

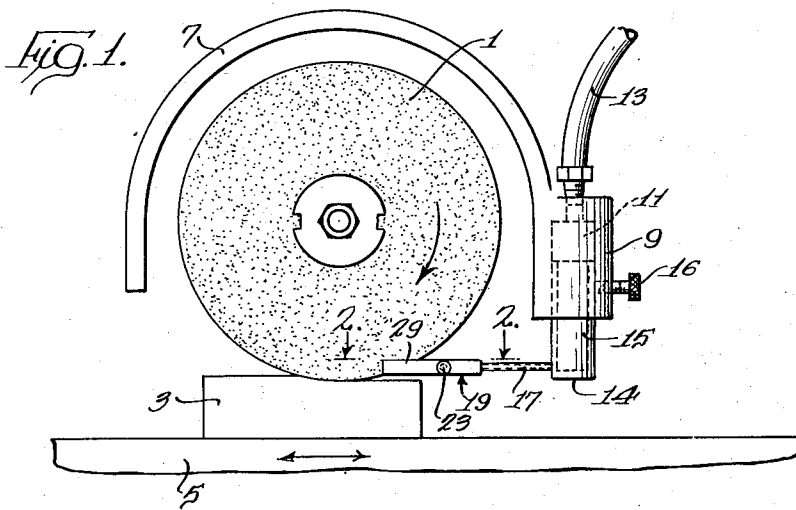
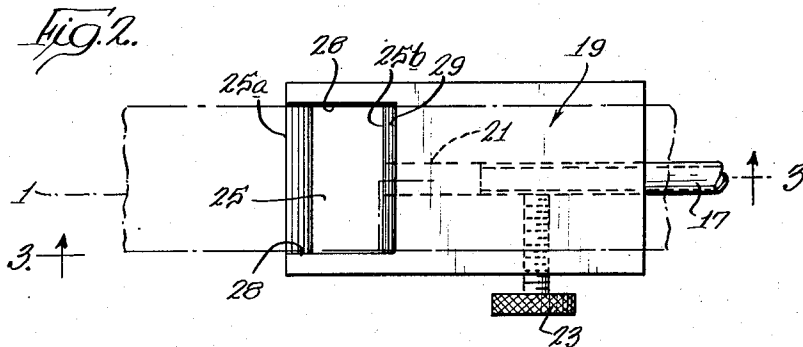
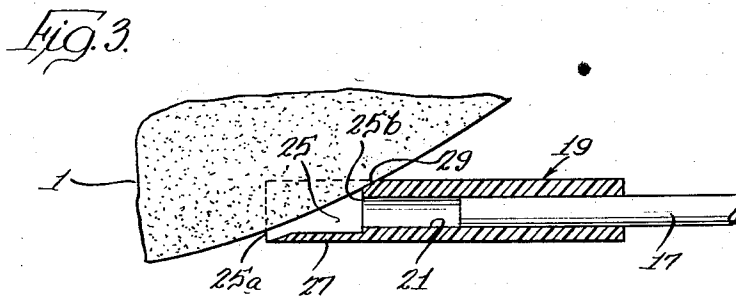
Aug. 18, 1959

L. A. WILLIAMS
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2,899,781

Filed May 10, 1957

2 Sheets-Sheet 1



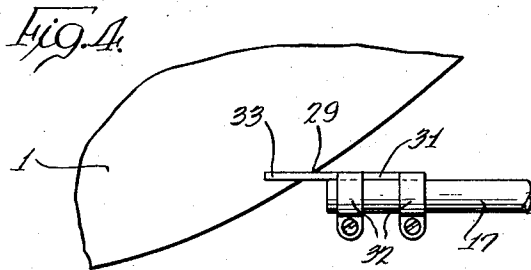
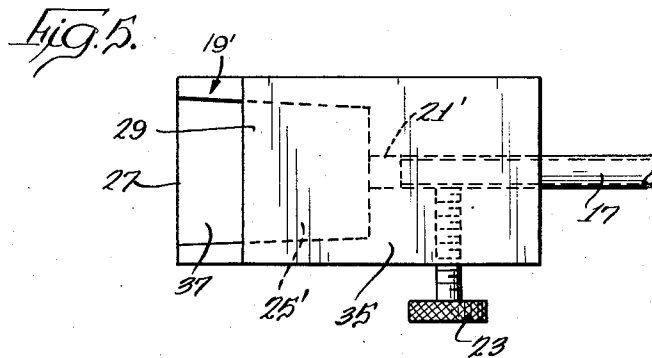
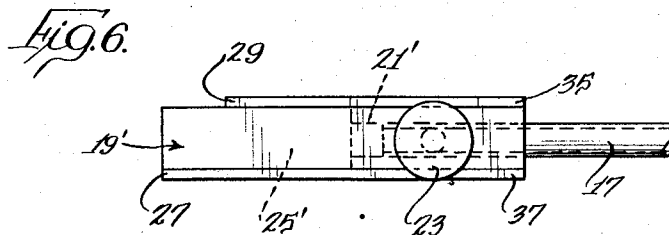
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2 Sheets-Sheet 2



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2,899,781

COOLANT APPLICATOR

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7 Claims. (Cl. 51—267)

This invention relates to a new and improved apparatus for applying coolant to grinding wheels and the like.

It has long been recognized that it is desirable to apply a coolant material to the working surface of grinding wheels in order to reduce heating effects, both in the work and in the wheel itself. The coolant may be water, to which sometimes a soluble oil is added, or it may be oil or any of a number of special preparations intended to ease the removal of grinding swart, to prevent wheel glazing or loading, to inhibit rust formation, etc. The coolant may be an electroconductive material, usually an aqueous saline solution for use in the process known as electrolytic grinding in accordance with the teaching of George F. Keeler as disclosed in his pending application for United States Letters Patent, Serial No. 310,244, filed September 18, 1952, entitled "Method and Apparatus for Electrolytic Cutting, Shaping and Grinding," and issued as Patent No. 2,826,540, dated March 11, 1958.

It is common to apply such coolants to grinding wheels by a kind of feed shoe which guides the liquid to the wheel face in close proximity to the area of contact with the work. Such feed shoes have been used for many years on surface grinders and cylindrical grinders. But while these feed shoes may appear superficially to direct the fluid onto the grinding wheel, much of the coolant actually falls onto the work. And, while this seems to produce a kind of puddle on the work (particularly in surface grinding) and while the wheel appears to dip into this puddle as it approaches the grinding area, this is only partially effective to carry liquid into the interface where the wheel touches the work. I have discovered that the reason for this is that a layer of air rotates with the wheel at substantially the surface speed thereof. Naturally, the air closest to the wheel moves at a rate most closely approaching the speed of the wheel. This moving air tends to be thrown away from the wheel by the centrifugal effect. This produces a pump or blower effect which can be readily detected by placing one's hand close to the wheel in the plane of rotation. A grinding wheel will be in typical operation be rotated with a velocity to yield a surface speed of 5000 surface feet per minute. Thus, the air blast close to the working surface approaches a speed of nearly a mile a minute. When the attempt is made to apply liquid coolant to a rotating grinding wheel by the ordinary feed shoe, this air blast actually tends to drive the liquid away from the wheel surface. As to the puddle on the work itself, one can see by careful observation that the puddle is actually blown aside by the air blast just as the wheel approaches tangency with the work. Apparently, almost none of the liquid in the puddle ever touches the wheel itself. Such liquid as does reach the wheel from the ordinary feed shoe is admixed with turbulent, high-velocity air, so that there are many voids or air bubbles in the liquid.

To get better coolant coverage on grinding wheels, it has been proposed to use high-velocity liquid jets pro-

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pelled by high-pressure pumps. It has also been proposed (for use with porous grinding wheels) to introduce coolant through the wheel itself so that the centrifugal force pumps the coolant to the peripheral working face. Neither of these proposals has found extensive use, perhaps because of the requirement for special equipment and apparatus.

I have found that by introducing a barrier to the air flow just ahead of the point where liquid is introduced, a very marked and surprising improvement in coolant feed is obtained with very little apparatus. It is not merely that the liquid can be more readily driven against the wheel, but, actually, it is not necessary to drive the liquid at all, for the wheel seems to suck the liquid in against its surface. The effect can be observed in this manner: If a conventional feed shoe is adjusted so that its lip clears the wheel by approximately one-eighth of an inch, for instance, the liquid flow can be adjusted by throttling, so that no liquid whatsoever touches the wheel and so that a dribble falls down onto the worktable. If, then, one's finger is brought into contact with the peripheral face of the wheel just above the feed shoe, the dribble over the lip of the shoe suddenly ceases, and the liquid jumps up toward the wheel and moves with it, apparently staying in contact for at least 15° to 30° of arc before discharging a plume of spray. I believe that the cause of this effect lies in this: that when the barrier of air moving with the wheel is intercepted there is created just behind the barrier a zone of low pressure (because of the Bernoulli effect) so that if liquid from a nozzle or shoe is available, even at normal atmospheric pressure, the liquid (instead of air) will move into the low-pressure area behind the barrier. The matter may be more complicated than this, as air will tend to flow in onto the wheel's peripheral surface from the side surfaces, and this side effect may be utilized to advantage as will be seen in the subsequent description.

From the foregoing it is apparent that a principal object of the invention is to apply coolant to the face of a grinding wheel in a manner which is positive, reduces voids or bubbles in the coolant on the wheel, and assures a solid film of coolant on the working surface of the grinding wheel as it approaches the workpiece which is to be ground.

Another object is to reduce or eliminate the barrier layer of air which revolves with the grinding wheel and which interferes with the application of coolant to the wheel.

Another object is to provide an inexpensive applicator susceptible of being attached at low cost to a very wide variety of existing grinding machines and utilizing existing coolant supply systems.

Other objects and advantages will appear from the following description taken in conjunction with the accompanying drawings in which:

Fig. 1 is a schematic elevation showing the coolant applicator of this invention in position against a grinding wheel;

Fig. 2 is a plan of the applicator in position taken along the line 2—2 of Fig. 1;

Fig. 3 is a sectional view of the applicator taken along the irregular line 3—3 of Fig. 2;

Fig. 4 is a schematic view of an alternate form of applicator; and

Figs. 5 and 6 are, respectively, plan and side views of a variant form of applicator.

Referring to Fig. 1, a grinding wheel 1 is arranged to be rotated in the conventional manner in the direction shown by the arcuate arrow. A workpiece 3 is shown mounted on table 5 (shown fragmentarily) of a surface grinder. The table 5 is arranged in the usual way to

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move back and forth in the direction shown by the straight arrows. While a surface grinder is shown, it is intended to represent more broadly any kind of grinding machine, such as, by way of example only, a cylindrical grinder, an internal grinder, a centerless grinder or a disc grinder.

A conventional wheel guard 7 is mounted about the wheel 1 and is shown as carrying an enlarged portion 9 having a bore 11 for receiving coolant from a supply line 13, which is connected to communicate with the bore 11 and which has its outer end connected to a conventional coolant supply pump (not shown) drawing from a sump tank to which coolant is returned from the work area, all in the usual way.

Within the bore 11, a hollow cylindrical sleeve member 15, having a closed bottom 14, is slidably and rotatably mounted, and locking screw 16 is provided to lock the sleeve member 15 in the desired adjusted position. The sleeve member 15 is arranged to fit snugly in bore 11, however, so that there will not be undue leakage of liquid.

As shown, I provide a tube 17 which is fixed by any suitable means to sleeve 15 and communicates with the bore thereof so that liquid may pass from supply line 13 into the bore 11, into the open center of sleeve 15, and thence into the bore of tube 17. For this tube, I have commonly used copper tubing of about $\frac{3}{16}$ " outside diameter, but, of course, the size is optional and is adjusted to the size of the wheel and the liquid requirements.

An applicator body 19 is mounted on the tube 17 for slidable adjustment thereon. As seen in Figs. 2 and 3, this is accomplished by providing a bore 21 in the body having the same diameter as the tube 17 into which the tube may adjustably project. A lock screw 23 threaded into the body 19 and against the tube 17 secures the latter in adjusted position.

The body 19 may be made of a tough, liquid-resistant plastic such as Lucite, nylon, Teflon, polyethylene or the like.

A pocket 25 is milled or molded into the body 19 extending from its extremity 25a to a point 25b, and having a depth such as to leave a lower lip 27 extending to the end of the body 19. The depth of pocket 25 should be such as to leave a thickness of about $\frac{1}{16}$ " for the lower lip 27 so that liquid can be delivered very close to the point of tangency between the wheel 1 and the work 3. Sometimes protuberances on the workpiece require elevating the applicator to avoid interference, and it is desirable to avoid excessive elevation by adding to what is necessary any unnecessary thickness of the lower lip member 27.

The width of the pocket 25 should be approximately the width of the working face of the wheel.

When the applicator is applied for the first time, it is mounted loosely on the tube 17, and its vertical height is adjusted so that its bottom surface will clear the work at the intended depth of cut. Then, with the wheel running, the applicator is advanced toward the wheel. If the pocket 25 is too narrow, the wheel will grind it away as necessary. The applicator should then be manipulated sideways in both directions to establish a slight clearance on the sides of the wheel. This clearance should be about .020" on each side, but is not very critical in most cases. The purpose of the clearance is to allow some of the liquid to find its way onto the sides of the wheel so that liquid will advance with the turning wheel and will be centrifuged outwardly toward the working face as the wheel turns, thereby assuring that the edge of the wheel (where wheel wear or breakdown is most likely to occur) is adequately wetted.

The applicator is pushed in against the wheel until upper lip 29 makes contact with the wheel. If, at this time, lower lip 27 is also against the wheel, it must be ground back (by temporarily removing the applicator from tube 17 so as to hold it in position to grind lower

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lip 27 and nothing else). The purpose is to be sure there is an easy passage between the lip 27 and the wheel to supply liquid onto the wheel. A clearance of $\frac{1}{32}$ " to $\frac{1}{16}$ " is ordinarily used, but this dimension is not at all critical.

What is important is that upper lip 29 be and remain in close proximity to the wheel surface, for it is this lip which serves as an interceptor of the air which moves around with the surface of the wheel. By grinding this upper lip 29 in against the wheel, only a minute clearance (if any) will remain. However, there may be some erosion of the upper lip 29, and when this occurs the applicator is advanced toward the wheel along tube 17, loosening locking screw 23 to make this adjustment. This adjustment need not be made too frequently, as some amount of wear at upper lip 29 can be tolerated as the bulk of the moving air is intercepted even with a visible gap between upper lip 29 and the wheel. When the gap becomes too wide, however, a substantial amount of air follows the wheel into the pocket 25 and when this is excessive the applicator will not feed properly.

In normal and proper operation, the coolant is picked up in the pocket 25 and feeds smoothly onto the wheel with a minimum of dribble and splatter at the applicator. The liquid can be seen hugging closely to the wheel for a path distance of 15° to 30° of arc or even more, at which point it begins to leave the wheel as a fine and smooth spray.

In Fig. 4 is shown a simple variant of the applicator, which utilizes the basic functional principles of the form shown in Figs. 1 to 3. Despite its simplicity it functions quite well. To a feed tube 17 mounted in any suitable manner to direct fluid at the working surface of wheel 1 I attach a plastic blade 31, using bent hose clamps 32 or other fastening means for the purpose. The blade is advanced toward the wheel until it is ground to form a continuous lip 29. If the blade is pushed farther against the wheel, side members 33 will be formed, assuming the blade 31 to be wider than the wheel's working face, thereby giving the blade a U-shaped appearance in plan. While these side members 33 are not essential, they seem to help achieve good distribution of the liquid. Curiously enough, even though the bore of tube 17 be of somewhat smaller diameter than the width of the wheel face, the liquid tends to spread over the entire wheel face, for the liquid seems to be lifted up against the under surface of blade 31, spreading out as it does so. Thus, if the outside diameter of the tube be of about the same dimension as the width of the wheel face, this will be satisfactory if the wall thickness of the tube is not more than about $\frac{1}{16}$ ".

As a variant of the foregoing forms, I have made applicators by specially manipulating tubing 17 of an outside diameter greater than the width of the wheel. The tube 17 is advanced toward the wheel in such a way as to grind a slot through the tube's upper wall and to leave clearance for fluid between the wheel and the lower portions of the tube wall. The upper part of the tube wall can thus be made to act as an interceptor of air (similar to the lip 29) while the sides and lower portions form a liquid feed zone behind the interceptor. While this arrangement can be made to work, it is not a preferred form, partly because of difficulty in getting everything just right, but, even more, because machine tool operators upon seeing what appears to be a simple tube will almost invariably readjust it (for example, after changing grinding wheels) so that the air-interceptor effect is lost, and the tube then functions poorly and more or less in the manner of a conventional feed shoe.

In Figs. 5 and 6, I have shown two views of a form of applicator, designed for ease of manufacture. A central body 19' is either molded or machined to provide a bore 21' and a pocket or well 25' as well as a screw thread for the locking screw 23. Top plate 35 and bottom plate 37 are then fastened by adhesive to the cen-

tral member with top plate 35 being somewhat shorter than bottom plate 37 so as to establish the desired relative positions of upper interceptor lip 29 and lower lip 27.

If desired, the entire applicator can be molded in one piece, drawing the plug members of the die endwise to clear the cavities in the piece. I have shown the pocket or well 25' as tapered to provide draft for the molding operation. In the drawing, the taper is exaggerated for clarity, but it should be held to the minimum necessary for molding. The tube bore 21' may also be molded to a taper and then cleaned by reaming to a straight bore.

When a formed wheel is used, the form is ground into the interceptor lip 29 so that rotating air is intercepted at all points of the form, whether the high or the low portions.

While I have shown and described several forms of the applicator of this invention to a grinding wheel on which the working surface is on the wheel periphery, the same principle may be applied where the peripheral surface is oblique to the plane of the wheel or to a wheel where the grinding surface is on the face. This will be readily understood by those skilled in the art.

Thus, I believe I have found a simple and inexpensive means of achieving a great improvement in coolant application.

While preferred embodiments of this invention have been shown and described, it will be apparent that numerous further modifications and variations thereof may be made without departing from underlying principles of the invention. It is, therefore, desired by the following claims to include within the scope of the invention all such variations and modifications by which substantially the results of this invention may be obtained through the use of substantially the same or equivalent means.

What I claim as new and desire to secure by Letters Patent is:

1. A device for applying a liquid coolant to a rotating grinding wheel having a continuous working face from a coolant supply tube, comprising means forming an air interceptor lip at the discharge end of the supply tube so that said lip is substantially in contact with the continuous working face of the grinding wheel to provide only a minute clearance therebetween, thereby to intercept with one side of said means the layer of air rotating with the wheel, and said means forming at its other side a space communicating with the outlet from the supply tube and from which the wheel picks up liquid coolant on its working face.

2. A device for applying a liquid coolant to a rotating grinding wheel having a continuous working face from a coolant supply tube, comprising a member having an air interceptor lip formed thereon, means mounting said member on the supply tube so that said lip is substantially in contact with the continuous working face of the grinding wheel to provide only a minute clearance between said lip and the working face, thereby to intercept with one side of said member the layer of air rotating with the wheel, and said member forming at its other side a space communicating with the outlet from the supply tube and from which the wheel picks up liquid coolant on its working face.

3. A device for applying a liquid coolant to a rotating grinding wheel having a continuous working face from a coolant supply tube, comprising a blocklike member having a wall thereof defining an air interceptor lip, means mounting said member on the supply tube so that said lip is substantially in contact with the continuous

working face of the grinding wheel to provide only a minute clearance between said lip and the working face, thereby to intercept the layer of air rotating with the wheel, and said member having other walls defining with said interceptor lip wall a space communicating with the outlet from the supply tube and through which the working face of the wheel rotates to pick up liquid coolant.

4. A device for applying a liquid coolant to a rotating grinding wheel having a continuous working face from a coolant supply tube, comprising a flat member having an air interceptor lip formed thereon shaped complementarily to the working face of the grinding wheel, means mounting said member on the supply tube so that said lip is substantially in contact with the continuous working face of the grinding wheel to provide only a minute clearance between said lip and the working face, thereby to intercept with one face thereof the layer of air rotating with the wheel, and said member forming at its other face a space communicating with the outlet from the supply tube and from which the wheel picks up liquid coolant on its working face.

5. A coolant applicator for use with a rotating grinding wheel and mountable on a coolant feed tube, comprising means forming a body having a bore therein by which the body may be rotatably and slidably mounted on a feed tube, a well section formed in the body and communicating with the bore and adapted to receive coolant at one end thereof from the feed tube and to deliver coolant to a grinding wheel having a continuous working surface from the other end, and means on said body forming an interceptor lip overlying said well section, said interceptor lip being adapted and arranged to stand substantially in contact with the working surface of the grinding wheel, whereby air rotating with the wheel may be intercepted and fluid in the well section may be applied to the wheel.

6. The method of supplying coolant to the continuous working surface of a rotating grinding wheel from a coolant supply tube, comprising holding an air interceptor member at the outlet end of the supply tube and substantially in contact with the continuous working surface of the wheel so that only a minute clearance exists therebetween and so that the member is in the path of the layer of air rotating with the wheel, whereby the air layer is intercepted by one face of the member, and flowing the coolant onto the wheel at the opposite face of the member and without substantial entrainment of air.

7. The method of supplying coolant to the continuous periphery of a rotating grinding wheel from a coolant supply tube, comprising grinding an air interceptor member against the periphery of the wheel so that an edge is formed thereon having a shape complementary to the peripheral contour of the wheel, holding the member at the outlet end of the supply tube so that its contoured edge is substantially in contact with the periphery of the wheel to define only a minute clearance therebetween and so that the member is in the path of the layer of air rotating with the wheel whereby the air layer is intercepted by one face of the member, and flowing the coolant onto the wheel at the opposite face of the member and without substantial entrainment of air.

References Cited in the file of this patent

UNITED STATES PATENTS

1,469,985	Bath	Oct. 9, 1923
1,680,360	Bath	Aug. 14, 1928