United States Patent [19]

Howard

[11] **3,867,795**

[45] **Feb. 25, 1975**

[54] **COMPOSITE RESINOID BONDED ABRASIVE WHEELS**

[75] Inventor: **William C. Howard,** Worcester, Mass.

[73] Assignee: **Norton Company,** Worcester, Mass.

[22] Filed: **Oct. 16, 1973**

[21] Appl. No.: **406,918**

[52] **U.S. Cl.** .... **51/209 R,** 51/206 NF, 51/207

[51] **Int. Cl.** **B24d 7/04**

[58] **Field of Search** .... 51/206 R, 206 NF, 209 R, 51/207, 358, 376–379, 401, 204, 209 DL

[56] **References Cited**

UNITED STATES PATENTS

2,877,105	3/1959	Smith	51/206 R UX
2,997,820	8/1961	Skoog	51/209 R
3,136,100	6/1964	Robertson	51/209
3,250,045	5/1966	Caserta	51/209 R
3,576,090	4/1971	Shoemaker	51/209 R

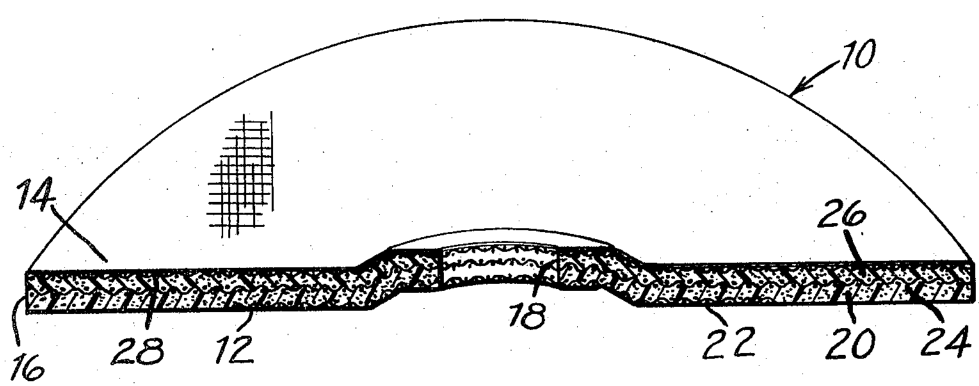
Primary Examiner—Donald G. Kelly

Attorney, Agent, or Firm—Walter Fred

[57] **ABSTRACT**

Reinforced resin bonded abrasive depressed and straight center wheels for portable snagging grinders in which the thickness of each wheel comprises a primary abrading portion containing a superior, expensive, premium, fast cutting and durable cofused alumina-zirconia abrasive particles and an adjoining secondary abrading portion containing different, less costly, slower cutting abrasive particles which, it has been discovered, does not materially reduce the grinding performance of the wheel from one made entirely with alumina-zirconia abrasive throughout the thickness of the wheel.

9 Claims, 3 Drawing Figures



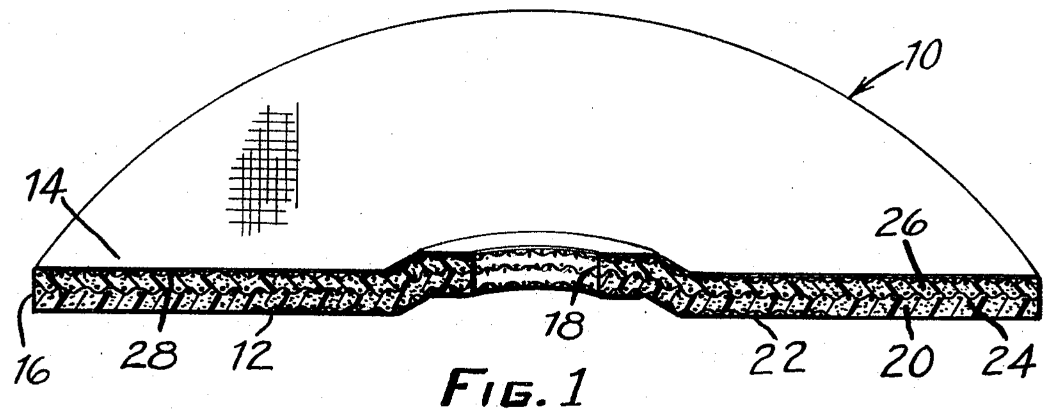


FIG. 1

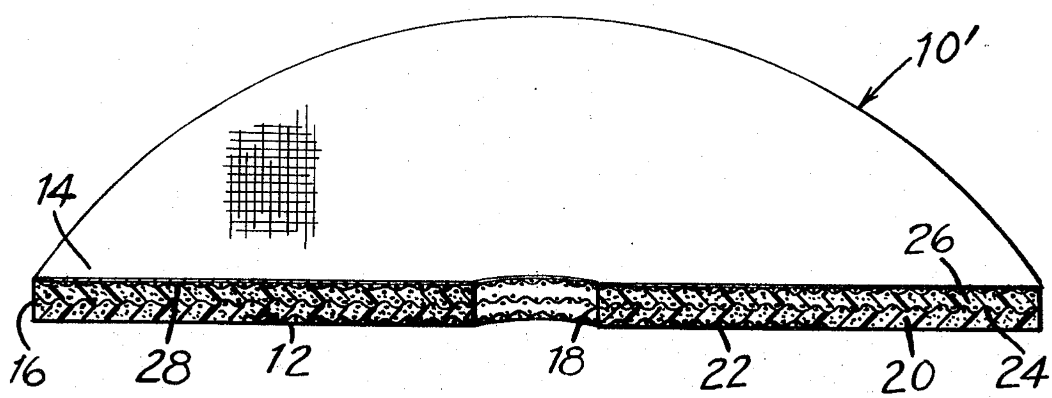


FIG. 2

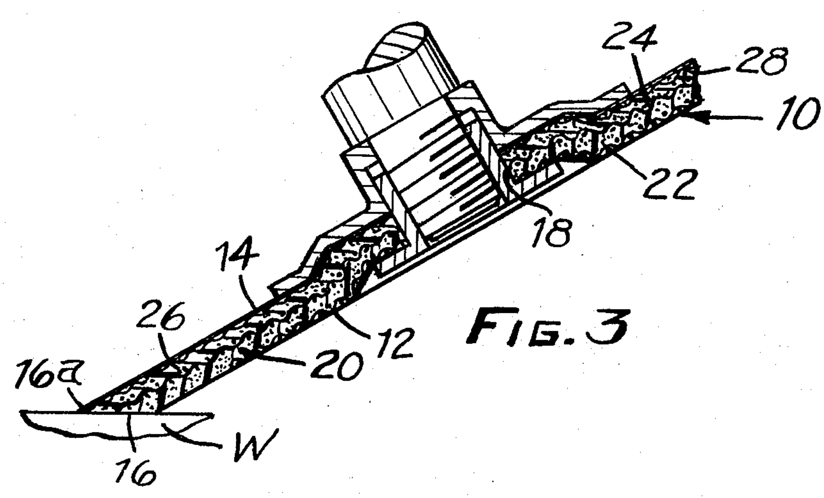


FIG. 3

COMPOSITE RESINOID BONDED ABRASIVE WHEELS

BACKGROUND OF THE INVENTION

1. Field of the Invention

The invention relates to resin bonded abrasive grinding wheels and particularly to relatively thin reinforced raised hub or depressed center and straight center snagging wheels for portable grinders.

2. Description of the Prior Art

Heretofore grinding wheels have been made with inner and outer layers, sides and zones varying either in density, hardness, type of abrasive, bond, and in the grit size of the abrasive particles as disclosed in the following publications U.S. Pat. Nos. 1,403,416, 1,616,531, 2,479,078, 2,877,105 and German Gebrauchsmuster No. 7,306,787 dated May 24, 1973. In use straight and depressed center or raised hub wheels of various shapes are usually attached and driven by hand operated portable grinders, and held at a slight angle to grind welding beads, flash, gates and risers off castings. During grinding the peripheral grinding face or edge of the wheel wears at an angle to the axis of rotation and the opposite sides of the wheel. As a result a sharp and relatively thin fragile peripheral edge is formed at the junction of the grinding face and the back or top side of the wheel. The fragile edge has a tendency to break away and contributes very little to removing the unwanted material. Also known, are wheels having various types of backing materials for reinforcing the fragile edge and for supporting the primary cutting or abrading portion of the wheel.

For many years and up to the present time depressed center also known as raised hub grinding wheels have been made in the United States with a backing layer of bonded abrasive particles of relatively fine grit size bonded between a layer of coarser primary abrasive particles of substantially uniform grit size and a fiber glass backing. The finer abrasive being of the same type as the coarser and usually include what are known in the art as abrasive fines which vary in grit size. When mixed and bonded together the fines tend to occupy the spaces between the larger particles and thereby densify and strengthen the backing layer of finer abrasive particles.

The Applicant's invention differs from the prior art in that abrasive particles of a tough, superior, more durable, faster cutting and more expensive alumina-zirconia abrasive material such as disclosed in U.S. Pat. No. 3,181,939 and a commonly owned prior copending application Ser. No. 386,718 filed Aug. 8, 1973 and to which reference may be had for details not disclosed herein, is used in the primary abrading portion and differs from the abrasive used in the secondary abrading portion of the wheel. U.S. Pat. No. 3,181,939 discloses rapidly cooled co-fused alumina-zirconia containing 10 to 60% zirconia. The preferred abrasive for this invention is the 35 to 50% zirconia, very rapidly cooled material of Ser. No. 386,718.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a sectional veiw through the center of a typical depressed center or raised hub wheel made according to the invention;

FIG. 2 is a sectional view through the center of a straight center wheel made according to the invention; and

FIG. 3 is a partial sectional view through a peripheral portion of a wheel showing the wheel inclined and the grinding edge thereof worn at an angle during grinding.

SUMMARY OF THE INVENTION

Depressed and straight center reinforced resin bonded abrasive grinding wheels comprising a primary abrading portion or layer containing tough, durable, fast cutting and relatively expensive bonded alumina-zirconia abrasive particles occupying a portion of the thickness of the wheel situated on the working or bottom side of the wheel. A secondary abrading portion or layer containing different, less expensive, less durable abrasive particles is bonded to the primary abrading portion and situated on the back or top side of the wheel. If desired and preferably there is a backing consisting of at least one layer of reinforcing material molded in and bonded to the back or top side of the secondary abrading portion of the wheel.

The reinforced wheel may have one or more additional layers or discs of fiber glass reinforcing material integrally molded and bonded therein. One layer of reinforcement is preferably bonded to and situated in between the secondary and primary abrading layers of the wheel. The central hub portion of the wheel is preferably further reinforced with a disc of fiber glass cloth molded in and bonded to the bottom side of the primary abrading layer or portion.

Therefore it is the primary object of the invention to provide reinforced resin bonded abrasive grinding wheels having a primary abrading portion comprising particles of co-fused alumina-zirconia abrasive material and a secondary abrading portion containing particles of different abrasive material.

DESCRIPTION OF THE PREFERRED EMBODIMENT(S)

Referring to the drawings wherein there is shown a depressed center or raised hub grinding wheel **10** and a straight center or hub wheel **10'**. The wheels are shown in only one of the many possible conventional shapes to which they may be made and known to those skilled in the art. For example, they may be molded to the shape of a shallow dish or saucer with curved or straight flaring sides and still have either a straight or depressed center portion about the mounting hole. As used herein the term straight center is meant to include wheels other than depressed center or raised hub and those having top and bottom surfaces which continue without any deviation or sharp bends to the center mounting hole. The construction of each of the wheels **10** and **10'** being substantially the same except for the configuration of the central hub mounting portion around the center mounting hole which may be adapted to receive any suitable mounting, such as shown in FIG. **3**, for attaching the wheel to the drive spindle or shaft of a portable grinder. In U.S. Pat. Nos. 3,081,584; 3,136,100; 3,500,592; and 3,596,415 there are disclosed wheel mountings which may be attached to the wheels disclosed herein and to which reference may be had for details not disclosed herein. Obviously, there are many other types of suitable mountings known to those skilled in the art which may be attached in various ways to the wheels. The mounting forms no

The wheels may be molded by first placing the paper side of the paper stick fiber glass disc **28** of composite backing material with a center hole around the arbor and in contact with the bottom of the mold. Then, spreading a uniform layer of a prepared abrasive mixture containing a suitable resin bond and the secondary abrasive particles on top of the fiber glass backing disc **28.** Thereafter, placing the disc **24** of fiber glass reinforcing material with a center hole about the arbor and onto the layer of secondary abrasive mix followed by spreading a uniform layer of a prepared mixture comprising a suitable and compatible resin bond and the primary abrasive containing particles of alumina-zirconia abrasive material thereon. Lastly, laying the hub reinforcing disc **22** with a center hole therein around the arbor and onto the layer of primary abrasive and placing a top mold plate of the desired shape to either produce the depressed center or the straight center hub portion of the wheels, on top of the layers. The mold assembly is then placed between the platens of either a conventional cold or hot press. Then the press is actuated to force the mold plate downwardly and compress the discs and abrasive mixtures together, at a pressure of 1 to 4 tons per square inch, into a self supporting structure of predetermined thickness, diameter and density. After molding the wheel is stripped from the mold and placed in an oven heated to a temperature of approximately 175°C for approximately 6 hours to fully cure the resin bond.

The resin bond may comprise any one of a number of the conventional and well known thermosetting or infusible resins, such as, phenol-aldehyde, epoxy, polyester, polyimides, and polybenzimadazole in either liquid for powder form. Preferably the resin bond comprises a phenolic (phenol-aldehyde) resin in powder form which is premixed with other fillers and coloring materials and then mixed with predetermined amounts of the secondary and primary abrasive particles.

A suitable primary abrasive mixture of primary abrasive particles and resin bond for a snagging operation may comprise the following percentage of ingredients by weight:

Ingredients		% by Weight
Abrasive-24 grit alumina-zirconia abrasive particles		78.54
Resin Bond	% by Weight	21.46
		100.00
VARCUM Chemical Co. No. 29–345 powdered phenolic resin	40.9	
Wallastonite - (Grade C-6 Interface Corp., Willsboro, New York)	53.0	
Calcium Oxide (CaO)	5.1	
Carbon Black	1.0	
	100.0	

The secondary abrasive mixture of secondary abrasive and resin bond may comprise the following percentage of ingredients by weight:

Ingredients		% by Weight
Abrasive-24 grit aluminum oxide abrasive particles		75.62
Resin Bond	% by Weight	24.38
		100.00
VARCUM Chemical Co. No. 29-345 powdered phenolic resin	40.9	
Wallastonite - (Grade C-6 Interface Corp.)	53.0	
Calcium Oxide (CaO)	5.1	
Carbon Black	1.0	
	100.00	

-Continued

In addition there was added to each of the primary and secondary abrasive mixtures of abrasive and resin bond 45 cc of furfural plasticizer and 25 cc of CARBOSOTA (creosote oil) for each pound of powdered phenolic resin. The CARBOSOTA being mixed separately with the resin bond and the furfural being mixed with and wetting the abrasive particles prior to mixing the wetted abrasive particle with the resin bond. Thereafter, to the entire mixture of wetted abrasive and resin bond there is added and mixed therewith 4 cc of a mixture of 60% by weight of furfural and 40% by weight of castor oil and lastly, 0.0005 of a pound (lb.) or 0.23 grams of dry colloidal silica (CAB-O-SIL) for each pound (lb.) of the entire abrasive mixture.

Referring to FIG. **3** there is shown a sectional view through a portion of a grinding wheel of the invention mounted on a shaft and positioned at an angle to the surface of the workpiece W being worked upon to show how in normal use the initial grinding face or edge **16** is worn at an angle to the back or top side **14** and bottom or working side **12.** It can be seen that when the wheel is used at an angle that the length of the grinding face **16** is increased and that the thinnest, weakest and most fragile part of the wheel is at and adjacent the outer tip or edge **16***a* located at the junction of the grinding face **16** and the back side **14.** When grinding pressure is applied, the edge **16***a* and the adjacent tapered portions of the secondary abrading portion have a tendency to break away because they are only supported by the fiber glass backing layer **28.** As a result, the secondary abrading portion **26** does much less grinding or cutting of unwanted material. In contrast, the primary abrading portion **20** does not have as fragile an edge or corner as the edge **16***a* and is more rigidly supported and backed up by the secondary abrading portion of the wheel. Therefore, the primary abrading portion **20** with the more durable faster cutting and more efficient alumina-zirconia abrasive therein does most of the grinding or cutting away of material without the tendency to break away.

Wheels 7 inches in diameter, one-quarter of an inch thick each with a seven-eighths inch diameter center hole were made according to the invention with the 24 grit size alumina-zirconia abrasive resin mixtures, and 24 grit aluminum oxide abrasive resin mixtures disclosed above. The wheels were tested and compared with a variety of other wheels all of comparable size and shape, 24 grit size particles and resin bond disclosed above but with variations in the type, amount by volume and location of abrasive particles in the wheel. Some of the wheels were made with aluminum oxide or the alumina-zirconia throughout, with the alumina-zirconia abrasive in the secondary portion and alumina in the primary portion, and with a mixture containing by volume 50% of alumina-zirconia and 50% alumina in both portions of the wheel. Another wheel had a mixture containing by volume 75% of alumina-zirconia and 25% garnet in the primary portion and alumina in the secondary portion. The alumina-zirconia abrasive used in all the wheels tested contained about 43% zirconia by weight.

The grinding tests were performed by mounting each wheel on an automated apparatus adapted to transverse and manipulate a Chicago Pneumatic 360 cycle right angle portable grinder rotatable at 5,200 RPM and inclined so the bottom side of the wheel was at an angle of 25° from a horizontal plane to simulate the position, applied force and movements of a hand operated portable grinder.

Each wheel tested was run four times during each of which the grinding wheels ground into the annular edge of a 12 inch O.D. × 10¾ inch I.D. ring of cast steel, mounted on a reversible rotary table rotated at 15 RPM in reversed directions every one-half minute. Each run lasted for a period of 15 minutes while a constant downward force of 20 pounds was applied to the wheel reciprocated 1⅝ inches across the annular edge. After each run the ring of cast steel was weighed and the wheel measured to determine the number of pounds of metal removed per hour and the number of cubic inches of wheel wear per hour. The "grinding ratio" of the wheel is the ratio of metal removed to wheel wear.

In the following Tables I and II, RGR refers to the "Relative Grinding Ratio" in percent which is determined by dividing the grinding ratio × 100 of the wheel being tested by the grinding ratio of a conventional standard wheel with 24 grit aluminum oxide abrasive throughout the wheel given an RGR rating of 100%. The "Relative Rate of Cut" in percent is indicated by RRC in the table and is determined by dividing the rate of cut × 100 of the wheel being tested with that of a comparable conventional standard wheel rated at 100% and made with aluminum oxide abrasive throughout. The results of one of the tests are shown in Table I below.

perior to the standard wheel with aluminum oxide in both the primary and secondary portions. The wheel having a mixture of one-half (50%) alumina-zirconia and one-half (50 %) aluminum oxide by volume in both the primary and secondary portions gave as expected a 159% RGR and 108% RRC which is an improvement over the standard wheel with aluminum oxide throughout but not equal to the wheel with alumina-zirconia in both portions of the wheel. However, the wheel of the invention with all of alumina-zirconia in the primary abrading portion of the wheel and aluminum oxide in the secondary portion gave a result of 247% RGR and 97% RRC which is very nearly equal to the wheel with alumina-zirconia throughout the wheel. In contrast, the wheel with the aluminum oxide in the primary portion and alumina-zirconia in the secondary portion gave a result of 102% RGR and 106% RRC which shows a performance equal to that of the standard wheel with aluminum oxide throughout the wheel. The data shows that the wheels made according to the invention with approximately one-half as much of the more costly alumina-zirconia located in the primary portion of the wheel and a less costly abrasive in the secondary portion performs very nearly as well as the wheel with alumina-zirconia throughout the wheel. Hence, only one-half as much of the premium abrasive is required with no apparent loss in performance.

In another embodiment of the invention the primary abrading portion may contain a primary abrasive mixture consisting of the superior co-fused primary alumina-zirconia abrasive particles and up to one-fourth or 25% by volume of the primary abrasive particles therein of a different, less costly, less efficient and less durable diluent or filler abrasive particles of material such as, garnet, flint, silica, emery, silicon, carbide, alumina and quartz and mixtures thereof which it has been discovered does not materially reduce the performance of the wheel below one without the 25% of diluent abrasive therein. As shown in Table I wheels were made and tested in which the primary and secondary

TABLE I

TYPE OF WHEEL	TYPE AND LOCATION OF 24 GRIT SIZE ABRASIVE PARTICLES PRIMARY PORTION	SECONDARY PORTION	WHEEL WEAR IN.³/HR.	METAL REMOVED LBS./HR.	RGR IN. %	RRC IN. %
STANDARD PRIOR ART WHEEL	aluminum oxide	aluminum oxide	3.43	2.91	100	100
VARIATION OF WHEELS	alumina-zirconia	alumina-zirconia	1.46	3.00	243	103
% BY VOLUME	50% alumina-zirconia mixed with 50% aluminum oxide	50% alumina-zirconia mixed with 50% aluminum oxide	2.32	3.13	159	108
	aluminum oxide	alumina-zirconia	3.58	3.08	102	106
WHEELS OF INVENTION	alumina-zirconia	aluminum oxide	1.34	2.82	2.47	97
% BY VOLUME	75% alumina-zirconia 25% garnet	aluminum oxide	1.78	2.91	193	100

As can be seen from the test data, the wheel with alumina-zirconia in both the primary and secondary portions with a 243% RGR and 103% RRC was far superior to the standard wheel with aluminum oxide in both the primary and secondary portions.

abrading portions were comprised of abrasive and resin bond mixtures consisting of the following percentage of ingredients by weights.

Primary Abrading Portion

Ingredients		% by Weight
Primary Abrasive Mixture	% by Volume	78.54
24 grit size particles of alumina-zirconia	75	
12 thru 28 grit size particles of garnet	25	
	100	
Resin Bond	% by Weight	21.46
		100.00
VARCUM Chemical Co. No. 29–345 powdered phenolic resin	40.9	
Wallastonite - (Grade C-6 Interface Corp.)	53.0	
Calcium Oxide (CaO)	5.1	
Carbon Black	1.0	
	100.0	

Secondary Abrading Portion

Ingredients		% by Weight
Abrasive-24 grit aluminum oxide abrasive particles		75.62
Resin Bond	% by Weight	24.38
		100.00
VARCUM Chemical Co. No. 29–345 powdered phenolic resin	40.9	
Wallastonite (Grade C-6 Interface Corp.)	53.0	
Calcium Oxide (CaO)	5.1	
Carbon Black	1.0	
	100.0	

The 25% mixture of garnet particles in the primary abrading portion had a particle grit size break down which was the sizing as prepared by the manufacture of the garnet, as follows:

Screen Size	Percent
thru 12 on 16	½– 3
thru 16 on 18	8 – 30
thru 18 on 24	50 – 65
thru 24 on 28	12 – 25

In addition there was added to each of the primary and secondary abrasive mixtures of abrasive and resin bond 45 cc of furfural plasticizer and 25 cc of CARBOSOTA (creosote oil) for each pound of powdered phenolic resin. The CARBOSOTA being mixed separately with the resin bond and the furfural being mixed with and wetting the abrasive particles prior to mixing the wetted abrasive particle with the resin bond. Thereafter, to the entire mixture of wetted abrasive and resin bond there is added and mixed therewith 4 cc of a mixture of 60% by weight of furfural and 40% by weight of castor oil and lastly, 0.0005 of a pound (lb.) or 0.23 grams of dry colloidal silica (CAB-O-SIL) for each pound (lb.) of the entire abrasive mixture.

The data in Table I discloses that the wheel with alumina-zirconia abrasive blended with 25% garnet abrasive particles in the primary abrading portion and 24 grit size aluminum oxide in the secondary portion gave a RGR of 193% and RRC of 100% and a performance nearly equal to the wheels with alumina-zirconia in only the primary portion and throughout the wheel.

In another embodiment a wheel of comparable size and shape was made according to the invention with finer 46 grit size alumina particles in the secondary portion and with a mixture of alumina-zirconia and 25% garnet in the primary portion. The wheel consisted of the following percentages by weight of ingredients.

Primary Abrading Portion

Ingredients		% by Weight
Primary Abrasive Mixture	% by Volume	79.6
20 thru 30 grit size alumina-zirconia	75	
12 thru 28 grit size garnet	25	
	100	
Resin Bond	% by Weight	20.4
		100.0
Union Carbide BRP5417 phenolic resin powder	42	
VARCUM 29–390 liquid resin (plasticizer)	14	
Wallastonite (Grade C-6 Interface Corp.)	42.9	
Carbon Black	1.1	
	100.0	

Secondary Abrading Portion

Ingredients		% by Weight
Abrasive-46 grit size aluminum oxide		77.8
Resin Bond	% by Weight	22.2
		100.0
Union Carbide BRP5417 phenolic powdered resin	42	
VARCUM 29–390 liquid resin (plasticizer).	14	
Wallastonite (Grade C-6 Interface Corp.)	42.9	
Carbon Black	1.1	
	100.0	

Of the total volume of the 20 thru 30 grit alumina-zirconia abrasive particles, one-third (33⅓%) were 20 grit, ⅓ were 24 grit and ⅓were 30 grit size particles. The garnet of 12 thru 28 grit size was of the same sizes disclosed before in the table above.

In addition there was added to each of the primary and secondary resin bonds 25 cc of CARBOSOTA (creosote oil) for each pound of dry powdered phenolic resin. The CARBOSOTA being mixed separately with the resin bond prior to mixing the abrasive particles therewith. Then, to each of the primary and secondary abrasive mixtures of abrasive and resin bond is added 4 cc of a mixture containing by weight 60% of furfural and 40% castor oil and lastly, 0.0005 pounds or 0.23 grams of colloidal silica (CAB-O-SIL) for each pound of the entire abrasive mixture.

The grinding wheel was tested and compared with a comparable standard wheel. The grinding test was performed on the annular edge of a rotating ring of cast steel of the same type, in the same manner and with the same apparatus disclosed above except that the wheel was reciprocated and traversed 3⅛inches across the edge instead of 1⅛ inches disclosed above. Results of the test are shown for comparison in Table II below.

TABLE II

TYPE OF WHEEL	TYPE AND LOCATION OF ABRASIVE PARTICLES PRIMARY PORTION	SECONDARY PORTION	WHEEL WEAR IN.³/HR.	METAL REMOVED LBS./HR.	RGR IN. %	RRC IN. %
STANDARD PRIOR ART	aluminum oxide	aluminum oxide	9.75	4.70	100	100

TABLE II – Continued

TYPE OF WHEEL	TYPE AND LOCATION OF ABRASIVE PARTICLES PRIMARY PORTION	SECONDARY PORTION	WHEEL WEAR IN.^{3}/HR.	METAL REMOVED LBS./HR.	RGR IN. %	RRC IN. %
WHEEL WHEEL OF INVENTION	24 grit 75% alumina-zirconia 20 thru 30 grit	46 grit aluminum oxide 46 grit	5.12	5.28	214	113
% BY VOLUME	25% garnet 12 thru 28 grit					

As can be seen the standard comparable wheel in Table II has a higher wheel wear and metal removal rate than the standard wheel shown in Table I above. This is due to the fact that the wheel forced downwardly by the 20 pounds of force had a longer transverse across the annular edge than those recited in Table I. As a result it cut more severely into the ring of cast steel. However, comparing the relative grinding ratio (RGR) and the relative rate of cut (RRC) discloses that the wheel with three-fourths (75%) alumina-zirconia, one-fourth (25%) garnet, and 46 grit aluminum oxide gave an RGR twice as good and an RRC slightly better than the 100 given the standard wheel and substantially equal to the 2.47 RGR and 97 RRC for the other wheel of the invention with all alumina-zirconia in the primary portion and 24 grit aluminum oxide in the secondary portion.

All of the wheels tested, including those of the invention, had substantially a volume percent composition of about 46% abrasive, 34% resin bond and 20% pores and a density of about 2.7.

It will thus be seen that there has been provided by the invention raised hub or depressed center and straight center portable grinding wheels in which the object hereinabove set forth together with the many thoroughly practical advantages are successfully achieved. As many possible embodiments may be made of the invention and as many changes might be made in the embodiments set forth above, it is to be understood that all matter hereinbefore set forth is to be interpreted as illustrative only and includes all embodiments and modifications coming within the scope of the appended claims.

What is claimed is:

1. A reinforced resin bonded abrasive grinding wheel of predetermined thickness having a relatively narrow peripheral grinding face usually presented and worn at an angle during grinding, extending between a top and a bottom side, reinforcing material bonded thereto and means for mounting the wheel for rotstion about its axis, wherein the improvement comprises:

a primary abrading portion extending along the bottom side to the peripheral grinding face and occupying a portion of the predetermined thickness of the wheel, and having

resin bonded primary abrasive particles of co-fused alumina-zirconia abrasive material containing from 10% to 60% by weight of zirconia; and

a secondary abrading portion bonded to and extending from the primary abrading portion to the top side and peripheral grinding face of the wheel and having

resin bonded secondary abrasive particles of a secondary abrasive material which differs from and of less durability than the alumina-zirconia abrasive material.

2. A reinforced resin bonded abrasive grinding wheel according to claim 1 wherein the primary abrading portion further comprises:

resin bonded diluent abrasive particles of an abrasive material selected from a group consisting of garnet, aluminum oxide, silicon carbide, emery, flint, silica, quartz and mixtures thereof mixed in with the alumina-zirconia particles and comprising up to 25% by volume of the abrasive particles in the primary abrading portion.

3. A reinforced resin bonded abrasive grinding wheel according to claim 2 wherein the diluent abrasive particles are made of garnet.

4. A reinforced resin bonded abrasive grinding wheel according to claim 1 wherein the secondary abrasive particles are made of an abrasive material selected from a group consisting of aluminum oxide, silicon carbide, garnet, silica, quartz, emery, flint and mixtures thereof and wherein the primary abrading portion occupies at least about one-half the thickness of the wheel.

5. A reinforced resin bonded abrasive grinding wheel according to claim 1 wherein the secondary abrasive particles are no larger than 16 grit size and wherein the alumina-zirconia particles are from 16 to 60 grit size.

6. A reinforced resin bonded abrasive grinding wheel according to claim 1 wherein the alumina-zirconia particles are of larger and coarser grit size than the secondary abrasive particles.

7. A reinforced resin bonded abrasive grinding wheel according to claim 4 wherein the secondary abrasive material is aluminum oxide.

8. A reinforced resin bonded abrasive grinding wheel according to claim 1 wherein the reinforcing material comprises:

a first disc of open mesh fiber glass cloth situated substantially between and bonded to the primary and secondary abrading portions of the wheel.

9. A reinforced resin bonded abrasive grinding wheel according to claim 8 wherein the reinforcing material further comprises:

a second disc of fiber glass cloth bonded to the bottom side and primary abrading portion of the wheel; and

a third backing disc of fiber glass cloth bonded to the top side and secondary abrading portion of the wheel.

* * * * *