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Fedjukin et al.

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[54] **CUTTING TOOL FOR FORMING SHAPED ARTICLES**

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[52] **U.S. Cl.** **51/204,** 51/60

[51] **Int. Cl.** **B24d 17/00**

[58] **Field of Search** ..... 51/60, 156, 157, 51/204, 206, 206.4, 206 P, 206 NF, 211 H

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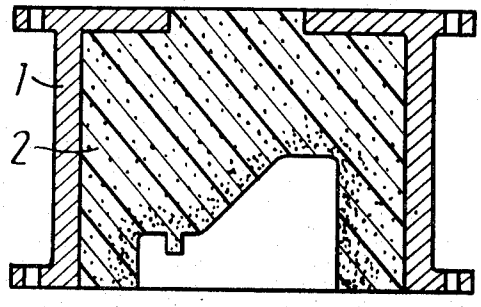
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Attorney—Waters, Roditi, Schwartz & Nissen

[57] **ABSTRACT**

A cutting tool for forming articles which acquire in the process of machining the negative shape of said tool. The tool consists of a holder and a shaped cutting element made of a compound based on polymers and cutting particles and fastened to said holder by a joint which is capable of withstanding the load imposed by the forces of cutting and of being easily destroyed during the replacement of the cutting element.

6 Claims, 9 Drawing Figures



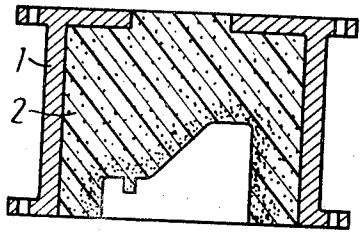


FIG. 1

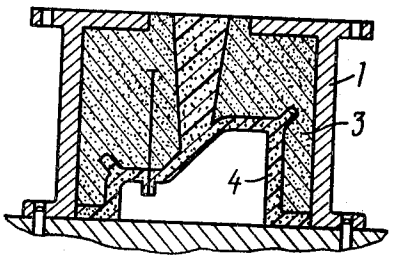


FIG. 2

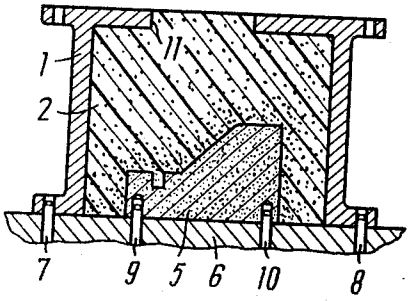


FIG. 3

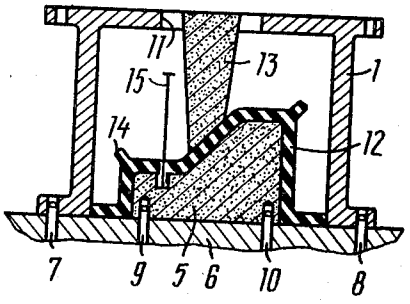


FIG. 4

FIG. 5

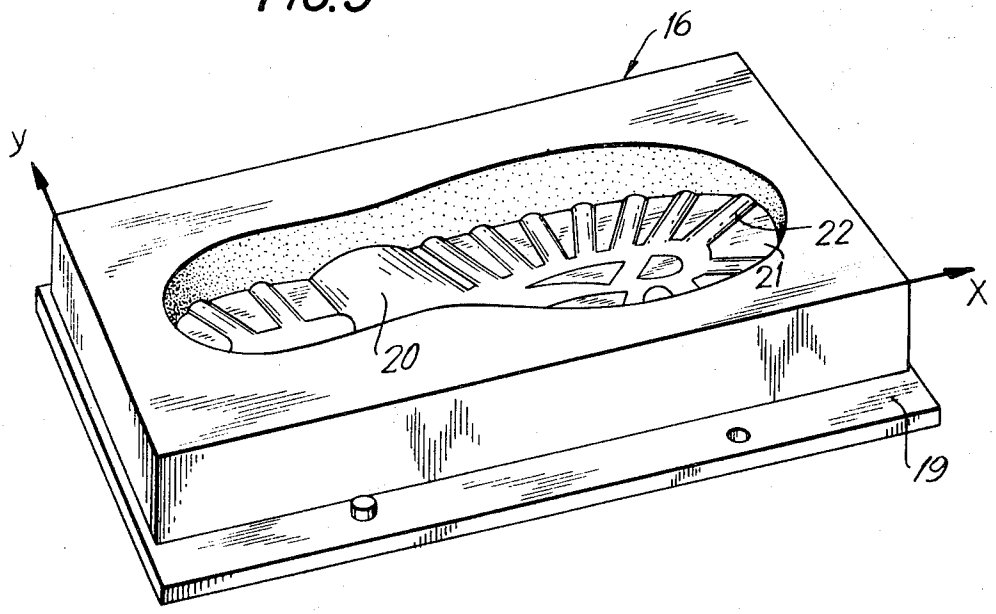


FIG. 6

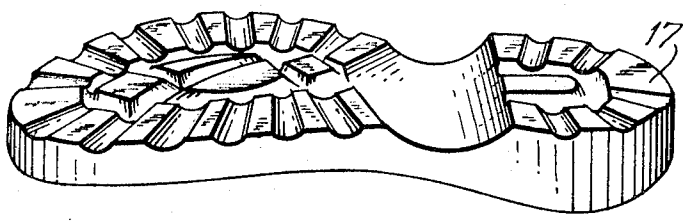


FIG.7

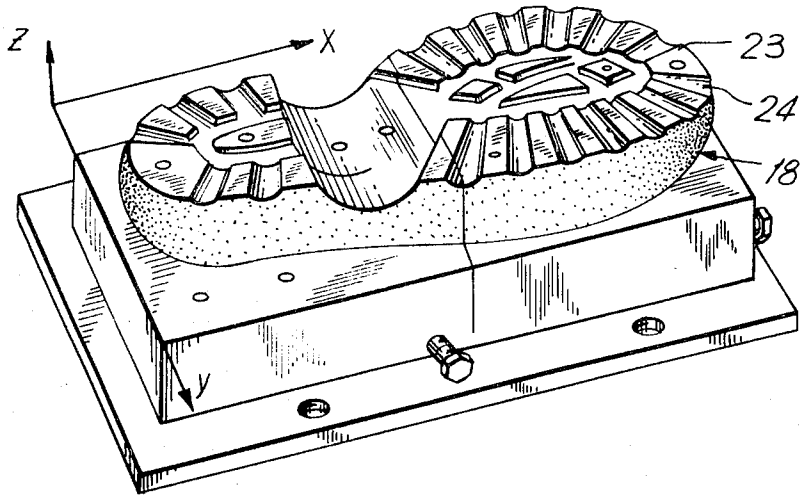


FIG.8

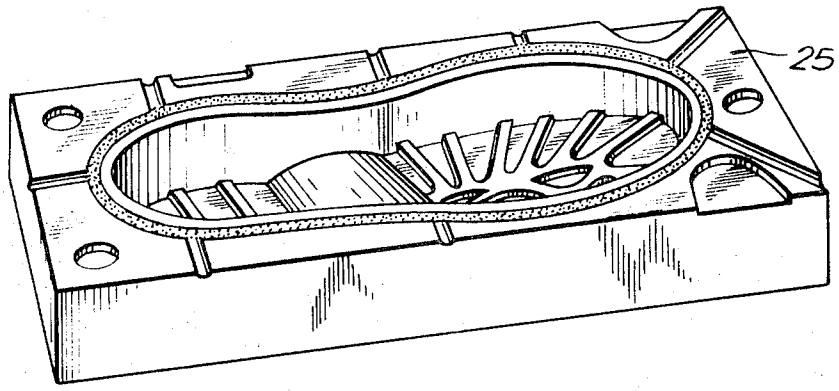
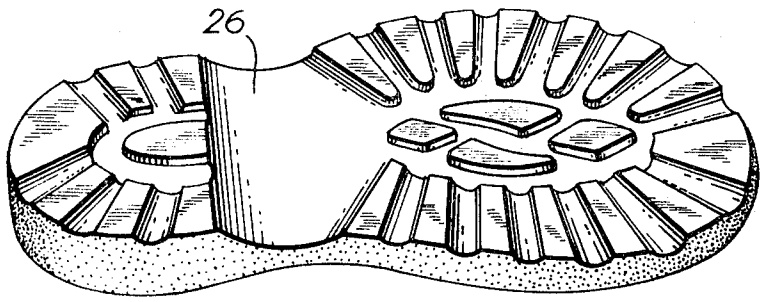


FIG.9



CUTTING TOOL FOR FORMING SHAPED ARTICLES

The present invention relates to the field of material machining and more specifically it relates to cutting tools for forming shaped articles and to the methods of manufacturing such tools.

Most effectively the present invention can be utilized in manufacturing complex-shaped graphite electrodes, designed for electroerosion machining of dies and press moulds.

The currently known cutting tools for forming articles which acquire in the course of machining the negative shape of these tools which reciprocate in two relatively-perpendicular directions, said tools each comprising a holder with a shaped cutting element. The shaped cutting element of the known tools is made of metal and, as a rule, is integral with the holder which is used for securing the tool in operation.

The cutting element of the tool has a shaped surface consisting of a large number of cutting members standing out of the tool body. The cutting elements can be formed either by means of manual serrations or by an electroerosion machining of the tool by a shaped electrode which has a positive shape of the product machined by the tool being manufactured. Both the first and second methods of making the known cutting tools are labor-consuming, calling for a great amount of hard physical labor (for serrating the cutting members or making the shaped electrode) and professional skill. As a result of the manual work, the shaped surface of the cutting tool may deviate from the negative shape of the product machined by this tool.

The design in which the shaped cutting element of the tool is made integral with the holder prevents (for reasons of economy) the use of materials with high cutting properties for the manufacture of such a tool, which adversely affects the tool strength. Therefore, the known tools cannot be utilized for machining articles made of hard alloys and hardened steels. These tools are used for forming articles made of graphite, wood and other easily cut materials.

However, even in this case, the strength of the tool is not sufficient since it loses its cutting ability after machining three to seven articles.

Experience has shown that it often becomes necessary to manufacture individual complex-shaped articles in which case the use of said cutting tools is not economical because the cutting portion of the tool and, consequently, its holder are used only once and their cost proves to be higher than the expenses involved in making the product directly, without this tool.

An object of the present invention resides in eliminating the aforesaid disadvantages.

Another object of the present invention resides in providing a cutting tool for forming shaped articles which, along with a simpler design and manufacture compared with the known tools, features a high cutting efficiency.

Another object of the present invention is to provide a cutting tool of the same type, which will ensure the manufacture of articles with a high accuracy of machining which eliminates the need for the manual work of a templet maker particularly in making dies and press moulds.

Still another important object of the present invention is to provide a cutting tool of this type which will

be cheap to manufacture and convenient in operation.

In compliance with the above and other objects, in the cutting tool for forming shaped articles which acquire in the process of machining the negative shape of said tool during its reciprocating motion in two relatively-perpendicular directions, there are provided a holder with a shaped cutting element made of a polymeric compound and cutting particles secured to the holder by a joint which is capable of withstanding the load of the cutting force and is easily destroyed during the replacement of said cutting element.

It is practicable that the shaped cutting element be secured to the holder by means of a binding layer of gypsum.

The most favorable solution of this problem is achieved when the tool is manufactured by pouring a polymeric compound and cutting particles on a pattern which has the positive shape of the article and, by removing said pattern after the polymers have hardened on its surface.

To impart high cutting properties to the tool, it is necessary, before pouring in the compound, to cover the pattern with a layer of a sticky material whose thickness is less than that of the cutting particles which are subsequently applied to this layer.

Due to such a design and manufacturing method, the cutting tool features high cutting properties and strength, ensures the manufacture of articles with a high machining accuracy, is cheap to manufacture and convenient in operation.

Now the invention will be described in detail by way of example with reference to the accompanying drawings in which:

FIG. 1 is a longitudinal section of the cutting tool;

FIG. 2 is a longitudinal section of the cutting tool whose shaped cutting element is secured to the holder by means of a binding layer;

FIG. 3 is a longitudinal section through the pattern and the tool, showing their relative positions in the process of manufacture;

FIG. 4 shows the relative positions of the cutting tool holder and pattern before pouring in the binding layer (longitudinal section);

FIG. 5 is a perspective view of the cutting tool;

FIG. 6 is a perspective view of the pattern having the positive shape of the product, namely the rubber shoe bottom;

FIG. 7 shows a graphite electrode manufactured by the cutting tool and designed for the electroerosion machining of the press mould;

FIG. 8 shows a press mould for the manufacture of rubber shoe bottoms; and

FIG. 9 shows a finished product, namely, the rubber shoe bottom.

The cutting tool for forming shaped articles comprises a holder 1 (FIG. 1) and a shaped cutting element 2.

The cutting element 2 of the tool, according to the invention, is made of a polymeric compound containint cutting particles and is fastened to a holder 1 by means of a joint which is capable of withstanding the load of the cutting forces and of being easily destroyed during the replacement of said cutting element. Such a joint may be constituted by a binding layer 3 (FIG. 2) of gypsum which fastens the cutting element 4 to the holder 1. Shown in FIG. 1 is a tool whose cutting element 2 is secured to the holder 1 by the compound proper.

Owing to such an arrangement the cutting tool has an easily replaceable cutting element (2 and 4). Thus, the holder 1 can be used many times. Additionally, such a design of the cutting tool provides for making the shaped cutting element from a polymeric compound and cutting particles made of costly materials possessing high cutting properties and strength, such as diamond, boron carbide, etc., while the holder 1 can be made of conventional structural steel.

The shaped cutting element 2 of the tool, according to the invention, is made as follows.

The polymeric compound (e.g. natural rubber, latex, cold- or heat-cured plastics) and cutting particles (for example, artificial corundum or silicon carbide) is prepared.

The size of the cutting particles is selected to suit the requirements of the tool capacity and the surface finish of the articles machined by said tool.

For instance, for roughing work the size of the cutting particles ranges from 1 to 3 mm while for finishing operations it should be from 0.01 to 0.03 mm.

The content of polymers in the compound varies from 20 to 60 percent of its total weight. For example, if the compound consists of epoxy resin (molecular weight 360–470) with polyethylene polyamine as a hardening agent, and cutting particles of electrocorundum, then the proportion is 10 parts of epoxy resin, 15–22 parts of electrocorundum and 1 part of polyethylene polyamine.

The compound prepared in this way is poured on the pattern 5 (FIG. 3) into the space formed by the holder 1, said pattern having the positive shape of the article.

The pattern is preliminarily installed on a plate 6.

It is practicable that the cutting properties of the tool be improved by coating the surface of the pattern 5 before the application of the compound with a uniform layer of a sticky material such as a consistent lubricant, for example fat-base grease. The thickness of this layer should be less than the size of the cutting particles which are subsequently applied to this layer.

The inner surface of the holder 1 is degreased for better adhesion with said compound.

The holder 1 is secured relative to the pattern 5 by means of pins 7, 8, 9 and 10. The compound is poured on the pattern 5 through the central hole 11 in the holder 1. The pattern 5 is removed after the hardening of the polymer.

When the cutting element 4 (FIG. 2) is fastened to the holder 1 by means of the binding layer 3 e.g., gypsum, the pattern 5 (FIG. 4) is preferably coated with a layer 12 of a plastic material, for example raw rubber, plasticine, etc. before pouring in said binding layer.

The thickness of the layer 12 is equal to that of the shaped cutting element of the tool.

A core 13 placed on this layer 12 is used to form the gate space required for pouring the compound on the pattern 5. Additionally, the layer 12 has ribs 14.

Then the material of the binding layer 3 (FIG. 2) is poured into the space formed by the holder 1 and layer 12. Then the layer 12 (FIG. 4) is removed and the space formed between the binding layer 3 (FIG. 2) and pattern 5 is filled with the polymeric compound and cutting particles for producing the shaped cutting element 4 of the tool. The ribs 14 protrude into layer 3 thus ensuring reliable adhesion of the cutting element 4 of the tool to the binding layer 3.

After hardening of the polymer, the pattern 5 is removed.

If the cutting tool is made with a complex-shaped cutting element whose surface has thin protruding elements, it is practicable for their strengthening to install so-called needles 15 (FIG. 4) on the pattern 5; after pouring of the compound these needles remain in the body of the tool cutting element.

If the cutting element of the tool made of said compound is secured to the holder by means of the same compound, it is practicable for reducing the weight of the entire tool to make the holder with a possibility to remove its side walls after the filling in of the compound.

The working surface of the cutting element of the tool may be made by successive members. For this purpose individual members of the cutting element are assembled into blocks which are then fastened to the holder.

The tool forms the shaped articles as follows.

The cutting tool 16 (FIG. 5) made to the pattern 17 (FIG. 6) by the method disclosed above is secured on a machine which imparts to said tool a motion relative to the article 18 (FIG. 7), this motion being simultaneous in two relatively perpendicular directions X and Y (FIG. 5), while in the third direction Z the article is fed to the tool 16 perpendicular to the former two directions (X and Y). In this example the tool 16 has a holder 19 (with the side walls removed) with the shaped cutting element 20 fastened directly to it.

In the course of machining, the article 18 acquires the negative shape of the cutting element 20 of said tool so that the hollows 21 (FIG. 5) and projections 22 of the tool correspond to the projections 23 (FIG. 7) and hollows 24 of the article 18.

In this particular case the machined article 18 is a graphite electrode which, in turn, is the tool for electroerosion machining of the press mould 25 (FIG. 8) intended for moulding the article 26 (FIG. 9) i.e., a rubber shoe bottom. The article 26 made in this manner is identical in shape and size to the pattern 17 (FIG. 6).

It should be noted that one and the same pattern can be used for making two mating parts, such as the punch-and-die set of a blanking die.

In addition, it is to be noted that the tool can be used for finishing (grinding) the shaped working surfaces of dies, press-moulds and other articles of complex shape.

Thus, the cutting tool realized in accordance with this invention features broad technological possibilities and its use offers a high technical and economical effect.

Those skilled in the art will understand that the present invention can be modified without departing from the spirit or the scope of the invention since said invention is not confined to the versions shown in the drawings and disclosed in the description, but is limited only by the appended claims.

What is claimed is:

1. A cutting tool which is reciprocable in two perpendicular directions to form an article which acquires the negative shape of the tool, said tool comprising a hollow holder, a shaped cutting element carried by said holder and confined with-in the boundary thereof, said shaped cutting element being constituted of a polymeric material with cutting means in the form of abrasive particles distributed in said polymeric material, and binder means filling said hollow holder between

the shaped cutting element and said holder for joining said cutting element and holder to withstand the forces developed during cutting of the article by the tool, said binder means being constituted of an easily destructable material to permit replacement of said cutting element in said holder.

2. A tool as claimed in claim 1 wherein said material of said binder means is gypsum.

3. A tool as claimed in claim 1 comprising needles embedded in said cutting element and binder means.

4. A tool as claimed in claim 1 wherein said binder means is constituted of the same polymeric material as the cutting element.

5. A tool as claimed in claim 1 wherein said holder is steel, and said particles are diamond, boron carbide, corundum, or silicon carbide.

6. A tool as claimed in claim 1 wherein said polymeric material is 20–60 percent by weight of said cutting element.

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