May 29, 1956 D. N. GELLERT 2,747,343

ABRASIVE ARTICLES AND THE LIKE AND HOLDERS THEREFOR

Filed Sept. 2, 1954 2 Sheets-Sheet 1

Fig. 1.

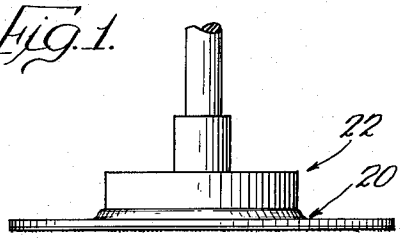


Fig. 2.

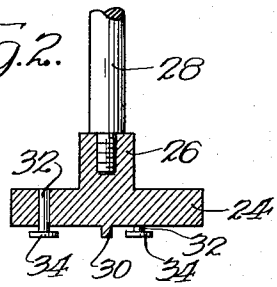


Fig. 3.

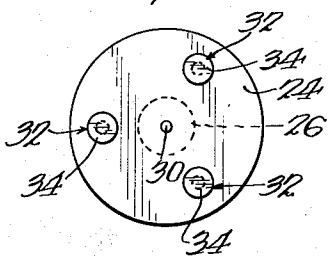


Fig. 4.

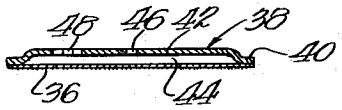


Fig. 5.

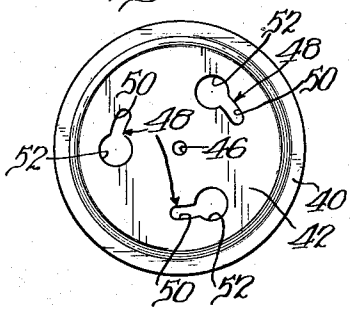


Fig. 6.

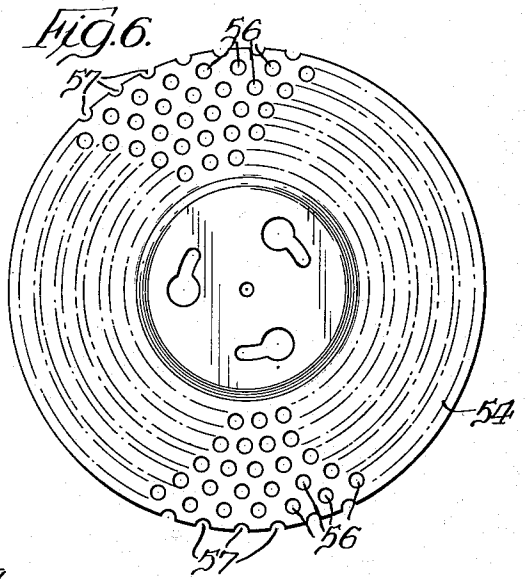


Fig. 7.

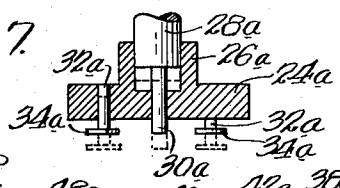
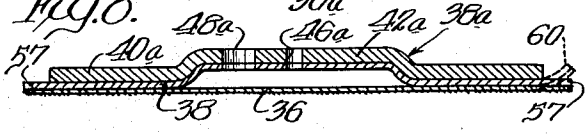


Fig. 8.



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ABRASIVE ARTICLES AND THE LIKE AND HOLDERS THEREFOR

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Fig. 9.

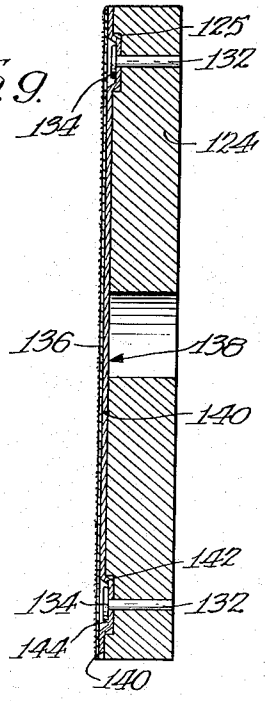


Fig. 10.

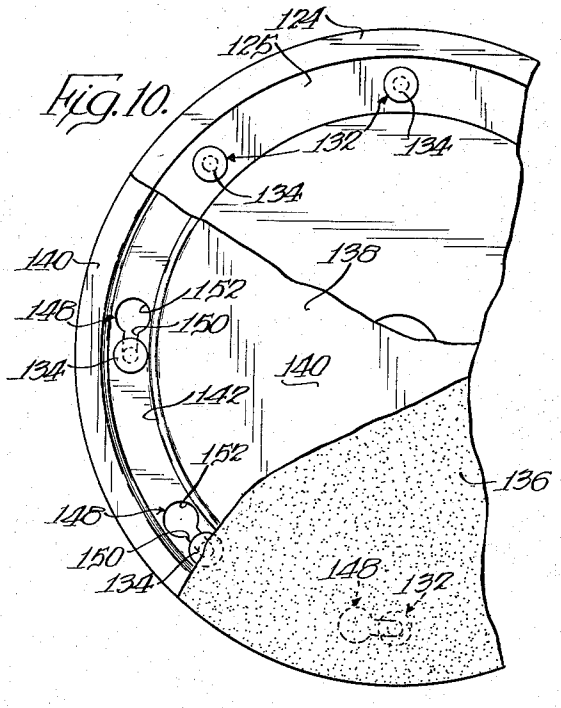


Fig. 11.

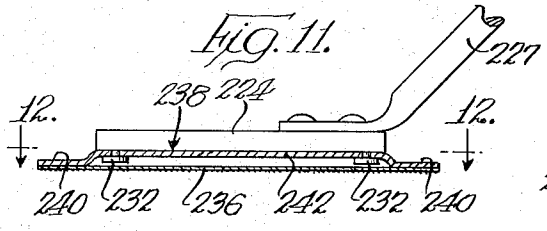


Fig. 12.

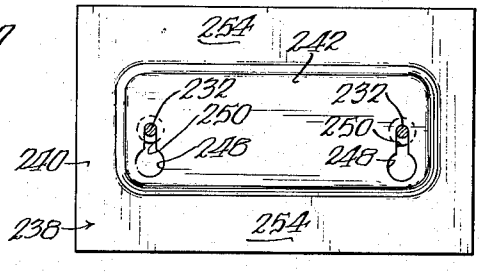


Fig. 13.

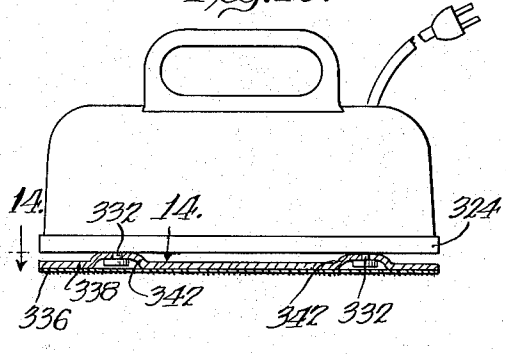


Fig. 14.

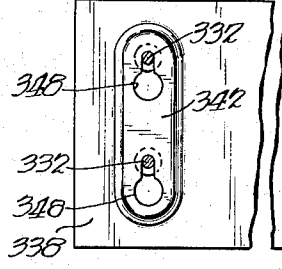
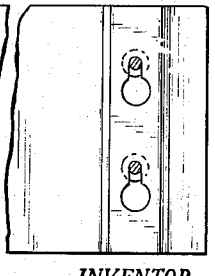


Fig. 15.



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2,747,343

ABRASIVE ARTICLES AND THE LIKE AND HOLDERS THEREFOR

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Application September 2, 1954, Serial No. 453,795

12 Claims. (Cl. 51—168)

The present invention relates to articles for finishing surfaces and to means for holding such articles.

In working on articles of manufacture, and in putting a finish on articles, a wide variety of flexible cloths, papers and the like are employed. For example, many grades of sandpaper and emery cloth, from extremely coarse to very fine, are used in a finishing operation known as sanding to remove burrs and the like and to smooth surfaces, and for high lustre finishes, billiard cloth and felt are frequently employed. These various materials are generically referred to herein as "finishing materials," and the present invention is equally applicable to all.

In the use of emery cloth, for example, it is customary to mount the cloth on a holder to facilitate manipulation of the cloth in performance of a sanding or abrading operation. For use in conjunction with rotary tools, for example, a customary emery cloth holder comprises a stem to be releasably secured in the tool chuck and a generally circular plate carried by the stem. In some instances the plate is metal, but in most instances the plate comprises a rubber flange molded to the stem. Two principal methods have been employed heretofore to secure discs of emery cloth and the like to the face of the holder plate. The first involves the use of one or more large headed screws adapted to be passed through the emery cloth and threaded into the plate. Usually, particularly in the case of rubber holders, a single screw is employed which is threaded into the stem of the holder. This method of attachment suffers many disadvantages in that it is not applicable to small diameter finishing discs because the screw would prevent use of the face of the disc, and that in large diameter discs the screw does not hold the marginal portions of the disc to the plate, thus permitting flapping and ready tearing of the disc. To overcome this latter disadvantage, glue or adhesive is customarily used in addition to the screw to hold the disc to the plate. Also, glue or adhesive alone has been used to secure small diameter discs to holders. In production assembly lines, the abrasive discs are worn out so rapidly that provision must be made for the ready removal of a used disc from, and the ready mounting for a fresh disc on, the holder. Permanent glue, adhesive, or cement is not practical for this purpose because it takes too long for the glue to set, and once the glue has set, it is practically impossible to remove the disc. Accordingly, pressure sensitive adhesives have been adopted almost universally to secure finishing articles to their holders. For small diameter discs, pressure sensitive adhesive alone is used to secure the abrasive disc to the holder, and in large sizes, a fastening screw may be used in addition to the adhesive.

The disadvantages of pressure sensitive adhesive are many and a basic problem resides in the inability of the adhesive firmly to bond the abrasive disc to the holder. Because of lateral force exertion, and inaccuracy in adhering a disc to a holder, the discs very frequently slide off of the holder, either fully or partially.

Small diameter discs are frequently used for fine finishing operations on dies, molds and the like, and whenever the disc slides with respect to the holder, pressure sensitive adhesive which is a permanently tacky substance, is smeared on the die. The die maker is then required to remove the sliding disc, apply a fresh disc, and clean up the die, usually with a new abrasive disc causing the disc to be clogged with adhesive, before work can be continued. If large diameter discs are not accurately mounted, or if they once commence to slip, centrifugal force acting on the discs at the high speeds of rotation normally encountered causes the disc to fly off of the holder, with consequent danger to the workman and others, not to mention the damage to which the article being finished is subjected. It is for this reason that at least one screw is employed to secure large diameter discs to their holders. However, the necessity for removing the screw each time a disc is to be changed, substantially slows down production. In either case, it is necessary, at quite frequent intervals, to apply a fresh coating of pressure sensitive adhesive to the holder. This is a particularly messy and objectionable operation, which causes substantial loss of time and results in the workman's hands and gloves becoming sticky rendering it difficult properly to manipulate the sander.

A number of proposals have been made heretofore in the art to overcome the disadvantages above noted and to provide attaching means accommodating a very convenient attachment and detachment of discs and eliminating a need for adhesive, particularly pressure sensitive adhesive. However, to the best of my knowledge of commercial practices, these proposals have failed entirely for one reason or another, such as lack of economy, inability to provide a disposable abrasive article, inability to provide an imperforate abrasive sheet, impracticality, and/or the absence of a true improvement, and the art continues to use and to be disgruntled with the two unsatisfactory methods of attachment above described.

It is an object of the present invention to provide improved finishing articles and holders therefor of a particularly economical and practical construction affording a disposable finishing article having an imperforate finishing surface and dispensing entirely with a need for pressure sensitive adhesive and/or complicated time consuming attaching means such as screws.

In the design of finishing articles of the nature herein referred to, it is a customary object, particularly in small size articles, to provide an imperforate finishing surface. If attaching means were permitted to extend through the sheet of finishing material, use of the material would be completely or substantially impaired. Even in large size articles, the extension of fastening means, such as a screw, through the article impairs its usefulness. To provide holes or other perforations in the finishing material accommodating the passage of fastening means reduces the useful surface of the finishing article and gives rise to weakened portions permitting tearing of the material. Further, the fastening means employed must not be disposed so closely to the finishing material as to render the finishing material uneven or bumpy yet, the article must be firmly supported throughout its area and means must be provided to prevent disassociation of the article and its holder in use. Also, users of finishing materials, particularly users of large quantities of abrasive sheets and discs, insist that the abrasive articles or discs be of a highly economical nature and entirely disposable after use. Articles that require resurfacing, return to the supplier, or the like, are not readily accepted.

It is a particular object of the present invention to provide an improved finishing article of such economy that the same is inexpensive and is completely disposable,

that includes an imperforate, firmly supported sheet of finishing material, and that also includes attaching means which in no way interfere with the finishing surface. In this latter respect, it is also an object of the invention to provide an improved holder for the said finishing articles including attaching means cooperable with the articles to retain the article on the holder and in no way disrupting the uniformity or evenness of the finishing surface.

While reference has been made hereinbefore to rotary sanding, grinding, or finishing tools, the present invention is not limited to rotary tools, but is applicable as well to hand mainpulated tools, reciprocating sanders and the like. In conjunction with hand manipulated tools, it has become a quite common practice to employ pressure sensitive adhesive for the purpose of securing the finishing material to the tool or holder block, with the consequent disadvantages above noted. Reciprocating sanders and many hand manipulated holders include means beyond each end of the mounting surface for clamping the opposite edges of the finishing material, such as sandpaper, to the holder with the material stretched across the mounting or backing surface. Use of such clamping means is very time consuming and it is exceedingly difficult for a workman to stretch the finishing material across the backing surface as tautly as is necessary to prevent unevenness, tearing, and the like.

It is an object of the present invention to provide, for use in conjunction with hand manipulated tools and reciprocating and rotary tools, improved finishing articles and attaching or holding means therefor enjoying all of the advantages enumerated above.

According to the present invention, the finishing article, such as to provide a rectangular or a disc-like abrasive or felt finishing surface, comprises an imperforate planar sheet of the appropriate finishing material and a backing therefor, the backing comprising a sheet of relatively stiff expendable material of the same size as the finishing material having a portion defining a plane surface to which the finishing material is permanently secured, as by a permanent glue, and a portion raised with respect to the plane surface portion. This raised portion is bridged and closed by the imperforate sheet of finishing material whereby a chamber or cavity is defined between the backing and the sheet of finishing material. In the upper surface of the raised portion of the backing, one or more slots are provided communicating with the said chamber. And that is the entirety of the finishing article of the invention. Since the backing is relatively stiff, the finishing sheet is firmly supported. Even though the finishing sheet bridges the raised portion of the backing, this raised portion, as will appear more fully hereinafter, is not of substantial size and the securement of the finishing material to all sides of the backing around the raised portion insures firm support of the finishing material. The backing being formed of expendable material is not expensive and the resultant article is economical and completely disposable after the finishing material has been worn out.

In conjunction with the above finishing article, the holder of the present invention comprises a mounting plate, such as a relatively small disc, preferably formed of metal, for rotary tools, or the metallic supporting plate of a reciprocating sander including one or more lock members projecting from one surface of the plate. The lock members includes surfaces spaced from the said surface of the plate by a distance equal approximately to the thickness of the backing materials of the finishing article and are of a thickness less than the depth of the chamber defined in the article. The lock members are adapted to be passed through the slot in the raised portion of the backing, whereupon the article and holder may be moved relatively to confine the backing between the said surfaces of the holder plate and the lock members detachably to mount the article on the holder. The lock members are thus disposed in the chamber, but being of a thickness less than the depth of the chamber do not in any way interfere with the evenness or regularity of the exposed surface of the finishing material.

As thus constructed, the finishing article and holder meet the above stated objects and afford an economical, completely disposable finishing article presenting a firmly supported, imperforate finishing surface. The cooperable attaching means on the holder and article insure a secure attachment of the article to the holder without interference in any way with the continuity, uniformity, and regularity of the finishing surface. The article is readily attached to and detached from the holder by a single relative movement of the two. Due to a particular relation of the slots and the lock members, relative movement of the article and holder to effect detachment of the two cannot occur during normal use of the finishing article. Yet, in the attachment of the two, no pressure sensitive adhesive is employed and the user is in no way exposed to any type of glue, cement or adhesive. Likewise, complicated, time consuming attaching means, such as screws, are eliminated thus substantially facilitating changing of finishing articles.

In the preferred embodiments of the invention, the slots in the raised portion of the backing of the article comprise keyhole slots and the lock members comprise headed pins. While keyhole slot and headed pin connections have previously been proposed in this art, no one has provided the particular economical and convenient arrangement described above. The backing material of the finishing article comprises economical fibre embossed to define the raised portion thereof. Suitably, the fibre is embossed and the keyhole slots are cut in the embossed portion in a single operation to maintain the economy of the article. Since fibre is quite extensively employed as a backing for conventional abrasive discs suffering the disadvantages above enumerated, it is apparent that the utilization of an embossed fibre backing will not substantially increase the cost of the finishing article. Coupling this fact with the customary use of several layers of pressure sensitive adhesive on conventional discs, it is to be appreciated that the finishing articles of the present invention will be just as economical, if not more so, than conventional finishing articles.

In addition to the foregoing, the present invention affords the further advantage, particularly in rotatable assemblies, of substantially decreased holder costs. Abrasive discs are provided in a plurality of diameters, from ½" on up. With conventional discs, it is essential to provide holders of the same diameter as the discs employed firmly to support the disc and/or to afford a flexible mounting for the disc. According to the present invention, the relatively stiff backing of the article firmly supports the finishing material, either rigidly or flexibly depending upon the thickness or construction of the backing, and the raised portion of the backing may be substantially uniform in a variety of sizes, whereby a single holder is optimumly applicable to a variety of sizes of articles.

As is to be appreciated, the present invention is capable of embodiment in a large number of species. While the rotary type above referred to is probably the most widely used, another rotary type of finishing article, particularly adapted for use on lathes, presents substantial problems, and it is an object of the invention to provide an embodiment of the invention particularly directed to the solution of these problems. This latter rotary type of article involves the use of a large diameter rigid face plate which is adapted to be rotated by a lathe, the abrasive article being secured to the face of this plate for a variety of grinding and finishing operations. Due to high speed operation and the large diameter of the discs employed, substantial difficulty has been been encountered in main-

taining the discs on the plate. The utilization of the finishing articles and headed pin attaching means of the present invention will, of course, substantially reduce the difficulty. In addition, I prefer to provide an improved face plate having an annular recess in the face thereof, the headed pins being located in the recess beneath the surface of the said face whereby the face plate is not obstructed by the pins and is usable for other conventional purposes. The finishing articles of the invention for use in conjunction with this plate are then provided with an annular embossed portion adapted to fit within the recess and having the keyhole slots therein for association with the headed pins. Due to this arrangement, the disc is securely held to the plate by the interlocking relationship of the disc backing in the recess, as well as the interlocking relationship of the pins in the slots.

A further object of the invention is the provision of an improved method of making finishing articles.

Other objects and advantages of the present invention will become apparent in the following detailed description of improved finishing articles and holders therefor, and manners of constructing the same.

Now, in order to acquaint those skilled in the art with the manner of making and using the abrasive articles and holders of the invention, I shall describe, in connection with the accompanying drawings, preferred embodiments of the abrasive articles of the invention, a preferred method of making the said articles, and preferred embodiments of the holding means for the said articles.

In the drawings:

Figure 1 is a side elevation of a finishing article of disc form and a holder therefor as assembled for use;

Figure 2 is a vertical section of one embodiment of the holder of the invention;

Figure 3 is a bottom view of the holder shown in Figure 2;

Figure 4 is a vertical section of one embodiment of a finishing disc constructed according to the invention;

Figure 5 is a plan view of the finishing disc shown in Figure 4;

Figure 6 is a plan view of a finishing disc of larger diameter than that shown in Figures 4 and 5;

Figure 7 is a vertical section of a second embodiment of the holder of the invention;

Figure 8 is a vertical section of a finishing disc associated with a reusable, rigid, reenforcing member therefor;

Figure 9 is a vertical section of a large diameter rigid rotary face plate or holder constructed according to the invention for use in lathes and the like, and a second embodiment of the finishing disc of the invention associated therewith;

Figure 10 is an end elevation of the assembly shown in Figure 9, portions of the finishing material being broken away to reveal the backing and portions of the backing being broken away to reveal the face plate;

Figure 11 is a side view, partly in section and partly in elevation, of a hand tool constructed according to the invention and a further embodiment of the finishing article of the invention associated therewith;

Figure 12 is a sectional view taken substantially on line 12—12 of Figure 11;

Figure 13 is a side view, partly in section and partly in elevation, of a reciprocating sander including a face plate constructed according to the invention and a still further embodiment of the finishing article of the invention associated with the said plate;

Figure 14 is a sectional view taken substantially on line 14—14 of Figure 13; and

Figure 15 is a view similar to Figure 14 showing a modified manner of embossing the backing of the finishing material.

Referring now to the drawings, and particularly to Figure 1, I have shown a finishing article **20** constructed according to the invention as assembled for use with a holder **22** also constructed according to the invention. The embodiment of the invention shown comprises a rotary assembly of disc form particularly adapted for use in portable rotary sanders, portable electric drills, drill presses, and other rotary tools. The finishing article **20** may be of substantially any diameter desired, an intermediate size being shown in Figure 1. To increase the diameter, the marginal flange is enlarged, and to decrease the diameter, the marginal flange is reduced, reductions substantially to the diameter of the holder being possible, as will appear more fully in the description of Figures 4 to 6.

The article holder **22** of the present invention is shown in detail in Figures 2 and 3 as comprising a circular plate or disc **24** having an integral axial extension **26** projecting from one surface thereof, and an axial stem **28** threaded into a tapped bore in the extension **26**. The plate **24** and stem **28** are preferably formed of metal, such as steel, and the stem is adapted to be secured in the chuck of a rotary tool. The stem is preferably removable from the plate **24** to avoid unnecessary duplication of stems, which rarely become worn, and to accommodate association with the plate of stems of various diameters to fit the sizing of the tool chuck. On the opposite or lower surface thereof, the mounting plate **24** is provided with an axial centering or locating pin **30**, which is shown as formed integrally with the plate. Upon a circle concentric with the pin **30**, the plate is provided with a plurality of circumferentially spaced lock members or means **32**, each comprising a pin having an integral head **34**. Suitably, the headed pins **32** are formed separately of the plate **24** and are press fitted into bores provided in the plate. The pins **32** are fitted in the plate **24** to define a predetermined spacing between the inner surface of the heads **34** of the pins and the lower plane surface of the plate for a purpose to be described.

One embodiment of the finishing article of the present invention is shown in Figures 4 and 5 as comprising, simply, an imperforate, planar sheet **36** of finishing material, such as emery cloth, sandpaper, billiard cloth, felt, or the like, and a backing **38** therefor. In the embodiment shown, the sheet **36** comprises a disc of finishing material of a predetermined diameter, particularly a small diameter disc, such as ½, ¾ or 1 inch. The backing **38** comprises a disc of the same diameter as that of the finishing material formed of a relatively stiff, yet very economical and completely expendable material. I prefer to form the backing of a composition material or fibre which is well known and has been used extensively in the art. A suitable material is sold under the name "Armite" by Spaulding Fibre Company, Inc., of Tonawanda, New York. This material, and others, may be used in the practice of the present invention in a variety of thicknesses, for example, .015 to .035 inch, and I have found a material thickness of .030 inch to be very practical for a wide range of disc sizes. "Armite" in this thickness is capable of some flexation, but is very stiff and tough, which are two requisites of the backing material. The backing disc **38** of tough expendable material includes a first portion **40** defining a substantially plane surface, in this embodiment a narrow, marginal, annular surface, and a second portion **42** raised with respect to the plane surface portion **40**, in this embodiment a raised, circular, central portion. The raised portion **42** defines a flat or plane upper surface on the disc **38** that is disposed in spaced parallel relation to the plane surface portion **40**. The disc **36** of finishing material is permanently and fixedly secured at its inner or non-abrasive surface to the lower surface of the plane annular portion **40** of the backing **38**, preferably by a permanent glue, adhesive, or cement. Mechanical fasteners are not employed because the same would interrupt, present obstructions in, or cause bumps in, the abrasive or finishing surface. Pressure sensitive adhesives are not employed because of the substantial

disadvantages of the same, as enumerated hereinbefore. Thus, the disc 36 is permanently and fixedly secured to the annular surface portion 40 of the backing 38 and bridges across the raised portion 42 of the backing to define a cavity, recess, or chamber 44 between the raised portion of the backing and the sheet of finishing material. The raised portion of the backing 38 is provided in the flat circular wall thereof with a central or axial aperture 46 and, on a circle concentric with the aperture, with a plurality of circumferentially spaced slots or openings 48, preferably comprising keyhole slots. Each keyhole slot includes an arcuate slot portion 50 disposed forwardly in the direction in which the article is to be rotated and an enlarged aperture 52 communicating with a rearward portion of the slot. As will be appreciated, the aperture 46 and slot 48 extend through the backing material and communicate with the chamber 44.

The abrasive or finishing article of the invention is thus seen to consist solely of an imperforate sheet of finishing material and an inexpensive and expendable or disposable backing therefor, the backing including a raised portion having a centering hole or aperture and a plurality of slots therein. If desired, as will be appreciated, each slot and the aperture could be provided in an individually or locally raised portion of the backing. In the manufacture of the finishing article, I prefer to practice a method facilitating the economical and practical formation and assembly of the backing and finishing material. The fibre employed for the backing 38, particularly the "Armite" material referred to, is readily worked if the same is dampened or moistened prior to forming. I prefer to moisten relatively long strips of this material, of a width slightly greater than the finished diameter of the resultant disc, and advance or feed a strip into a die in increments slightly greater than the finished diameter of the disc. The die, as composed of a die head and a base plate having a generally cylindrical cavity therein, holds the marginal edges of the material about the cavity and embosses a portion of the material, to define the raised portion thereof, and simultaneously cuts the centering aperture and the keyhole slots in the base or flat wall of the embossed portion. As the strip is advanced, embossed portions are defined in the strip in longitudinally spaced relation. Gang dies may be employed if desired, as is known. While the strips of backing material are being embossed, a relatively large sheet of finishing material is disposed abrasive face down on a table or the like and a permanent glue, adhesive, or cement, of any type conventional in the art, is applied to part or all of the inner or back surface of the material. The embossed strips are then placed on the glued surface of the finishing material, while the glue is still tacky, and strips are placed on the said surface until the strips cover the full area of the sheet of finishing material. Hold down means may be applied to the strip, if necessary, to insure an intimate and permanent bond between the strips and the finishing material, and the glue is then permitted to dry. When the glue is dried, the combined sheet and strips are passed through a cutting punch. This punch may suitably include a centering pin enterable into the centering aperture in each embossed portion of the strips and a circular cutter coaxial with the pin adapted to cut through the backing and finishing materials around each embossed portion of the strips to define the discs shown in Figures 4 and 5. Thus, the method of forming the articles of the present invention comprises, simply, the steps of simultaneously embossing and cutting slots in the embossed portion of an expendable fibre, permanently gluing a sheet of finishing material to the unembossed portions of the fibre, and cutting or trimming the fibre and the finishing material to the same size. This method insures the economical and practical formation of a truly expendable finishing article.

Referring now to Figure 6, I have shown a modification of the finishing article of Figures 4 and 5 which is identical to the finishing article described, except that the same includes a larger plane surface portion 40 provided merely by increasing the diameter of the discs 36 and 38 to define a large, marginal, annular flange 54, a similar flange being shown on the article in Figure 1. In the small diameters, say ½ inch to 1½ inches, the discs are normally required to be rigid and the formation of the articles as shown in Figures 4 and 5 insures the desired rigidity. In larger sizes, however, flexibility of the marginal flange 54 is usually essential and the marginal flange, by appropriate selection of the thickness of the backing material, can be made more or less flexible. Yet, the central portion of the disc possesses substantial rigidity as is required. I prefer to employ backing material of sufficient thickness to insure the rigidity, strength and toughness required of the raised central portion of the disc. Then, to afford varying degrees of flexibility of the marginal flange, varying numbers of perforations, as indicated at 56 in Figure 6, or no perforations at all, are provided in the marginal flange portion of the backing only. These holes may suitably be made simultaneously with the embossing of the backing, or in a separate step, but are made only in the backing, not in the finishing material. Thus, the finishing surface remains imperforate as desired.

The abrasive or finishing article and its holder are specifically correlated to one another. The plate of the holder is preferably of a diameter equal to that of the embossed central portion of the finishing disc. For a ½ inch diameter disc, the plate diameter may suitably be ⅜ inch. This diameter is entirely suitable for disc sizes of ½, ¾ and 1 inch. Thus, a single holder serves for three sizes and a single embossing die is employed in the manufacture of the three sizes. In discs of a diameter greater than 1 inch, the forces brought to bear are considerably greater than it is desirable to increase the size of the holder and the size of the embossed portion of the disc as well. Suitably, a holder having a 1 inch diameter plate could be employed with the next three or four sizes of discs, perhaps up to 3 inch diameter discs. And so on up the scale. In substantially all size discs above, say, 1¼ inches, the discs take the form of those shown in Figures 1 and 6, while the smaller sizes take generally the form shown in Figures 4 and 5. In all instances, the holder is preferably formed as shown in Figures 2 and 3. In contrast to conventional assemblies, wherein a special holder must be provided for each disc size, it is to be appreciated that the present invention affords substantial economies. Also, the need for only a single die to emboss and cut the slots in a plurality of sizes of discs affords further economies.

In a given assembly of disc and holder, the headed pins on the holder and the keyhole slots in the backing of the finishing material are located on circles of equal diameter, at equal circumferential spacings. In the embodiment presently being described, three headed pins and three keyhole slots, at equal spacings have proven entirely satisfactory. The apertures 52 of the keyhole slots are of a size to accommodate passage of the heads 34 of the pins 32 and the slot portions 50 are of a size to receive the pins, but not to accommodate passage of the heads 34. The central aperture 46 in the backing is of a size conformably to receive the centering pin 30 on the holder. To assemble or mount an article on a holder, the article is positioned to accommodate initial entry of the centering pin 30 on the holder into the centering aperture 46 in the backing. The article may then be rotated with respect to the holder, if necessary, to dispose the slot apertures 52 in alignment with the pin 32, whereupon, the article may be moved axially inward on the holder to dispose the exposed surface of the flat central portion of the backing in engagement with the lower surface of the plate 24 and to locate the heads 34 of the pin in the cavity or chamber 44 in the article. Thereafter, the article is rotated with respect to the holder, counterclockwise as viewed in Figures 5 and 6, to move relatively the exposed pin portions of the pins 32 into the slot portions 50 of the keyhole slots

48. As previously described, the distance between the opposed surfaces of the plate 24 and the heads 34 of the pins is substantially equal to, i. e., only slightly greater than, the thickness of the backing material. Accordingly, upon the movement described, parts of the raised flat portion of the backing are confined between the pin heads and the plate 24, whereby the disc is securely mounted on the holder. Attachment of discs to the holder in the manner described is very conveniently and efficiently carried out, the movement consisting actually only of moving the disc into engagement with the holder and rotating one or the other in the appropriate direction. Likewise, detachment is swiftly effected manually. In use, however, the disc will not be detached from or moved with respect to its holder. The direction of movement of the holder, as viewed from the stem end, is clockwise in practically all tools of the character referred to, thus imparting clockwise rotation to the article as the same is viewed in Figures 5 and 6. Thus, the rotation insures that the pins 32 are constantly positioned in engagement with the end wall of the slot portions 50 of the keyholes, and any resistance to movement applied to the disc further insures such positioning. The locating pin 30 and the headed pins 32 further insure against any lateral movement of the disc relative to the holder so that the disc is positively held solely for rotation with the holder.

The embossing of the fibre backing in relation to the thickness of the heads 34 of the pins 32 and the length of the centering pin 30 is preferably such as to define a cavity or chamber 44 of a depth greater than the thickness of the pin heads 34, and of a depth greater than the length of the portion of the pin 30 received within the chamber. By this arrangement, the pins 30 and 32 will be confined closely to the surface of the backing and will be spaced from the finishing material so as to avoid any possible interference with, or bumpiness or irregularities in, the finishing surface. The finishing material is firmly supported by the annular marginal portions 40 of the disc, and is stretched relatively tautly across the area of the raised portions 42. The backing material is tough and relatively stiff to insure firm support of the finishing material without appreciable distortion in the area of the embossed portion of the disc. Being tough, the fibre will retain its shape and will withstand rough handling to insure ready attachment of an article to a holder and to prevent tearing of the fibre in use.

In view of the foregoing, it is to be appreciated that the finishing articles and holders of the invention meet the objects hereinbefore set forth, and afford a finishing article having the distinct advantages of an imperforate abrasive sheet presenting a uniform or regular, continuous finishing surface that is rigid or marginally flexible as desired, and that is not interrupted or made irregular by fastening means, the article as a whole being completely disposable after being worn out. Also, the invention affords the advantage that should an abrasive article be only partially worn in a given operation, the same may, if desired, be preserved for a further operation merely by removing the same from the holder and saving it, since the backing and attaching means are in no way damaged by use. The abrasive article is of particularly economical manufacture, especially in view of the method of the invention. The holders of the invention also afford substantial economies in that only a single holder is required for a variety of sizes of articles.

As pointed out in the foregoing, the headed pins on the holder are press fitted into the plate to define a distance between the opposed surfaces of the pin heads and plates equal normally to the thickness of the backing. To facilitate the adjustment of the headed pins and the centering pin, the holder construction shown in Figure 7 is preferred. In this construction, the cylindrical plate 24*a* is provided with a tubular axial extension 26*a* and an axial bore communicating with the interior of the tube. The tubular extension and axial bore are adapted for the reception of an integral member comprising a stem portion 28*a* and a centering pin portion 30*a*, the said member being adapted to be press fitted into the tubular extension and axial bore to define a centering pin 30*a* projecting a predetermined length below the surface of the plate 24*a*, as is indicated in solid and dotted lines in Figure 7. Likewise, the headed pins 32*a* are press fitted into their bores to dispose the heads 34*a* thereof a predetermined distance from the lower surface of the plate.

In some industries, particularly automobile fender and body repair shops and the like, an extremely rigid support of the abrasive disc is required, with possibly only a very small marginal portion of the disc being flexible. As pointed out hereinbefore, I have substantially settled upon a uniform thickness of backing material for all discs, irrespective of diameter, namely a thickness of .030 inch. In large diameter discs, however, this material thickness does not afford the rigidity required in some uses of abrasive discs, but does afford, particularly when perforated, the usually essential flexibility. To rigidify the disc of the present invention for these special purposes, and in keeping with the economies of the present invention, I provide the rigidifying or reenforcing member shown in Figure 8. This member comprises a relatively thick disc 38*a* of fibre, suitably "Armite," which is centrally embossed to define a marginal plane surface portion 40*a* and a raised central portion 42*a*, the embossing being such as to define a raised portion complemental to that of the abrasive disc backing member. The disc 38*a* is of a thickness to be extremely rigid and strong, a thickness of 1/16 inch having been found adequate. Within the raised portion 42*a* thereof, the reenforcing disc 38*a* is provided with a central locating aperture 46*a* and three circumferentially spaced keyhole slots 48*a*, the same as are provided in the backing 38 of the finishing article. The disc 38*a* is not fixedly secured or glued to the finishing article in use, but only backs the article up, whereby the reenforcing member is reuseable many times over to back up a plurality of finishing articles.

In use, the reenforcing disc 38*a* is detachably mounted on the holder in the same manner as a finishing article, and a finishing article is then mounted on the holder in engagement with the member 38*a*. To facilitate such mounting, it is apparent that the headed pins 32 or 32*a* and centering pin 30 or 30*a* of the holder must project sufficiently far from the plate 24 or 24*a* to accommodate the thickness of both the backing 38 of the finishing material and the reenforcing member 38*a*. In this respect, the holder shown in Figure 7 is of particular benefit. Specifically, since I prefer to employ backing material stock of uniform thickness, .030 inch, and reenforcing material of uniform thickness, 1/16 inch, the components of the holder of Figure 7 are readily assembled for use either with the backing alone, shown in solid lines in Figure 7, or with both the members 38 and 38*a*, as shown in dotted lines in Figure 7. By utilizing a press having two stops, alternatively usable, assembly in either the solid or dotted line position is readily effected. In either case, the backing alone or the backing and the reenforcing member are combined between the heads of the pins 32*a* and the surface of the plate 24*a* when the assembly of article and holder is completed. In the manufacture of the holder of Figure 7, I have found it particularly economical and practical to form the plate 24*a* and integral stem 26*a* of bronze, and the stem 28*a* and pins 32*a* of steel. By leaving the plate 24*a* in its natural bronze condition when the pins are set in one position, and by plating the plate 24*a* chromium or the like in holders having the pins thereof set in the other position, users of the holders and discs are afforded a color coded assembly assuming use of the proper holders with finishing discs alone, and proper holders for the combination of finishing discs and a reenforcing member.

The reenforcing or rigidifying member 38*a* may be of

the same diameter as the finishing disc with which used, or may, as shown in Figure 8, be of a slightly smaller diameter to leave a small flexible marginal portion 60, which is adapted to flex as indicated in dotted lines. Because the rigidifying member 38a closely supports this portion of the disc, the flexible portion 60 bends about a very small radius, thus assuming efficient finishing of sharp corners, short radius curves, and the like. The flexibility of the margin 60 of the disc is especially enhanced in the performance of the said function by notching the peripheral margin of the disc, suitably by means of semi-circular perforations 57, as indicated in Figure 6. Further, the notches or perforations 57 eliminate a long existing complaint in the art. Heretofore, the marginal edge of rigidified discs has been subject to fraying and tearing, with consequent shortness of disc life. According to the present invention, the notches 57 accommodate ready bending of the marginal edge of the disc before any such fraying or tearing can take place, whereafter no such fraying or tearing will occur.

As will be appreciated from the foregoing description of the backing 33 of the finishing article of the invention, the reenforcing member 38a is very economical of manufacture, and highly efficient in use. While the member 38a is reusable, the same is of such low cost as to represent an exceedingly minor investment in a finishing operation even if the same were discarded after a single use. The improved holder of Figure 7 is also highly economical of manufacture, particularly in view of the fact that a single assembly of components is readily adjusted to a variety of desired sizings merely by adjustment of the press used in effecting the assembly.

In addition to the general type of disc-like finishing articles above described, industry frequently employs lathes for rotary sanding and finishing operations, particularly in instances wherein large diameter discs, twenty inches for example, are required to be rotated at high speeds. Lathes are frequently employed for this purpose in tool rooms, machine shops, tool and die shops, and the like. Customarily, the setup involves a large diameter abrasive or finishing material disc, and a rigid face plate of substantially the same diameter as the disc. These face plates may also be used for other purposes, and are preferably unobstructed. While the embodiments of the invention above described could be employed for this purpose, I prefer to adopt the special purpose assembly which is shown in Figures 9 and 10. According to the present invention, the rigid face plate comprises a circular metallic plate 124 of sufficient thickness to maintain rigidity. The plate may or may not be axially apertured, as desired. Adjacent its periphery, the plate 124 is provided in the working face thereof with an annular recess 125 of a depth substantially less than the thickness of the plate. Within this recess, a plurality of circumferentially spaced holes are drilled in the plate and a headed pin 132 is press fitted in each hole to be located entirely within the recess 125, i. e., with its head 134 spaced inwardly from the working face of the plate to maintain an unobstructed face. Each pin is so located in the annular recess as to have the head thereof spaced a predetermined distance from the base wall of the recess.

The finishing article comprises an imperforate, planar disc-like sheet 136 of finishing material permanently glued or secured to a fibre backing 138. The fibre backing includes first portions 140 defining a plane surface to which the sheet 136 is glued and embossed portions 142 defining a raised annulus on the backing of the same diameter as the annular recess 125 in the plate 124. The embossed portions 142 of the backing are bridged by the disc or sheet 136 to define a cavity or chamber 144. The embossed portion of the backing is also provided in the base wall thereof with keyhole slots 148 communicating with the chamber. Each slot comprises a slot portion 150 disposed forwardly in the direction of rotation and an enlarged aperture 152 communicating with a rearward portion of the slot. The slots are disposed at equal circumferential spacings, the same as those of the headed pins 132, and are each adapted for the reception of a pin in substantially the same manner as previously described.

To assemble the article on a holder, the embossed annulus 142 of the backing is disposed in the annular recess 125 in the plate to center the article on the plate, whereafter attachment of the article to the holder is accomplished in substantially the manner described in conjunction with Figures 1 to 6. Despite high speed rotation, the pins fitting in the keyhole slots will maintain the article on the plate and the interfitting relation of the embossing on the article and the recess in the plate will insure against lateral movement or disassociation of the article. Yet, upon stopping of the machine, the article is very swiftly detached manually from the plate and a fresh article attached. The wornout article, being highly economical, is fully disposable. Thus, it is to be appreciated that the embodiment of the invention shown in Figures 9 and 10 enjoys the same benefit and advantages as the embodiments disclosed in Figures 1 to 8.

In addition to rotary disc finishing articles, such as the types above described, hand manipulated and machine operated finishing articles are widely employed wherein the movement applied to the article is a straight line unidirectional or reciprocating motion. For example, in Figures 11 and 12, I have shown a hand tool of a type frequently employed by die makers, including a mounting plate 224 and a manipulating handle 227. As constructed according to the present invention, the plate 224 comprises a stiff metallic member, from the lower surface of which protrudes one or more, preferably a pair of headed pins 232, the pins suitably being aligned on the longitudinal axis of the plate. The finishing article, which may be square, rectangular, or of any desired form, includes an imperforate, substantially planar sheet 236 of finishing material permanently cemented or otherwise secured to a backing 238, preferably formed of fibre. The backing 238 includes plane surface portions 240 to which the finishing material is secured, and an embossed portion 242 within which keyhole slots 248 are formed. The keyhole slots are disposed transversely of the principal direction of movement of the assembly and have the slot portions 250 thereof located with the end wall thereof substantially on the longitudinal axis of the backing, whereby the article may be attached to and centered on the holder. In the embodiment shown, the tool is adapted for longitudinal reciprocating movement, and the keyhole slots parallel the transverse axis of the tool. To afford a flexible finishing article, if desired, marginal flange portion 254 of the sheet and backing are provided. The manner of assembly, uses and advantages of the tool are apparent, particularly to those skilled in the art, from the foregoing description.

In Figures 13, an electrically operated reciprocatory sander is shown, including a base or mounting plate 324. According to the present invention, a plurality of headed pins 332 are projected through the plate, the pins suitably being four in number and located adjacent the four corners of the base plate. The finishing article comprises an imperforate sheet or rectangle 336 of finishing material permanently glued or cemented to an embossed fibre backing 338, the sheet 336 being secured to the unembossed portions of the backing. The embossed portions of the backing, as indicated at 342, may suitably comprise a pair of channels extending transversely of the longitudinal axis of the article adjacent the opposite ends of the backing. One form of embossing is shown in Figure 14, wherein the embossing terminates entirely within the boundaries of the backing, and a second form is shown in Figure 15 extending continuously across the backing. In each embossed portion, a pair of spaced keyhole slots 348 are formed, each adapted for the reception of a headed pin 332, the slot extending transversely

of the article. Since reciprocation is effected longitudinally of the machine, the slot and pin arrangement insures secure attachment of the article to the reciprocating base plate. Attachment and detachment of the article is readily effected, and the assembly affords the advantages of the invention in reciprocating sanders and like reciprocable tools.

From the foregoing, it is to be appreciated that the present invention affords substantial advantages in the art in providing an improved abrasive article including an imperforate finishing surface that is rigid or marginally flexible, and that is uniform and regular throughout its full area, an abrasive article of very low cost that is disposable after use, improved attaching means for abrasive articles eliminating entirely the need for pressure sensitive adhesives, screw fasteners, complicated clamping means and the like, improved holders for abrasive articles of low ultimate cost and great practicality, improved rigidifying or reenforcing means for abrasive or finishing articles, and an improved method of making finishing articles.

While I have described only what I regard to be the preferred embodiments of my invention, and the preferred method of making the same, it is to be appreciated that various changes, rearrangements and modifications may be made therein without departing from the scope of the invention, as defined by the appended claims.

I claim:

1. A finishing article and a holder therefor, said article comprising a generally planar imperforate sheet of finishing material and a backing therefor, said backing comprising a sheet of relatively stiff expendable material including a portion defining a substantially plane surface and a surface portion raised with respect to the said plane surface portion, said sheet of finishing material being fixedly secured to said plane surface portion of said backing and bridging across the raised portion of said backing, the raised portion of said backing defining a space between said backing and said sheet of finishing material, and cooperable lock means on said holder and said backing for readily attaching said article to and detaching said article from said holder, the lock means on said backing consisting solely of slot means provided in the said raised portion thereof accommodating entry of the lock means on said holder into the space between said backing and said sheet of finishing material.

2. A finishing article and a holder therefor, said article comprising a generally planar imperforate sheet of finishing material and a backing therefor, said backing comprising a sheet of relatively stiff expendable material including a portion defining a first substantially plane surface and a portion defining a second substantially plane surface disposed in spaced parallel relation to said first plane surface, said sheet of finishing material being fixedly secured to said first plane surface portion of said backing and bridging across the area of said second plane surface portion of said backing, said second plane surface portion of said backing defining a space between said backing and said sheet of finishing material, said holder including a substantially plane surface cooperable with the exposed surface of said second plane surface portion of said backing, said holder including lock means projecting from the said surface thereof and defining a surface spaced from the said surface of said holder, said backing in the said second plane surface thereof having slots therein accommodating entry of said lock means on said holder into the said space between said backing and said sheet of finishing material to confine said second plane surface portion of said backing between the said surface of said lock means and the said surface of said holder detachably to secure said article to said holder.

3. A finishing article and a holder therefor, said article comprising a substantially planar imperforate sheet of finishing material and a backing therefor, said backing comprising a sheet of relatively stiff expendable fibre including a portion defining a substantially plane surface and an embossed portion raised with respect to the plane surface, said sheet of finishing material being fixedly secured to the plane surface portion of said backing, said raised portion of said backing defining a space between said backing and said finishing material, said holder comprising a plate having at least one headed pin projecting from one surface thereof, the head of said pin being spaced from said surface, said raised portion of said backing having at least one keyhole slot therein, said slot including an enlarged aperture of a size accommodating passage of the head of said pin therethrough and a slot portion accommodating entry solely of the pin portion of said headed pin, said aperture accommodating passage of said head into the space between said backing and said finishing material whereupon said article and said holder may be moved relatively to dispose said pin portion in said slot portion with said head disposed between said backing and said finishing material to confine part of the raised portion of said backing between said head and said plate detachably to secure said article to said holder, said keyhole slot being formed in said raised portion of said backing to so relate the slot portion thereof to the normal direction of movement of said article and holder as normally to prevent inadvertent relative movement of said article and hold holder in use.

4. A rotatable finishing article and holder therefor, said article comprising an imperforate disc of finishing material and a backing therefor, said backing comprising a disc of relatively stiff expendable material of the same diameter as said disc of finishing material having a portion defining a substantially plane surface and a portion raised with respect to the plane surface, said disc of finishing material being fixedly secured to the plane surface portion of said backing, said raised portion of said backing defining a space between said finishing material and said backing, said raised portion of said backing having a plurality of circumferentially spaced keyhole slots therein, said holder comprising plate means having a plurality of circumferentially spaced headed pins projecting from one surface thereof, said slots being aligned with and adapted for the reception of said headed pins, each of said slots including a slot portion disposed forwardly in the direction of rotation of said article, and an enlarged aperture communicating with the rearward end of said slot portion, each of said apertures accommodating passage of the head of a pin into the space between said backing and said finishing material, whereupon said article may be rotated with respect to said holder to dispose the pin portions of said pins in said slot portions and to dispose the heads of said pins between said backing and said finishing material and to confine parts of the raised portion of said backing between the heads of said pins and the said surface of said plate means, whereby said article is detachably attached to said holder, said holder being rotatable to maintain said pins in engagement with the end wall of the slot portions of said slots to rotate said article and retain said article on said holder.

5. A rotatable finishing article and holder therefor, said article comprising an imperforate disc of finishing material and a backing therefor, said backing comprising a disc of relatively stiff expendable fibre of the same diameter as said disc of finishing material having an annular marginal portion defining a substantially plane surface and an embossed circular central portion raised with respect to the plane surface, said disc of finishing material being fixedly secured to the plane annular surface portion of said backing and bridging across the raised central portion of said backing, said raised portion of said backing defining a space between said finishing material and said backing, said raised portion of said backing hav-

ing a plurality of circumferentially spaced keyhole slots therein, said holder comprising a disc having a plurality of circumferentially spaced headed pins projecting from one surface thereof, said slots being aligned with and adapted for the reception of said headed pins, each of said slots including a slot portion disposed forwardly in the direction of rotation of said article and an enlarged aperture communicating with the rearward end of said slot portion, each of said apertures accommodating passage of the head of a pin into the space between said backing and said finishing material, whereupon said article may be rotated with respect to said holder to dispose the pin portions of said pins in said slot portions and to dispose the heads of said pins between said backing and said finishing material and to confine parts of the raised portion of said backing between the heads of said pins and the said surface of said disc, whereby said article is detachably attached to said holder, said holder being rotatable to maintain said pins in engagement with the end wall of the slot portions of said slots to rotate said article and retain said article on said holder.

6. A rotatable finishing article and holder therefor, said article comprising an imperforate disc of finishing material and a backing therefor, said backing comprising a disc of relatively stiff but flexible expendable fibre of the same diameter as said disc of finishing material having an annular marginal portion defining a substantially plane surface and an embossed circular central portion raised with respect to the plane surface and including a flat circular surface disposed in spaced parallel relation to said plane surface, said disc of finishing material being fixedly secured to the plane annular surface portion of said backing and bridging across the raised central portion of said backing, said raised portion of said backing defining a generally cylindrical space between said finishing material and said backing, said raised portion of said backing having a plurality of circumferentially spaced keyhole slots in the said flat surface thereof, said holder comprising a disc including a surface portion of a diameter substantially equal to that of said flat circular surface and a plurality of circumferentially spaced headed pins projecting from said surface portion of said disc, said slots being aligned with and adapted for the reception of said headed pins, each of said slots including a slot portion disposed forwardly in the direction of rotation of said article and an enlarged aperture communicating with the rearward end of said slot portion, each of said apertures accommodating passage of the head of a pin into the space between said backing and said finishing material, whereupon said article may be rotated with respect to said holder to dispose the pin portions of said pins in said slot portions and to dispose the heads of said pins between said backing and said finishing material and to confine part of the flat circular surface of said backing between the heads of said pins and the said surface portion of said disc, whereby said article is detachably attached to said holder, said holder being rotatable to maintain said pins in engagement with the end wall of the slot portions of said slots to rotate said article and retain said article on said holder, the annular marginal portions of said backing and said finishing material being of a diameter substantially greater than that of said holder and being flexible to accommodate finishing of curved and irregular surfaces.

7. A rotatable finishing article and holder therefor, said article comprising an imperforate planar disc of finishing material and a backing therefor, said backing comprising a disc of relatively stiff expendable fibre of the same diameter as said disc of finishing material having portions defining a substantially plane surface and an embossed annular portion raised with respect to the plane surface, said disc of finishing material being fixedly secured to the plane surface portions of said backing and bridging across the raised annular portion of said backing, said raised portion of said backing defining an annular space between said finishing material and said backing, said raised portion of said backing having a plurality of circumferentially spaced keyhole slots therein, said holder comprising a plate having an annular recess therein and a plurality of circumferentially spaced headed pins projecting from the base wall of said recess, said raised annular portion of said backing being aligned with and adapted to be received in said recess, said slots being aligned with and adapted for the reception of said headed pins, each of said slots including a slot portion disposed forwardly in the direction of rotation of said article and an enlarged aperture communicating with the rearward end of said slot portion, each of said apertures accommodating passage of the head of a pin into the space between said backing and said finishing material, whereupon said article may be rotated with respect to said holder to dispose the pin portions of said pins in said slot portions and to dispose the heads of said pins between said backing and said finishing material and to confine parts of the raised portion of said backing between the heads of said pins and the base wall of said recess, whereby said article is detachably attached to said holder, said holder being rotatable to maintain said pins in engagement with the end wall of the slot portions of said slots to rotate said article and retain said article on said holder, said raised portion of said backing fitting within said recess and securely retaining said article on said holder.

8. An article for finishing surfaces comprising an imperforate abrassive sheet and a backing therefor, said backing comprising a sheet of relatively stiff but flexible expendable fibre having a portion defining a substantially plane surface and an embossed portion offset with respect to said plane surface, said finishing material being fixedly secured to the said plane surface portion of said backing and bridging across the embossed portion thereof, said embossed portion of said backing defining a space between said backing and said finishing material, said embossed portion of said backing having a plurality of spaced keyhole slots therein communicating with said space to accommodate the entry of headed pin lock means into said space.

9. A rotatable article for finishing surfaces comprising an imperforate disc of finishing material and a disc-like backing therefor, said backing comprising a disc of relatively stiff expendable fibre having at least one portion defining a substantially plane surface and at least one embossed portion raised with respect to the plane surface, said finishing material being fixedly secured to the said plane surface portion of said backing and bridging said embossed portion thereof, said embossed portion of said backing defining a space between said backing and said finishing material, said embossed portion of said backing having a plurality of circumferentially spaced keyhole slots therein with the slot portions thereof disposed forwardly in the direction of rotation of the article.

10. A rotatable finishing article and holder as set forth in claim 6, including a reenforcing member between said backing and said holder, said reenforcing member comprising a relatively thick rigid fibre disc having an annular marginal portion defining a plane surface and an embossed circular central portion complemental to the embossed central portion of said backing, said reenforcing member in the embossed portion thereof having keyhole slots aligned with the keyhole slots in said backing, said reenforcing member being detachably mounted on said holder and confined between said holder and said backing in the same manner as said article is detachably mounted on said holder, said plane annular portion of said reenforcing member abutting against and rigidifying at least a portion of the normally flexible annular portion of said article.

11. A rotatable holder for finishing articles comprising a generally cylindrical plate having an axial tubular extension projecting from one surface thereof, an axial

bore and a plurality of bores circumferentially spaced about a circle concentric with said axial bore, a generally cylindrical stem having a reduced pin-like axial extension, said stem being press fitted in said tubular extension with said pin-like extension projecting through said axial bore beyond the opposite surface of said plate, and a headed pin press fitted in each of said circumferentially spaced bores with the head thereof disposed in spaced relation to said opposite surface of said plate, said pins and said stem being press fitted in said plate to define a predetermined projection of said pin-like extension beyond said opposite surface of said plate and a corresponding predetermined common spacing of the heads of said pins from said opposite surface of said plate.

12. A rotatable holder for finishing articles comprising a generally cylindrical plate, an axial tubular extension for said plate including a portion projecting from one surface of said plate, said plate and extension defining an axial bore and a plurality of bores circumferentially

spaced about a circle concentric with said axial bore, a generally cylindrical stem having a reduced pin like axial extension, said stem being disposed in said tubular extension with said pin like extension projecting through said axial bore beyond the opposite surface of said plate, and a plurality of headed pins fixed in said circumferentially spaced bores with the heads thereof disposed in spaced relation to said opposite surface of said plate.

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2,469,429	Beam et al.	May 10, 1949
2,616,230	Hough	Nov. 4, 1952