

Aug. 15, 1933.

W. J. SCHULTZ
METAL WORKING IMPLEMENT

1,922,178

Filed Jan. 27, 1932

2 Sheets-Sheet. 1

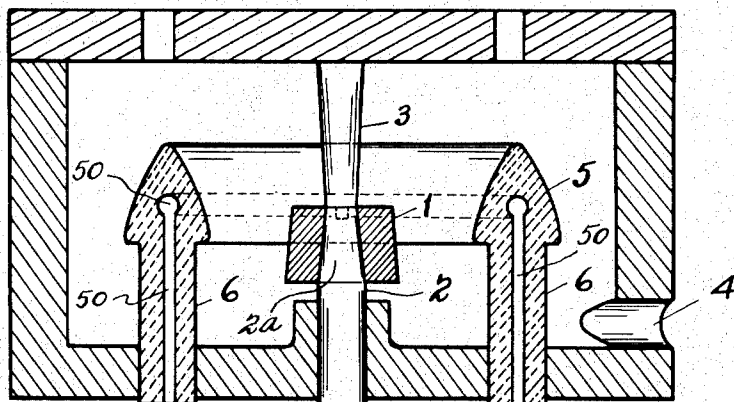


Fig. 1

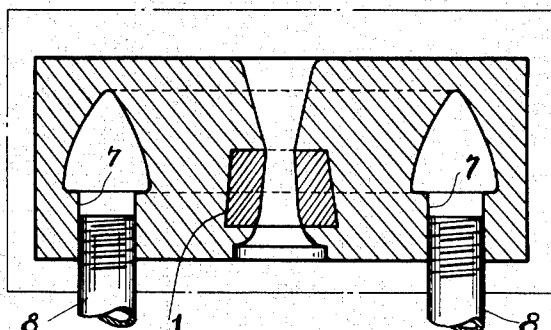


Fig. 2

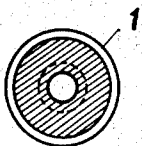


Fig. 3

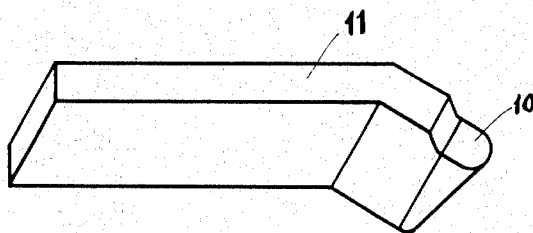


Fig. 4

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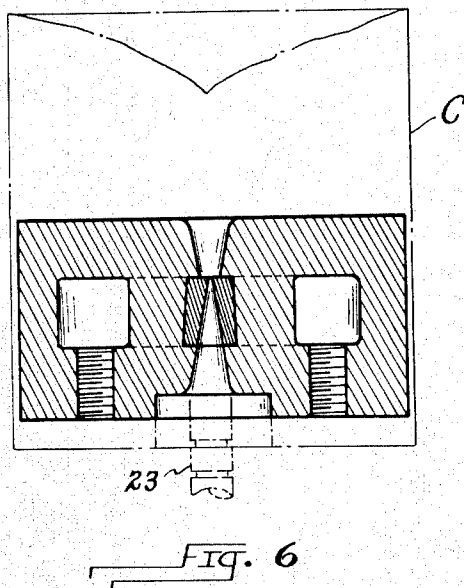
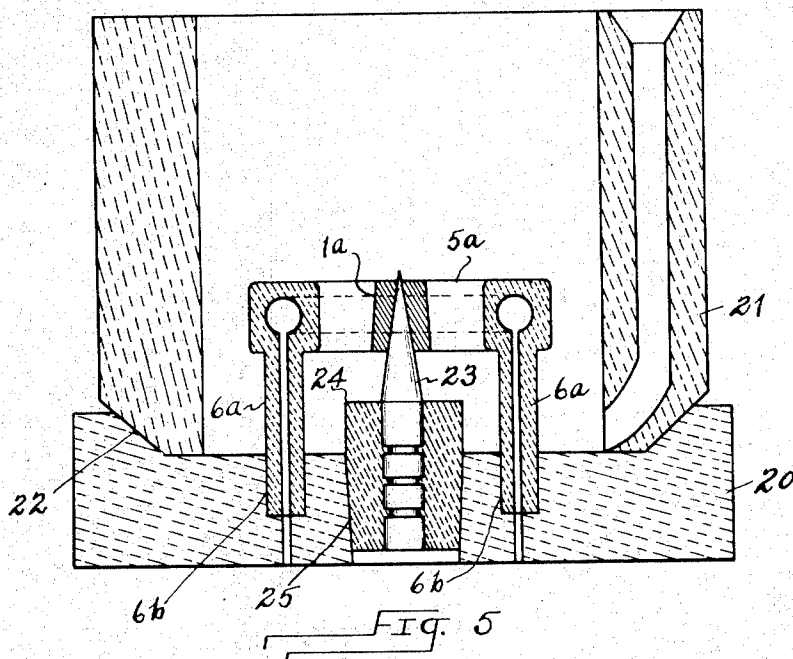
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METAL WORKING IMPLEMENT

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2 Sheets-Sheet 2



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UNITED STATES PATENT OFFICE

1,922,178

METAL-WORKING IMPLEMENT

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Application January 27, 1932. Serial No. 589,169

4 Claims. (Cl. 205—26)

The invention relates to metal-working imple-
ments of composite structure, two representative
types of which are wire-drawing dies and tools
for cutting metal. A die for the drawing of wire,
5 for example, usually comprises an orificed block
of some extremely hard substance, such as the
diamond (which, in the strict sense of the word,
is itself the die) and a metallic carrier or casing
in which the block is very firmly secured or
10 embedded. It is usually essential that the set-
ting of the block in its carrier shall be of the
greatest attainable rigidity, for the block when
in service is often subjected to strains and shocks
so very great that an irregularity or looseness
15 of mounting so slight in magnitude as to be termed
microscopic may cause the block of diamond or
other valuable substance to crack and thus ruin
the die.

In the accompanying drawings Figure 1 is a
20 view in sectional elevation of a suitable mold for
the formation of a composite die structure em-
bodying the invention. Figure 2 is a like view
of the finished composite die. Figure 3 is a cen-
tral cross-sectional view of the orificed block of
25 the die. Figure 4 is a view in perspective of a
lathe tool embodying the invention. Figure 5
shows in central vertical section a mold of modi-
fied structure for the forming of the composite
die. Figure 6 is a like view, showing in outline
30 the casting made in the mold of Figure 5, and
illustrating the finished die structure.

In recent years it has been found that for wire-
drawing purposes what are known as cemented
carbides of some of the more refractory metals,
35 such as tungsten or tantalum, may be used as
die substances, as substitutes for the diamond,
the ruby or the sapphire. The hardness and
durability of these cemented carbides approxi-
mate the hardness and durability of the precious
40 stones referred to, and their cost is less; but they
are nevertheless subject to failure under heavy
stresses, and their cost of manufacture is rela-
tively high. They therefore can be used economi-
cally in dies or other metal-working implements
45 only as the precious stones are used, that is, as
smaller bodies set into or supported by larger
bodies of cheaper metal.

Heretofore it has been the general practice in
the manufacturing of composite dies for drawing
50 wire provided with working blocks of cemented
tungsten or tantalum carbide, to form the block
and grind its exterior surface to a slight taper,
and then to fit this tapered block into a corre-
sponding cavity in a cup or matrix of tool steel or
55 other suitable substance, ordinarily metal. The

block may or may not be brazed into its carrier;
in some cases it has been secured in place me-
chanically, as by wedging; in other cases the
tungsten carbide block has been molded into the
matrix or cup of steel, under heat and pressure, 60
as shown and described, for example, in United
States Letters Patent No. 1,637,109. But in what-
ever manner the block has been secured, it has
heretofore been true that the heavy strains or
shocks which are incident to the drawing of wire 65
have often caused premature cracking or break-
ing of the block.

It is the object of the present invention to pro-
duce such a composite die or other metal-working
implement, by casting a carrier body upon (and
70 in the case of a die, entirely around) the surface
of the work-engaging body (or core) of cemented
carbide, the carrier body being of such material
hereinafter specified, as to form with the sub-
stance of the block, or other work-engaging body, 75
a union secure against failure under the strains of
service. Continuing, for present purposes, spe-
cific reference to the manufacture of dies for the
drawing of wire, and choosing by way of example
cemented tungsten carbide as the material for the 80
block, that substance has the property of con-
ducting heat much more rapidly than steel, and
its coefficient of thermal expansion is much lower
than are those of steel and of numerous ferrous
alloys which might conceivably be used as mate- 85
rial for the carrier for the tungsten carbide block.
Most metals which I have tried are not suitable
for use as material for the carrier for the cemented
carbide block, for the reason that the union be-
tween the block and the carrier is insecure in 90
spots, or not sufficiently rigid. I believe that this
is due to the differences in coefficients of expansion
between the block on the one hand and the carrier
on the other; but however that may be, the results
with cast steel and various steel alloys have been 95
unsatisfactory. I have found, however, that
when an iron of the type to be presently described
is cast in a suitable mold upon and around the
surface of the cemented tungsten carbide block, a
very intimate and satisfactory union is obtained, 100
and that the composite die thus formed is superior
in service to any of which I am aware.

The metal which I prefer to use for the cast
carrier is one which is known commercially as
Meehanite, and it is the product of the methods 105
described in United States Letters Patent No.
1,499,068, No. 1,683,086, No. 1,683,087 and No.
1,731,346. Briefly stated, this product is obtained
by the addition to the better grades of molten
commercial cast iron of a small amount of a sili- 110

cide of an alkaline earth metal, such as calcium or magnesium, or by the addition of metallic calcium. The product has been called synthetic processed and graphitized cast iron, and it possesses the physical properties of density, tensile strength, and thermal conductivity in much greater degree than ordinary cast iron. Its content of graphitic carbon is apparently in a nodular form instead of existing as flakes of graphite, and in structure the metal is close grained and homogeneous. In order to define this metal I have called it in the appended claims "modified cast iron". Modified cast iron, then, as used in this specification, will be understood to be the metal last above defined.

During the operation of forming the composite structure the outer portion of the tungsten carbide block becomes absorbed by or dissolved in the molten metal, decrementally or in gradually decreasing quantities outwardly. Thus the cross-sectional areas immediately surrounding the undissolved carbide block will partake to some extent of the physical properties of the block itself, and areas further away will partake of these properties to a lesser degree. It will be seen, therefore, that there is a gradation of physical properties away from the unaffected carbide block through the immediately adjacent portions of the carrier and outwardly, thus assuring the best possible bonding between the carrier and the carbide block, and overcoming any tendency of the block to be cracked or broken under the severe conditions to which it is subjected in operation.

Referring first to Figure 1 of the drawings, the carbide block 1, which in this case is pierced entirely through, is set upon the tapering shoulder 2a of a core portion 2 of the mold. The core portion 2 is constructed of a baked sand composition known to foundrymen, and is "pasted" in position in the bottom of the mold. Foundrymen's paste is also used to secure the block 1 upon the core portion 2, and, additionally, a core portion 3 is secured in place, as shown, between the top of core portion 2 and the top of the mold. The molten modified cast iron may be supplied to the mold through the gate 4, and the molten metal may be poured in the usual way.

Heretofore in wire-drawing apparatus the dies have been provided with auxiliary water-cooled rings, surrounding the dies and serving with some degree of success to maintain the dies in a cool condition. However, the results have not been all that they were desired to be. I have discovered how a composite die may be constructed to permit direct cooling within its own body—this resulting in improved temperature conditions during service. To provide a water-cooled die, I construct an annular baked-sand core member 5, having integrally attached thereto the downwardly projecting legs 6, to form in the casting inlet and outlet ports for the annular water-chamber formed by the core 5. Advantageously the core 5 and legs 6 are provided with vents 50 for the escape of gases during the casting operation.

After the solidified casting has been removed from the mold and the substance forming the core members broken up and cleaned out of the casting, the wire-drawing orifice in the inner carbide block may be machined with diamond dust, in the usual manner. The inlet and outlet openings 7 may be threaded, and the water pipes 8 inserted in the openings 7, and the die be thus completed, as shown in Figure 2.

The mold may be constructed of a baked-sand composition, and in such case will comprise a stool 20 and a body 21, as shown in Figure 5.

The two mold members are complementary in shape at 22, so that they nest snugly together in accurate relative positions. As in the case of the structure first described, the mold 20, 21 may be provided with an annular core-member 5a, having two legs 6a to provide outlet and inlet ports for the annular chamber formed in the casting by the core-member 5a. The legs 6a are "pasted" in secure position in sockets 6b provided in the stool 20.

The carbide block 1a is supported upon the pointed end of a stem 23; the block may be pierced through, or only partly pierced, but in either case it is positioned upon the point of stem 23. Foundrymen's cement or paste is used with good results to secure the block upon the stem.

I have found that an unusually sturdy and precise positioning of the block 1a may be obtained by this structure. The stem 23 may be formed of modified cast iron and be initially molded within a sand core 24, and the core 24 is then baked. The baked-sand core is provided with tapering sides, to fit a tapered seat 25 provided in the mold stool 20. The core 24 is "pasted" in seat 25. In the completed structure the block 1a will be found to have maintained its truly centered position. The stem 23 is readily machined out, and the drawing orifice shaped to proper size and condition for service when the casting C (Figure 6) is being finished into its final form.

While the method of manufacture of the carbide block forms no part of the present invention, it may be said that in some cases it will be advantageous to place the carbide block in the mold in a partially sintered state, since it is possible during the molding operation to sinter the block finally, without the use of hydrogen or other reducing gases and packing materials previously regarded as necessary to the proper sintering of the carbide.

Also, if there should be used a sintered carbide block having its pores filled with cast iron, as described for instance in United States Letters Patent No. 1,512,191, the sintered carbide block may be set in the mold, as shown, and both the saturation of the carbide block and the formation of the composite die be completed in a single operation.

Owing to the fact that the relative sizes of the carbide block and the cast iron carrier, together with the temperature of the molten metal and the time of cooling, will exercise an important influence upon the product, it will be seen that by carefully regulating conditions of size, time and temperature, the amount of carbide which will be absorbed or dissolved in the cast carrier may be regulated with great accuracy, and a superior product be thereby obtained.

It may be remarked that a carbide block of exceedingly small wall thickness may be employed as a result of my invention. For example, I have constructed a wire-drawing die in which the wall of the carbide block is less than one-sixteenth of an inch thick. Manifestly, great savings in the valuable metal may be thus effected, and field for use widened. Indeed, I contemplate its use in wire guides and bearings, and in other machine parts normally subject to great wear.

In view of the foregoing description, the manufacture of the lathe tool shown in Figure 4 of the drawings need not be described in detail. It is made up of a working tip 10 formed of the

carbide, and a shank 11 formed of the modified cast iron hereinbefore specified, the parts being welded together in a molding operation substantially the same as that already described.

5 It will be understood that by reference to the carbide of which the block is formed I intend to include the hard carbides of tungsten, tantalum, silicon, titanium, zirconium, thorium, beryllium, vanadium, chromium, molybdenum, uranium, and of alloys and mixtures of such elements. Also, the term "cemented carbide" as heretofore employed may not in all cases be accurately descriptive of the method of manufacture. For example, in some instances the term "sintered carbide" has been employed. Whatever may be the detailed method of manufacture, these hard metallic carbides constitute in themselves a well known class of metallic substances, and by the use of the term "carbide" in the appended claims I intend to include blocks made of such hard metal compositions or bodies, whatever may have been the specific method employed in their production.

I claim as my invention:

25 1. A metal-working implement comprising a

carbide metal block having a supporting body of modified iron cast and autogenously welded upon its surface.

2. A wire-drawing die consisting of an orificed block of tungsten carbide set in a carrier of modified cast-iron in a union characterized by the autogenous penetration of the block material into the substance of the carrier material incident to the casting of the carrier upon the previously formed block. 80 85

3. A metal-working implement comprising a carbide metal block set in a carrier of modified cast-iron in a union characterized by the autogenous penetration of the block material into the substance of a carrier material incident to the casting of the carrier upon the previously-formed block. 90

4. A metal-working implement comprising a tungsten carbide metal block set in a carrier of modified cast-iron in a union characterized by the autogenous penetration of the block material into the substance of the carrier material incident to the casting of the carrier upon the previously-formed block. 95

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