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NICKEL ALLOY FOR AUTOMOTIVE VALVE SEATS

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4 Claims

ABSTRACT OF THE DISCLOSURE

Exhaust valve seats of an alloy differing from S-Monel by small amounts of carbon and/or lead dispersed in the base component in the form of a separate phase have a much longer useful life in automotive engines fueled with lead-free gasoline.

This invention relates to internal combustion engines, and particularly to valve seats for engines operated with lead-free gasoline, and to an alloy for making the valve seats.

Lead oxide is one of the most toxic ingredients in automotive exhaust fumes, and it has been proposed therefore to ban the use of tetraethyl lead in gasoline. While it is the primary purpose of tetraethyl lead in gasoline to raise the octane rating, it is believed that decomposition products of tetraethyl lead form a coating on valves and valve seats which retards wear of the valve seat. It has been found that exhaust valve seats in engines operated with lead-free gasoline suffer premature wear.

The primary object of this invention is the provision of an alloy for valve seats and other engine surfaces which prevents premature wear when the engine is operated with lead-free gasoline. A concomitant object is the provision of a valve seat made of the alloy.

It has been found that the wear resistance of valve seats made of a nickel-copper-silicon alloy of the type known as S-Monel can be increased greatly by incorporating therein small amounts of dispersed carbon and/or lead as a separate lubricant phase.

The base component of the alloy of the invention consists of at least 60% nickel, 27% to 33% copper, 3.0% to 5.5% silicon, and incidental impurities, the principal impurities and their permissible upper limits being iron (7% max.) and manganese (2% max.), also small amounts of other elements. The alloy should have a minimum tensile strength of 70 kg./mm.², minimum yield strength of 55 kg./mm.², an elongation of 1% to 4%, and an impact value (Izod) of 0.15 kgm. to 0.79 kgm.

Although carbon and lead are soft, and high hardness is an important factor in wear resistance, the lubricants of the invention can greatly improve the wear resistance of the base component, hereinafter referred to as S-Monel for the sake of brevity, when present in small amounts, 0.3% to 1.0% carbon, 0.05% to 3.0% lead, or 0.3% to 3.0% lead plus carbon when both are present simultaneously.

The solid solubility of lead in S-Monel is minimal, and an amount of lead in excess of about 0.05% added to the molten S-Monel in the ladle prior to casting is found in the cast alloy as a finely dispersed separate phase at the grain boundaries and within the grains of the S-Monel base. Carbon is more soluble in the base component, and an excess over approximately 0.2% is precipitated as graphite, mostly within the grains of the nickel alloy. The cooling rate does not affect the precipitation of the solid lubricant. The mechanical properties of the alloy are impaired when the indicated upper limits of the lubricant are exceeded. The impact strength

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is particularly affected when lead exceeds the permissible maximum. The lubricant improves not only the wear resistance of valve seats made from the alloy, but also facilitates the casting of valve heat blanks, and particularly the machining of the blanks.

All percentage values in this specification are based on the weight of the base component.

The invention will further be illustrated by an example.

A valve seat for an exhaust valve in a two-cylinder internal combustion engine of 800 cubic centimeter displacement was prepared by casting a blank, and machining the green casting. The valve seat consisted of an alloy of the invention containing 0.42% C, 4.33% Si, 61.57% Ni, 30.15% Cu, 0.12% Pb, balance impurities. It had a Rockwell C hardness of 39.5 and cooperated with a valve of plated Stellite.

The engine was operated at 4,000 r.p.m. with commercial, lead-free gasoline (Shell) for 20 hours and developed 16 H.P. The wear of the valve seat was evaluated in terms of the sinking surface. The measured value was 0.004 mm. When the engine was provided with an otherwise identical valve seat of S-Monel, the wear under the same conditions was 0.009 mm. The difference in wear was minimal during runs with leaded gasoline in which abrasion of the valve seat of the invention was 0.003 mm., and abrasion of the S-Monel valve seat 0.004 mm.

As is evident from the comparison tests described above, the wear resistance of the valve seat made of the alloy of the invention, when used in an engine burning lead-free fuel, is as good as that of an S-Monel valve seat in the same engine when burning leaded fuel.

While the invention has been described with reference to an exhaust valve in an internal combustion engine, other applications for the heat, corrosion, and wear resistant alloy of the invention will readily suggest themselves to those skilled in the art. It should be understood, therefore, that within the scope of the appended claims, this invention may be practiced otherwise than as specifically disclosed.

What is claimed is:

1. A valve seat for an automotive internal-combustion engine essentially consisting of an alloy, said alloy essentially consisting of a base component and a lubricant dispersed in said base component;

said base component including 27% to 33% copper, 3.0% to 5.5% silicon, the balance of said base component consisting of at least 60% nickel and incidental impurities;

said lubricant being at least one member of the group consisting of carbon and lead, the amount of said lubricant being 0.3% to 1.0% when said lubricant is carbon, 0.05% to 3% when said lubricant is lead, and 0.3% to 3.0% when said lubricant is carbon and lead;

all percentages being by weight of said base component.

2. A valve seat as set forth in claim 1, wherein said alloy contains substantially 0.42% C, 4.33% Si, 61.57% Ni, 30.15% Cu, 0.12% Pb, the balance consisting of incidental impurities, and the alloy having a hardness of Rockwell C 39.5.

3. A valve seat as set forth in claim 1, wherein said lubricant is present as a separate phase in an amount of at least 0.05%.

4. A valve seat as set forth in claim 3, wherein said impurities mainly consist of an amount of iron not exceeding 7% and an amount of manganese not exceeding 2%.

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