# United States Patent [19]

**Rothman et al.**

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[54] **NITROGEN STRENGTHENED FE-NI-CR ALLOY**


[75] Inventors: **Michael F. Rothman; Dwaine L. Klarstrom,** both of Kokomo; **George Y. Lai,** Carmel, all of Ind.

[73] Assignee: **Haynes International, IMC.,** Kokomo, Ind.



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[52] **U.S. Cl.** ..... **420/584;** 420/586; 420/586.1; 420/53; 420/51; 420/43

[58] **Field of Search** ..... 420/584, 585, 51, 43, 420/53, 586, 586.1



[56] **References Cited**

U.S. PATENT DOCUMENTS

| | | | |
|---|---|---|---|
| 2,121,391 | 6/1938 | Arness | 148/327 |
| 2,398,702 | 4/1946 | Fleischmann | 420/52 |
| 2,423,615 | 12/1947 | Franks et al. | 420/48 |
| 2,513,467 | 7/1950 | Franks et al. | 420/47 |
| 3,306,736 | 2/1967 | Rundell | 420/47 |
| 3,561,953 | 2/1971 | Niimi et al. | 420/47 |
| 3,615,368 | 10/1971 | Braumel | 420/50 |
| 3,627,516 | 12/1971 | Bellot et al. | 420/584 |
| 3,758,294 | 9/1973 | Bellot et al. | 420/584 |
| 4,224,062 | 9/1980 | Danfors | 420/50 |
| 4,409,025 | 10/1983 | Sugitani | 420/584 |
| 4,438,084 | 3/1984 | Rapp | 423/387 |
| 4,463,061 | 7/1984 | Otoguro | 428/683 |
| 4,523,951 | 6/1985 | Andreini et al. | 420/57 |

FOREIGN PATENT DOCUMENTS

| | | |
|---|---|---|
| 55-21547 | 2/1980 | Japan . |
| 56-98457 | 8/1981 | Japan . |



*Primary Examiner*—Deborah Yee

*Attorney, Agent, or Firm*—Buchanan Ingersoll; Joseph J. Phillips; Lynn J. Alstadt



[57] **ABSTRACT**

A corrosion resistant metal alloy having improved formability and workability is disclosed which alloy contains in weight percent about 25% to 45% nickel, about 12% to 32% chromium, of at least one of 0.1% to 2.0% columbium, 0.2% to 4.0% tantalum, and 0.05% to 1.0% vanadium, up to about 0.20% carbon, about 0.05% to 0.50% nitrogen and the balance being iron plus impurities and wherein the carbon and nitrogen content are controlled so that the amount of free carbon and nitrogen defined as

$$(C + N)_F = C + N - \frac{Cb}{9} - \frac{Ta}{18} - \frac{V}{4.5}$$

is greater than 0.14% and less than 0.29%. The alloy may also include in limited amounts one of aluminum, titanium, silicon, manganese, cobalt, molydenum, tungsten, boron, zirconium, yttrium, cerium and other rare earth metals.


**16 Claims, No Drawings**