A FEW CHARACTERISTICS OF RUSTLESS INVAR

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We know, from H. Masumoto's research work, of some remarkable properties of iron-cobalt-chrome alloys. We noted : 1° that the Fe 37, Co 54, Cr 9 % alloy, in annealed and slowly cooled bars is really an invar with a dilatability still lower than that of Ch.-Ed. Guillaume's invar nickel-steel; 2° that this metal is appreciably rustless; 3° that it is remarkably stable (Guillaume unstability coefficient 1 μ, while that of ordinary invar is at leat 3 μ; 4° that its elasticity coefficient (Young's modulus) is about 18.200 Kg/mm^2. These characteristics make it therefore suitable for the manufacture of geodetic wire. Now, having had a bar drawn into a 1 mm. 65 thick wire we were surprised to note a considerable increase in dilatability from $0.7.10^{-6}$ to $8.2.10^{-6}$, while in the case of nickel invar, wire-drawing produced, on the contrary, a small decrease (about 1.10^{-6}).

The Imphy Works that kindly worked out this alloy for the "Bureau International des Poids et Mesures" and undertook the wire-drawing, determined the effect of gradual annealing on the dilatability of the cold-drawn metal. The results obtained have been confirmed and rendered more explicit by ourselves. It is to be noted that dilatability decreases slightly as the annealing temperature increases, it then goes up to $10,5.\ 10^{-6}$, after 750° C. and goes down rapidly to somewhere about zero, after an annealing temperature of approximately 900° C. Beyond this figure and up to 1.100° C., dilatability is no longer affected by annealing.

Our measurements were taken on a 24 m. long wire with a dilometer capable of submitting it to various tensile stresses. Moreover, this arrangement enabled us to determine Young's modulus and its thermic coefficient on the same sample. Starting at 16.500 Kg/mm^2 for the cold-drawn wire, the modulus increases gradually up to 19.600 Kg/mm^2, after annealing at 750° C. Beyond this, the modulus shows a minimum (E = 14.800 Kg/mm^2) when annealing at 800° C and goes up to about 17.000 to 18.000 Kg/mm^2; it is therefore definitely greater than that of ordinary invar (15.000 Kg/mm^2).

As regards the thermoelastic coefficient, we noted that starting from a normal value for ferrous metals (-300.10^{-6}) it changed its sign with a rapid decrease of dilatability. We have therefore before us a metal which, at an annealing temperature somewhere about 800° C. is an *elinvar* with poor dilatability. One of the characteristics of this alloy when compared with Guillaume's invar and elinvar which contain nickel and are separate, is its extreme sensitiveness to cold hammering or drawing. It is interesting to note that the high dilatability of the extruded alloy involves no anisotropy, as was shown by a measurement taken by Mr. M. Roux, which in a transversal direction gave a dilatability similar to the one mentioned above. We must however note that the elastic strength of this rustless invar is low; which is likely to somewhat restrict its applications; in particular, it would hardly be suitable for the manufacture of geodetic wire for land surveying.