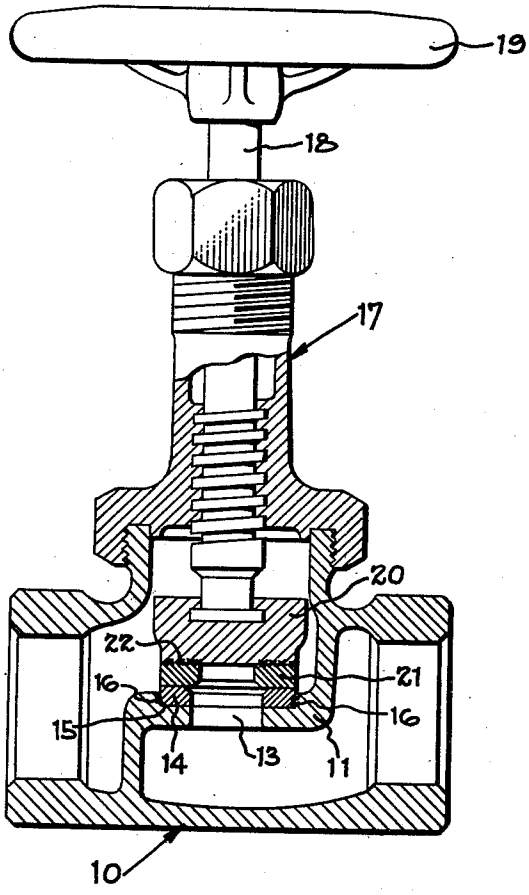
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HARD DUCTILE ALLOY

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HARD DUCTILE ALLOY

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This invention relates to an alloy which is characterized by extreme hardness but also by a reasonable amount of ductility which particularly adapts castings fabricated from the alloy for use where nominal flexing or ability to withstand some distortion is required. This general type of alloy is disclosed in United States Patent No. 2,245,566, issued June 17, 1941, for "Welding Rod"; it comprises substantially 6 to 12% silicon, 9 to 30% chromium and the balance nickel.

Castings made from such an alloy are too hard to be machined by turning or boring in the usual manner, and therefore, they must be formed to shape by grinding. Because of its extreme hardness and wear resistance, such an alloy is potentially useful where such characteristics are desirable, as in the seats of valves which are required to withstand the abrasion incidental to the flow of fluids sometimes under high velocity and pressure. However, if valve seats in the form of castings are made from such an alloy and are brazed in position in the valve structure. the heat of brazing causes, or may cause, slight warpage, cupping or distortion of the seat elements to occur, thereby defeating the precision with which the seat element initially may have been fabricated. The alloy of the identified patent is not sufficiently flexible, or it is too lacking in ductility, to be distorted sufficiently to overcome the warpage, and the pressure exerted on a distorted alloy metal seat by the valve closing means is apt to cause it to fracture or break. Thus, although the total amount of distortion caused by the heating incidental to the brazing of the piece may actually be very small, still the brittleness of the alloy is high and it cannot reliably survive the small deflection which is requisite to physically distort the cast element to its original state.

I have discovered that nickel-chromium-silicon alloys having a hardness and wear resistance desirable for valve seats can be made sufficiently ductile to permit any warpage incidental to the brazing operation to be overcome by physical force, incorporating therein a minor percentage of copper which does not exceed substantially 5% by weight of the alloy. Although the silicon content of the alloy shown in the aforesaid patent is relatively high, the addition of the copper does not cause silicion precipitation as would normally be expected. Most significantly, the incorporation of copper in the alloy does not impair hardness, but does increase ductility, the increase in ductility being roughly proportional to the amount of copper utilized.

A typical example of the use of the alloy in a valve structure is disclosed in the accompanying drawing, although it is to be understood that the alloy may be used for any purpose where hardness and ductility are both desired.

The figure of the drawing is a sectional view of an otherwise conventional globe valve structure. In the drawing, **10** indicates the body casting. Within the casting is the seat diaphragm **11** separating the two ends of the valve, in which is located aperture **13**. An apertured

valve seat element **14** is mounted in a seat recess in the diaphragm portion **15** and is secured in position by a braze **16**, conventionally silver. Mounted over the valve seat **14** is bonnet **17** and stem **18** on the outer end of which is the valve handle **19**. Swiveled to the lower end of the stem is the movable valve element **20** on which a valve seat element **21** is mounted and secured by a braze **22**. Valve seats **14** and **21** are fabricated from the alloy herein described.

The valve seat elements are fabricated from the alloy by casting thereof, after which they are ground to shape and then brazed in position, as by silver soldering. The seat elements may be of any desired shape; for example, they may be in the form of thin annular rings having ground or ground and lapped facial surfaces, which are engageable with one another.

If these discs become distorted or cupped as a result of the heat to which they are subjected when being brazed in place in the valve body, then, when the valve handle is operated to close the valve, the seats will not initially engage one another over their entire facial areas as intended. However, by exerting somewhat greater closing force on the valve handle either one or both of the disc elements will flex sufficiently, without breaking, to permit them to be brought into complete facial engagement. In this manner the valve may be closed completely due to the inherent ductility of the nickel-chromium-silicon-copper alloy.

In general, the alloy should comprise from one-half percent to 5% copper, 6 to 12% silicon, 9 to 30% chromium and the balance nickel. For valve seat castings the preferred alloy comprises 4½ to 5% copper by weight, 7 to 10% silicon, 15 to 20% chromium and the balance nickel.

A comparison of typical alloys disclosed in United States Patent No. 2,245,566 and the alloys of the present invention indicates the degree to which ductility may be attained without sacrifice of hardness.

Heat No.	1836	1811	1831	1837	1818	1830	1824
Ni, percent	73	71.7	75	69.5	69.6	71.4	70.5
Cr, percent	17	18.5	17	16.2	16.2	16.2	16.2
Si, percent	10	9.8	8	9.5	9.51	7.6	8.6
Cu, percent				4.8	4.8	4.8	4.8
Brinell Hardness	522	490	469	522	509	443	484
Deflection	.688	.650	.750	.936	1.00	.9375	.875

Deflection, as given in this table, is the deflection of a ¼ inch diameter cast round rod of alloy held firmly at one end, the deflection being measured at a point 6 inches from the point at which the rod is held.

Like the composition shown in the aforesaid United States Patent No. 2,245,566, the alloys of the present invention are adapted for use in welding, but unlike the previous compositions, the alloys of the present invention provide improved ductility in weld deposits as well as extreme hardness and resistance to abrasion. The invention, therefore, contemplates alloys which are made in the form of welding rods, and weldments fabricated therefrom, as well as castings for valve seats and other uses where ductility is required in combination with hardness and abrasion resistance.

Having described my invention, I desire to be limited only by the following claims:

1. A valve seat comprising a casting of an alloy consisting essentially of ½ to 5% copper, 6 to 12% silicon, 9 to 30% chromium, and the balance nickel.

2. A valve seat comprising a casting of an alloy consisting essentially of 4½ to 5% copper, 7 to 10% silicon, 15 to 20% chromium, and the balance nickel.

3. A valve seat thermally bonded to a seat support, said valve seat being formed of a hard ductile alloy con-

sisting essentially of ½ to 5% copper, 6 to 12% silicon, 9 to 30% chromium, and the balance nickel.

4. A valve seat thermally bonded to a seat support, said valve seat being formed of a hard ductile alloy consisting essentially of 4½ to 5% copper, 7 to 10% silicon, 15 to 20% chromium, and the balance nickel.

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