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TUNGSTEN-RUTHENIUM ALLOY AND POWDER-METALLURGICAL METHOD OF MAKING

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This invention relates to an alloy of tungsten containing ruthenium.

It is an object of the present invention to provide a tungsten-base alloy having improved properties.

Still another object of the present invention is to provide a tungsten base alloy with ruthenium as a constituent thereof.

Another object of the present invention is to provide a tungsten-ruthenium alloy having improved characteristics of high density and proportional limit and wherein the alloy has special pertinence to applications such as gyroscopic fly-wheels of high angular velocity and radiation shielding.

Yet another object of the present invention is to provide a tungsten-ruthenium alloy having improved characteristics of high tensile strength and hardness whereby the alloy has special pertinence to applications such as long-wearing electrical contacts.

Still another object of the present invention is to provide a novel alloy comprising, in part, tungsten and ruthenium, which exhibits high ductility and whereby such an alloy may be rolled, headed or swaged without fracture.

Other objects of the present invention and the nature thereof will become apparent from the following description and claims.

In contrast to most tungsten alloys which are characterized by brittleness, this alloy is quite ductile and may be worked easily.

It has been found that an alloy of tungsten containing ruthenium to approximately 0.5% exhibits great improvement as hereinafter described.

A preferred method for producing this alloy consists in dissolving ruthenium trichloride in warm water until saturation is reached and then adding tungsten powder about 1 micron diameter while stirring constantly and thoroughly. This mixture is dried at 200–300° C. and the residue placed in a hydrogen atmosphere furnace and fired at 800° C. for one hour, thereby reducing the ruthenium compound to metallic ruthenium. To that mixture is added nickel, iron and molybdenum powders 3–5 microns diameter in such proportion that the overall composition by weight is 180 parts tungsten, 12 parts nickel, 3 parts iron, 4 parts molybdenum and one part ruthenium. This mixture is ball-milled until complete blending ensues whereupon it is placed in a powder press and molded into the desired shape at a pressure of 20,000 p.s.i. after which it is sintered in a dry hydrogen atmosphere at 1460° C. for about one hour.

Table I shows the constituents of this alloy compared to a similar alloy manufactured by the assignee. The latter is known by the brand-name "Gyromet 1100" and has achieved wide usage.

TABLE I

Item	W	Ni	Fe	Mo	Ru
"Gyromet 1100," percent	90	4	2	4	0
Subject Alloy, percent	90	6	1.5	2	0.5

Table II lists a comparison of the mechanical properties of the aforementioned alloys from which it can be noted that the subject alloy has a 50% greater proportional limit and 5 times the elongation of "Gyromet 1100." Unquestionably, these values indicate a major improvement has been made in the form of this novel alloy.

TABLE II

Characteristic	Gyromet 1100	Subject Alloy
Proportional Limit, p.s.i.	90,000	133,000
Tensile Strength, p.s.i.	150,000	160,000
Percent Elongation	2	10
Density, g./cc.	17.25	17.25

The ratios of nickel to iron to molybdenum are such that small deviations from these ratios should still result in alloys of comparable properties.

The invention heretofore described features a novel alloy of approximately 90% tungsten, 6% nickel, 2% molybdenum, 1.5% iron and 0.5% ruthenium with qualities of high proportional limit, high elongation and high density.

Having described this invention completely, the following claims are made:

1. An alloy consisting essentially of 90% tungsten, about 6% nickel, about 2% molybdenum, about 1.5% iron and about 0.5% ruthenium.

2. A method of forming a ductile alloy of tungsten containing ruthenium comprising the steps of: preparing a saturated solution of ruthenium trichloride in warm water, adding tungsten powder approximately 1 micron diameter while stirring constantly, drying at 200–300° C., placing residue in a hydrogen furnace at 800° C. for one hour, adding nickel, iron, and molybdenum powders 3–5 microns diameter in such proportions that the mixture comprises 180 parts W, 12 parts Ni, 3 parts Fe, 4 parts Mo and 1 part Ru, ball-milling this mixture until the constituents are completely blended, molding this powder in a powder press at 20,000 p.s.i. and finally sintering the compacts in a hydrogen atmosphere for one hour at 1460° C.

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