Oct. 4, 1966 W. G. CROWE 3,276,170

SOLID ABRASIVE ARTICLE

Filed March 30, 1964

FIG. 1

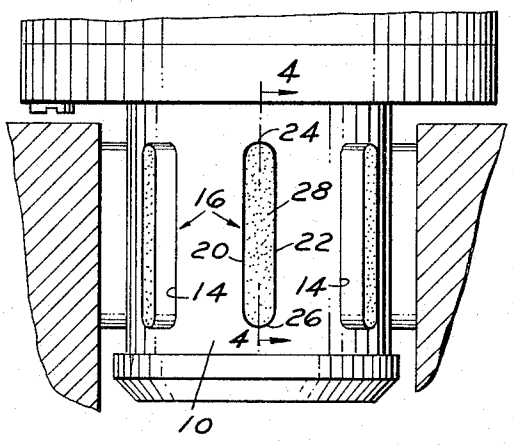


FIG. 2

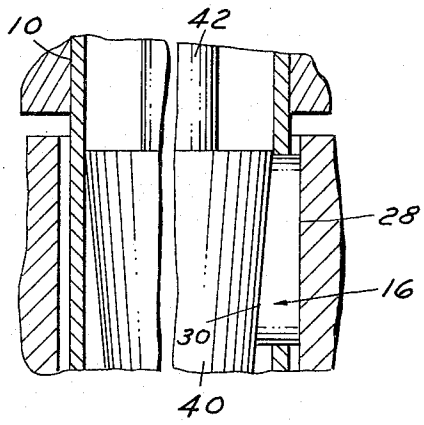


FIG. 6

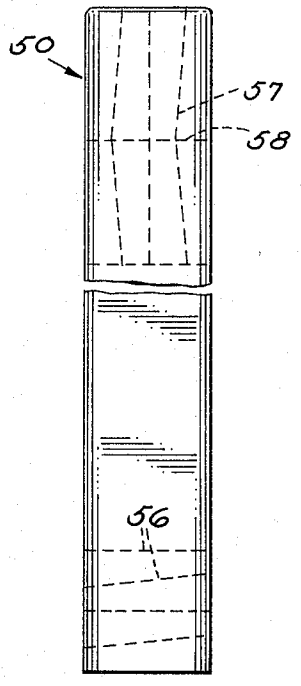


FIG. 5

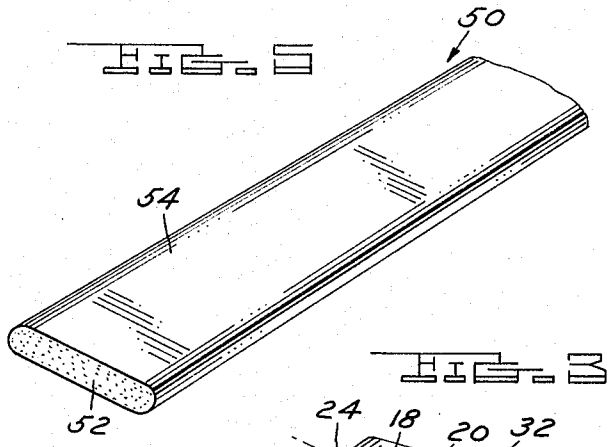


FIG. 3

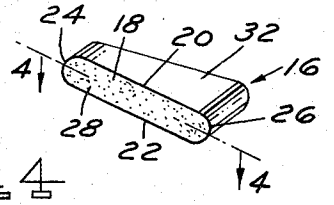
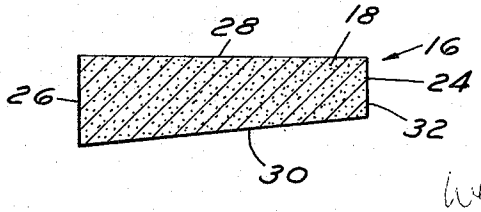


FIG. 4



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SOLID ABRASIVE ARTICLE

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9 Claims. (Cl. 51—204)

This invention relates to an abrasive article for use in a honing tool, and to a method of making the same.

One of the essential objects of the invention is to provide a honing element, for use in a honing tool provided with slots for the reception of a plurality of elements, which comprises a solid bonded abrasive stick of substantial length relative to its width having a relatively thin nonabrasive coating covering certain surfaces of the abrasive stick but not covering certain other surfaces, particularly its working face.

Another object of the invention is to provide a honing element in which the coating is relatively thin and substantially uniform on all surfaces of the solid abrasive stick which it covers and is of such character as to wear readily so as not to interfere with the abrasive action.

Another object is to provide a coating for the abrasive stick of such character as to provide frictional engagement with the walls of the slots in the tool body, without abrasion of the slot walls or tool expansion cone.

Another object is to provide a method of making a honing element, of the type described above, which method comprises the steps of providing an article comprising an elongated piece or slab of a solid bonded abrasive material having a relatively thin non-abrasive surface coating thereon, and severing the elements from the article by cutting either transversely or lengthwise thereof.

Another object is to provide an elongated coated solid abrasive article for use in the method from which the individual abrasive elements may be severed.

Other objects and features of the invention will become apparent as the description proceeds, especially when taken in conjunction with the accompanying drawing, wherein:

FIGURE 1 is a fragmentary side elevational view, with parts in section, illustrating a honing tool inserted in a bore being honed, with the abrasive elements of my invention in the slots of the tool.

FIGURE 2 is a fragmentary longitudinal sectional view of the structure shown in FIGURE 1, with parts broken away and in section.

FIGURE 3 is a perspective view of the abrasive element.

FIGURE 4 is a sectional view of the abrasive element, taken on the line 4—4 in FIGURES 1 and 3.

FIGURE 5 is a perspective view, with portions broken away, of an elongated coated abrasive article from which the abrasive elements may be severed in the practice of the method of the invention.

FIGURE 6 is a fragmentary side elevational view of the elongated abrasive article.

Referring now more particularly to the drawing, and especially to FIGURES 1 to 4 thereof, the honing tool is semi-diagrammatically indicated at **10** and is an elongated tubular member which is provided with a plurality of circumferentially spaced slots **14** elongated in the direction of length thereof. The honing elements **16** are of identical construction and are respectively disposed in the slots for radial expansion and retraction relative to the honing tool.

Referring to FIGURES 3 and 4, each honing element **16** comprises an elongated bonded abrasive stick **18** which is of substantial length relative to its width and thickness. As seen in FIGURES 1 and 3, the sides **20** and **22** of the abrasive stick lie in parallel planes, and the ends **24** and **26** may be rounded as shown to blend or merge smoothly with the adjacent sides **20** and **22**. Actually the ends could be of some other shape. The front or working face **28** of the abrasive stick intersects the sides and ends **20–26** at substantially right angles thereto and is a substantially plane surface, although it may be somewhat crowned due to the fact that it will take the curvature of the bore being honed. The rear face of the abrasive stick is designated **30** and is tapered with respect to the front face for a purpose which will be brought out more clearly hereinafter.

The abrasive stick **18** is preferably covered on all of its surfaces except its front working face **28** with a relatively non-abrasive, thin coating **32** of uniform thickness. While preferably the lead side of the stick, that is the side facing in the direction of tool rotation, is coated, it might be left uncoated because there is not as much tendency of the tool slot to wear on the lead side. The thrust or trailing side should be coated to prevent abrasion of the tool slot, and the rear face should be coated to prevent abrasion of the expansion cone which is more fully described hereinafter. Preferably the coating **32** will be of a thickness in the range of approximately .002"–.006". Actually the coating could be any thickness up to say 1/32" (which expressed in decimals is .03125"). The range of .002"–.006" is preferred, however, because more abrasive surface can be presented to the work, that is the slot is not filled up with an extra thickness of coating **32** which is non-abrasive. A thin coating, such as in the preferred range, is just as effective in preventing wear of the tool slot or expansion cone, as a thick coating. The coating also serves to support edges, particularly the trailing edge, of the working face of the stick **18**. The material covering the abrasive stick is more in the nature of a coating than a housing or casing or shell, as will be understood from an appreciation of the relatively thin nature thereof. Therefore, the article or element **16** may appropriately be called a solid abrasive article.

The coating **32** may be formed of a number of different relatively non-abrasive materials. A thermosetting resin, particularly a polyester epoxy copolymer is preferred. Also suitable is acrylic latex, which is a base for many paints. Other materials such as acrylic resin, vinyl resin, melamine alkyd, furfural acid polymer and polyvinyl acetate may be employed as the material for the coating.

Referring again to FIGURES 1 and 2, the slots **14** in the honing tool have substantially the same outline as the coated abrasive elements, to closely receive the same. In other words, the side walls of the slots are parallel and spaced apart a distance substantially equal to the width of the abrasive elements, and the ends of the slots match the ends of the abrasive elements and spaced apart a distance substantially equal to the length of the coated abrasive elements. The coated material is of a character which will have a close friction fit in the slots, so that the abrasive elements will tend to be retained in the slots and will not drop out due to centrifugal force of rotation. There is not so much friction however as to prevent the honing elements from being expanded radially outwardly by the cone **40** carried by the adjusting rod **42** which is reciprocable within the tool **10**, or from being mechanically retracted. The taper of the cone corresponds to the taper on the coated rear wall of the abrasive element, so that the cone surface has a full surface-to-surface contact with the coated rear wall of the abrasive element. Obviously when the cone **40** is moved downwardly in FIGURE 2, the abrasive elements are cammed in a radially outward direction. The coating **32**,

while it is non-abrasive, is of such character as to wear readily so as not to interfere with the abrasive action. The coating should wear at at least the same rate as the abrasive and preferably, as in the case of polyester epoxy copolymer, faster.

Referring to FIGURES 5 and 6, there is shown an elongated abrasive article **50** employed in the practice of the method of making the abrasive elements illustrated in FIGURES 3 and 4. The article **50** comprises an elongated piece or slab **52** of a bonded abrasive material. The slab is of substantial length relative to its width and thickness. The flat sides of the slab **52** are parallel to each other and spaced apart a distance equal to the width of the abrasive sticks **18**. This dimension of the abrasive slab **52** is its thickness. The edges of the abrasive slab **52** are spaced apart exactly the same distance as the ends **24** and **26** of the abrasive sticks, and are shaped exactly the same. The distance between the edges of the abrasive slab **52** is the width dimension of the slab and corresponds to the length of the abrasive elements. The slab **52** is preferably completely covered on all of its side and edge surfaces with the same coating which covers the abrasive sticks. As noted, one side, corresponding to the lead side of the stick to be formed, could be left uncoated although preferably it also is covered. This coating in FIGURES 5 and 6 is indicated by the reference character **54**, although it will be understood that it is the same coating, both in thickness and material as the coating **32** for the abrasive sticks.

The abrasive elements **16** are formed from the abrasive article **50** by cutting the abrasive article either transversely along lines spaced lengthwise thereof, which is preferred, or lengthwise along laterally spaced lines. Transverse cutting lines are designated **56** in FIGURE 6 of the drawing. The spacing between the lines of severing corresponds with the thickness of the abrasive elements to be formed, and it will be noted that the cutting lines are angled to provide the proper taper between the front working face and the rear face of the abrasive elements. After the abrasive elements have been severed from the elongated abrasive article **50** by transverse cutting, it will be understood that the rear face of the abrasive stick **18** will be uncoated, since it is one of the severed surfaces. Preferably, the rear face of the abrasive element thus formed will, after severing, be covered with a coating of the same thickness and material as the coating **32** on the remaining side and end surfaces of the abrasive stick. The rear face of the stick is preferably coated so as to avoid abrasion of the adjusting cone **40**.

It will be understood that when the elements **16** are cut from the article **50** transversely, the length of the severed abrasive elements corresponds to the width of the article **50**, the width of the severed elements corresponds to the thicknss of the article **50**, and the thickness of the severed elements corresponds to the spacing between the cutting lines **56**.

Alternatively, the abrasive elements may be cut from the slab lengthwise, that is along the longitudinal lines of severing designated **57** and transverse lines **58**. Longitudinal severing involves certain problems not involved in transverse severing. Thus the upper end of the slab in FIGURE 6 should be coated with the coating **54** before severing, and contoured to correspond with the slot ends. If not, the ends of the elements formed therefrom would have to be contoured and then coated after severing. Also the opposite ends of the uppermost elements severed, and both ends of the intermediate elements severed, should be contoured and then coated after severing. Also the rear tapered surfaces of the elements which are uncoated due to severing should be coated. The front working faces of those elements which are contoured and coated should be ground down flat to remove the coating.

Preferably, the coating is brushed or sprayed on in liquid form at or near room temperature and allowed to cure at that temperature. The polyester epoxy copolymer is well suited for this method of application. Accordingly, the abrasive slab **50** can be fully treated in accordance with accepted methods involving bonded abrasives before the coating is applied and while the abrasive is exposed on all surfaces. Such treatment involves introducing, by differential air pressure, a fill agent, such as sulphur, into the abrasive. This requires a substantial amount of the abrasive to be exposed to be successful. Heretofore, relatively thick plastic casings have been molded around the abrasive. However, the heat of the molding operation, which might run as high as 400° F. for phenolic resins, would melt out the fill agent if the treatment was applied before molding. Accordingly, it was necessary to treat after molding. Treatment after molding had the disadvantage that much of the abrasive surface was covered by the molded casing, and hence the fill agent did not adequately penetrate the abrasive. Since according to the procedures described herein, the coating is applied at or near room temperature, the abrasive may be pre-treated, and the fill agent will not be melted out.

It will be understood therefore, that in accordance with the preferred method, the slab **50** will be treated before being coated, and also that if the elements **16**, shown in FIGURE 3, are formed separately or by some other method than by severing from a slab, the elements will first be treated and then coated.

The coating on the articles is very thin and hence a maximum amount of abrasive is presented to the bore being honed. The coating material, which as noted is preferably a polyester epoxy copolymer, is unaffected by liquids that may be encountered in a honing operation, such as water, oils and kerosene. Since the coating is thin, it generates a minimum of heat by contact with the bore being honed. Excessive heat of course will distort the part being honed. The coating is extremely durable and because of its thinness allows a maximum of coolant to reach the abrasive. In order to obtain the maximum realization of these benefits and advantages, the coating will preferably be .002"–.006" in thickness.

What I claim as my invention is:

1. A honing element for a honing tool having a body provided with slots for the reception of a plurality of said elements and an adjusting member for radially moving said elements outwardly of said body and applying a pressure thereto, said element comprising a bonded abrasive stick of substantial length relative to its width and thickness, said abrasive stick having a fill agent therein penetrating substantially the entire body of said abrasive stick, and a relatively thin liquid applied coating of a relatively non-abrasive material covering said abrasive stick on certain of its surfaces but not covering its working face, said coating being curable at or near room temperature and of such character as to wear with the abrasive stick while providing such frictional engagement with the walls of the slots in the tool body, without abrasion of the slot walls, as to frictionally retain said elements on the tool body within the slots but permitting them to be moved outwardly by the application of a positive force by the adjusting member.

2. The honing element defined in claim **1**, wherein the thickness of said coating is in the range of approximately .002"–.006".

3. The honing element defined in claim **1**, wherein said coating is formed of a thermosetting resin.

4. The honing element defined in claim **1**, wherein said coating is a polyester epoxy copolymer.

5. The honing element defined in claim **1**, wherein said coating is plastic formed at least in part from a polyester resin.

6. The honing element defined in claim 1, wherein said coating is a plastic formed at least in part from an epoxy resin.

7. The honing element defined in claim 1, wherein the thickness of said coating is in the range of approximately .002"–.031".

8. The honing element defined in claim 1, wherein said coating is a polyester epoxy copolymer, and said fill agent includes sulphur.

9. The honing element defined in claim 8, wherein the thickness of said coating is in the range of approximately .002"–.006".

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