Oct. 30, 1945. I. F. SUWA 2,388,020

UNIVERSAL TYPE GRINDING TOOL

Filed Feb. 2, 1944

Fig. 1.

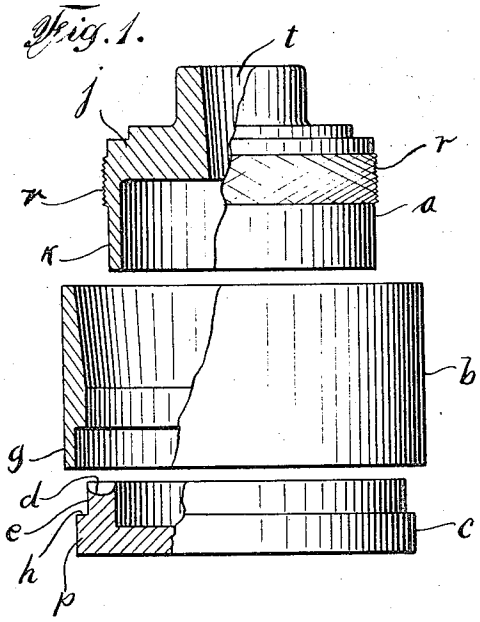


Fig. 4.

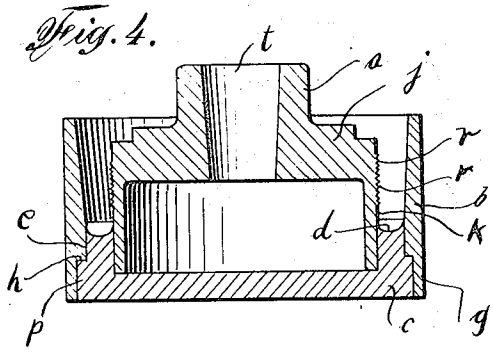


Fig. 5.

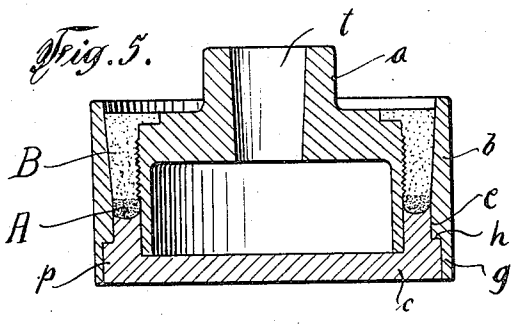


Fig. 3.

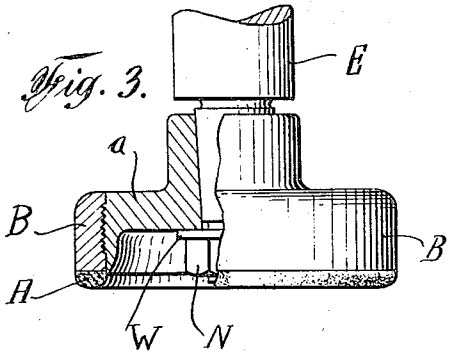


Fig. 6.

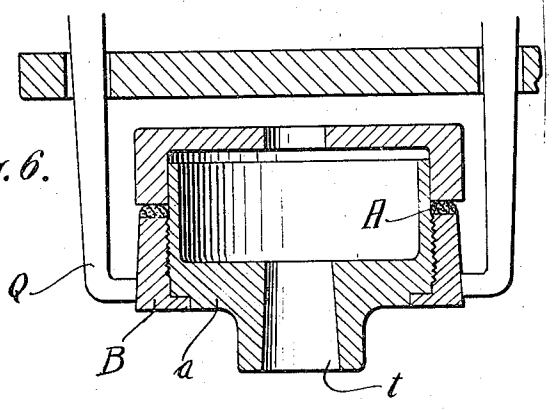


Fig. 2.

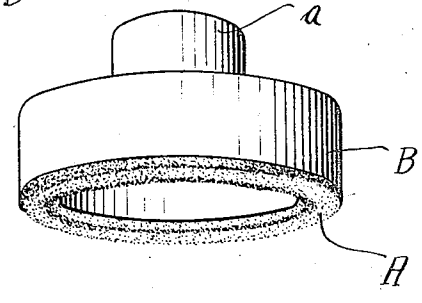
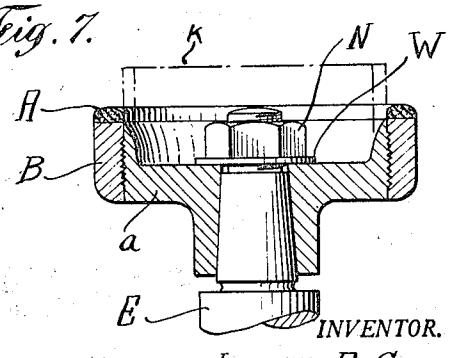


Fig. 7.



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UNITED STATES PATENT OFFICE

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UNIVERSAL TYPE GRINDING TOOL

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Application February 2, 1944, Serial No. 520,749

5 Claims. (Cl. 51—209)

This invention relates to grinding tools and more particularly to grinding tools known in the art as universal grinding tools wherein an annular grinding area having an arcuate grinding surface is provided, which grinding area is secured to a base rotatable about an axis passing through the center of the grinding area normal to the grinding face of the said grinding area.

The object of the invention is to provide an improved method of producing such a universal grinding tool.

Another object is to provide an improved universal grinding tool.

Still another object is to provide such a tool having means to detachably secure the tool in axially centered position on the end of an axially rotatable spindle.

Other objects will be apparent as the invention is more fully hereinafter disclosed.

In accordance with these objects, I have devised the universal grinding tool and the method of producing the same, a specific embodiment of which is illustrated in the accompanying drawing.

In the drawing:

Fig. 1 is a side elevational view partly in section of the improved tool of the present invention;

Fig. 2 is a perspective view of the same;

Fig. 3 illustrates in dissembled relation one feature of the present invention;

Fig. 4 illustrates the parts shown in Fig. 3 in assembled relation;

Fig. 5 illustrates the next stage in the forming of the tool of the present invention;

Fig. 6 illustrates the first step in shaping of the tool of the present inveniton; and

Fig. 7 illustrates the final step in shaping of the tool of the present invention.

In the universal type grinding tool of the present invention it is essential that the arcuately curved grinding area of the tool be mounted upon the end of an axially rotatable spindle to be rotated about its center axis in a plane normal to the axis of rotation of said spindle and in a position substantially in advance of the rotating spindle end to permit the angular deflection of the axis of rotation to the plane of rotation of the surface of the lens blank. Considerable difficulty has heretofore been experienced in providing such a mounting for the curved grinding area of the tool while at the same time providing for the detachable mounting of the tool on the end of the spindle. The present invention aims to overcome this difficulty.

In my copending application Serial No. 520,748 filed Feb. 2, 1944, which application is assigned to the same assignee as the present application, is described and claimed an improved method of forming a grinding tool which consists essentially in mold-sintering a volume of an abrasive mixture consisting of metal powder and abrasive particles while in contact along one face with a relatively larger volume of sinterable metal powder in which is embedded a machinable metallic insert member, the exterior surface of which is provided with recesses and protuberances providing keyways for the mechanical interlocking of the sintering metal powder thereto. Following mold-sintering the insert member of the composite metallic body thus produced is shaped to provide for the detachable securing of the same onto a grinding head.

The present invention is an adaptation of this general method to the forming of grinding tools of the universal type. Such tools are normally used in the rough grinding of surfaces of relatively large diameter, for example, surfaces having a diameter above about 3 inches.

In the grinding of the larger diameter surfaces, it is believed obvious even when employing the ring-type axially rotating grinding tool having a diameter approximating at least one-half the diameter of the surface, that with increase in diameter the cost of the tool increases rapidly with increase in diameter, particularly in the case of tools provided with an abrasive surface comprised of a sintered mixture of metal powder and relatively expensive abrasive material such as diamond fragments.

One of the major difficulties involved in the production of such larger diameter tools is to obtain accurately dimensioned ring-shaped grinding surfaces of relatively small thickness comprised of a sintered metallic composition that is securely attached to a suitable backing metal which backing is provided with means to mechanically secure the same to a rotatable grinding head in a manner assuring axial rotation of the grinding face about its center in a plane normal to the axis of rotation.

This difficulty is overcome by the practice of the present invention, which consists essentially in mold-sintering a relatively small ring-shaped volume of the metallic abrasive composition while in contact along its rear face with a relatively larger substantially tubular-shaped volume of a sinterable metal powder, the inner face of said tubular-shaped volume of metal powder being

maintained while sintering in contact with the roughened exterior surface of a machinable metallic insert member, thereby to obtain a composite metal body, the metallic insert member of which subsequently may be shaped to provide for the mechanical attachment of the same onto the end of a rotatable spindle for axial rotation about an axis passing through the center of the sintered ring-shaped section of the composite metal body.

In the practice of the present invention, and to avoid many of the difficulties involved incident to variations in the shrinkage constants of metal powders and of abrasive mixtures of metal powder and abrasive particles, I prefer to employ in the practice of the present invention a relatively low shrinkage and rust-resistant mixture of metal powders described and claimed in Kott application Serial No. 515,972, filed December 28, 1943, now Patent No. 2,367,406, issued January 16, 1945, which application is assigned to the same assignee as the present application, in the forming of the ring-shaped metallic abrasion area and in the forming of the sintered tubular-shaped backing section of the composite sintered tool product of the present invention.

The metal powder mixture of said Kott application consists essentially of 3 to 10% one of the metals Mn and Ni in powder form passing about 200 mesh; .20 to .30% at least one of the metals Cu, Au and Ag in powder form passing about 300 mesh; .10% indium in powder form passing about 300 mesh; balance carbonyl iron containing about .87% carbon in powder form passing about 400 mesh. The preferred specific composition consists of 5% Mn, .25% Au and Ag in about equal amounts, .10% indium, balance Fe containing .87% C. This mixture of metal powders sinters at about 750° C. into a relatively dense metallic body of high strength and ductility without compaction and is especially suitable for the purposes of the present invention.

The preferred metallic abrasive mixture of the present invention consists of the above metal powder mixture and diamond fragments approximating 120 mesh size, each of which fragments are surfaced with a relatively thin adherent film of a platinum group metal, such as rhodium, the metal powder and diamond fragments being admixed in the relative proportions of three (3) parts metal powder to one (1) part diamond fragments (by weight).

In accordance with the present invention, the universal type grinding tool of the present invention is produced by disposing a relatively small volume of the abrasive mixture of metal powder and diamond fragments in an annular recess in the bottom of a substantially non-shrinking mold, the bottom of which recess is arcuately curved to provide the desired universal contour to the sintered abrasive mixture. Superposed on top of this relatively small volume of abrasive mixture is sustained a relatively larger volume of sinterable metal powders, the inner surface of said metal powder lying in contact with the roughened exterior surface of a tubular sleeve extension of a machinable metal insert. After heat-treating to sinter the superposed metal powders, the sintered composite metal product is then shaped to condition the same for mechanical attachment to the end of a rotatable spindle with the arcuate face of the annular or ring-shaped sintered abrasive composition disposed concentrically about the axis of rotation of the spindle and in a plane substantially normal to the axis of rotation of the spindle.

To obtain this desired result, I have found that a relatively heavy walled metal mold surfaced interiorly with some refractory material, such as aluminum oxide, calcium oxide, magnesium oxide, graphite and the like, is the most suitable material for use as substantially non-shrinking mold material. Preferably, I employ a steel alloy, such as for example, cold rolled steel, although various other steel alloys of high or low alloy content would be equally utilizable.

Preferably also, but not necessarily, I employ a three-sectional mold consisting of a base plate and engaging outer and inner tubular wall sections, the inner section of which consists of a tubular extension of the metal insert piece to the exterior surface of which it is desired to secure the tubular sintered tool. This preferred arrangement is illustrated in the drawing (Fig. 3) wherein in three juxtapositioned figures the three co-operating mold sections are shown in side elevation partly in section.

Referring to Fig. 1, the mold consists of 3 parts, *a*, *b*, and *c*, which engage together as shown in Fig. 4. Part *c* is a relatively heavy sectioned base plate *p*, the upper face of which is provided with an annular extension *e*, the top face of which is arcuately grooved as indicated at *d*.

Part *b* is a heavy walled tubular piece having an inside diameter approximating the outside diameter of annular extension *e* and a cut-out section *g* adapting the said bottom end to seat on shoulder *h* of base plate *p*. The inside diameter of part *b* at the top is somewhat greater than the outside diameter of extension *e* to provide a tapered inside surface to the part *b* substantially as indicated.

Part *a* consists essentially of a heavy sectioned cap *j* provided with tubular skirt extension *k*, the outside diameter of which extension *k* approximates the inside diameter of extension *e* on base plate *p*, the bottom end thereof resting on base plate *p*. The size, shape and configuration of heavy sectioned cap *j* of part *a* may be widely varied without essential departure from the present invention. The particular shape shown in the drawing is one designed to provide for the ready securing of the cap onto the tapered threaded end E of a rotatable spindle by a mechanical means, such as nut N and lock washer W.

As indicated in Fig. 4, when parts *a*, *b* and *c*, are assembled together the space gap between the tapered inner face of part *b* and the outer face of part *a* form a tubular channel overlying arcuate recess *d* in the top face of extension *e* of base plate *p*, the width and heighth of which may be varied widely without departure from the invention. This tubular channel is filled first with a layer of the abrasive composition A (Fig. 5) and on top of this a layer of metal powder B, the relative volumes of which being at least 1 to 4 and usually 1 to 5 or more. By corrugating, knurling or otherwise providing the outside face *k* of part *a* with recesses and extensions *r*, the metal powder on subsequent sintering will be caused to mechanically attach itself to the outer periphery of part *a*.

Sintering of metal powder compositions A and B onto part *a* is obtained by heating the assembly to temperatures approximating 750° C. under substantially non-oxidizing conditions for a period of about one (1) hour after first heating to about 100° C. for an extended time interval to drive off all water vapor and surface adsorbed gases contained in the metal powder and on the surface of the metal mold. Following heat-treating the

mold and sintered composite product is cooled rapidly, as by quenching, to prevent oxidation of the sintered product.

After being removed from the mold the sintered composite product is mounted in chuck Q with the face of sintered abrasive section A against plate T and with the annular abrasive section A disposed concentric about the rotating axis of the chuck Q. The heavy sectioned cap end *j* of part *a* then may be shaped to adapt the same to be mechanically secured onto the end of a rotatable spindle E. To facilitate this, I prefer as indicated in the drawing to preform part *a* to provide therein tapered opening *t*, so that subsequent machining be reduced to a minimum and be limited to that required to correct for such warping as may have occurred therein during sintering. When tapered opening *t* has been trued and centered, the composite body then may be mounted on the tapered end E of a shaft or spindle and replaced in the lathe chuck and the extending end of skirt *k* machined off to the dotted line shown in Fig. 7 to produce the finished tool product shown in Fig. 1 and in perspective in Fig. 2.

Alternative ways of mechanically securing cap-insert *a* to spindle E may be provided without departure from the present invention.

Having hereinabove described the present invention generically and specifically and given one specific embodiment of the same, it is believed apparent that the same may be widely varied without essential departure therefrom and all such modifications and departures are contemplated as may fall within the scope of the following claims.

What I claim is:

1. A grinding tool of the universal type, said tool consisting of a metallic base member consisting of cold rolled steel, an annular sleeve extension on one face of said base member, the exterior face of said sleeve being provided with a roughened surface, an annular body consisting of a sintered mixture of metal powders containing about 5% Mn, .25% Au and Ag in about equal amounts, .10% indium, balance Fe containing about .87% C integral with the roughened exterior surface of said sleeve extension and a ring-shaped section of a sintered metallic abrasive composition integral with the end of said annular body and extending beyond the end of said sleeve extension, the face of said ring-shaped section being arcuately curved to provide a convex surface.

2. The tool of claim 1, wherein said ring-shaped section consists of a sintered mixture consisting of about 25% diamond fragments having a size approximating 120 mesh, the surface of each said fragment being covered with a relatively thin film of a platinum group metal and about 75% of a metal powder mixture consisting of about 5% Mn passing 200 mesh, about .25% of a 50–50 mixture of Au and Ag passing about 300 mesh., .10% indium passing 300 mesh, balance Fe containing about .87% C passing about 400 mesh.

3. A grinding tool of the universal type, said tool comprising a metallic base member consisting of a machinable metal, a tubular sleeve extension on said base member, the exterior face of said sleeve being provided with a roughened surface, an annular body of sintered metal integral with the roughened exterior surface of said sleeve extension, said annular body consisting of a rust-resistant alloy containing 3 to 10% of one of the metals Mn and Ni, .20–.30% of at least one of the metals Cu, Au and Ag, .10% indium, balance Fe containing about .87% C, and an arcuately shaped ring-shaped body of a metallic abrasive material integral with the end of said annular body of sintered metal extending beyond the end of said sleeve extension, the said base member being provided with means to detachably secure the same onto the end of a rotative spindle to be rotated thereby about an axis passing through the center of said ring-shaped section perpendicular to the arcuate face thereof.

4. A grinding tool of the universal type, said tool comprising a metallic base member consisting of a machinable metal, a tubular sleeve extension on said base member, the exterior face of said sleeve being provided with a roughened surface, an annular body of sintered metal integral with the roughened exterior surface of said sleeve extension, and an arcuately shaped ring-shaped body of a metallic abrasive material integral with the end of said annular body of sintered metal extending beyond the end of said sleeve extension, said ring-shaped body of a metallic abrasive consisting of a sintered mixture of metal powder and diamond fragments, the constituents of the metal powder consisting of 3 to 10% one of the metals Mn and Ni, .20–.30% at least one of the metals Cu, Au and Ag, .10% indium, and the balance Fe containing about .87% C and the said diamond fragments each being provided with a firmly adherent thin film surface coating of a platinum group metal, the said base member being provided with means to detachably secure the same onto the end of a rotative spindle to be rotated thereby about an axis passing through the center of said ring-shaped section perpendicular to the arcuate face thereof.

5. A grinding tool of the universal type, said tool comprising a metallic base member consisting of a machinable metal, a tubular sleeve extension on said base member, the exterior face of said sleeve being provided with a roughened surface, an annular body of sintered metal integral with the roughened exterior surface of said sleeve extension, said annular body consisting of a rust-resistant alloy containing 3 to 10% of one of the metals Mn and Ni, .20–.30% of at least one of the metals Cu, Au and Ag, .10% indium, balance Fe containing about .87% C, and an arcuately shaped ring-shaped body of a metallic abrasive material integral with the end of said annular body of sintered metal extending beyond the end of said sleeve extension, said ring-shaped body of a metallic abrasive consisting of a sintered mixture of metal powder and diamond fragments, the constituents of the metal powder consisting of 3 to 10% one of the metals Mn and Ni, .20–.30% at least one of the metals Cu, Au and Ag, .10% indium, and the balance Fe containing about .87% C and the said diamond fragments each being provided with a firmly adherent thin film surface coating of a platinum group metal, the said base member being provided with means to detachably secure the same onto the end of a rotative spindle to be rotated thereby about an axis passing through the center of said ring-shaped section perpendicular to the arcuate face thereof.

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