Feb. 21, 1956 W. MARTIN ET AL 2,735,249

COLD GRINDING MACHINE

Filed Dec. 30, 1953

Fig. 1.

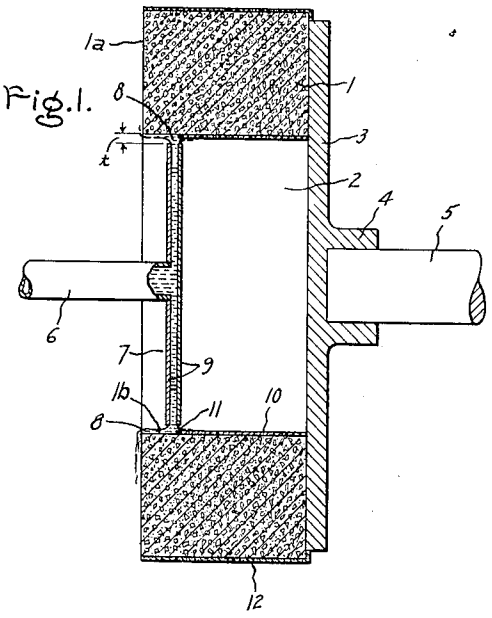


Fig. 2.

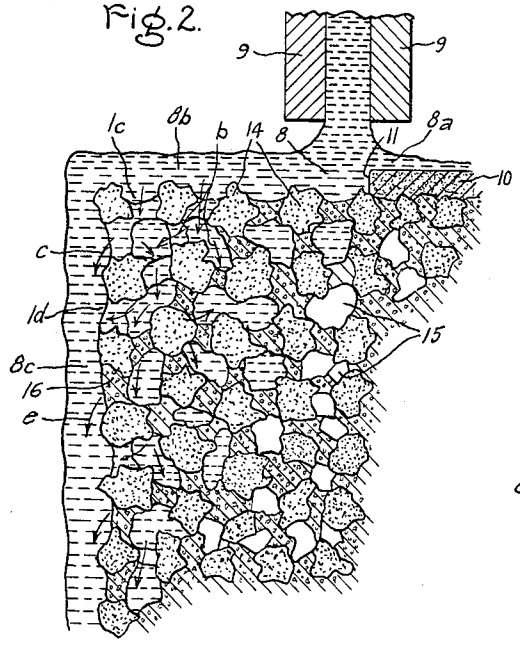
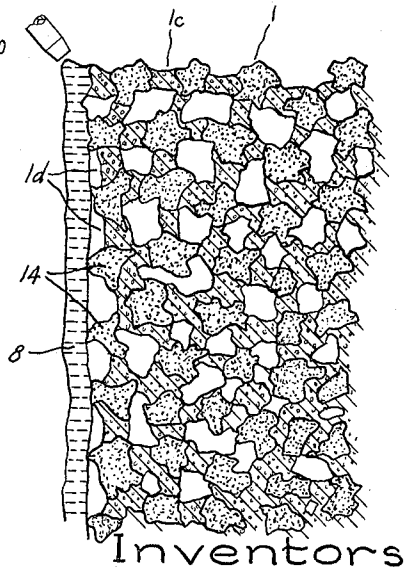


Fig. 3.



Inventors:
William Martin,
Elbert J. Weller,

by Clyde A. Watts
Their Attorney,

United States Patent Office 2,735,249 Patented Feb. 21, 1956

2,735,249

COLD GRINDING MACHINE

William Martin, Schenectady, and Elbert J. Weller, Scotia, N. Y., assignors to General Electric Company, a corporation of New York

Application December 30, 1953, Serial No. 401,146

6 Claims. (Cl. 51—267)

This invention relates to grinding machines and more particularly to a grinding machine employing a grinding wheel adapted to grind workpieces on the radial face thereof.

In grinding operations, such as sharpening tools, it is desirable to remove stock from the workpiece being ground as fast as possible in order to keep the cost of the operation low. However, when stock is removed at a high rate, the chips from the workpiece become highly heated. This heat is conducted to the grinding wheel and the workpiece causing the binder in the grinding wheel to glaze and the chips to weld to the abrasive particles of the wheel with the result that it clogs the grinding surface on the wheel, requiring the frequent dressing thereof. In addition, with the high rates of grinding speed attained in the present state of the art, the temperature rise of the workpiece may reach the point where it is annealed or hardened. It is therefore important that means for cooling the workpiece and the chips be provided to overcome these problems.

Cooling of the workpiece being ground by providing a flow of coolant across the working face of the grinding wheel has been employed. This method has proved to be insufficient in many instances, primarily because sufficient coolant does not come into close contact with the workpiece at the cutting edges of the abrasive grains of the wheel where the chips are being removed. The coolant many be liberally supplied, but when this method of application of coolant is utilized, the initial contact of the workpiece with the grinding face sweeps the coolant aside, thus preventing substantially all of the coolant from passing between the wheel and the workpiece and entering the voids between abrasive grains of the wheel where it will come into intimate contact with the chips at the point where the material is being removed by the cutting edges of the abrasive grain of the wheel. Moreover, the fanning action produced by the rough surface of the wheel deflects the coolant therefrom.

It is therefore an object of this invention to provide coolant in intimate contact with the cutting edge of the abrasive grains of the grinding wheel.

It is a further object of this invention to pass a coolant through the interstices of the grinding wheel adjacent its working face so as to emerge at all points on its working face.

A still further object of this invention is to provide for the delivery of a substantially unbroken band of water adjacent the working face of a face type grinding wheel.

Another object of this invention is to provide means for confining a substantially unbroken layer of water on the inner peripheral surface of a face type grinding wheel immediately adjacent its working face.

Further objects and advantages of this invention will become apparent and this invention will be better understood by reference to the accompanying drawing and description, and the features of novelty which characterize this invention will be pointed out with particularity in the claims annexed to and forming part of this specification.

In the drawing,

Figure 1 is a sectional view of a portion of a grinding machine illustrating this invention.

Figure 2 is an enlarged fragmentary sectional view of our invention illustrating the flow of coolant in accordance with this invention.

Figure 3 is a fragmentary sectional view illustrating a prior method of providing coolant to the working face of the grinding wheel.

In accordance with the illustrated embodiment of our invention, a pair of closely spaced, circular plates having their outer peripheries closely adjacent the inner periphery of the grinding wheel are provided to deliver a substantially unbroken band or layer of coolant on the inner surface of a face type grinding wheel closely adjacent to the working face thereof. An impervious coating on the inner periphery of the grinding wheel terminating adjacent the working face thereof prevents the entry of the coolant into the grinding wheel at points remote from its working face. Because of the influence of centrifugal force, the layer of coolant collecting on this coating tends to flow toward the working face of the grinding wheel to aid in confining the unbroken band of coolant in intimate contact with the uncoated portion of the inner periphery of the wheel causing the coolant to completely fill the interstices of the grinding wheel adjacent its working face. The distance of the pair of circular plates from the inner periphery of the grinding wheel is such that it prevents the uneven surface of a grinding wheel from serving as a fan effective to prevent the coolant from forming an unbroken layer of water filling all pores of the uncoated portion of the inner periphery of the grinding wheel. An impervious coating may also be placed on the outer periphery of the grinding wheel. This outer coating prevents the emergence of the coolant through the outer periphery of the wheel and assists in causing the coolant to completely fill the interstices of the wheel adjacent the working face and to emerge through all the pores in the working face of the grinding wheel thereby to provide a liberal supply of coolant in intimate contact with the cutting edges of the abrasive grain and surrounding the chips as they are removed from the workpiece to cool the same and to reduce the friction between the chips and the abrasive grains.

As shown in the drawing, a face type porous grinding wheel 1 is provided with a central axially extending cavity 2. The porous wheel 1 is mounted on a back plate 3 and is fixedly secured thereto by any suitable means. Back plate 3 is provided with an apertured hub 4 which is fixedly secured to shaft 5 of the machine to rotate therewith.

In order to deliver a coolant to the grinding wheel 1, a fluid delivery tube 6 connected to a source of coolant (not shown) is provided with a fluid distributing means 7 positioned within the central bore 2 of the grinding wheel adjacent working face 1*a* thereof. Fluid distributing means 7 serves to maintain a substantially unbroken annular band or layer of coolant 8 on the inner periphery of the grinding wheel 1 closely adjacent to the working edge 1*a* of the grinding wheel. While any means which would provide a substantially unbroken annular band of coolant 8 in constant intimate contact with the inner periphery 1*b* of the grinding wheel may be used, the use of a pair of closely spaced circular plates 9 which define a radially projecting channel for the coolant from supply tube 6 is preferred. The distance between circular plates 9 is determined so that a continuous band of coolant 8 is maintained. It has been found a distance of 1/32" to 5/16" will accomplish this purpose in a wheel having a diameter of 14".

The distance *t* between the outer periphery of the coolant distributing plates **9** and the inner periphery **1***b* of the grinding wheel should not be greater than approximately ¼" and preferably within the range of 1/32" to 3/32". Tests have shown, for example, that where the distance *t* was approximately 3/32", a single-point cutting tool was held against the face **1***a* of the grinding wheel with the maximum force which the operator could manually apply, and there was no appreciable increase in the temperature of the tool, and it did not feel warm to the touch during or immediately after being sharpened. Under similar conditions, except that the distance *t* was 5/16", the tool being sharpened was extremely hot to the touch after being ground for approximately the same period of time. Because of the coarser grain size of the wheel in the second-mentioned test, the tool being ground would normally be heated less than with the fine grained grinding wheel used in the first test.

While it is not intended that this invention should be restricted thereto, it is believed that when the coolant is released from between distributing plates **9** at too great a distance from the grinding wheel, the irregular surface provided by the particles of the grinding wheel serve as a fan to prevent the coolant from forming a band or layer of coolant in intimate contact with the entire area of the inner peripheral surface **1***b* of the grinding wheel to thereby maintain the pores **1***c* on surface **1***b* completely filled. Under these conditions, centrifugal force cannot cause an adequate supply of coolant to emerge from the pores of the working face **1***a* because of the inadequate supply of coolant entering the wheel.

In order to prevent the coolant from entering the grinding wheel at a point remote from the working face **1***a* thereof, an impervious coating **10** is applied on the inner periphery thereof. It will be noted that the layer **10** terminates, as indicated at **11**, at a point adjacent the working face **1***a* of the grinding wheel to provide for the radial entry of coolant into the wheel and preferably at a point within ⅛" of the working face. While any suitable impervious coating or layer **10** may be used, it is preferred that this layer be made of sulphur because it may be applied from a solution with little penetration of the wheel and forms a dry, brittle coating which may be easily removed adjacent the working face of the wheel as the wheel progressively wears without producing a residue to clog the pores **1***c* in the wheel. It is likewise desirable to coat the outer periphery of the wheel with a coating **12**. The coating **12** in conjunction with the coating **10** and the back plate **3** serve to form a sealed chamber for the purposes hereinafter more fully described.

In operation, coolant under a low pressure (e. g. 15 p. s. i. gage) passes through tube **6** and between plates **9** to deliver a band **8** of substantially uninterrupted coolant on the inner periphery of the grinding wheel under a pressure sufficient to insure its intimate contact therewith adjacent the end **11** of coating **10**, as best shown in Figure 2. A portion of the coolant will attempt to flow along the inner periphery of the grinding wheel as indicated at **8***a*. However, centrifugal force operating on this portion of the coolant resists the movement away from the working face and the pressure head on coolant **8***a* resulting therefrom aids plates **9** in confining the coolant in the vicinity of band **8** to insure that it is forced into the pores or voids **1***c* between adjacent abrasive grains **14** so that the interstices between the adjacent grains of the wheel and the connecting binder material **16** therebetween are constantly maintained full of coolant. Other portions of the incoming coolant **8***b* will flow axially toward the working face of the grinding wheel, and because of centrifugal force will be thrown radially outwardly over the working face of the wheel as at **8***c*. It is apparent that this arrangement insures that band **8** will constantly be forced into intimate contact with the periphery of the grinding wheel and will maintain the pores **1***c* of the wheel full of coolant at all times.

As the coolant enters the wheel, centrifugal force operating on the coolant tends to force the coolant to the outer periphery of the wheel, as indicated by the arrows in Figure 2. The individual grains of the wheel will divide the radial coolant flow as indicated by the arrows at *b*, causing a portion of the coolant to emerge from the working face of the wheel at point *c* while more of the coolant flows further radially outwardly through the wheel and emerges from other points of face **1***a* as indicated at *e*. Since the grinding wheel is porous as at **15**, these pores will under normal conditions be filled with air. As the coolant seeks to pass from the inner periphery to the outer periphery of the wheel, this air is pressurized to force the coolant through the pores of the wheel on its working face. The chamber formed by the impervious coating **10** and **12** and the backing plate **3** tends to aid in preventing the leakage of air from the grinding wheel to maintain this pressure.

By this arrangement the voids **1***d* between the grains **14** on the working face of the wheel are maintained full of coolant below the periphery of the working surface in intimate contact with the cutting edges of the individual abrasive grains **14**. Since it is these cutting surfaces which remove the small chips of material during the grinding operation, coolant is provided at the point where the heat is being generated and serves to reduce the amount of heat generated by lubricating the chips and reducing the chip friction between the chips and grains **14**.

It will be further observed that the coolant **8***c* flowing over the working surface **1***a* in a radial direction assists in forming a shield tending to prevent the coolant from emerging from the grinding wheel. This, coupled with the fact that centrifugal force changes the direction of flow of the coolant emerging from the wheel, likewise assists in maintaining the coolant under pressure at the point where it emerges from the wheel and consequently maintains all the voids **1***d* between abrasive grains on the face **1***a* full of coolant, thereby assisting in the elimination of dry spots on the working face of the wheel.

Figure 3, in which like numbers refer to like parts, illustrates the surface application of coolant to the working face of a grinding wheel. It will be noted that the voids **1***d* are not maintained full of coolant **8**, but the coolant merely skims along the working surface of the tops of the grains **14**. In this construction the work piece will sweep away the coolant **8** from the surface of the grinding wheel, and since the voids **1***d* contain no coolant, there will be very little coolant immediately available at the points where the heat is being created by the removal of the chips.

From the foregoing, it is apparent that this invention provides a means for insuring that the coolant will be continuously maintained in contact with the cutting edges of the individual abrasive grains of the grinding wheel, so that the heat may be carried away directly from the point at which it is created. It will be further apparent that because of this reduction in heat, the physical properties of the article being ground are not changed, and it has been found that a smoother finish may be obtained than where other means of supplying coolant to a grinding wheel are used. For example, utilizing the present invention in connection with a 180 grain silicon carbide wheel (39C180H8V), a profilometer reading of 5–7 microinches was obtained whereas a 7–10 microinch finish was obtained with a 220 grit diamond impregnated wheel (D220J100N(⅛)).

While there is illustrated and described a particular embodiment of this invention, further modifications and improvements will occur to those skilled in the art. It is to be understood, therefore, that this invention is not to be limited to the specific embodiment shown, and it is intended in the appended claims to cover all modifications thereof which do not depart from the spirit and scope of this invention.

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

1. In a porous face type grinding wheel having a central bore and a radial working face, means positioned within said bore to hold a substantially unbroken band of coolant in intimate contact with the portion of the inner peripheral surface of said wheel contiguous the working face thereof to force the coolant to flow through the interstices of said wheel to maintain the pores in the working face thereof full of coolant, and means on the portion of the inner peripheral surface of said wheel remote from the working face for preventing the entry of coolant into said wheel at points remote from said working surface.

2. The combination of a porous face type grinding wheel through which coolant is adapted to flow, said grinding wheel having a central bore and a radial working face, coolant supply means for holding substantially unbroken band of coolant in intimate contact with the portion of the inner periphery of the grinding wheel contiguous the working face thereof, said means comprising a pair of spaced circular plates positioned within the bore and extending substantially to the inner periphery of said grinding wheel, and an impervious coating on the inner periphery of said grinding wheel remote from said working face for causing the coolant normally tending to enter the grinding wheel at points remote from the working face thereof to flow toward the working face of said grinding wheel to aid said plates in confining said unbroken band of coolant to the portion of the inner periphery of the wheel contiguous the working face and forcing the coolant to fill all the pores in the contiguous portion of the inner periphery of the wheel.

3. In combination, a porous face type grinding wheel having a central bore, a pair of closely spaced circular disks within said bore for directing a stream of coolant toward the inner periphery of said wheel to form a continuous unbroken band of coolant in intimate contact therewith, an impervious coating on the inner periphery of said grinding wheel remote from the working face thereof, and an impervious coating on the outer peripheral surface of said grinding wheel, said impervious coatings being effective to promote the emergence of said coolant through the working face of said wheel.

4. In combination with a face type porous grinding wheel having a central bore and a radial working face, circular disk means within said bore and extending substantially to the inner periphery of said grinding wheel for holding a continuous unbroken band of coolant on a portion of the inner peripheral surface of the grinding wheel contiguous said face, and an impervious coating on a second portion of the inner peripheral surface of said wheel remote from said working face for aiding said disk means in holding said coolant in intimate contact with said portion contiguous said face to force said coolant to fill all the pores therein.

5. The combination recited in claim 4 in which said circular disk means extends to within ¼" of the inner periphery of said grinding wheel.

6. In combination, a face type porous grinding wheel having a central bore and a radial working face, coolant means associated with said bore for supplying a band of coolant thereto, and limiting means on said wheel for causing said coolant to flow under the effect of centrifugal force from said bore through said porous wheel for discharge in a generally transverse direction onto said radial working face, said limiting means comprising an impervious covering on all portions of said wheel except said radial working face and a limited portion of said bore contiguous to said radial working face.

References Cited in the file of this patent

UNITED STATES PATENTS

Re. 16,043	Joseph	Apr. 14, 1925
500,561	Carpenter	July 4, 1893
639,955	Warner	Dec. 26, 1899
1,100,845	Richter	June 23, 1914
1,662,023	Baumberger	Mar. 6, 1928
1,972,160	Osterholm	Sept. 4, 1934
2,560,944	Garrison	July 17, 1951
2,612,015	Krafft	Sept. 30, 1952