W. M. FULTON.

FLEXIBLE WALL.

APPLICATION FILED APR. 18, 1907. RENEWED SEPT. 26, 1908.

903,465. Patented Nov. 10, 1908.

Fig. 2.

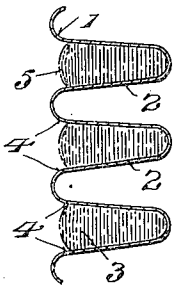


Fig. 1.

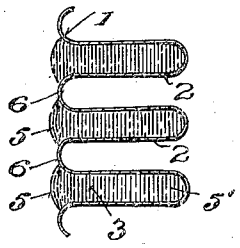


Fig. 3.

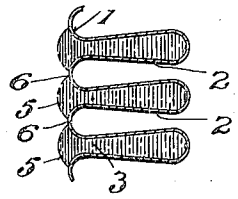
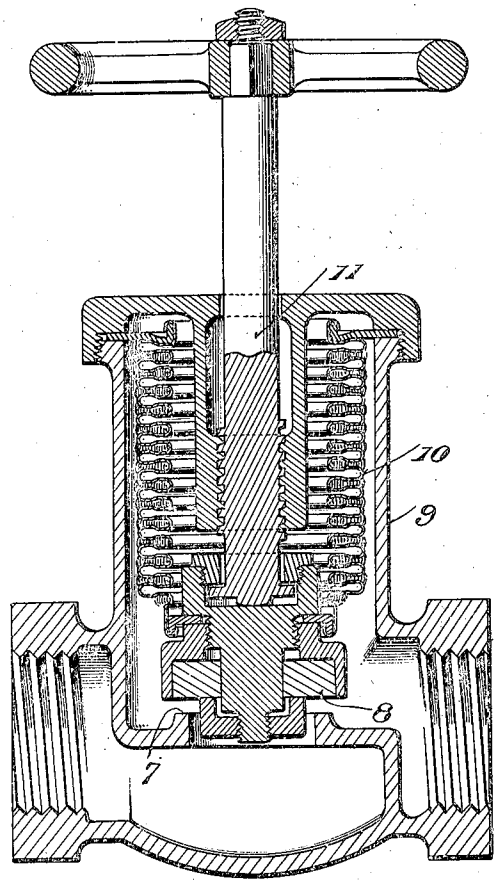


Fig. 4.



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UNITED STATES PATENT OFFICE.

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FLEXIBLE WALL.

No. 903,465. Specification of Letters Patent. Patented Nov. 10, 1908.

Application filed April 18, 1907, Serial No. 369,005. Renewed September 26, 1908. Serial No. 454,852.

To all whom it may concern:

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

The invention relates to flexible corrugated tubular walls for confining vapors, and particularly the vapors of such liquids as water, turpentine, carbon-tetrachlorid, etc., whose boiling points are considerably above ordinary atmospheric temperature.

The primary object of the invention is to lessen the objectionable effect of high temperatures on the resilience of the corrugated metal walls confining such heated vapors and to obviate as much as possible the formation of incrustations on the corrugations which when deposited tend to stiffen the wall and prevent its easy collapse and expansion and also act chemically upon the metal to hasten the destruction of the wall.

To accomplish the objects of this invention I provide a flexible tubular wall of metal for confining the heated vapor, the wall having corrugations whose openings on the side exposed to the vapor are sufficiently narrow to permit the retention of liquid within the corrugations by the capillary film of liquid spanning said openings.

To illustrate one of the applications of this invention it will be described in connection with valve construction, as shown and described in my application Sr. No. 321,284, filed June 11, 1906. This invention is equally useful in other relations such as in steam damper regulators and other liquids than vapor of water may be confined, such as vapor of turpentine and the like.

In order that the invention may be more readily understood reference will be had to the accompanying drawings which are designed merely as illustrations to assist the description of the invention and not as defining the limits thereof.

Figures 1, 2 and 3 are enlarged diagrammatic views of corrugations retaining liquid in the normal, expanded and collapsed positions of the corrugations; and Fig. 4 is a view in vertical section of a steam valve provided with my improvement.

Referring to Figs. 1, 2 and 3, I have therein diagrammatically illustrated on enlarged scale corrugations filled with liquid and retained therein by capillary attraction, in which Fig. 1 shows the corrugations in normal position, while Figs. 2 and 3 show the same corrugations in expanded and collapsed position respectively. The wall 1 is made of a material such as copper, brass or steel, having a molecular attraction for the fluid confined by the wall, and is provided with corrugations 2, 2, having spaces at parts 3, 3, between them, such that when the wall is in expanded position, Fig. 2, the capillary attraction of liquid at the openings 4, 4, of the corrugations exerts a force great enough to overcome the action of gravity upon the liquid and confine the latter within the corrugations. It will be also noted that the space at the openings between the corrugations is such that the capillary film, 5, 5, extends partly around the curved portions 6, 6, when the wall is collapsed, Fig. 3, and practically join each other. When the wall is expanded as indicated in Fig. 2, the capillary film recedes somewhat into the folds of the corrugations.

When a wall of this character is used in a collapsible and expansible vessel which responds to fluctuations of steam pressure to operate a valve stem, for example, there is a constant tendency for the steam to assume the temperature of the air and is hence continually condensed on the walls of the corrugations. Two objectionable results ensue: 1. The large volume of heat thus imparted to the flexible wall due to the "latent heat of condensation" of the steam is so great that the wall cannot dissipate it into the surrounding atmosphere by the relatively slow process of radiation as fast as the supply is renewed by fresh steam from the boiler, and the result is that the wall maintains a temperature not greatly below that of the steam. This high temperature has a tendency to slowly "draw the temper" from the wall so that it gradually loses some of its resilience, and its elastic limit is thus lowered with the result that there is increased liability of the wall being strained when in use and thus having its life shortened. 2. There is nearly always more or less mineral matter in water, and while such matter is generally not volatile so that there is a tendency for steam to consist of pure water, it is nevertheless a well known fact that very small amounts of said mineral and vegetable matters are carried

over by the steam and are deposited upon any object against which the steam may be condensed. Hence, during the long continued use of a flexible wall, such as that used in a damper regulator, the amount of mineral matter, and other impurities, deposited upon said wall by the continual condensation of steam thereon, becomes a matter of moment, for evidently an incrustation upon said wall will tend to stiffen same and prevent its easy collapse and expansion, and there is furthermore great probability that, in most cases, this incrustation contains substances which, in the presence of heat and moisture, will act upon the wall chemically and hasten its destruction.

It will be evident that the retention of liquid in the corrugations prevents the objections pointed out above, for when a new wall is first put in use, some liquid is condensed into the corrugations, and being retained there, all further condensation must take place against the capillary film 5, 5, instead of against the wall. The temperature of the wall is then governed mainly by the temperature of the condensed liquid, the greater portion of which lies within the corrugations 2, 2, remote from the sphere of condensation, and heat is dissipated therefrom by radiation from the wall surface to the outside atmosphere. This heat can be replenished only by the relatively slow processes of conduction and convection through the body of the liquid from the film 5 to the remote regions 5', which furnishes a striking contrast to the large store of heat supplied in the case of a wall upon which condensation is allowed to take place directly. Experience shows that the temperature of the wall is greatly reduced by the retention of condensed liquid with the corrugations according to my invention. Furthermore, the amount of mineral matter and other impurities carried into the corrugations by the vapor is confined to the exceedingly small supply contained in the first supply of liquid that is condensed therein, and the amount of such matter cannot be continually increased by the constant action of condensation, as in the case of a wall freely exposed to the vapor at all times.

It will be noted in Fig. 1 that a small portion of the curved portions 6, 6, of the corrugations are exposed to the action of condensation, and when the wall is expanded, as shown in Fig. 2 the amount of exposed surface is increased. Experience shows that the oscillation of the capillary film around the surface 6, 6, as the wall is expanded from its collapsed position in Fig. 3 to its expanded position in Fig. 2, and re-collapsed, as the regulator operates, tends to cleanse the surface 6, 6, and the proximity to this surface of the large amount of liquid in the corrugations cools it quite effectually. I may, however, make my corrugations so narrow that, even when the wall is expanded, the capillary films will practically meet around the surfaces 6, 6.

In Fig. 4 I have illustrated one application of the principle of the invention to a quick-opening valve for controlling the flow of steam where the corrugated wall serves as a substitute for a valve packing, as described in my application Sr. No. 321,284, above referred to. Only so much of the construction will be here described as to enable the present improvement to be understood. The valve illustrated is of the angle valve type having a seat 7, receiving a valve 8, and provided with a valve casing 9, inclosing the corrugated wall 10, which separates the steam space from the valve stem 11. The lateral portions of the corrugations connecting the bends are bent to meet each other and nearly close the openings of the folds. On the steam-exposed side, water of condensation collects and fills the spaces, effecting the results previously explained. This form of corrugation lends itself especially to the assistance of the capillary effect in retaining liquid in the folds of the corrugations. The extent of expansion of the corrugations is limited by the valve seat 7, which thereby prevents the opening of the folds so wide as to permit the liquid to escape. Means for limiting the expansion of the wall so that the corrugations will not open greatly beyond their normal position also protects the wall, and I preferably employ such means in connection with this form of wall.

What is claimed is:

1. A flexible corrugated wall for confining a vapor, said wall having corrugations the successive folds of which are in sufficient proximity to constitute liquid-retaining recesses, the liquid being retained therein against gravity by capillary action while the wall expands and collapses.

2. A flexible corrugated wall for confining a vapor, said wall having corrugations the successive folds of which are in sufficient proximity at their openings to constitute liquid-retaining recesses, the liquid being retained therein against gravity by capillary action while the wall expands and collapses.

3. A flexible corrugated wall for confining a vapor, said wall having corrugations the successive folds of which are in sufficient proximity to constitute liquid-retaining recesses, the liquid being retained therein against gravity by capillary action while the wall expands and collapses and means limiting the expansion of the wall within the limits of capillary action for the corrugations.

4. In a steam valve, a flexible corrugated tubular packing wall, said wall possessing a molecular attraction for water and having corrugations whose openings are sufficiently narrow where the steam enters them to allow said openings to be spanned by a capillary

film strong enough to retain water in the corrugations.

5. A flexible corrugated tubular wall for confining a vapor, said wall possessing a capillary attraction for the liquid of said vapor, and having corrugations having laterally inclined portions connected by alternate concave and convex portions, said concave and convex portions being arranged in sufficiently close proximity to allow a capillary film to span the space between them and cover a portion of the surface thereof with sufficient strength to retain condensed liquid in the corrugations.

6. A flexible corrugated tubular wall for confining a vapor, possessing a capillary attraction for the liquid of said vapor; and having corrugations whose openings are sufficiently narrow where the vapor enters them, to allow said openings to be spanned by capillary films strong enough to retain condensed liquid in the corrugations when the wall is positioned with its axis approximately normal to the surface of the earth.

In testimony whereof I have signed this specification in the presence of two subscribing witnesses.

WESTON M. FULTON.

Witnesses:
L. E. GEORGE,
WALTER DAVIS.