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ALLOYED STEEL

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2 Claims. (Cl. 75—128)

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This invention relates to an alloyed steel designed particularly for the manufacture of motor valves and other motor equipment, although its use is not limited thereto.

One of the objects of this invention is to reduce the free carbon content to a minimum.

Another object is to produce a steel which is harder and tougher than ordinary valve steels, can be worked with equal facility and is highly resistant to corrosion.

As is well known, motor valves are operated at very high temperatures, and alloy steels that are suitable for use in valves operated at room or other relatively low temperatures, are not usable as motor valve steels.

The valves in modern motors designed for increased power and higher speeds must resist the combined action of heat, corrosion, wear, and stresses to a much greater degree than any other part of the engine. The use of "doped" fuels also adds to the severity of operating conditions to which valves are subjected. In view of these numerous and rigid requirements, relatively few steels are suitable for this purpose.

The motor operating temperature is of paramount importance in the selection of a valve steel. The operating speed and the valve spring pressure, as well as the temperature of operation of a motor are the factors which govern the valve stresses.

The present steel, by virtue of its chemical composition, has a greater hardness at room temperature and retains this hardness to a greater degree after heating than other steels. The hardness is, moreover, very uniform throughout the entire valve. Such uniformity will minimize the residual stresses in a valve and for this reason decreases the susceptibility to warping.

Among the advantages of the present alloy steel are its superior physical and chemical properties; its resistance to temper-embrittlement, and its tensile strength are superior to any known high chrome steels; it was the brittleness developed in high chrome steels which caused automotive engineers to discontinue their use and substitute other types of valve steels.

A serious objection to valve steels containing a relatively high carbon content is that a large amount of free carbon is left in the steel. In order to have the carbon go into solution, I have

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discovered that with the addition of a relatively small percentage of nitrogen in the composition, substantially all of the carbon goes into the solution. This has been determined from a large number of tests.

The composition of the valve steel here under discussion is substantially as follows:

	Per cent
Carbon	.15–.25
Manganese	.90–1.50
Silicon	.75–1.25
Phosphorus	.020 max.
Sulphur	.020 max.
Chromium	20.00–22.00
Nitrogen	.12–.25
Nickel	10.00–12.00
Tungsten	2.00–3.00

Remainder Iron

When nitrogen in the range of 0.14 to 0.22 percent is added to the composition containing 0.15 to 0.25 percent carbon the following effects were observed:

(*a*) Increased the forgeability at 2100° Fahr. as measured by torque-twist test,

(*b*) Increased the annealed hardness, especially for the higher water treating temperature,

(*c*) Increased the yield point and tensile strength about 45% and 30% respectively, with negligible effect on the percent reduction in area or percent elongation,

(*d*) Increased the hot-hardness values at 1200° Fahr. and 1400° Fahr. by about 30% and 40%, respectively,

(*e*) Increased the strength at least 25% at 1400° Fahr.,

(*f*) Improved the corrosion resistance in boiling 65% nitric acid (Huey test), and

(*g*) Had a pronounced beneficial effect on taking the carbides into solution and breaking up the tendency to form "clusters."

The beneficial effects of nitrogen seem to be due to the property of increased carbon solubility at all working temperatures, as compared to those steels without the nitrogen. Increased carbon, in solution, would account for the increase in strength, forgeability and higher hardness at elevated temperatures, and would also account for the greater yield strength, tensile strength,

and corrosion resistance (Huey test) at room temperature.

For the hot Brinnell tests, specimens of the present alloy steel have been water treated from 1900° F., and then tested at 1200 and 1400° F. The resulting hardness was as follows:

	Room temperature	1200° F.	1400° F.
Type:	*Hardness*	*Hardness*	*Hardness*
Without nitrogen	157	106	80.
With .25% of nitrogen	229	131	113.

From which it will be observed that with the addition of nitrogen to the composition, the room temperature hardness and the hardness at elevated temperatures was greatly increased.

From the above description it is manifest that I have produced a valve steel, substantially devoid of free carbon; harder, tougher and not likely to corrode under actual usage in motors using the present day gaseous compounds.

What I claim as new and desire to secure by Letters Patent is:

1. A composition for the manufacture of valve steel, containing carbon .15 to .25%; manganese .90 to 1.50%; silicon .75 to 1.25%; phosphorus .020 maximum; sulphur .020 maximum; chromium 20 to 22%; nitrogen .15 to .25%; nickel 10 to 12%; tungsten 2 to 3%, and the remainder iron.

2. A composition for the manufacture of valve steel, containing carbon .15 to .25%; manganese .90 to 1.50%; silicon .75 to 1.25%; phosphorus .020 maximum; sulphur .020 maximum; chromium 19.86 to 21.78%; nitrogen .14 to .22%; nickel 10 to 12%; tungsten 2 to 3%, and the remainder iron.

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REFERENCES CITED

The following references are of record in the file of this patent:

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