# United States Patent

McCann et al.

[15] 3,653,881

[45] Apr. 4, 1972


## [54] ALLOY FOR USE IN SPARK PLUG ELECTRODES


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[73] Assignee: **General Motors Corporation,** Detroit, Mich.



[22] Filed: **Aug. 3, 1970**

[21] Appl. No.: **60,758**

[52] **U.S. Cl.** ..... **75/171**

[51] **Int. Cl.** ..... **C22c 19/00**

[58] **Field of Search** ..... 75/171, 170; 148/32, 32.5



[56] **References Cited**

UNITED STATES PATENTS

| | | | |
|---|---|---|---|
| 2,266,318 | 12/1941 | Heller | 75/171 |
| 2,958,598 | 11/1960 | Mogford | 75/171 |



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[57] **ABSTRACT**

Alloys adapted for use in spark plug electrodes, the alloy being so constituted as to retain a low electrical resistivity while possessing a high degree of resistance to oxidation and corrosion. The alloy consists essentially of the following constituents on a weight percent basis, chromium 2.0–2.5, iron 3.0–3.5, manganese 1.75–2.25, silicon 1.75–2.25, titanium 0.2–0.4, the balance being nickel.


**2 Claims, No Drawings**

# ALLOY FOR USE IN SPARK PLUG ELECTRODES

This invention relates to an improved oxidation and corrosion resistant alloy especially adapted for use in spark plugs as the center electrode material. As is well known, the high temperatures existing in the combustion chamber together with the sulfur, lead, halogens and water vapor contained in the combustion gases set up conditions which cause rapid deterioration of the spark plug electrodes. This problem has been getting worse with time in that engine operating temperatures and pressures are increasing as greater demands for efficiency, power output and emissions control are made.

The prior art includes numerous alloys, one of which is disclosed in U.S. Pat. No. 2,266,318 granted Dec. 16, 1941. This alloy consists primarily of nickel with additions of chromium and columbium (niobium). However, as is well known in the art, columbium is a very high cost material and increased amounts are required for greater corrosion resistance. Also, the processing of alloys with columbium is very difficult in that it tends to readily oxidize and form an oxide contaminant in the alloy.

We have succeeded in developing an alloy composition showing increased resistance to corrosion over alloys currently in use in the art, while at the same time maintaining a relatively low electrical resistivity. The alloys of our invention are primarily nickel with small but significant amounts of each of chromium, iron, manganese, silicon and titanium. A small amount of carbon as impurity not in excess of 0.05 percent by weight may also be present. The following table shows the composition of our invention as compared with the compositions of two alloys in current use. Our composition, made by melting the constituents together in a furnace and controlled to minimize oxidation, is identified as No. 296, the currently used alloys being identified as No. 23 and Inconel 600.

WEIGHT PERCENT

| | Cr | Fe | Mn | Si | Ti | Ba | C | Ni |
|---|---|---|---|---|---|---|---|---|
| 23 | 1.5 to 2.0 | 0.25* | 1.75 to 2.25 | 0.2* | 0.05 | 0.025 | 0.05 | bal. |
| 296 | 2.0 to 2.5 | 3.0 to 3.5 | 1.75 to 2.25 | 1.75 to 2.25 | 0.2 to 0.4 | — | 0.05* | bal. |
| Inconel 600 | 14.0 to 17.0 | 6.0 to 10.0 | 1.0* | 0.5* | — | — | 0.15* | bal. |

* Maximum

A preferred composition consists essentially of the following constituents in the indicated amounts on a percent by weight basis:

| | |
|---|---|
| Chromium | 2.3 |
| Iron | 3.3 |
| Manganese | 2.1 |
| Silicon | 1.9 |
| Titanium | 0.3 |
| Nickel | Balance |

In evaluating the properties of our alloy as compared with those of existent alloys now in use, we have found that the alloys of our invention exhibit superior corrosion resistant properties. We also have found that the electrical resistivity when measured in microohm centimeters is relatively low as is required for its intended use in the ignition system.

The following chart shows the average results of extensive laboratory testing evaluating the corrosion resistance and resistivity:

| Alloy | Corrosion resistance [1] to 60 wt. percent PbO, 40 wt. percent $PbBr_2$ | Corrosion resistance [1] to 60 wt. percent PbO, 20 wt. percent $PbBr_2$ 20 wt. percent $PbSO_4$ | Electrical resistivity, $\mu\Omega$ cm. |
|---|---|---|---|
| 23 | 1.00 | 1.00 | 30 |
| 296 | 1.96 | 2.23 | 58 |
| Inconel 600 | 0.92 | 1.96 | 100 |

[1] Corrosion resistance = $\frac{\text{Wt. loss of 23 alloy}}{\text{Wt. loss of sample}}$

In performing the corrosion tests the alloy samples were placed in crucibles containing the corrosion inducing materials noted and heated to an elevated temperature and maintained at such temperature for a period of time. In the case of the lead oxide—lead bromide tests, the temperature is 1,370° F. and the period is 5 minutes. In the case of the tests including lead sulphate the temperature is 1,490° F. and the period is 3 minutes. The samples were then removed and thoroughly cleaned and weighed.

It can thus be seen from the foregoing that we have developed an alloy which has outstanding resistance to corrosion and oxidation while at the same time retaining a low order of electrical resistivity. As indicated, such properties are highly desirable in spark plug electrodes where high temperature and pressure and products of combustion impose severe corrosion stresses on the spark plug electrodes.

Our invention is more particularly set forth in the claims which follow.

We claim:

1. An oxidation and corrosion resistant alloy for use in spark plug electrodes consisting essentially of, on a weight percent basis, about 2.0 – 2.5 chromium, about 3.0 – 3.5 iron, about 1.75 – 2.25 manganese, about 1.75 – 2.25 silicon, about 0.2 – 0.4 titanium, the balance being nickel.

2. An alloy as set forth in claim 1 wherein said constituents are present in the amount of about 2.3 percent chromium, about 3.3 iron, about 2.1 percent manganese, about 1.9 percent silicon, about 0.3 percent titanium, the balance being nickel.

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# UNITED STATES PATENT OFFICE
# CERTIFICATE OF CORRECTION

Patent No. 3,653,881 Dated April 4, 1972

Inventor(s) David M. McCann; John Hrinevich, Jr.

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Col. 1, in the table entitled "WEIGHT PERCENT", in the alloy identified as No. "23", add an asterisk after the "0.05" in the "Ti" column and add an asterisk after the "0.05" in the "C" column; in the same table, delete "1110" after the word "Inconel"; delete the word "to" appearing in the alloy column after "Inconel 600"; insert the word -- to -- between the figures "14.0" "17.0" in the "Cr" column; insert the word -- to -- between the figures "6.0" "10.0" in the "Fe" column.

Col. 2, claim 2, line 52, insert the word -- percent -- after "3.3".

Signed and sealed this 18th day of July 1972.

(SEAL)
Attest:

EDWARD M.FLETCHER,JR.
Attesting Officer

ROBERT GOTTSCHALK
Commissioner of Patents