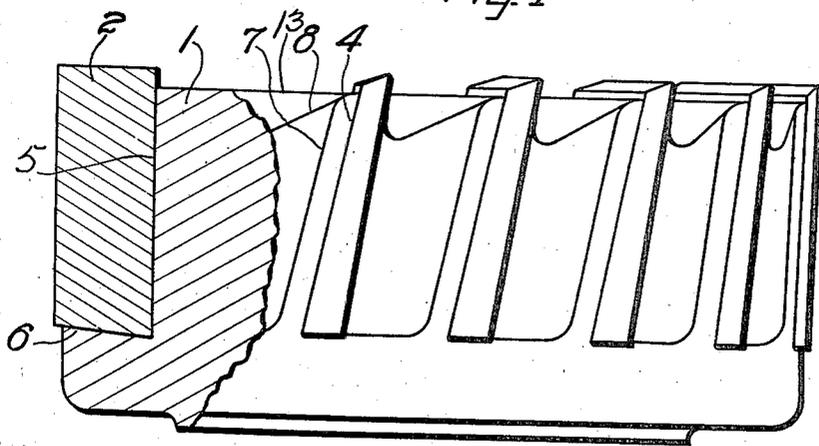
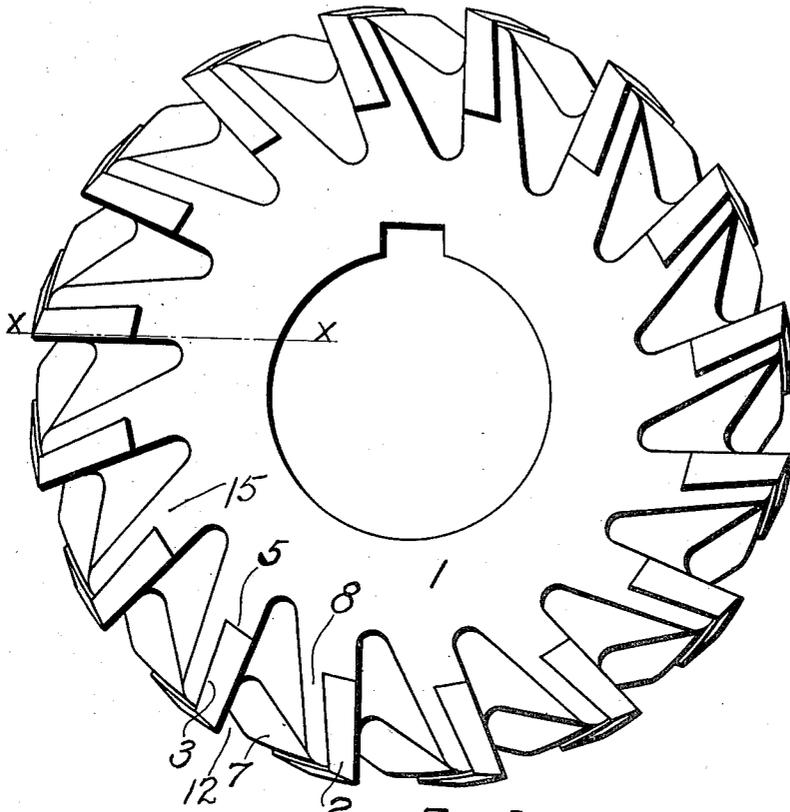


C. F. HEINKEL.  
METHOD OF JOINING MATERIALS.  
APPLICATION FILED MAR. 22, 1910.

1,090,533.

Patented Mar. 17, 1914.

2 SHEETS-SHEET 1.



Witnesses:  
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*Henry R. Saylor*

Fig. II

Inventor:  
*Christian F. Heinkel.*

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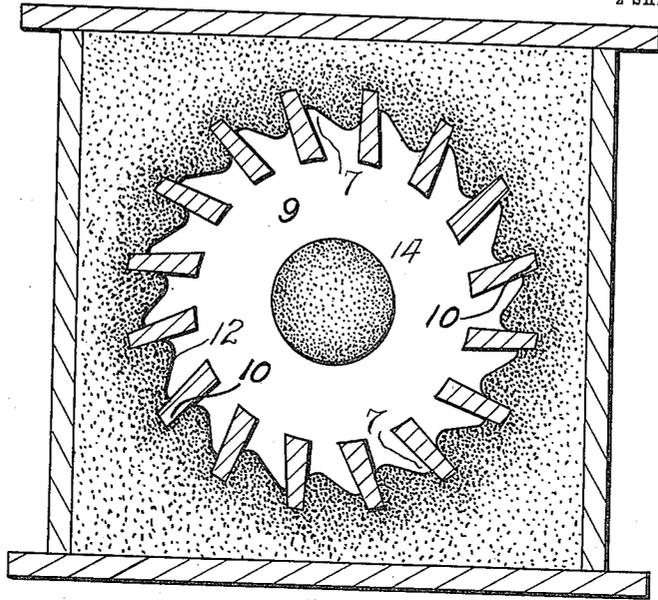


Fig. III

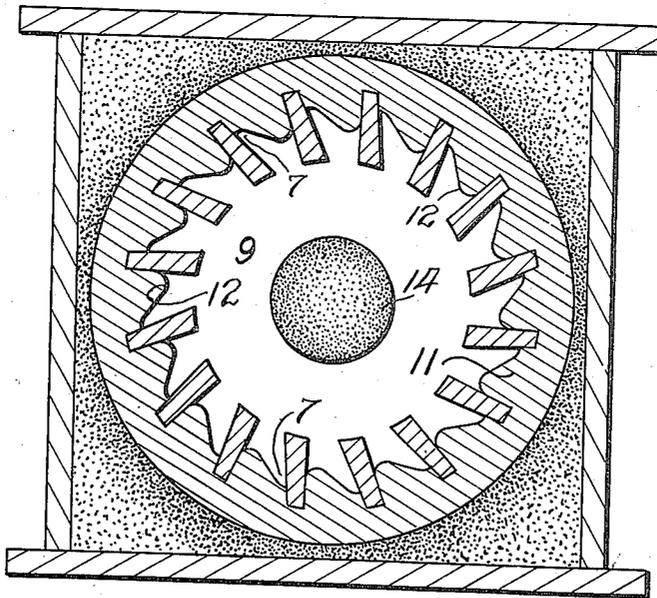


Fig. IV

Witnesses:

Henry R. Lydon  
Elmer G. Essig

Inventor:

Christian F. Heinkel.

# UNITED STATES PATENT OFFICE.

CHRISTIAN F. HEINKEL, OF CLEVELAND, OHIO.

## METHOD OF JOINING MATERIALS.

1,090,533.

Specification of Letters Patent.

Patented Mar. 17, 1914.

Application filed March 22, 1910. Serial No. 550,953.

To all whom it may concern:

Be it known that I, CHRISTIAN F. HEINKEL, a citizen of the United States, residing at Cleveland, in the county of Cuyahoga and State of Ohio, have invented a new and useful Method of Joining Materials, of which the following is a specification.

My invention relates to a method of joining materials by means of forming one of said materials and casting the other of said materials thereto.

The object of my invention is the efficient production of a better joint than heretofore and to improve and cheapen production. I attain this object by the method sufficiently illustrated in the accompanying drawings and described hereinafter and particularly set forth in the claim.

The principal feature of my invention is to provide beveled or inclined faces on the part or parts which are to be united or joined to a casting; these beveled or inclined faces being so arranged to force these parts down upon their seats while the cast material is shrinking and subsequently to keep these parts down upon their seats after the casting has cooled, which is due to internal strains in the casting and well known in the art.

In the said accompanying drawings: Figure I is an end-view of a milling-cutter or reamer; Fig. II is a side-view of Fig. I, partly broken away on line  $x-x$  of Fig. I to show the seats of the cutters; Fig. III is a section, on a smaller scale, through a mold before pouring the casting, but having the cutters inserted into place; and Fig. IV is a section, also on a smaller scale, through a mold before pouring the casting, but having the cutters and a chill inserted into place.

Similar numerals refer to similar parts throughout the several views.

The reamer or milling-cutter shown in the drawings consists of body 1 and of cutters 2.

In carrying out my invention in its most simple form, I prefer to construct a mold 9 which conforms to the general contour of the body 1 and is provided with core-prints 10 which are adapted to receive the cutters 2. Mold 9 may be constructed either in sand as shown in Figs. III and IV and by means of a suitable pattern, or of metal, both methods of constructing a mold being well known in the art. I then form the cutters 2 of suitable material. That portion of cutters 2 which projects outside of the body 1

after casting being adapted to enter said core-prints 10, and that portion of cutters 2 which is to be surrounded by the body material having inclined or beveled faces 4, 5, and 6. Faces 4 are beveled longitudinally and radially, so that the faces 6 are wider than the front faces of the cutters 2, and the faces 5 are wider than the outside or circumferential faces of said cutters, and the faces 6 are beveled so that the faces 5 are longer than the outside or circumferential faces. It will be seen that the heavier or thicker portion of cutters 2 is directed toward the main portion of body 1, whereas the lighter or thinner portion is directed outward. It will further be seen that adjacent faces of that portion of cutters 2 which is to be surrounded by the body-material form acute angles. The purpose of thus arranging the faces will appear hereinafter. The cutters 2 are then hardened and placed into the core-prints 10, similar to the cores in the usual casting mold. The molten body-material is then poured into the mold 9. The casting must, in this instance, be removed from the mold 9 and cooled as soon as it has sufficiently set and before the heat radiated by the molten body-material anneals or otherwise detrimentally attacks the cutters 2. Said cooling may be accomplished either by an air-blast, or an oil-bath, or a water-bath, or any other cooling-means adapted to the material composing the cutters 2. The tool is then finished in the usual manner. These steps constitute a simple method of producing the cutting-tool. Finishing of the tool, as set forth in the last step, does not properly pertain to joining the materials and is therefore omitted in the annexed claim.

Although the steps hereinbefore set forth are sufficient for, or adapted to certain cases, it has been found that the cutters 2 may become annealed in cases in which the body-material, which surrounds the cutters 2, is bulky and does not set before the heat radiated therefrom detrimentally attacks the cutters 2. In such cases the projections 7 and 8 and, if necessary, the portion 15 of body 1 should be rather light as to bulk to the end that said projections and said body-portion may cool quickly and divert excessive heat from the cutters 2, but the projections 7 and 8 should be sufficiently strong to form a suitable backing for the cutters 2. Said body-portion may also be, conveniently,

proportioned by enlarging or diminishing the size of the core 14. Projections 7 are provided to form a backing or abutment for the cutters 2 on the circumferential face of the tool as well as to form the usual chip-grooves 12 on said face. The projections 8 are provided to form a backing or abutment for the cutters 2 on the end face of the tool as well as to form the usual chip-grooves 13 on said face. Said proportioning of the projections 7 and 8 and said body-portion is best accomplished by suitably constructing or arranging the mold 9 which is well known in the art. When, however, such proportioning of the projections 7 and 8 and said body-portion is not sufficient to prevent detrimental attack upon the cutters 2, such as annealing for instance, or when the projections 7 and 8 become too light or weak by such proportioning, one or more chills should be placed in the mold 9. One such chill 11 is shown in Fig. IV of the drawings and it will be seen that the outer or circumferential portion of the cutters 2 projects into core-prints which are provided in the chill 11, while the face or end portions of the cutters 2 enter the aforesaid core-prints in the mold 9 which is not definitely shown in the drawing but is well known in the art. Said chill diverts some of the heat from the cutters 2 and acts as an additional safeguard to prevent said detrimental attacks. In such a case, the mold 9 should be constructed or arranged to accommodate the chill 11, as seen in Fig. IV for instance.

If the cutters 2 are placed in the mold when annealed or soft, or if they get annealed while casting, they must be hardened after casting, which may be done in the usual manner with either carbon steel or with high-speed steel when the body 1 is cast of material which is capable of withstanding the necessary temperature. The average high-speed steel requires about 2200 to 2400 degrees Fahr. for proper hardening. If the cutters 2 are made of high-speed steel, and the body-material melts at or below that temperature; the cutters 2 may become loose while being hardened after casting the body 1. In such a case the cutters 2 must be hardened before being placed into the mold 9 and any or all of the hereinbefore described safeguards may be employed to prevent any detrimental attack upon the cutters 2.

While casting body 1 oxidation may take place between the cutters 2 and the body 1; to prevent this I apply an agent to the cutters 2 before placing them into the mold; such an agent may be a coat of tin, or blue-vitriol, or pure red-lead, or any other suitable substance.

The cost of production of these tools may, in some cases, be materially reduced by placing the cutters 2 into the mold 9 before said

cutters are hardened and by hardening them by means of the heat radiated by the casting. To accomplish this, I prefer to place the cutters 2 into the mold 9 in their annealed or soft state. After casting the body 1, I leave the tool in the mold 9 sufficiently long to allow the cutters 2 to absorb sufficient heat from the molten body-material for proper hardening thereof. I then remove the tool from the mold 9 and subject it to a cooling-means, such as an air blast, or an oil or water-bath or other suitable cooling-means whereby the cutters 2 are hardened, thus hardening the cutters 2 by means of the heat radiated by the casting-material and eliminating the expense of heating the cutters for hardening.

It will be seen that the faces of the cutters 2 are arranged at an angle with each other or inclined, as previously stated, and it is desirable that at least two such faces are so arranged and, preferably, substantially at right angles with each other. When so arranged, the cutters 2 will be forced upon two seats and in two angularly disposed directions while the body-material is shrinking thereon. For instance, referring to the drawing, when the casting-material shrinks upon the faces 4 of the cutters 2, the faces 5 and 6 will be forced upon their seats, radially inward and longitudinally backward, and in two angularly disposed directions. The forcing of the cutters 2 as stated is occasioned by the cooling of the molten body-material. It is well known in the art that molten material shrinks while cooling and this property is made use of in this invention. When first pouring the molten material into the mold said molten material fills said mold and surrounds the cutters 2 except at the core-prints 10; when this molten material cools, it shrinks where it is allowed to do so, but the cutters 2, being a solid mass, do not allow the said cooling mass to shrink, and consequently the said cooling mass, being prevented from shrinking by the solid mass of the cutters 2, will hug or pinch or close upon the said solid mass and hold it with considerable pressure even if the faces of the cutters 2 were parallel, but cutters with such parallel faces will soon work loose, due probably to the internal strains being released in time or by the vibrations set up in the tool while in operation. It has been found that when the faces of the cutters 2 are inclined as hereinbefore set forth, a much better joint is obtained since the cutters 2 are held upon two seats and in two different directions, one direction radially inward and the other longitudinally backward. As has been stated, the molten material shrinks upon the cutters 2 and hugs or pinches them. It will be seen that the said inclined faces form wedges or act like wedges and it is well known in

the art that a wedge will tend to move end-  
wise or away from pressure when a load is  
applied upon its inclined or wedge face. In  
this invention, the shrinking mass sur-  
5 rounds these inclined faces or wedges and  
puts a pressure thereon while cooling.  
These wedges tend to move away from said  
pressure and, in doing so, will force them-  
selves upon their respective seats as herein-  
10 before set forth.

It will be seen that, with this invention, a  
better joint than heretofore is efficiently pro-  
duced, and that the cost of production is re-  
duced. For instance: In the milling-cutter  
15 or reamer shown, the cutters may be made  
of high-speed steel and the body of steel  
casting, thus cheapening production since  
the cost of such a tool, if made of high-speed  
steel throughout would be much higher than  
20 when made as shown, not only as to cost of  
material, but also as to labor required to  
finish the tool, since the cast body may be  
cast to the required form so that very little  
finishing is required on the body, whereas  
25 with a tool made of high speed steel through-

out much more labor would be required for  
finishing the same.

Tools with a body cast to cutters have been  
made, I therefore do not claim that broadly,  
but

I do claim:

The method of forming a composite cast-  
ing consisting in spacing in a mold and at  
the periphery thereof a series of hardened  
inserts having wedge-shaped sections in two 35  
planes substantially at right angles to each  
other, positioning them to present their bases  
toward the interior of the casting to firmly  
seat them in the surrounding metal, propor-  
tioning the space filled by the surrounding 40  
metal to confine its bulk and limit its heat-  
ing effect upon the inserts, casting a softer  
metal around the inserts and cooling the  
casting before the heat of the cast-in metal  
anneals the inserts.

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Witnesses:

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