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(54) **USE OF A HIGH DAMPING CAPACITY, TWO-PHASE FE-MN-AL-C ALLOY.**

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Description

This invention relates to a high damping capacity, two-phase Fe-Mn-Al-C alloy.

Previously, alpha-gamma two-phase alloys have been developed by adding molybdenum and cobalt to the Fe-Ni-Cr alloy system for the purpose of making alloys having both better stress corrosion and hydrogen embrittlement resistance. However, none of these alloys was designed for the purpose of higher damping capacity. The iron-based materials that have been used for high damping capacity are the cast irons. The graphite in gray cast irons is the most important factor for absorbing the high frequency vibration wave. But cast irons generally are not workable, making them of limited value in high damping applications.

According to the present invention, there is provided use of a ferrite-austenite two-phase alloy for high damping capacity applications, said alloy having a composition comprising of 10 to 45 wt% manganese, 4 to 15 wt% aluminum, up to 12 wt% chromium, 0.01 to 0.7 wt% carbon and optionally containing 0 to 4.0 wt% molybdenum, 0 to 4.0 wt% copper, 0 to 2.0 wt% nickel, 0 to 3.5 wt% niobium, up to 500 ppm boron, up to 0.2 wt% nitrogen, 0 to 3.5 wt% titanium, 0 to 2.0 wt% cobalt, 0 to 3.5 wt% vanadium, 0 to 3.5 wt% tungsten, 0 to 2.0 wt% zirconium, up to 2.5 wt% silicon, the balance iron and impurities, the composition being such that the ferrite phase of said alloy comprises 25% to 75% by volume of the alloy, the remainder being essentially austenite, said alloy having a damping capacity of about the same level as that of ductile iron.

For a better understanding of the invention, and to show how the same may be carried into effect, reference will now be made, by way of example only, to the accompanying drawings, in which:-

Figure 1 depicts the damping capacity curve for an alloy in accordance with the present invention; and

Figure 2 depicts the damping capacity curve for ductile iron.

In Fe-Mn-Al-C alloys, manganese and carbon are gamma-phase formers and aluminum is an alpha-phase former. By suitable compositional arrangement, Fe-Mn-Al-C alloys can be designed to be fully gamma phase, such as Fe-29Mn-7A1-1C. Reduction of the manganese or carbon or both of them and the increase of aluminum can promote the appearance of alpha phase, and make the alloy an alpha + gamma two-phase steel. The volume fraction of alpha phase can be controlled by changing the amount of manganese or aluminum or carbon or other ferrite-forming elements.

Example 1

This example illustrates the effect of the element compositions on the change of a volume fraction in the Fe-Mn-Al-C based alloys. Manganese and carbon are austenite phase stabilizers and aluminum is a ferrite phase former. The effect of the carbon content on the ferrite fraction of the Fe-Mn-Al-C based alloys is shown in Table I, in which the chemical composition of aluminum and manganese are essentially constant and the carbon content decreases from 0.5 wt% to 0.11 wt%. With the decreasing of carbon content, the ferrite phase volume fractions of the alloys increases from 0% to 36%. With the change of manganese, carbon and aluminum contents, the volume fractions of ferrite phase and balanced γ phase is controlled to be from 25% to 75%. Within this ferrite fraction range, excellent damping capacity is always found in the Fe-Mn-Al-C based alloy.

Table I

composition alloy No.	Mn (wt%)	Al (wt%)	C (wt%)	ferrite vol%
1	26.0	7.4	0.5	0
2	26.3	7.6	0.34	11.9
3	25.8	7.4	0.11	36.0

Example 2.

This example illustrates the good damping capacity of the said $\alpha + \gamma$ two-phase Fe-Mn-Al-C based alloys which have been measured and determined with comparison to ductile cast iron. The test sample of the invention contained 19.7Mn-5.84Al-5.74Cr-0.19C. The ferrite volume fraction is about 65% balanced with γ phase. The damping capacity curves of the damping capacity tests of the Fe-Mn-Al-C based alloy and ductile cast iron are shown in Fig. 1 and Fig. 2. It is seen that the damping capacities of the two alloys are almost equivalent.

Example 3.

This example illustrates the good workability of $\alpha+\gamma$ two-phase Fe-Mn-Al-C based alloys. The alloys listed in Table II were cast into ingot; homogenized at 1200°C; cut and hot forged at 1200°C; further annealed at 1150°C and descaled. The alloys were cold rolled into 2.0 mm thick strip and annealed. The ferrite volume percentages of these strips were measured and are listed in Table III. The mechanical properties of these annealed strips are also listed in Table III. It is seen that the alloys of the invention have good workability and excellent mechanical properties.

Table II

alloy no.	Mn	Al	C	Cr	Other
#109	25.1	6.7	0.287	5.6	200ppmN_2
#108	30.3	6.3	0.244	5.8	----
#320	21.6	6.8	0.11	0	----
#317	20.0	6.1	0.4	5.5	0.92Mo
#129	33.4	10.3	0.47	2.1	0.2Ti
#116	29.5	10.2	0.4	0	0.1Nb

Table III

sample no.	0.2% proof stress (ksi)	ultimate tensile stress (ksi)	% elongation	hardness (Rb)	ferrite %
#109	45	103	42	84	45
#108	39	94	44	80	28
#320	41	98	43	82	67
#317	44	101	41	83	75
#129	61	112	38	86	65
#116	59	109	37	85	73
1 ksi = 6.895 MPa					

Claims

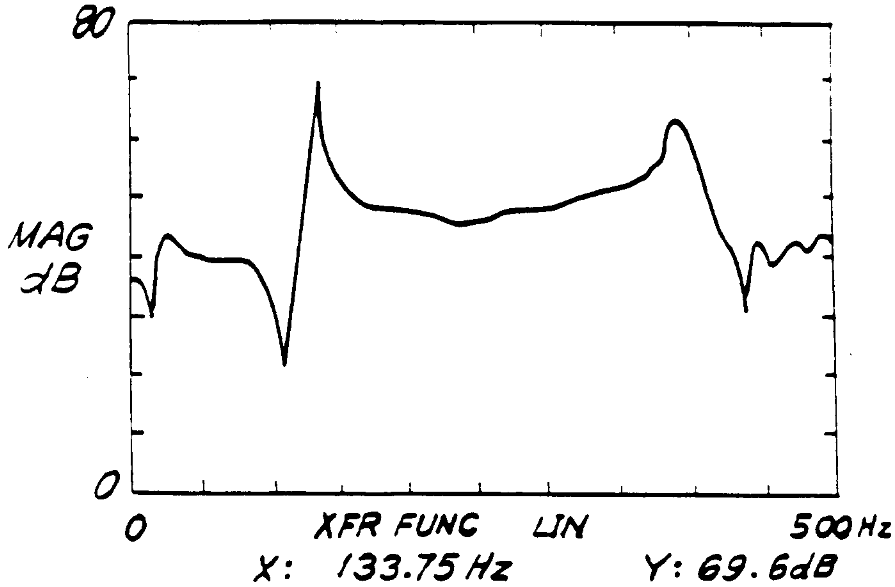
1. Use of a ferrite-austenite two-phase alloy for high damping capacity applications, said alloy having a composition comprising of 10 to 45 wt% manganese, 4 to 15 wt% aluminum, up to 12 wt% chromium, 0.01 to 0.7 wt% carbon and optionally containing 0 to 4.0 wt% molybdenum, 0 to 4.0 wt% copper, 0 to 2.0 wt% nickel, 0 to 3.5 wt% niobium, up to 500 ppm boron, up to 0.2 wt% nitrogen, 0 to 3.5 wt% titanium, 0 to 2.0 wt% cobalt, 0 to 3.5 wt% vanadium, 0 to 3.5 wt% tungsten, 0 to 2.0 wt% zirconium, up to 2.5 wt% silicon, the balance iron and impurities, the composition being such that the ferrite phase of said alloy comprises 25% to 75% by volume of the alloy, the remainder being essentially austenite, said alloy having a damping capacity of about the same level as that of ductile iron.

Patentansprüche

1. Verwendung einer Ferrit-Austenit-Zweiphasenlegierung in Anwendungen, die ein hohes Dämpfungsvermögen verlangen, wobei diese Legierung eine Zusammensetzung aufweist, die 10 bis 45 Gew.% Mangan, 4 bis 15 Gew.% Aluminium, bis zu 12 Gew.% Chrom und 0,01 bis 0,7 Gew.% Kohlenstoff umfaßt und gegebenenfalls 0 bis 4,0 Gew.% Molybdän, 0 bis 4,0 Gew.% Kupfer, 0 bis 2,0 Gew.% Nickel, 0 bis 3,5 Gew.% Niob, bis zu 500 ppm Bor, bis zu 0,2 Gew.% Stickstoff, 0 bis 3,5 Gew.% Titan, 0 bis 2,0 Gew.% Cobalt, 0 bis 3,5 Gew.% Vanadium, 0 bis 3,5 Gew.% Wolfram, 0 bis 2,0 Gew.% Zirkon und bis zu 2,5 Gew.% Silicium enthält, wobei der Rest Eisen und Verunreinigungen ist und die Zusammensetzung derart ist, daß die Ferritphase der Legierung 25 bis 75 Vol.% der Legierung umfaßt, der Rest im wesentlichen Austenit ist und die Legierung ein Dämpfungsvermögen mit etwa dem gleichen Wert wie duktiles Eisen hat.

Revendications

1. Utilisation d'un alliage à deux phases ferrite-austénite pour des applications nécessitant un pouvoir d'amortissement élevé, ledit alliage ayant une composition renfermant 10 à 45% en poids de manganèse, 4 à 15% en poids d'aluminium, jusqu'à 12% en poids de chrome, 0,01 à 0,7% en poids de carbone, et contenant éventuellement 0 à 4,0% en poids de molybdène, 0 à 4,0% en poids de cuivre, 0 à 2,0% en poids de nickel, 0 à 3,5% en poids de niobium, jusqu'à 500 ppm de bore, jusqu'à 0,2% en poids d'azote, 0 à 3,5% en poids de titane, 0 à 2,0% en poids de cobalt, 0 à 3,5% en poids de vanadium, 0 à 3,5% en poids de tungstène, 0 à 2,0% en poids de zirconium, et jusqu'à 2,5% en poids de silicium, le complément étant constitué de fer et d'impuretés, la composition étant telle que la phase ferrite dudit alliage représente 25% à 75% en volume de l'alliage, le restant étant essentiellement de l'austénite, et ledit alliage présentant un pouvoir d'amortissement à peu près du même niveau que celui du fer ductile.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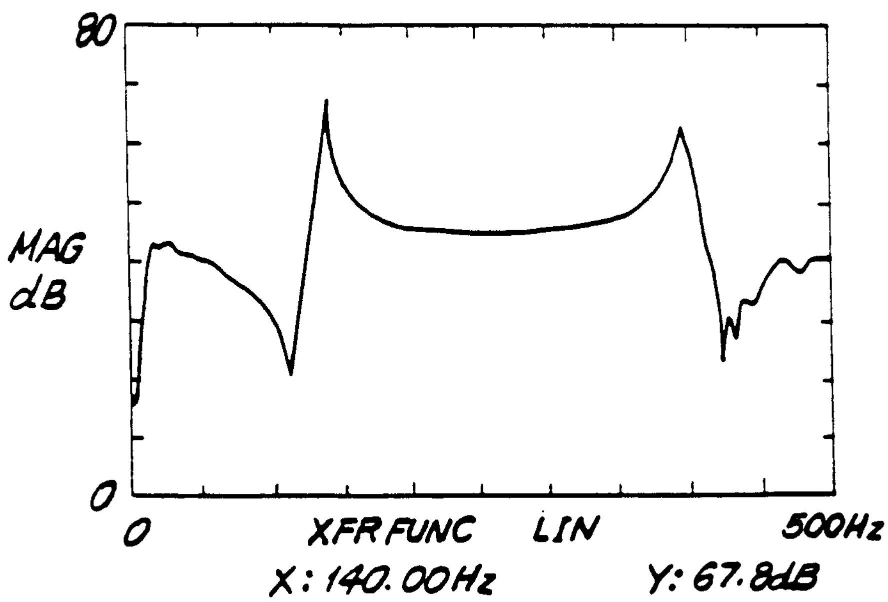
X: 133.75 Hz
Y: 69.6dB

FIG.1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Y: 67.8dB

FIG.2