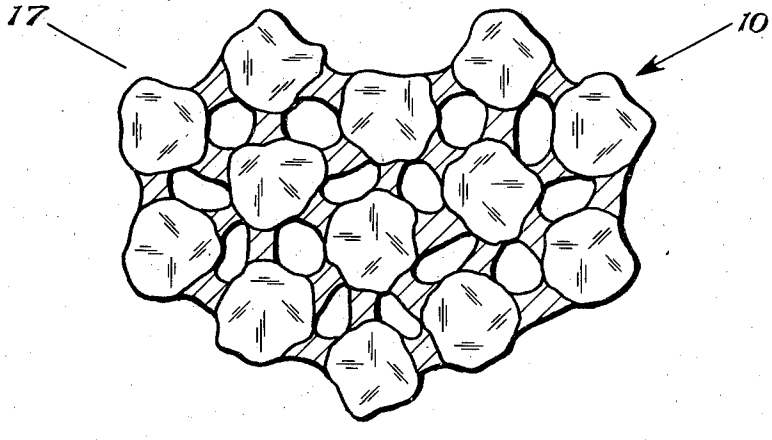


FIG. 4



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PULPSTONE

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Application September 19, 1945, Serial No. 617,184

2 Claims. (Cl. 51—206)

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The invention relates to pulpstones. This application shows but does not, except in combination with other features, claim the subject matter of the invention of our copending application Serial No. 616,984, filed September 18, 1945.

One object of the invention is to provide a free-cutting pulpstone. Another object of the invention is to provide a pulpstone which does not overheat. Another object of the invention is to provide a pulpstone which can be effectively burred without excessive wear of the burr. Another object of the invention is to provide a pulpstone which will absorb more horsepower than previous stones.

Another object of the invention is to provide a pulpstone that requires but infrequent burring Another object of the invention is to provide a pulpstone of long life. Another object of the invention is to provide a pulpstone which gives greater production per unit of horsepower consumed. Other objects will be in part obvious or in part pointed out hereinafter.

The invention accordingly consists in the features of construction, combinations of elements, and arrangements of parts, as will be exemplified in the structure to be hereinafter described, and the scope of the application of which will be indicated in the following claims.

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

Figure 1 is an end elevation of a pulpstone constructed in accordance with the invention, typical portions being shown in cross-section;

Figure 2 is a fragmentary sectional view on an enlarged scale of a typical portion of the pulpstone, including one of the abrasive blocks;

Figure 3 is a highly magnified fragmentary sectional view of the abrasive composition of a block; and

Figure 4 is a highly magnified fragmentary sectional view of the composition of the holding portion of a block.

Referring first to Figure 1, the pulpstone according to the invention comprises a plurality of blocks 10 set about and secured to a central core 11 which preferably is of concrete. In the usual case there will be a plurality of rows of blocks 10, that is to say, the axial dimension of the pulpstone requires more than one block at each circumferential position. The procedure for manufacturing a pulpstone from a multitude of abrasive blocks such as the blocks 10 is set forth in prior U. S. Letters patent, for example, see No. 2,141,608 to Larsson. Briefly, a ring of blocks

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10 is formed by placing them together with intervening sheets 12 of a deformable material such as disclosed in Larsson Patent No. 2,054,771; a second, a third, etc., ring of blocks 10 are then built upon the first ring, the entire structure is clamped together with circumferential clamps, placed in an oven and heated to around 160° C. for about 24 hours, which heat sets the deformable material 12. Then removable sleeves, preferably tapered, are placed in the center of the hollow cylinder formed of the blocks 10, a series of concentric cages 13 made of steel hoops are placed between the removable sleeves and the blocks 10, and concrete is poured into the annular space and allowed to set.

This invention is more particularly concerned with the abrasive structure and base structure of the blocks 10 and a particular species of holding bolt which is embedded in the concrete center 11 and secured in the blocks 10.

Referring now to Figures 2 and 3, each block 10 consists of an outer abrasive zone 15 consisting of abrasive grains and bond and relatively large pores 16. This zone 15 extends across the whole width of the block, meaning the axial direction of the pulpstone, and across the whole circumferential dimension of the pulpstone, that is to say, a cross-section in a plane perpendicular to the axis of the pulpstone would be the same taken anywhere except that irregularities and minor variations are of no consequence. The remainder of each block 10 consists of a holding zone 17, also formed of abrasive grains bonded with the same bond and having a certain porosity and not having what have been characterized as large pores.

Any suitable abrasive material may be used, preferably aluminum oxide, better described as fused alumina, or silicon carbide. We will first give a specific typical example of the manufacture of a block according to the invention. A quantity of fused alumina abrasive of the purer type, for example, around 98% Al_2O_3, of 24 grit size is mixed with clays such as commonly used in the abrasive art. The quantities may be selected to provide 44 volume per cent of abrasive and about 14.3 volume per cent of bond. To this is added enough coke in granular form to make 15 volume per cent in the pressed article. The size of the coke granules may be grit size 12 to grit size 14. This is the first mixture for the outer or abrasive zone 15.

A second mixture is made of the same abrasive of the same grit size and the same bond but

calculated to give 50 volume per cent of abrasive and 11.5 volume per cent of bond.

A mold of substantially the shape of a block 10 is provided. The bottom of the mold represents the inner boundary of the block. A quantity of the second mixture is charged into the bottom of the mold to form the holding zone 17. A quantity of the first mixture is then charged in the upper part of the mold upon the said second mixture and then the entire contents of the mold is pressed to give a total porosity of 26.7 volume per cent of the abrasive zone 15 resulting in 38.5 volume per cent porosity of the holding zone 16. The block is then stripped from the mold, baked to dry it, and fired in a ceramic kiln to vitrify it in the usual way. During the firing in the ceramic kiln the coke burns away, leaving the large pores 16 which are substantially of the same size as the original coke granules and forming an additional 15 volume per cent of pores. Thus the total porosity of the zone 15 is 41.7 volume per cent. In place of coke any other material which burns out in the kiln or is otherwise eliminated after the block 10 is molded can be used. A number of other materials are known to the art, for example, naphthalene can be used which will be eliminated during the baking operation before vitrifying.

In a preferred embodiment of the invention we provide each block with a number of holding bolts 20, preferably four bolts to a block. Each holding bolt 20 has a threaded end 21 having a large rounded thread 22, leaving a rounded helical groove 23 between convolutions of the thread. Each holding bolt 20 is, in the finished pulpstone, in threaded engagement with a threaded hole 24 in a block 10. In each hole 24 there is a rounded thread 25 of abrasive material fitting in the helical groove 23. In an illustrative embodiment of the invention the rounded helical groove 23 has a radius of .135 inch and the rounded thread 22 has a radius of .115 inch. In this embodiment the pitch of the thread 22 is .5 inch and the threaded end 21 is 2.25 inches long.

For the formation of the threaded holes in the blocks 10 we may provide metal cores (preferably of hardened steel) having threads and grooves of the same shapes as the threads 22 and grooves 23, but these cores are longer than the threaded ends 21 and they are slightly larger in diameter, for example, of the order of .025 inch larger in overall diameter. Such cores extend through correspondingly threaded holes in the bottom mold plate of the mold for manufacturing the blocks 10, and the abrasive mixture of the zone 17 is molded and pressed around them. Each such core has some means for turning it, for example, a screw driver slot in the outer end, and after the mixture is pressed the cores are screwed out of the holes which they have formed in the "green" block. Unscrewing of the cores is preferably done after all parts have been stripped from the "green" block except the bottom plate.

It is somewhat surprising that a threaded hole having a strong thread of dense abrasive, and to the desired size and shape within close limits, may be thus formed since it was feared that the abrasive-bond mixture would not flow well into the reentrant portions of the core represented by the abrasive thread 22, but satisfactory results have been achieved in actual practice. Other manners of forming the threaded holes are considered less practical, since drilling and threading a vitrified block would be prohibitively costly,

while accurately threading a hole in a "green" block would be difficult.

The bolts 20 have large diameter portions 27 which may be 1 inch in diameter, with conical or bevelled sides 28, which may be of a .75 inch diameter. The portions 27 and 28 thus constitute integral rings with bevelled sides. These are spaced apart by reduced diameter portions 29. We further provide portions 30 of uniform cross-section adjacent the threaded ends 21. At some time before pouring the concrete we wind a piece of cardboard or heavy paper 31 of the order of .010 inch thick around each portion 30 or similarly coat such portions with a substance which will melt and flow into the concrete when the stone is heated in use. Paraffine is a good example. The purpose of such materials is to keep the rigid concrete away from the bolt at this locus of the portions 30. Thereby such portions 30 are capable of moving slightly in the concrete by bending thereof and compression of the paper or because there is a void in the concrete at this locus. Thus differential expansion between the blocks 10 and the central core 11 is permitted without cracking the stone. Such differential expansion (including contraction) otherwise sets up a shearing force upon the bolts 20 by reason of the fact that the concrete phases changes abruptly to the abrasive phase.

After a block 10 has been vitrified the holes 24 therein are filled with a suitable cement. We find that an excellent cement for this purpose is phenol formaldehyde "A" stage resin plasticized to the consistency of a heavy cream by means of liquid furfural. Shortly after the holes 24 have been filled with such liquid it is poured off. Even in a short time it penetrates some distance into the abrasive, sealing the holes against admittance of pulp water when the stone is used. Furthermore, the cement strengthens the abrasive thread 24. After the cement and the threaded holes 24 have been air dried, some more cement is brushed onto the threaded ends 21 of the bolts 20 and they are then screwed into the blocks 10 to the position shown in Figures 1 and 2. The previously described heating of a complete set of blocks 10 in an oven for 24 hours at 160° C. hardens the above cement at the same time that it hardens the sheets 12 of deformable material. For filling the holes 24 and coating the threaded ends 21 we may use other cements, such as semi-hard rubber, vulcanized in situ, or a self-curing resinous mixture, copper oxide cement, or a watery mixture of Portland cement.

The threads of abrasive material 25 are strong because they are rounded and of generous size. Furthermore, by rounding the threads 22 and the grooves 23, difficulty in screwing the bolts 20 into the blocks 10 after the blocks have been vitrified is eliminated. The threads 22 should have a radius of no less than .020 inch, that is, a diameter of no less than .040 inch.

However, we are not limited to rounded threads, since square or V-shaped threads may be used. The V thread may have an angle of 60 degrees or a different angle. Nevertheless such threads should also preferably be of generous size, and the thread in the abrasive should preferably be of no less size. If a square thread is used, the width of the thread should be no less than .040 inch. If a V thread is used, the width half way from the base to the top should be no less than .040 inch. If in each case the corresponding dimension of the abrasive thread is no less than .040 inch, it follows that the pitch of the thread

on the bolt is no less than .080 inch. In this range, the smallest threads and pitches should be used only with blocks having abrasive of fine grit size.

Considering now the best practical embodiments of the invention, the range of volume percentage of the abrasive in the zone 15 may be from 36 volume per cent to 60 volume per cent. The grit size of such abrasive has a preferred range of from No. 16 to No. 90 in the zone 15. The volume percentage of the bond in this zone may vary between 6 volume per cent and 24 volume per cent if the abrasive is fused alumina, and from 14 volume per cent to 32 volume per cent if the abrasive is silicon carbide.

The grit size of the coke or other eliminatable material may be best stated as not smaller than the abrasive up to several times the size of the abrasive. The volume percentage of this eliminatable material may vary between 5 and 30% and possibly within even wider limits. We at present prefer 15% as an arbitrary figure which gives good results in actual practice. It should be understood that with so many factors the permutations are considerable.

The volume percentage of abrasive in the zone 17 is preferably from 36 to 60. The volume percentage of bond if the abrasive is alumina may run from 6 to 24. The volume percentage of bond if the abrasive in the holding zone 17 is silicon carbide may run from 14 to 32. The grit size of the holding zone, however, may run finer than in the abrasive zone. We may use any grit size from No. 16 to No. 150 or even finer than 150. While a useful stone might be made there is nevertheless no reason that we know of for having a coarser grit in the holding zone than the abrasive zone and in many cases we prefer to have finer grit in the holding zone to obtain a stronger structure.

Pulpstones made in accordance with the present invention will stand up under rough usage. Because of demands for increased production due to the war and otherwise, pulp makers have been running their stones at greater speeds and using higher pressures and furnishing more horsepower to the grinders. The pulpstone illustrated in Larsson Patent No. 2,141,608, particular features of which are described in other patents, was designed to be and found to be practically unbreakable. But that was under those conditions; the pulp makers finding that the stones illustrated in that patent will usually stand higher speeds, are using higher speeds, which results in a small percentage of breakdowns. So now a still stronger pulpstone is again wanted.

The holding bolts 20 with the threaded ends 21 in the zone 17 of strong composition hold the blocks 10 to the central core 11 with great strength. Furthermore, the open porosity of the zone 15 permits the pulp water to penetrate the blocks 10, thus keeping them cooler.

The action of the porous abrasive material having large open pores, or induced pores of large size, is a rapid rate of cut of the logs without excessive pressure. That is to say, the pulpstone is free-cutting. It is also easier to burr since the burr will break it down more readily. It needs burring less frequently, because it is naturally

rougher on the surface than dense abrasive, or abrasive material without induced pores.

It will thus be seen that there has been provided by this invention an article 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 embodiment 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.

We claim:

1. A pulpstone in the shape of a body of revolution the curved surface of which is the outer surface of a plurality of bonded abrasive blocks, comprising a plurality of said bonded abrasive blocks, a central concrete core, a plurality of means each including a metal bolt to hold said blocks to said core, each of said means comprising a portion of varying cross-section of said bolt embedded in said concrete core, a thread on said bolt, a mating thread in a hole in said block, and a layer of cement in the hole in said block and upon said threads, the pitch of the thread on the bolt being at least .080 inch, said blocks having an abrasive zone outside of the radius of said bolts having large induced pores not smaller than the grit size of the abrasive thereof up to several times said grit size and to the extent of at least 5 volume per cent of said abrasive zone, and said blocks having an inner zone holding said bolts which has only fine pores smaller than the grit size of the abrasive grains thereof.

2. A pulpstone in the shape of a body of revolution the curved surface of which is the outer surface of a plurality of bonded abrasive blocks, comprising a plurality of said bonded abrasive blocks, a central concrete core, each block having an outer zone of abrasive grains of a grit size from 16 to 90 bonded with vitrified bond, the volume percentage of the abrasive being anywhere between 36 to 60, the volume percentage of the vitrified bond being anywhere from 6 to 32, and a porosity of two kinds, large pores of a size not less than the grit size of the abrasive up to several times such size in amount between 5 and 30 volume per cent, and the remainder small pores smaller than the grit size of the abrasive, each block having an inner zone of abrasive grains and vitrified bond having only pores smaller than the grit size of the abrasive thereof, and means in the inner zone of each block and extending into the concrete core holding said blocks to said core.

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