UNITED STATES PATENT OFFICE.

CHARLES EDOUARD GUILLAUME, OF SEVRES, AND LOUIS CHARLES DUMAS, OF PARIS, FRANCE, ASSIGNORS TO THE SOCIÉTÉ ANONYME DE COMMENTRY-FOURCHAMBAULT, OF PARIS, FRANCE.

ALLOY OF IRON AND NICKEL AND ARTICLES MADE THEREFROM.

SPECIFICATION forming part of Letters Patent No. 626,655, dated June 6, 1899.

Original application filed November 16, 1897, Serial No. 658,741. Divided and this application filed November 22, 1898. Serial No. 697,155. (No specimens.)

To all whom it may concern:

Be it known that we, CHARLES EDOUARD GUILLAUME, a citizen of the Republic of Switzerland, residing in Sevres, (Seine,) and LOUIS CHARLES DUMAS, a citizen of the Republic of France, residing in Paris, France, have invented certain new and useful Improvements in Alloys of Iron and Nickel and Articles Made Therefrom, (the same being the subject-matter of Letters Patent in France, No. 262,737, dated December 31, 1896,) of which the following is a specification.

This invention relates to alloys of iron (or steel) and nickel, and particularly to an alloy having a predetermined coefficient of expansion—to wit, the same or approximately the same as that of glass—the special object contemplated by the invention being the manufacture of various articles composed of glass united to metal.

This application is a division and continuation of our application filed November 16, 1897, Serial No. 658,741.

We have discovered that alloys of nickel and steel expand and contract under variations of temperature in accordance with a law which is peculiar to such alloys and differs generally from the laws governing the expansion of iron and nickel separately.

By varying the proportions of iron and nickel products are obtained whose coefficients of expansion vary within considerable limits, but in accordance with a law expressed by a simple ratio. When the proportion of nickel is less than twenty per cent., the coefficient of expansion lies between that of iron and that of nickel. The coefficient of expansion increases until with twenty-two to twenty-four per cent. of nickel it closely approximates that of brass, when it attains its maximum. As the proportion of nickel is further increased beyond twenty-four per cent. the coefficient of expansion of the alloy diminishes progressively until when the content of nickel reaches about thirty-seven per cent. it is practically *nil*. Beyond this proportion the coefficient of expansion again increases progressively and becomes approximately equal to that of platinum, when the proportion of nickel reaches forty-five per cent. It will thus be seen that to obtain an alloy having the same coefficient of expansion as glass, which is slightly less than that of platinum, we may add a proportion of nickel either sufficiently less or sufficiently greater than thirty-seven per cent. (which represents the minimum) to obtain the desired result. An alloy having twenty-nine per cent. or one having forty-four per cent. of nickel possesses the same or practically the same coefficient of expansion as glass.

The alloy may be produced in crucibles or Martin furnaces or by any of the ordinary processes employed in steel manufacture, and it may contain, besides iron and nickel, varying quantities of metals and metalloids, such as ordinarily enter into the composition of steel—as, for example, carbon, silicon, and manganese, or, as impurities, traces of sulfur or phosphorus. The addition of small quantities of chromium or tungsten does not noticeably affect the property of expansion of the alloy.

It will be understood that within the scope and spirit of the invention an alloy having the desired coefficient of expansion may be produced by mixing the practically inexpansible alloy—*i. e.*, containing about thirty-seven per cent. of nickel—with other metals or alloys in proper proportion, depending, of course, upon the coefficient of expansion of such other metal or alloy.

Our invention is advantageously applicable for the production of objects or articles wherein glass and metal are combined or connected. Among its applications we may mention the manufacture of incandescent lamps, spectacle-frames, mirrors, optical instruments, &c.

We claim as our invention—

1. An alloy of nickel and iron having the same coefficient of expansion as glass, substantially as described.

2. An article composed of glass and of an alloy of nickel and iron having the same coefficient of expansion as glass united thereto, substantially as described.

In witness whereof we have hereunto signed our names in the presence of two subscribing witnesses.

CHARLES EDOUARD GUILLAUME.
LOUIS CHARLES DUMAS.

Witnesses:
J. ALLISON BOWEN,
CHARLES MARDELET.