

March 5, 1974

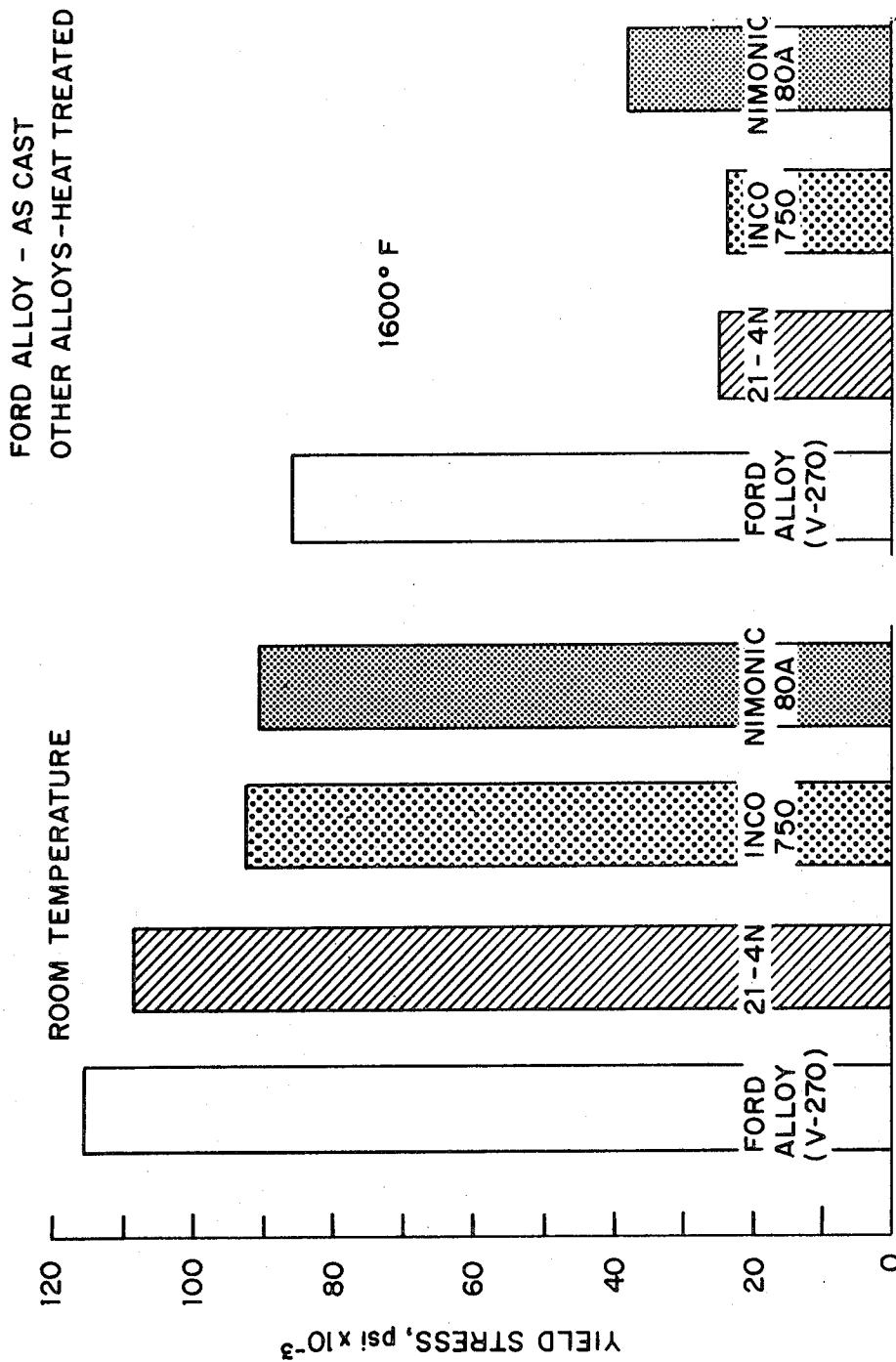
R. G. DAVIES ET AL

3,795,510

VALVE COMPONENTS

Filed Nov. 21, 1968

4 Sheets-Sheet 1



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VALVE COMPONENTS

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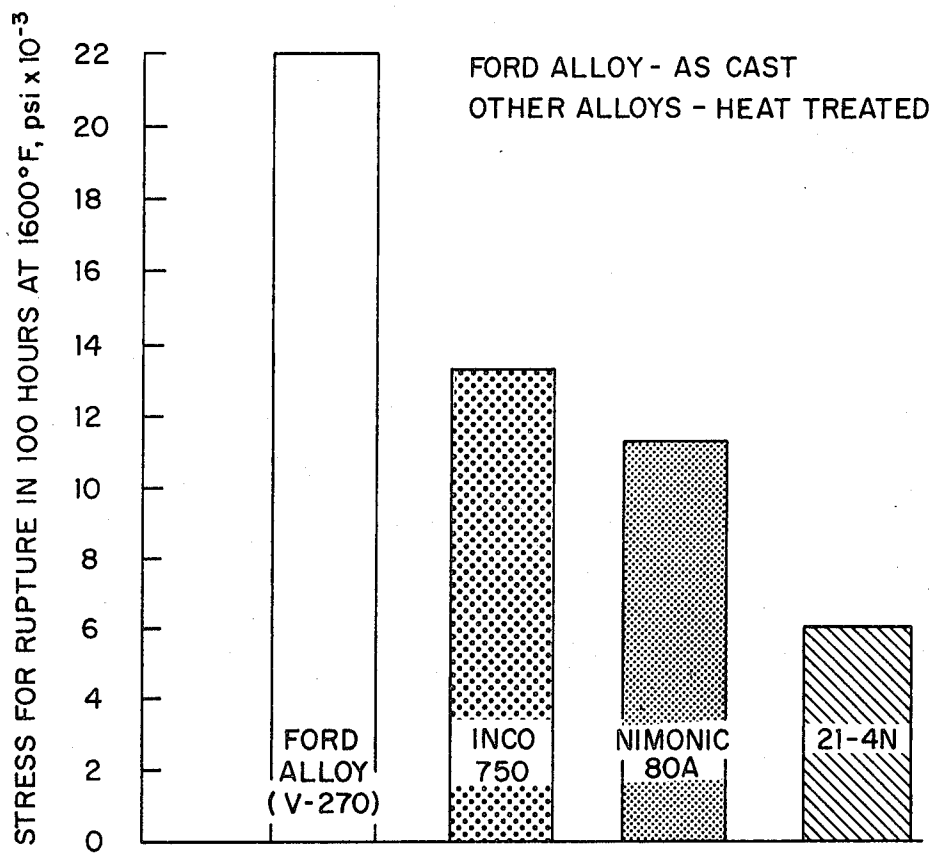


FIG. 2

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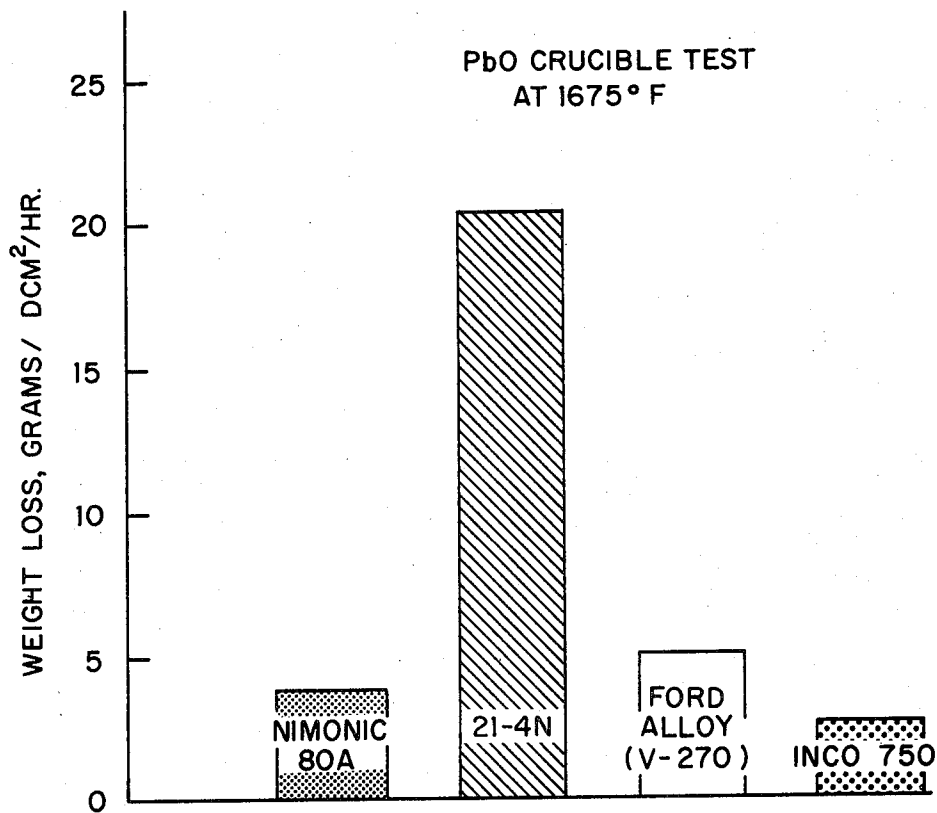


FIG. 3

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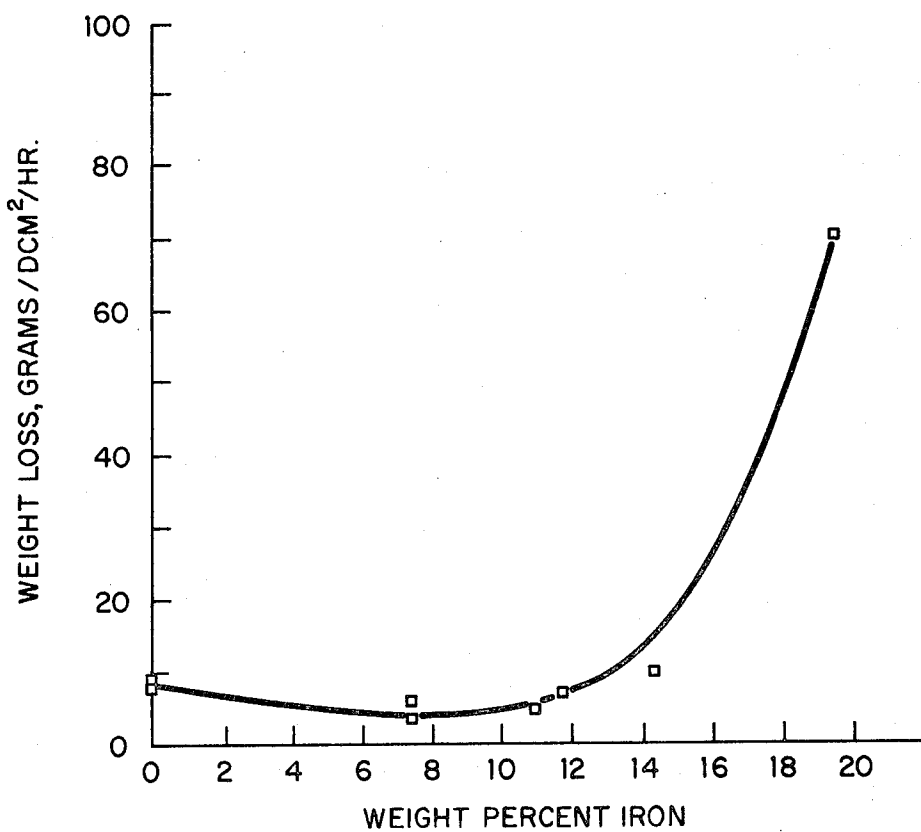


FIG. 4

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3,795,510

VALVE COMPONENTS

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U.S. Cl. 75—171

1 Claim

ABSTRACT OF THE DISCLOSURE

This invention relates to internal combustion engine valve system components which are exposed to exhaust gas and must be resistant to oxidation, sulfidation and the effects of lead compounds at high temperatures. A typical composition of such a component is 20% chromium, 5.5% aluminum, 2.5% titanium, 7.5% iron, 0.15% carbon, remainder nickel.

This invention is predicated upon the discovery that certain quaternary alloys of nickel, chromium, aluminum and titanium possess a combination of qualities highly desirable in internal combustion engine valve components which are exposed to exhaust gas and must be resistant to oxidation, sulfidation and the effects of lead compounds at high temperatures.

Attention is invited to a scholarly dissertation upon the properties of this general type of alloys published in Journal of Metals, October 1956 at pages 1356 to 1362 by A. Taylor. We have discovered that certain nickel base, chromium, aluminum titanium alloys altered with as much as 14% iron are particularly attractive as internal combustion engine valve system components. Particular reference is had to poppet valve heads and valve seat inserts, both of which are subject to the action of hot exhaust gas contaminated with lead compounds. These alloys are used in the as-cast condition. The cast poppet valve heads were frictionally welded to a carbon steel valve from to economize the expensive alloying ingredients in the head.

To document the properties of the alloys described in this specification, a typical such alloy designated V270 has been compared in detail with four other commercially popular and available high temperature alloys, one an iron base alloy and the other three nickel base alloys. The chemical composition of these alloys are given on the following table.

TABLE I

Alloy	Composition of—									
	C	N	Mn	Cr	Co	Mo	Nb	Fe	Ti	Ni
Nimonic 80A	0.06	0.10	19.5	1.1	0.9	6.8	2.5	1.3	Balance	
Inconel X750	0.04	0.70	15.0	0.9	6.8	2.5	0.8	Balance		
21-4N	0.53	0.40	9.0	21.0	4.2	2.0	0.8	6.1	Balance	
Inco 713	0.12	12.5	7.5	2.5	5.5	Balance				
V270	0.15	20.0	7.5	2.5	5.5	Balance				

FIG. 1 has been presented to graphically illustrate the superior properties of the claimed alloys as compared to three popular competitive high temperature alloys. Note that the showing to the left of FIG. 1 relates to yield stress at room temperature while the showing to the right is at the much more critical temperature of 1600° F., which is approximately the maximum temperature now contemplated in internal combustion engine valve system components.

FIG. 2 is a comparable showing and relates to the stress required for rupture in 100 hours at 1600° F. The superior properties of the claimed alloys are clearly apparent insofar as creep rupture is concerned.

FIG. 3 relates to the resistance of the alloys to attack by hot lead compounds and is reported in weight loss of a standard specimen in grams per dcm.² per hour of expo-

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sure. This resistance to lead compound attack is a critical parameter for metals exposed to hot exhaust gas from leaded gasoline.

FIG. 4 has been presented to demonstrate that the iron content of the claimed alloys can be increased to about 14% without loss of resistance to lead compound attack. This is economically important as it enables the alloy to be fabricated from more economical alloys such as ferro-chromium and ferro-titanium. Iron is, of course, per se the cheapest constituent of the alloy.

It is important that these alloys have the maximum possible amount of gamma prime dissolved in a gamma matrix at operating temperature. The amount of gamma prime should be at least twenty percent. The presence of the titanium in this alloy permits this particular structure to be obtained.

The following table is presented to illustrate the resistance of a variety of alloys to attack by molten lead oxide.

TABLE II
Composition wt. percent—Balance Ni

Cr	Fe	Al	Ti	PbO, wt. loss in g./dcm. ² /hrs.
20	7.1	5.6	2.5	2.67
16	7.0	5.6	2.5	3.3
20	5.6	4.5	3.6	8.4
20	7.5	4.5	3.6	3.1
20	7.5	7.0	5.0	11.5
20	8.0	4.0	5.0	1.6
16	10.0	5.0	5.0	1.8
16	15.0	5.0	5.0	15.3
16	20.0	5.0	5.0	37.0
15	5.0	7.0	5.0	2.5
20	7.5	5.6	2.5	4.8
20	12.0	6.1	1.8	5.7
22	10.0	5.0	1.0	7.3
22	11.4	5.0	1.8	7.9
15	20.0	4.9	2.2	18.5
15.8	14.4	5.2	2.3	7.7

NOTE.—All alloys contain ~0.15 C.

We claim as our invention:

1. The as-cast nickel base internal combustion engine valve system component consisting essentially of 20% chromium, 5.5% aluminum, 2.5% titanium, 7.5% iron, 0.15% carbon, remainder nickel.

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CHARLES N. LOVELL, Primary Examiner

U.S. Cl. X.R.

123—188 AA; 148—32