J. R. PEIRCE.

DIVIDING MARBLE SLABS.

APPLICATION FILED JUNE 13, 1907.

914,303.

Patented Mar. 2, 1909.

3 SHEETS—SHEET 1.

FIG. 1.

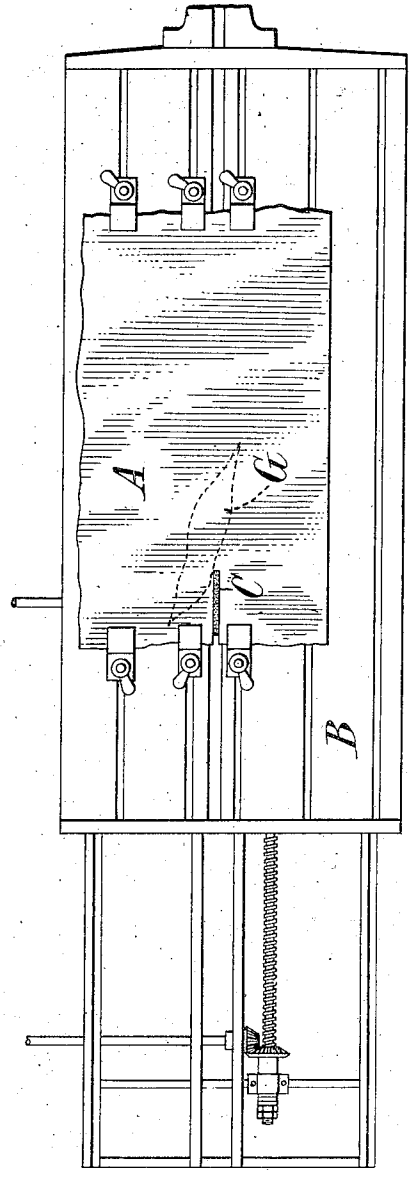
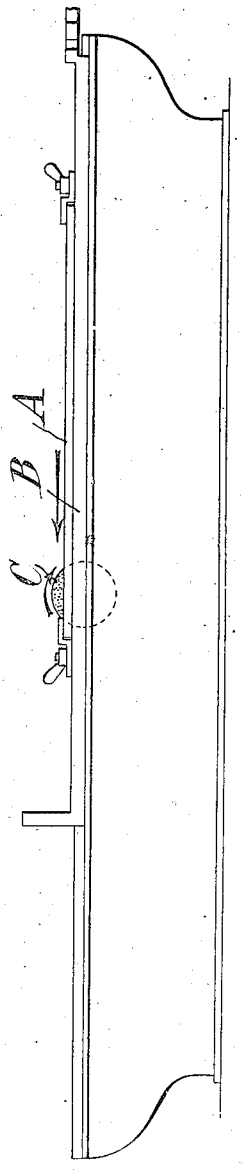


FIG. 2.



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3 SHEETS—SHEET 2.

FIG. 3.

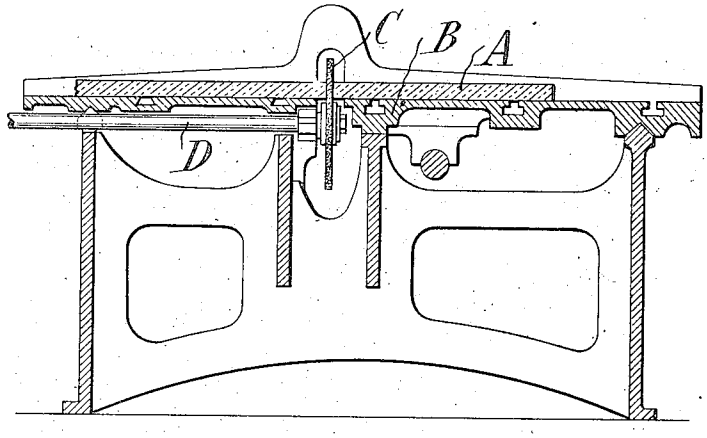
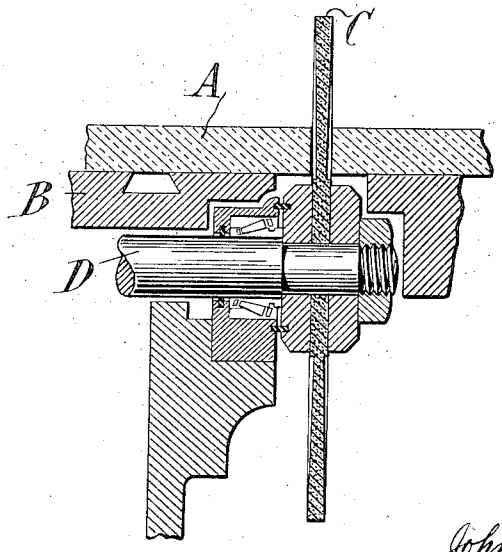


FIG. 4.



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3 SHEETS—SHEET 3.

FIG. 5.

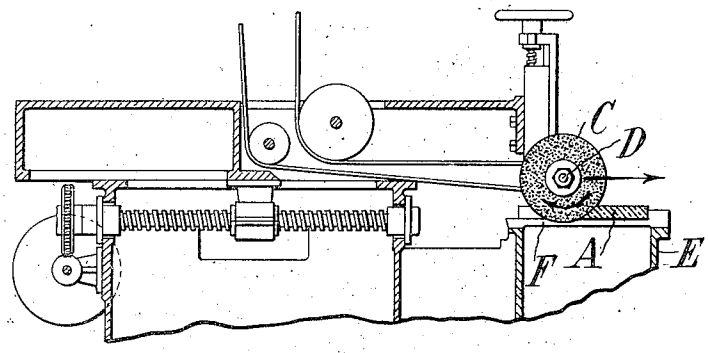
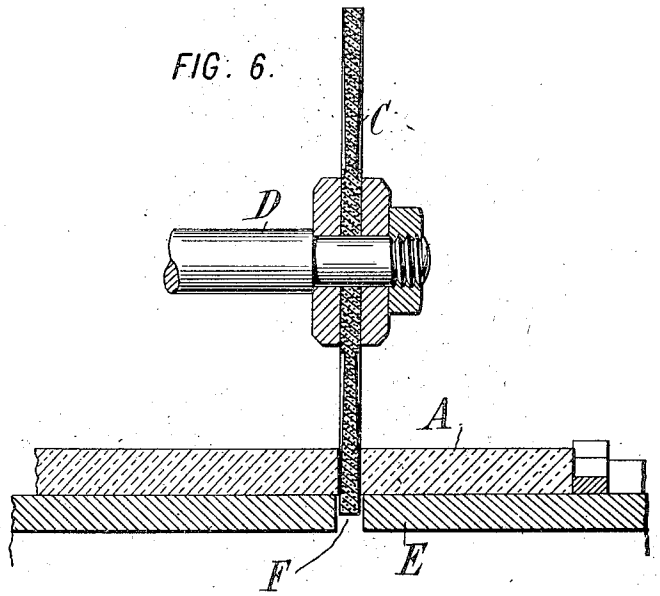


FIG. 6.



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UNITED STATES PATENT OFFICE.

JOHN ROYDEN PEIRCE, OF NEW YORK, N. Y., ASSIGNOR TO ROYDEN MARBLE MACHINERY COMPANY, OF NEW YORK, N. Y., A CORPORATION OF NEW JERSEY.

DIVIDING MARBLE SLABS.

No. 914,303. Specification of Letters Patent. Patented March 2, 1909.

Application filed June 13, 1907. Serial No. 378,741.

To all whom it may concern:

Be it known that I, JOHN ROYDEN PEIRCE, a citizen of the United States, residing in the borough of Manhattan, city, county, and State of New York, have invented certain new and useful Improvements in Dividing Marble Slabs, of which the following is a specification.

This invention aims to provide for dividing slabs of marble, onyx or the like by a process analogous to the operation of a steel circular saw with fixed teeth cutting through a hard wood plank. For this purpose a rapidly revolving thin wheel of carborundum agglomerated with a firm (preferably a vitrified) bond is used, the sharp particles of which act like the fixed teeth of a steel saw instead of being easily torn out of their matrix and acting as a loose sharp abradant. The bond is so hard and strong as to facilitate the making of the wheel of minimum thickness. This possibility of using a very thin wheel not only cheapens the wheel and insures the removal of a comparatively insignificant quantity of marble, but also calls for the expenditure of a minimum amount of power to drive it, and permits the wheel to be forced through the marble at a high speed for a given power. Notwithstanding its thinness, the wheel cannot be substantially deflected by the usually oblique irregularities of the marble even when forced through the marble at a rapid rate, and will make a straight cut at comparatively high speed without stunning the marble or breaking the wheel. The rapid revolution of the carborundum wheel introduces a gyroscopic effect which immensely strengthens its resistance to lateral deflection, and permits the use of a wheel so thin (five-sixteenths 5/16 of an inch or less) in practice for wheels of 10, 12 or 14 inches diameter that it would be easily broken by a slight pressure when at rest. Such wheels, however, when in rotation, withstand a series of lateral blows or pressures such as are necessarily encountered by reason of the lack of homogeneity of the marble, and the necessary imperfections of even the best machinery. The bonding of the particles so that they act as fixed teeth instead of as a loose abradant, makes the wheel durably effective, the particles not being torn from their matrix before they have done approximately all the work which they are capable of doing, and have become so dulled that they are practically worthless.

The particular field of usefulness of the invention, namely, the dividing of comparatively thin slabs, makes possible the use of wheels of the smallest diameter and consequently of the highest efficiency and the greatest thinness. The diameter is necessarily limited by the impossibility of molding integrally of large diameter, a wheel which shall be so thin as to satisfy the commercial requirements of low initial expense, low consumption of power and small waste of marble, and the techincal requirement of sufficient lateral strength to prevent deflection. Concerning the possibility of deflection, I have observed that the use of wheels with a soft bond operating at commercially possible speeds, results in the cutting of a line which is far from straight, and which would not be accepted by builders for the edges of wall facing slabs or the like. As such a wheel runs into an extra hard portion of the marble at a good speed, it is materially deflected out of a straight line; and it would require impracticably slow and careful feeding to be worked through the marble in a substantially straight line, as well as resulting in a less sharp edge on the marble. The invention is also restricted to the use of a wheel of the materials and structure described.

Marble cut by this process is left with a clean sharp edge and a perfect arris. There is little or no subsequent rubbing or polishing of the edge, such as is always necessary with marble cut by hand. In fact the arrises are sharper than in marble coped by hand and afterward subjected to the necessary rubbing of the edges.

An additional feature of great importance is the flaring of the edge of the carborundum wheel. I have found that such flaring reduces the number of breakages of the coping wheels to a negligible point, whereas without such flaring the wheels are in danger of breaking more or less often. The exact reason why flaring of the edge should reduce the tendency of the wheel to break is not clear, especially as the flaring wheels used have their greatest thickness, their thickness at the edge, no greater than the thickness of the flat wheels, and the material removed from the flared edge inward to the hub would

seem to lessen their capability of resisting lateral pressures. Nevertheless the difference in this respect is clear and very much in favor of the flared wheels.

Further advantages in detail are referred to hereinafter in connection with the accompanying drawings of apparatus for carrying out the process of the invention.

Figures 1, 2 and 3 are respectively a plan, side elevation, and cross-section of an apparatus in which the cutting wheel is mounted underneath the slab; Fig. 4 is an enlarged detail in cross-section of the same machine; Fig. 5 is a longitudinal section of another type of machine in which the wheel is mounted above the slab; Fig. 6 is an enlarged detail in cross-section of the same.

Referring to the embodiment of the invention illustrated, the marble slab A may be mounted upon a movable bed B having a slotted center through which projects upward the carborundum wheel C, mounted on a shaft D rotating in fixed bearings; so that the slab is moved bodily while the wheel is held in a stationary position; or (as in Figs. 5 and 6) the slab A may be on a fixed table E, and may be cut by the wheel C, which is given not only a rapid rotation but a bodily movement across the slab with its lower edge extending into a slot F in the table. These are two familiar types of sawing machines, and need not be here described in further detail. The wheel C in each case is carried upon a comparatively small shaft rotated rapidly in antifriction bearings, so as to secure maximum speed without the necessity for high pressure such as necessarily accompanies the use of steel tools on marble. The wheels for example may be rotated at about 2,000 revolutions per minute, or a peripheral speed of approximately a mile a minute. The wheels are preferably of 10, 12 or 14 inches diameter, the smallest diameter being the most efficient. As the diameter of the wheel is increased the area of contact with the marble increases, and the total pressure on the wheel necessary to secure a given unit pressure between the wheel and the marble, or to secure the desired penetration of the cutting edges into the marble, increases; and at the same time the lateral strength of the wheel to resist such total pressure, decreases as its diameter is increased. The maximum thickness of the wheels which I use is about a half inch. For most work, wheels of five-sixteenths (5/16) of an inch in thickness will stand the strain satisfactorily, and in especially light work I have even used wheels of one-quarter of an inch in thickness with success. The rate of feed of the wheel longitudinally through the marble varies between wide limits by reason of the wide variations in the hardness and degree of uniformity encountered in marbles, and from other causes. The machines which I have used are designed for speeds from six inches to thirty-six inches a minute, and this range will cover most of the cases arising in practice.

The material of the wheels is carborundum of a degree of coarseness depending upon various conditions. An increase in the coarseness of the grain increases up to a certain point the rapidity of cutting. On the other hand the grain must be so fine as to permit of the molding of the wheel with a number of grains across its thickness, and this, with the thin wheels which are essential to success, restricts the size of the grains. Furthermore the finer grains have a supplementary advantage in leaving a better edge and arris than the coarser grains. I prefer for most classes of work to use approximately 10-grit or 10-mesh carborundum, that is to say carborundum whose grains will pass through a sieve of 10 meshes to the linear inch.

The wheels are formed by molding them in the usual way with a bond which must hold the particles of carborundum so firmly that they cut like the fixed teeth of the ordinary steel saws used in sawing hard wood, and are durably efficient, so that they do substantially all their work while bound in to the wheel. This is very important in connection with the dividing of thin slabs, because after the particles are once torn out from their matrix, they can remain in operative position, that is between the wheel and the marble, for only the briefest moment of time. In common stone sawing machines where a steel or other flat non-toothed blade revolves or reciprocates in the groove in a thick stone block while a loose abradant is fed into the same groove with water, the abradant is held in cutting position between the blade and the stone for a substantial period of time; furthermore with such processes it is customary only to use abradants which become dulled much more rapidly than carborundum, since it is impossible to assure the abradant's being in the operative position for a period of such length as would be necessary to utilize all the cutting power of carborundum. But for dividing slabs in the manner contemplated by the present invention, it is important to carry the cutting particles of carborundum within the matrix of the wheel during their life so to speak,—that is to say, during the entire period during which they are efficiently sharp.

The bond is not only such as to hold the teeth firmly, but it is itself hard and strong, so that notwithstanding the thinness of the wheel it cannot be substantially deflected. In Fig. 1 there is indicated in dotted lines a portion G such as frequently occurs in marble, and which may be materially harder than the rest of the slab. The wheel may strike this hard portion G at a very slight angle, so that the tendency to deflect the

wheel will be very great. Nevertheless the bond must be so hard and strong as to prevent any deflection which will be noticeable to the eye, otherwise the slab could not be laid on a wall with joints of the perfection which are demanded in practice. Furthermore such hard spaces G in the marble tend to break the wheel, but my experiments have shown that by the use of a hard bond, such for example as a vitrified bond, and by reason of the added strength due to the gyroscopic action of the rapidly revolving wheel, I may employ wheels of the dimensions stated in practically all classes of work.

In my efforts to provide an operative machine with the very thin wheels which are essential to commercial success, I have found that with thin wheels of the style in the market (and previously used only for sharpening small tools and similar work), that is, having flat faces, the number of breakages in a week's running of the machine amounted to a substantial item of expense, this disadvantage however being insufficient to overcome the technical and commercial advantages of using a thin wheel. I have, however, succeeded in practically eliminating this disadvantage also by dishing the faces of the wheels slightly, so that their edges flare as indicated in Figs. 4 and 6. This feature of construction while removing the last obstacle to commercial success of the wheels, adds practically nothing to their cost. In the ordinary manufacture of the wheels they are molded and then baked, and their faces are afterward dressed to a plane. The dressing of the faces to the dished shape shown is no more expensive than the dressing of them to a flat surface, it being necessary only to feed the dresser progressively deeper into the face of the wheel as it moves toward the center thereof. This feature of construction is claimed in a prior application for patent No. 260,792, filed May 17, 1905, independently of the qualifications of the present invention.

For keeping marble as cool as possible and reducing the friction of the wheel, it is preferable to employ jets of water projected upon the edge and side faces of the wheel.

Preferably the bond used is so hard that particles of carborundum cannot be torn out by the resistance of the marble, but have to be pulled out or broken to a sharp edge by the use of a dresser when the wheel becomes dull. While a vitrified bond is preferable for this purpose, a rubber or possibly a shellac bond might be made sufficiently hard. But these bonds are expensive, and the making of them so hard would sacrifice their principal advantage, namely, their resiliency.

What I claim is:—

1. The process of dividing a marble slab which consists in cutting through it with a wheel of carborundum rotating rapidly with slight pressure, said wheel having a diameter of approximately twelve inches, and being agglomerated with such a firm vitrified bond that the sharp particles cut like fixed teeth, and the bond being so hard and strong that notwithstanding the thinness of the wheel it cannot be substantially deflected by the oblique irregularities of the marble while operating with a rapid feed, said wheel being approximately five-sixteenths of an inch thick at its edge and having its side faces dished.

2. The process of dividing a marble slab which consists in cutting through it with a rapidly rotating wheel of carborundum, said wheel having a maximum thickness of not more than approximately half an inch, and being agglomerated with such a firm bond that the sharp particles cut like fixed teeth, and the bond being so hard and strong that notwithstanding the thinness of the wheel it cannot be substantially deflected by the oblique irregularities of the marble while operating with a rapid feed.

3. The process of dividing a marble slab which consists in cutting through it with a rapidly revolving thin wheel composed of carborundum agglomerated with such a firm bond that the sharp particles cut like fixed teeth, and the bond being so hard and strong that the wheel notwithstanding its thinness cannot be substantially deflected by the oblique irregularities of the marble while operating with a rapid feed.

4. An apparatus for dividing a marble slab including a wheel composed of carborundum, and means for rotating it rapidly with slight pressure and for moving it through the slab, said wheel having a diameter of approximately twelve inches, and being agglomerated with such a firm vitrified bond that the sharp particles cut like fixed teeth, and the bond being so hard and strong that the wheel notwithstanding its thinness cannot be substantially deflected by the oblique irregularities of the marble while operating with a rapid feed, said wheel being approximately five-sixteenths of an inch thick at its edge and having its side faces dished.

5. An apparatus for dividing a marble slab including a wheel composed of carborundum, and means for rotating it rapidly and for moving it through the slab, said wheel having a maximum thickness of approximately half an inch, and being agglomerated with such a firm bond that the sharp particles cut like fixed teeth, the bond being so hard and strong that notwithstanding the thinness of the wheel it cannot be substantially deflected by the oblique irregularities of the marble while operating with a rapid feed.

6. An apparatus for dividing a marble slab including a thin wheel composed of carborundum, and means for rotating it rapidly and for moving it through the slab, the carborundum being agglomerated with such a firm bond that the sharp particles cut like fixed teeth, the bond being so hard and strong that the wheel notwithstanding its thinness cannot be substantially deflected by the oblique irregularities of the marble while operating with a rapid feed.

In witness whereof, I have hereunto signed my name in the presence of two subscribing witnesses.

JOHN ROYDEN PEIRCE.

Witnesses:
DOMINGO A. USINA,
THEODORE T. SNELL.