

UNITED STATES PATENT OFFICE

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DIE BLOCK

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This invention relates to steel alloys which are particularly adapted for use in die blocks used for hot work forging processes, and steel items requiring great hardness, durability and strength, and has for its principal object to provide an alloy of the class described, having desirable characteristics approximating those of the nickel, chromium, molybdenum type such as described in my prior Patent No. 1,464,174 and my co-pending application Serial No. 33,331, filed July 26, 1935, but more economical to manufacture, due to the use of less expensive alloying elements. The alloy forming the subject of this application is, therefore, sufficient to meet usual commercial requirements which are not so severe as to demand more expensive alloys such as my previously patented alloy hereinabove referred to. The alloy also has the further advantage of being commercially machinable even when hardened and tempered to relatively high hardnesses.

In carrying out my present invention, I utilize as the principal alloying elements chromium, molybdenum and copper. My experiments have shown that chromium-copper-molybdenum steels have tensile and impact values fairly comparable to chromium-nickel-molybdenum steels, with the added advantage of greater uniformity of hardness penetration.

The preferred ranges of the principal alloying elements are as follows:

Carbon	Per cent
Chromium	.25 to 1.10
Molybdenum	.25 to 1.50
Copper	.05 to 2.00
	.25 to 6.00

Other elements such as manganese in fractions up to 1.00%, nickel in residual amounts up to .25%, or silicon in small fractions may be present, as is often the case in special alloy steels of this class.

For most purposes, I find that preferred ranges of elements are substantially as follows:

Carbon	Per cent
Chromium	.25 to .65
Molybdenum	.25 to 1.00
Copper	.05 to 1.00
	.25 to 4.00

These chromium-copper-molybdenum steels

are particularly characterized by uniformity of hardness penetration. For example, a block 11 inch cube of this alloy having .50% carbon, .75% chromium, .35% molybdenum and 2.85% copper, was hardened and tempered to a surface hardness of 364 Brinell. When cut in half, this block showed a center hardness of 352 Brinell, with a corresponding uniformity of hardness throughout the block section. Such uniformity of hardness penetration in large sections is unusual, and is not obtainable in steels in common usage.

These steels are quite free from internal and thermal ruptures, thereby requiring less careful handling in manufacturing and processing. As a hot work steel, such as in a die block, this steel can be used at its higher hardnesses without danger from heat checking.

The steel is readily machinable when annealed by heating above the critical range, and allowing it to cool slowly. To harden, this steel is heated to above the critical range and cooled rapidly by quenching in a suitable medium, and tempering is done in the usual manner by reheating after quenching to the desired point. It is also machinable in hardened and tempered condition for many commercial purposes up to approximately 450 Brinell hardness.

I claim as my invention:

1. A die block for hot forging made of steel alloy consisting of carbon ranging from .25 to 1.10%, chromium .25 to 1.50%, molybdenum .05 to 2.00%, copper .25 to 6.00%, and the balance essentially all iron.

2. A die block for hot forging made of steel alloy consisting of carbon ranging from .25 to .60%, chromium from .25 to 1.00%, molybdenum from .05 to 1.00%, copper from .25 to 4.00%, and the balance essentially all iron.

3. A tempered die block for hot forging made of steel alloy consisting of carbon ranging from .25 to 1.10%, chromium .25 to 1.50%, molybdenum .05 to 2.00%, copper .25 to 6.00%, and the balance essentially all iron.

4. A tempered die block for hot forging made of steel alloy consisting of carbon ranging from .25 to .60%, chromium from .25 to 1.00%, molybdenum from .05 to 1.00%, copper from .25 to 4.00%, and the balance essentially all iron.

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