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HARD METAL ALLOY FOR STRUCTURES OPERATING UNDER PRESSURE AND/OR SLIDING MOTION

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In cases where certain structures, such as shafts, stop rings of mechanical hammers and cams of valve shafts, wear their corresponding counterparts, such as bearing linings, chucks of rotating mechanical hammers and tappets of internal combustion engines, by pressure and/or a sliding motion, it is customary to use for such counterparts, hard metal alloys which have high ductility and resistance to abrasion, for example cemented carbides such as sintered hard metal alloys consisting of tungsten carbides with an addition of about 6 to 12% cobalt, iron or nickel. The parts working together with the counterparts made of such hard metal alloys, however, could not be made out of the same hard metal alloys, due to freezing of the component parts. The same thing happened if the percentage composition of the hard metal alloys used for the working parts and their corresponding counterparts was made different. On account of this difficulty the working parts of the corresponding counterparts of hard metal alloys which are being subjected to pressure and/or sliding motion, generally have been made of strong and hard steel, such as chrome nickel steel. However, as the hardness of all known steels is far below the hardness of the known hard metal alloys such as cemented carbides a rapid wearing of the steel working parts always had to be accepted as unavoidable.

Extensive investigations have shown that the alloying, which causes the freezing, between the individual particles of rubbing bodies does not affect in like manner all the substances of which the hard metals are composed. The particularly surprising result was obtained, that the carbides of titanium, zirconium, vanadium, niobium and tantalum show a very slight tendency to weld with cemented tungsten carbide. This slight tendency to weld is shown by said carbides of the fourth and fifth group of the periodic system of elements, and as was found, also by metallic chromium and chromium carbide, even when they have absorbed tungsten carbides in solid solution as combination crystals in their grids.

In accordance with the present invention, it is proposed to use hard metal alloys made of mixtures of 30 to 95% tungsten carbide and 70 to 5% of one or several carbides of titanium, zirconium, vanadium, niobium, tantalum, chromium, or metallic chromium, for the working parts (for instance shafts) of combinations subjected to pressure and/or sliding motion, and to use hard metal alloys such as cemented tungsten carbide consisting of tungsten carbide and up to 20% of one or several metals of a lower melting point, especially of the iron group, for the counterparts, such as bearing linings. It is advisable that the working parts as well as the corresponding counterparts should be produced in a well known manner by sintering. Depending upon the extent to which the danger of welding is of importance for any given purpose, the amount of other carbides or metallic chromium, which are used for the making of the working parts in addition to tungsten carbide, may be varied between 5 and 70%. The balance of tungsten carbide increases the ductility and tensile strength of the working parts.

Tantalum carbide may be added to the counterparts, in quantities of less than 5%, in order to increase their hardness. If particularly high demands are made concerning the tensile strength of the working parts, additions of metals with a lower melting point, especially of the iron group, may be made to the mixture of tungsten carbide and aforesaid carbides or metallic chromium. However, as these metals increase the tendency to freeze to the counterpart, the proportion of such metals with a lower melting point must not exceed 10%, and under no circumstances should it become equal to the contents of the counterpart of metals with a lower melting point.

The following tabulation contains recommended compositions of the component working and counterparts:

	Working part	Counterpart	Working part	Counterpart	Working part	Counterpart
	Percent	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
Tungsten carbide	80	95	35	85	60	88
Titanium carbide	5		30		25	
Zirconium carbide					5	
Vanadium carbide			20			
Niobium carbide	5					
Tantalum carbide	10		5			
Chromium carbide			10			
Metallic chromium					3	
Cobalt		5			6	12
Nickel				10	1	
Iron				5		
	100	100	100	100	100	100

What we claim as new and desire to secure by Letters Patent of the United States, is:

1. In combination, a bearing element and a

cooperating counterpart element one of said elements consisting of a cemented tungsten carbide, the other element consisting of a hard metal alloy consisting of about 30 to 95% tungsten carbide and 70 to 5% of one or more of the carbides from the group titanium carbide, zirconium carbide, vanadium carbide, columbium carbide, chromium carbide, the lower percentage of tungsten carbide being associated with the higher percentage of the carbides from said group.

2. In combination, a bearing element and a cooperating counterpart element, one of said elements consisting of a cemented carbide containing about 5 to 15% metal of the iron group, about 5% tantalum carbide with the remainder tungsten carbide, the other element consisting of a sintered hard metal alloy containing an appreciable quantity but less than 10% of metal of the iron group the remainder of the alloy consisting of about 30 to 95% tungsten carbide and 70 to 5% of one or more carbides from the group titanium carbide, zirconium carbide, vanadium carbide, columbium carbide, chromium carbide, the lower percentage of tungsten carbide being associated with the higher percentage of the carbides from said group.

3. In combination, a sintered bearing element and a cooperating sintered counterpart element, one of said elements consisting substantially of tungsten carbide and up to about 20% lower melting point metal, said other element containing about 30 to 95% tungsten carbide and 70 to 5% of one or more carbides from the group titanium carbide, zirconium carbide, vanadium carbide, columbium carbide, chromium carbide, the lower percentage of tungsten carbide being associated with the higher percentage of one or more carbides from said group.

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