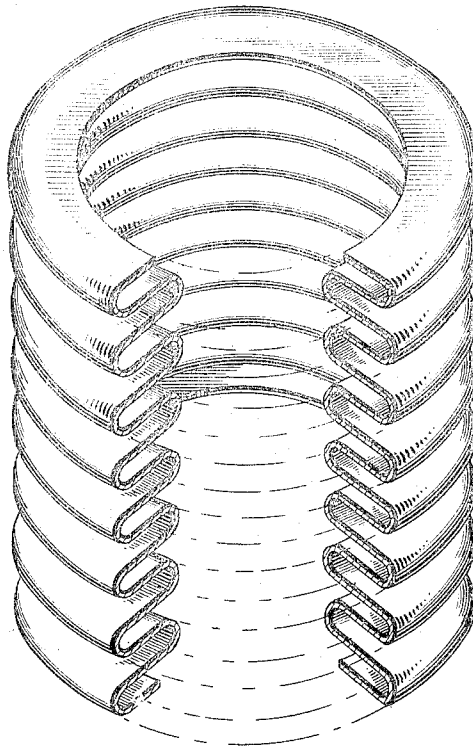


W. M. FULTON.
FLEXIBLE WALL.
APPLICATION FILED JUNE 25, 1918.

1,368,253.

Patented Feb. 15, 1921.



Inventor
Weston M. Fulton,

By

Wm. Cameron, Lewis & Massey
Attorneys.

UNITED STATES PATENT OFFICE.

WESTON M. FULTON, OF KNOXVILLE, TENNESSEE, ASSIGNOR TO THE FULTON COMPANY, OF KNOXVILLE, TENNESSEE, A CORPORATION OF MAINE.

FLEXIBLE WALL.

1,368,253.

Specification of Letters Patent.

Patented Feb. 15, 1921.

Application filed June 25, 1918. Serial No. 241,819.

To all whom it may concern:

Be it known that I, WESTON M. FULTON, a citizen of the United States of America, and a resident of Knoxville, Tennessee, have invented a new and useful Improvement in Flexible Walls, which invention is fully set forth in the following specification.

This invention relates to the construction of corrugated flexible walls, and particularly to the construction of resilient walls such as disclosed, for example, in my prior Patents No. 887,084, granted May 12, 1908, No. 947,229, granted Jan. 25, 1910, No. 967,010, granted Aug. 9, 1910, No. 971,838, granted Oct. 4, 1910, No. 979,460, granted Dec. 27, 1910, No. 1,095,100, granted Apr. 28, 1914, and others.

An object of this invention is to so construct a member of this kind, which is subject to repeated flexure that it will withstand the stresses to which it is subjected, without excessive fatigue, consequent deterioration and eventual rupture, for a maximum period of time.

A further object of the invention is to so construct such a member, subject to repeated flexure, that it will withstand frequent changes in temperature or pressure, or both, without deterioration for a maximum period of time.

Flexible walls of the type disclosed in my patents above referred to are, as fully pointed out in Patent No. 967,010, subject to complex and varying stresses owing to the repeated longitudinal expansion and contraction of the wall and the consequent flexure of the elements composing such wall. The strains developed therein are further complicated, frequently, by the high temperature or pressure, or both, and the repeated changes in such temperature or pressure, or both, to which the wall is subjected. Thus, if the wall be employed as a packing or an actuating member for a valve as disclosed, for example, in my prior Patents No. 894,429, granted July 28, 1908, No. 903,465, granted Nov. 10, 1908, No. 907,771, granted Dec. 29, 1908, No. 1,153,681, granted Sept. 14, 1915, No. 1,176,212, granted March 21, 1916, and others, it is at times subjected to the high temperature and pressure of the controlled fluid, while at other times subjected only to normal temperature and pressure. At the same time, the wall, at each change of the operating conditions, by ex-

pansion or contraction, has set up therein strains of a complicated nature. Particularly if the valve be in a high pressure steam system, the changes in temperature and pressure may be great and the strains accentuated, accordingly, to a considerable extent. It therefore becomes of great importance that the wall be so constructed as to withstand the temperature and pressure changes and the strains set up by the repeated flexure thereof without, through excessive fatigue of the material and its consequent deterioration, likelihood of the rupture of said wall.

Flexible walls of this type have heretofore been made of such materials as copper, brass, bronze, aluminum, steel, etc., and experience has demonstrated that walls made of alloys withstand the operating stresses better than walls made of elementary metals such as copper. But difficulty has been experienced, particularly under conditions of severe service such as above pointed out, from the tendency of the walls to deteriorate and crack, after they have been in use for a time, owing to the eventual excessive fatigue of the material.

I have discovered, however, that, if the wall be made of an alloy of metals which are completely soluble in each other, in all proportions when solid as well as when liquid, the difficulties heretofore experienced are, to a great extent, overcome and the walls are capable of withstanding, through long periods of time, the repeated strains arising from their flexure, even under great temperature and pressure changes, without appreciable deterioration. The alloy which I prefer to use in one composed of copper and nickel. As copper and nickel are completely soluble in each other in all proportions when solid as well as when liquid, the proportions of these constituents may vary within wide limits and will depend, to a considerable extent, upon the conditions of the service to which the member is to be put and the other properties of the material required by such service. As an example, however, and one which I have found to be suitable for general use, an alloy composed of 15% nickel and 85% copper gives excellent results.

The reason why an alloy of the type above characterized is better able to withstand deterioration than the alloys heretofore em-

ployed is not at this time fully understood, but, as a result of microscopic and chemical analysis, is now believed to be as follows: The constituent metals of alloys heretofore employed have not been completely soluble in each other when solid. Therefore, at the point of solidification, there has been a relation of supersaturation of one metal to the other with a consequent tendency of the supersaturated metal to separate out. The repeated flexure of the wall tends to cause a molecular readjustment therein and the supersaturated metal, in its effort to reach a condition of equilibrium, has separated out and formed lines of weakness. With an alloy wherein the component metals are soluble in each other in all proportions when solid as well as when liquid, however, there is no condition of supersaturation when the alloy solidifies and therefore no tendency, owing to a lack of equilibrium, of one metal to separate from the other upon repeated flexure of the wall. Therefore no lines of weakness are developed and the wall is able to withstand the repeated stresses without deterioration. But whether this explanation be the true one or not, the fact remains that, in accordance with my discovery, a wall constructed of an alloy of metals which are completely soluble in each other in all proportions when solid as well as when liquid is capable of withstanding repeated stresses under adverse temperature and pressure conditions without excessive fatigue and deterioration for a much longer period of time than any of the alloys heretofore employed.

Furthermore, an alloy of this type possesses, from a commercial standpoint, the further advantage that it is not essential that the component metals be chemically pure. In the case of such alloys as copper-zinc, the presence of other metals is frequently highly detrimental. In the case of copper-nickel, however, the presence of small amounts of other materials, such as iron and zinc, does not appear to be harmful so long as the quantities of the latter are sufficiently small to be completely soluble in the copper and nickel when solid as well as

when liquid. Therefore, while from a theoretical standpoint a pure copper-nickel alloy is desirable, as chemically pure copper and nickel in commercial quantities are hard to obtain, the alloy may be made of these metals as found on the market, with a consequent lessening of the cost of manufacture but without apparent lessening of the capacity of the alloy to withstand fatigue, provided that the quantity of these other metals be sufficiently small so that they are completely soluble in the copper and nickel when solid; otherwise, if there be a condition of supersaturation, the repeated flexure of the wall will tend to cause, by readjustment of the molecules, a separation out of one of the components with the consequent development of lines of weakness.

The accompanying drawing shows, for purposes of illustration only, an expansible and collapsible wall provided with axial corrugations, of the type disclosed in my patents above referred to, constructed of copper-nickel alloy. This wall may be made in any suitable way such, for example, as by cutting the metal from a sheet, forming a tubular wall by the process described in my Patent No. 967,010, and then making the same into a flexible corrugated member as described in my Patent No. 971,838. The process of making the flexible wall, however, constitutes no part of the present invention and it is to be expressly understood that any suitable process may be employed to this end.

What is claimed is:—

1. A tubular, axially-corrugated member of copper-nickel alloy.
2. An expansible and collapsible member constructed of an alloy of copper and nickel.
3. A flexible axially-corrugated tubular member constructed of a metallic alloy the components of which are completely soluble in each other in all proportions when solid as well as when liquid.
4. A flexible corrugated wall constructed of an alloy of copper and nickel.

In testimony whereof I have signed this specification.

WESTON M. FULTON.