ABSTRACT: For releasably mounting an abrasive disc on a rotary driver that has angular driving fingers, a molded hat-shaped plastic hub on the back of the disc has inclined webs for engagement by the fingers with tightening action, the webs being reinforced by integral ribs and a central boss.
MEANS TO RELEASABLY ATTACH AN ABRASIVE DISK TO A ROTARY DRIVER

BACKGROUND OF THE INVENTION

In accord with the teaching of the Mackay U.S. Pat. Nos. 3,149,442 and 3,158,972, a power-actuated rotary driver or holder has a concentric socket with three angular driving fingers therein pointing in the direction of rotation and a disposable abrasive disc has a sheet metal hub structure on the back thereof for releasable engagement by the angular driving fingers. The hub structure is a sheet metal stamping of relatively shallow hat-shaped configuration having a brim that is bonded directly to the abrasive disc and having a crown with three apertures to receive the three angular fingers.

An inherent defect of the described prior art structure is the weakness and undue yieldability of the web of the crown that is engaged by the angular driving fingers of the holder. In the first place, the sheet metal web across the crown portion is relatively thin and therefore inherently prone to flex and bulge and especially so because the center of the crown is unsupported. This inherent weakness is increased by the fact that metal is removed from the web of the crown to form the finger-receiving apertures. It is also to be noted that the driving torque is transmitted to the hub structure solely by abutment of the three angular fingers against the three edges of the sheet metal apertures and if any of the three edges buckles, the loading on the other two edges is correspondingly increased.

Another disadvantage of the prior art hub structure that is inherent in the use of sheet metal is that the shallow crown must be drawn with liberal radii of curvature at the outer end of the crown and again at the base of the crown to avoid overstressing the sheet metal in the drawing operation. Consequently the crown has sloping sides which prevent such effective interlocking of the crown with the socket of the holder as is required for positive accurate centering of the hub structure relative to the holder.

A still further inherent weakness is found in the fact that only the outer brim of the hat-shaped configuration is bonded to the back of the abrasive disc. The area of the outer brim is a relatively small part of the total area of the hub structure and, as heretofore noted, the span of the crown is not directly supported at any point.

The object of the present invention is to avoid these defects and disadvantages of the hub structures of widely used prior art abrasive discs.

SUMMARY OF THE INVENTION

The presently preferred embodiment of the invention is a hub structure in the form of a molded hat-shaped body of a suitable plastic.

The crown of the hat-shaped configuration is solid plastic except for three apertures that receive the angular driving fingers of the complementary holder and except for three recesses on the underside of the crown that form three webs for engagement by the angular fingers. These apertures and recesses of the crown of the hub structure form three ribs integral with the three webs, the ribs radiating from a central boss to a continuous ring-shaped peripheral portion of the crown. The three radial ribs of the crown and the central boss portion of the crown together with the peripheral ring portion of the crown are all bonded directly to the back of the abrasive disc. Thus, by far the major portion of the area of the plastic hub structure is bonded directly to the abrasive disc with consequent high strength and only the exceedingly short spans of the three webs are free from direct support by the abrasive disc.

The described hub structure makes possible multiple points of contact by the three angular drive fingers for effective transmission of torque to the abrasive disc. The crown of the hub structure is shaped and dimensioned for positive centering engagement with the concentric socket of the holder and the three webs have sloping surfaces for cam action by the angular drive fingers to draw the crown into the concentric socket.

The features and advantages of the invention may be understood from the following description and the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

In the drawings, which are to be regarded as merely illustrative:

FIG. 1 is a perspective view of a conventional rotary holder together with the preferred embodiment of an abrasive disc for releasable attachment to the holder;

FIG. 2 is a bottom plan view of the hub structure that is bonded to the back of the abrasive disc for releasable engagement with the holder;

FIG. 3 is a transverse section of the hub structure as seen along the angular line 3–3 of FIG. 2;

FIG. 4 is an enlarged fragmentary section along the line 4–4 of FIG. 2 to show the tapering configuration of a web of the hub structure;

FIG. 5 is a transverse section along the angular line 5–5 of FIG. 2 showing the central boss portion of the hub structure;

FIG. 6 is a sectional view showing how the abrasive disc is releasably attached to the rotary holder;

FIG. 7 is a sectional view similar to FIG. 4 showing one manner in which the hub structure may be dimensioned relative to the cooperative angular drive fingers;

FIG. 8 is a similar view showing another manner in which the hub structure may be dimensioned for cooperation with the angular drive fingers;

FIG. 9 is a similar view showing a third manner in which the hub structure may be dimensioned for cooperation with the angular drive fingers;

FIG. 10 is a perspective view of a second embodiment of a hub structure which is in the form of a sheet metal stamping;

FIG. 11 is an enlarged fragmentary view showing the hub structure of FIG. 10 at an intermediate stage in its fabrication;

FIG. 12 is a transverse section taken along the line 12–12 of FIG. 10 showing one manner in which the hub structure may be dimensioned for cooperation with the angular drive fingers and;

FIG. 13 is a fragmentary sectional view similar to FIG. 12 showing another manner in which the sheet metal hub structure may be dimensioned for cooperation with the angular drive fingers.

DESCRIPTION OF THE PREFERRED EMBODIMENT OF THE INVENTION

As shown in FIG. 1 the presently preferred embodiment of the invention includes an abrasive disc generally designated 10, having a hub structure, generally designated 12, united therewith for cooperation with a rotary driver or holder, generally designated 14, that is of a well known construction. As indicated in FIG. 6 the abrasive disc 10 comprises a flexible backing sheet 15 which carries a layer 16 of finely divided abrasive particles. The hub structure 12 is suitably bonded to the back of the abrasive disc and is of what may be described as a hat-shaped configuration having a central raised crown 18 and a surrounding brim 20. In a well-known manner, the holder 14 has a concentric socket 24 to receive the crown 18 of the hub structure 12 and three angular drive fingers 25 are provided in the socket for releasable engagement with the hub structure 12. As best shown in FIG. 7, each of the angular drive fingers 25 has an inner base portion 26 and an outer end portion 28. For cooperation with the holder 14, the crown 18 of the hub structure 12 has three apertures 30 to receive the three fingers respectively.

As shown in section in FIG. 6, the holder 14 incorporates a concentric hollow cylinder 32 having a transverse backwall 34 with a concentric threaded opening 35 therein. Suitably united with the hollow cylinder 32 is a surrounding support pad 35 which may be made of flexible elastic material to yieldingly back up the abrasive disc 10.
The holder 14 has a shank 38 by means of which it may be mounted on a suitable power means such as a power tool. The hollow cylinder 32 is mounted in a shank 38 by means of a central aperture 40 that is positioned inside the cylinder and forms therewith a cylindrical annular space 42. The plug 40 has a forward circumferential shoulder 44 and has a neck portion 45 that is threaded into the opening 35 of the backwall 34 of the cylinder, the plug being drawn tight against the inner surface of the backwall. In the construction shown, the neck portion 45 has a threaded blind bore 46 for engagement with a reduced threaded portion 48 of the shank 22.

Retractably mounted in the cylindrical annular space 42 is a pressure ring 50 having an inner circumferential shoulder 52 for cooperation with the circumferential shoulder 44 of the plug to limit the outer axial movement of the holder of the surrounding ring. A suitable coil forms in the annular space 42 urges the centering pressure ring 50 towards its outer limit position.

The forward end face of the plug 40 is provided with a sheet metal end cap 55 that is anchored to the plug by a central screw 56. The end cap 55 together with the surrounding centering pressure ring 50 forms the previously mentioned concentric socket 24 of the holder and the end cap is lanced to form the three angular drive fingers 25. All of the driving fingers 25 point to the same rotary direction which, in this instance, is counterclockwise as viewed in FIG. 1.

To mount the abrasive disc 10 on the holder 14, the abrasive disc is positioned against the holder with the crown 18 of the hub structure 12 of the disc centered in the pressure ring 50 and with the three apertures 30 of the crown registered with the three driving fingers 25. The abrasive disc is then pushed against the holder for retraction of the pressure ring 50 and to cause the three drive fingers 25 to enter the three apertures 30 of the crown. The abrasive disc is then rotated in the direction to which the three angular drive fingers point with consequent engagement of the three drive fingers with three corresponding webs 58 of the hub structure as shown in FIG. 6.

For the purpose of releasably locking an installed abrasive disc against reverse rotation relative to the holder, the holder may be provided with a suitable locking pin 60 that is shown in FIG. 6. The locking pin 60 is slidably mounted in a bore 62 of the plug 40 that interrupts the screw thread of the neck of the plug and the locking pin also extends through a longitudinal groove 64 in the backwall 34 of the hollow cylinder 32 to prevent loosening rotation between the plug and the hollow cylinder. The locking pin 60 is reduced in diameter to form a circumferential shoulder 65 and to provide annular clearance for a coil spring 66 that acts against the shoulder to urge retraction of the locking pin. The outer reduced end of the locking pin 60 extends through an aperture 68 in the end cap for advance into one of the three apertures 30 of the hub structure to lock the hub structure against reverse rotation relative to the holder. A suitable knurled manually operable nut 70 is threaded onto the neck portion 45 of the plug in the path of retraction of the locking pin 60. Once the abrasive disc is mounted on the holder 14 the nut may be rotated to advance the locking pin 60 into its effective locking position. In like manner, the nut may be unscrewed to permit the small coil spring 66 to retract the locking pin for release of the abrasive disc.

The construction of the hat-shaped plastic hub structure 12 may be understood by reference to FIGS. 2—5. It is to be noted that the crown 18 of the hub structure is solid except for the provision of the three apertures 30 and except for the further provision of the recesses 72 on the underside of the crown adjacent the three apertures respectively. Each of the three recesses 72 forms one of the previously mentioned webs 58 that are engaged by the angular drive fingers. Preferably as indicated in FIG. 2, each of the recesses 72 is of curved configuration in bottom plan view.

The three apertures 30 and the three adjacent recesses 72 are spaced radially inwardly from the outer circumference of the crown 18 of the hub structure and, therefore, the crown has a continuous peripheral ring portion 74. The three apertures 30 and the three recesses 72 cooperate not only to form the peripheral ring portion 74 of the crown 18 but also to form an axial portion of the crown that may be termed an axial boss 75. In addition the apertures and recesses form three radial ribs 76 that are integral with the boss 75 at their inner ends and are integral with the peripheral ring portion 74 at their outer ends. It is to be noted that by virtue of the curved configuration in plan of the three recesses 72, each of the three radial ribs progressively increases in width towards its juncture with the axial boss 75 and also progressively increases in width towards its juncture with the outer ring portion 74, such a configuration lending strength to the ribs.

It is important to note that in addition to the brim 20 of the hub structure being bonded directly to the back of the abrasive disc 10, the peripheral ring portion 74 together with the three radial ribs 76 and the axial boss 75 are also directly bonded to the back of the abrasive disc. It is also to be noted that the three webs 58 are strengthened by adjacent portions of the axial boss 75, adjacent portions of the radial ribs 76 and adjacent portions of the peripheral ring portion 75 of the crown 18.

An important feature of the preferred practice of the invention is the concept of tapering the webs 58 to make them wedge-shaped in thickness as shown in FIG. 4, each web having an inclined inner surface 78. By virtue of this configuration of the webs, the rotation of the abrasive disc that is involved in mounting the abrasive disc on the holder causes the webs 58 to cooperate with the corresponding angular drive fingers 25 for cam action to draw the crown of the hub structure tightly into the concentric socket 24 of the holder in opposition to the pressure of the coil spring 54.

As indicated in FIG. 7, each of the angular drive fingers 25 may make two point contact with the hub structure, one point of contact being indicated at 80 where the base portion of the driving fingers abuts the edge of a web 58, the other point of contact being indicated at 82 where the outer end portion of the drive fingers presses against the web 58. If desired, the hub structure may be shaped and dimensioned to cause each of the angular driving fingers to make three-point contact therewith. Thus FIG. 8 shows an angular drive finger 25 in endwise abutment against a rib 76 of the hub structure at a third point 84. In FIG. 7 torque is transmitted to the driving disc at the edges of the three webs 58 and in FIG. 8 torque is additionally transmitted to the driving disc by the outer ends of the angular fingers 25 abutting the three radial ribs 76.

FIG. 9 shows a drive finger 25 in endwise abutment against the corresponding rib 76 at the previously mentioned contact point 84 but with the base portion 26 of the finger moved away from the edge of the corresponding web 58. Thus in FIG. 9 the driving torque is transmitted to the hub structure solely at the three relatively strong radial ribs 76.

FIGS. 10—12 illustrate a second embodiment of the invention in which the hub structure, generally designated 12a, is a sheet metal stamping of the same hat-shaped configuration with a crown 18a and a brim 20a. The crown has the usual three apertures 30 but in the construction shown the sheet metal forms a radial rib 76a adjacent each aperture, the rib being a radial flange of the sheet metal. At an intermediate point in the fabrication of the hub structure 12a the crown of the hub structure has three apertures 30b of the configuration shown in FIG. 11 wherein each aperture forms a tongue 85 in the plane of the outer face of the hub 18a. Subsequently, the tongue 85 is bent inwardly of the crown to form a rib 76a.

FIG. 12 shows how the hub structure 12a may be dimensioned relative to the angular drive fingers 26 to cause the torque to be delivered to the hub structure 12a solely by abutment of the ends of the drive fingers against the radial ribs or flanges 76a. On the other hand, if received as a substructure 12a may be dimensioned relative to the angular drive fingers 25 as shown in FIG. 13 to cause the driving torque to be transmitted to the hub structure solely by abutment of the base portions 26 of the fingers against the edges of the corresponding webs 58a.
It is to be noted that in both hub structures 12 and 12a the crown of the hub structure and the holder have mating cylindrical surfaces which in profile are parallel with the axis of rotation to provide positive self-centering interlocking of the hub structure with the holder. Thus FIG. 3 shows how a peripheral surface 86 of the crown is cylindrical and FIG. 6 shows how this cylindrical peripheral surface of the crown mates with cylindrical inner surface of the pressure ring 50. In like manner, FIG. 12 shows how the sheet metal hub structure 12a may be drawn slightly deeper than a conventional sheet metal hub structure to form the crown 18a of the hub structure with a cylindrical peripheral surface 88 which positively interlocks with the inner cylindrical surface of the pressure ring as shown at the right in FIG. 12.

My description in specific detail of the selected embodiments of the invention will suggest various changes, substitutions and other departures from my disclosure.

I claim:

1. In an abrasive article for use with a rotary holder that has a given number of circumferentially spaced angular drive fingers, each finger having a base portion extending outwardly from the holder and having an outer end portion with all of the fingers pointing in the same circumferential direction, the combination of:
   an abrasive disc; and
   a hub structure united with the back of the disc for releasable engagement by said fingers to hold the disc on the holder for rotation therewith;
   said hub structure being of hat-shaped configuration with a brim lying against the back of the disc and a crown projecting axially from the brim;
   said crown having said given number of circumferentially spaced apertures to receive said fingers respectively and having said given number of webs adjoining the apertures respectively;
   each of said apertures having leading edge and a trailing edge with respect to said circumferential direction, the fingers hooking over the leading edges of the webs;
   said crown having said given number of substantially radial ribs on its underside adjacent the respective trailing edges of the apertures to strengthen the crown and especially the respective webs.

2. A combination as set forth in claim 1 in which the crown is shaped and dimensioned relative to the angular fingers to cause the ends of the fingers to abut said flanges respectively to transmit torque force to the crown through the flanges.

3. A combination as set forth in claim 1 in which the hub structure is a body of plastic material formed with molded ribs.

4. A combination as set forth in claim 1 in which the hub structure is a shaped piece of sheet metal with the sheet metal turned inwardly of the crown to form radial flanges to serve as said ribs.

5. In an abrasive article for use with a rotary holder that has a given number of circumferentially spaced angular drive fingers, each finger having a base portion extending outwardly from the holder and having an outer end portion with all of the fingers pointing in the same circumferential direction, the combination of:
   an abrasive disc; and
   a hub structure united with the back of the disc for releasable engagement by said fingers to hold the disc on the holder for rotation therewith;
   said hub structure being formed with said given number of circumferentially spaced apertures to receive said fingers, respectively, and having webs adjoining the apertures for engagement by said outer end portions of the fingers respectively in response to insertion of the fingers through the aperture and relative rotation of the disc counter to said circumferential direction;
   the surface of said web being inclined for cam action by the fingers on the webs to tighten the hub structure against the holder.

6. A combination as set forth in claim 5 in which the holder is formed with a concentric socket dimensioned to seat the hub structure and to cause the cam action to tighten the hub structure in the socket.

7. A combination as set forth in claim 6 in which the socket and the hub structure are shaped to interlock in a positive manner to keep the hub structure centered relative to the holder.

8. A combination as set forth in claim 7 in which the socket and the hub structure have complementary circumferential surfaces substantially parallel in profile to the axis of the holder.

9. A combination as set forth in claim 5 in which the hub structure is shaped and dimensioned for contact of said base portions of the fingers against the edges of the respective webs for transmission of torque from the holder to the hub structure.

10. In an abrasive article for use with a rotary holder that has a given number of circumferentially spaced angular driving fingers, each finger having a base portion extending outwardly from the holder and having an outer end portion with all of the fingers pointing in the same circumferential direction, the combination of:
   an abrasive disc; and
   a hub structure united with the back of the disc for releasable engagement by said fingers to hold the disc on the holder for rotation therewith;
   said hub structure being formed with said given number of circumferentially spaced apertures to receive said fingers respectively and having webs adjoining the apertures for engagement by said outer end portions of the fingers respectively in response to insertion of the fingers through the aperture and relative rotation of the disc counter to said circumferential direction;
   the surfaces of said web being inclined for cam action by the fingers on the webs to tighten the hub structure against the holder;
   said hub structure being formed with said given number of generally radial ribs unitary with the webs to reinforce the webs.

11. A combination as set forth in claim 10 in which the ribs form shoulders positioned for abutment by the ends of the fingers for transmitting torque from the holder to the hub structure.

12. A combination as set forth in claim 10 in which the hub structure in the region of said ribs is bonded to the disc.

13. A combination as set forth in claim 12 in which the hub structure has an axial portion bonded to the disc said axial portion being integral with the ribs with the ribs radiating therefrom.

14. A combination as set forth in claim 13 in which the ribs are of increased width towards their inner ends for added strength.

15. A combination as set forth in claim 10 in which the ribs are of increased width towards their outer ends for added strength.

16. In an abrasive article for use with a rotary holder that has a given number of circumferentially spaced angular drive fingers, each finger having a base portion extending outwardly from the holder and having an outer end portion with all of the fingers pointing in the same circumferential direction, the combination of:
   an abrasive disc; and
   a hub structure united with the back of the disc for releasable engagement by said fingers to hold the disc on the holder for rotation therewith;
   said hub structure being of a hat-shaped configuration with a brim lying against the back of the disc and a crown extending axially from the brim;
   said crown having said given number of circumferentially spaced apertures to receive said fingers respectively;
the webs extending from the apertures in said circumferential direction, the inner surfaces of the webs cooperating with said outer end portions of the fingers to releasably retain the disc on the holder; said apertures and said recesses forming opposite sides of ribs extending radially outward from an axial portion of the crown;

said axial portion of the crown, said ribs and said brim being bonded to the disc.

17. A combination as set forth in claim 16 in which said webs have inclined surfaces for cam action with said fingers to tighten the hub structure against the holder.

18. A combination as set forth in claim 17 in which the hub structure is shaped and dimensioned for abutment of said inner portions of the fingers against the edges of the respective webs for transmission of torque from the holder to the hub structure.

19. A combination as set forth in claim 16 in which said outer end portions of the fingers abut endwise against said ribs respectively for transmission of torque from the holder to the hub structure.

20. In an abrasive article for use with a rotary holder that has a given number of circumferentially spaced angular drive fingers, each finger having a base portion extending outwardly from the holder and having an outer end portion with all of the fingers pointing in the same circumferential direction, the combination of:

an abrasive disc; and

a hub structure united with the back of the disc for releasable engagement by said fingers to hold the disc on the holder for rotation therewith;

said hub structure being of a hat-shaped configuration with a brim lying against the back of the disc and a crown extending axially from the brim;

said crown having said given number of circumferentially spaced apertures to receive said fingers respectively;

said crown having said given number of recesses on its inner side forming webs adjacent the respective apertures with the webs extending from the apertures in said circumferential direction, the inner surfaces of the webs cooperating with said outer end portions of the fingers to releasably retain the disc on the holder;

said aperture and said recesses forming opposite sides of said ribs with the ribs extending radially outward from an axial portion of the crown;

said axial portion of the crown, said ribs and said brim being bonded to the disc;

said apertures and recesses being spaced radially inward from the perimeter of the crown whereby the crown has a continuous concentric peripheral ring portion integral with the webs and rib;

said ring portion of the crown being bonded to the disc

21. A combination as set forth in claim 20 in which said ribs are of increased width both towards their junctures with said axial portion of the crown and towards their junctures with said peripheral ring portion of the crown.