

## UNITED STATES PATENT OFFICE

2,150,255

## INTERNAL COMBUSTION ENGINE VALVE

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4 Claims. (Cl. 123—188)

My invention relates to improvements in valves for internal combustion engines and particularly in exhaust valves, valve seats, valve seat inserts and similar elements which are exposed when in use to the corrosive effects of the exhaust gases from internal combustion engines.

Valves for the most part have heretofore been forged or cast practically exclusively from steel alloys, principally because such compositions have been developed which have had the desired strength, hardness and toughness at valve operating temperatures, the desired workability for manufacture into valves, a fairly high degree of resistance to scaling and hot oxidation, and which have not been too high in cost.

With the advent of the anti-knock gasolines and the development of higher compression ratios in engines designed to use such gasolines as fuel has come the demand for better valves, and particularly in aircraft engines better valves would be acceptable to the industry substantially irrespective of the cost.

It has heretofore been proposed to use nickel-chrome alloys of the nichrome type for internal combustion engine valves because of their extremely high resistance to corrosion, and valves, having head portions of such alloys welded to steel stems, have been tried and abandoned largely because of their inherent lack of strength at valve operating temperatures.

Chrome-nickel base alloys, and particularly those containing chromium from about 5% to 30% and nickel from 70% to about 90% are extremely resistant to corrosion and hot oxidation and possess many other characteristics admirably adapting them for valves. Nevertheless, these alloys are not acceptable for use in valves in modern type high-compression engines using anti-knock fuels because of the fact that they soften at high temperatures.

I find, however, by incorporating in the base chrome-nickel alloys described above from 0.05% to 2.5% by weight of beryllium that the hardness and strength of the alloy at valve operating temperatures is increased to the extent that very superior valves may be formed therefrom either by forging or casting.

The specific gravity of beryllium is very low and hence small proportions by weight constitute

relatively large proportions by volume of the composition.

The outstanding effect of the beryllium additions on the alloy where used for forged valves is a very substantial increase in the yield point of the composition as well as the strength at high temperatures.

Where the composition is used for cast valves, the effect of the beryllium addition is particularly marked in the remarkably clean surface of the valve in the "as cast" condition. Furthermore, the beryllium addition somewhat lowers the melting point of the composition and very greatly increases the fluidity of the metal when molten so that smooth, clean, homogeneous castings having attenuated sections may be readily made therefrom.

What I claim is:

1. An internal combustion engine valve formed from an alloy containing chromium from 5% to 30%, nickel from 70% to 90% and beryllium from 0.05% to 2.5%; said valve having a substantially higher yield point and substantially greater strength at valve operating temperatures than it would otherwise have without the beryllium.

2. An internal combustion engine valve formed from an alloy containing chromium from 15% to 25%, nickel from 75% to 85%, and beryllium from 0.05% to 0.5%; said valve having a substantially higher yield point and substantially greater strength at valve operating temperatures than it would otherwise have without the beryllium.

3. A cast internal combustion engine valve formed from an alloy containing chromium from 5% to 30%, nickel from 70% to 90%, and beryllium from 0.05% to 2.5%; said valve having a substantially higher yield point and substantially greater strength at valve operating temperatures than it would otherwise have without the beryllium.

4. A cast internal combustion engine valve formed from an alloy containing chromium from 15% to 25%, nickel from 75% to 85%, and beryllium from 0.05% to 2.5%; said valve having a substantially higher yield point and substantially greater strength at valve operating temperatures than it would otherwise have without the beryllium.

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## CERTIFICATE OF CORRECTION.

Patent No. 2,150,255.

March 14, 1939.

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It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 1, second column, line 29, for "to 0.5%" read to 2.5%; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 25th day of April, A. D. 1939.

(Seal)

Henry Van Arsdale  
Acting Commissioner of Patents.