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CHROMIUM TUNGSTEN MOLYBDENUM
COBALT ALLOY STEEL

Leo Klüger, Vienna, Germany, assignor to Akom-
fina A.-G. für kommerzielle und finanzielle
Angelegenheiten, Zurich, Switzerland

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The invention relates to a chromium tung-
sten molybdenum cobalt alloy steel in particular
for the making of milling tools, and consists in
from 0.25 to 3% of tantalum being added to
the alloy.

In making or, respectively casting of tools with
sharp edges, cutting edges, corners etc., using
steels alloyed with chromium, tungsten, mo-
lybdenum and cobalt, a great disadvantage arises
owing to the material in the parts of the mould
forming the edges, cutting edges, corners etc.
being chilled. Due to this chilling effect and
to the shrinking occurring after the ensuing con-
gealing, in the cutting places where the metal
has receded cavities arise giving cause to a saw-
like indentation of the edge, cutting edge etc.
requiring very material subsequent working and
whose faults sometimes are past help. The loss
thereby is very considerable, sufficing to render
doubtful the advantages to be gained by casting
in comparison with working from the solid.

When according to the invention a small per-
centage of tantalum is added to the aforesaid
alloy steel, the picture changes immediately.
The addition of tantalum prevents the chilling
effect of the casting mould and its disagreeable
consequence and assures the 100 per cent. forma-
tion of perfectly sharp edges, corners, cutting
edges etc. in the moulds, neither poor looking
nor showing any other defects. This is because
the tantalum is raising the congealing point or,
respectively, delaying the congelation. No sud-
den chilling of the metal occurs in the mould,
and the formation of cavity-producing elements
is avoided. Likewise the structural differences
occurring, due to the chilling, in the chilled
corners, cutting edges etc. on the one side
and in the metal underneath on the other—and
which can hardly be made up for even by subse-
quent thermic treatment—are avoided, the struc-
ture on the contrary becoming completely equal
and free of tension due to the addition of the
tantalum, which is of particular weight for the
subsequent annealing; the qualities of the alloy
are improved equally.

Adding tantalum to the aforesaid basic alloy
entails quite a number of unexpected effects of
far-reaching importance. For instance the sen-
sibility of the alloy towards hardening is de-
creased to a minimum, no changes of volume oc-
curring in the case of sudden fluctuations of
temperature. Moreover a fine casting capacity
is attained; in this, it came as a surprise that
when iron was present in the alloy, the higher
carbon content promoting the desired thinness
could be maintained in spite of the presence of
tantalum, whereas in general it is known from
the practice that in adding tantalum to alloys
destined for cutting tools the carbon content re-
quires to be decreased. This results in the sharp

edges, corners, cutting edges etc. even of the
most complicated tools, for instance, milling
tools, being completely filled in when casting, the
exterior of the tools being, in consequence,
smooth and well-looking. The material is easy
to work upon after annealing. A quite peculiar
advantage is the elimination of the hardening
of the tools entailing so many difficulties, it being
possible to harden the alloy in the lower hard-
ening temperature range of from about 900 to
about 1200° C. The addition of a small percent-
age of tantalum to the basic alloy for tools known
for itself already therefore represents a technical
and economic progress of the utmost importance;
due to it has become possible for the first time
fully to eliminate the unequality formerly occur-
ring in alloys of this kind.

The percentage of tantalum, that is, its in-
crease or decrease is most closely interconnected
both with the percentage of carbon and molyb-
denum in the alloy and with the percentage of
cobalt; on the one hand it is preferably chosen
equal to the total of the contents in carbon and
molybdenum while on the other hand it rises and
drops in proportion to the percentage of cobalt.
Thus, for instance, a content in cobalt of 1% cor-
responds with a content in tantalum of 0.25-
0.5%. When the percentage of cobalt is in-
creased to 2% the content in tantalum rises to
approximately 0.5-1%.

Apart from iron, the alloy improved by the ad-
dition of tantalum essentially contains the fol-
lowing ingredients:

C	Cr	W	Mo	Co	Ta
Percent 0.25-1.3	Percent 2-16	Percent 3-6	Percent 0.25-2.5	Percent 0.25-6	Percent 0.25-3

The advantages of the addition of tantalum
or, respectively their effect upon the alloys
mentioned are to a very high degree increased
by even a small addition of copper (0.1-1%)
which may partially even replace the tantalum.

If needed other ingredients improving its ef-
ficiency may be alloyed to the steel. Thus an
alloy of the following composition has proved
highly advantageous:

C	Cr	W	Mo	Co	Mn	Si	Ta	Cu
Per- cent 0.30	Per- cent 10	Per- cent 3	Per- cent 1	Per- cent 2	Per- cent 0.35	Per- cent 0.25	Per- cent 2	Per- cent 0.30

I claim:
1. An alloy steel having percentages in car-
bon of from 0.25 to 1.3%, chromium of from 2
to 16%, tungsten of from 3 to 6%, molybdenum

of from 0.25 to 2.5%, cobalt of from 0.25 to 6%, tantalum of from 0.25 to 3%; the balance being iron and little quantities of substances such as manganese, silicon and vanadium.

5 2. An alloy steel as claimed in claim 1, in which the content of tantalum is substantially one-third of the total parts by weight of carbon and molybdenum.

3. An alloy steel as claimed in claim 1, in which the content of tantalum is approximately one-third to one-half of the content by weight of cobalt.

LEO KLÜGER.