

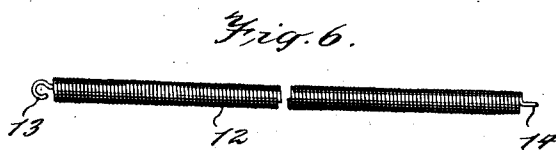
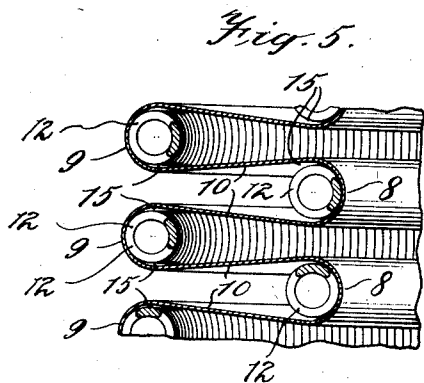
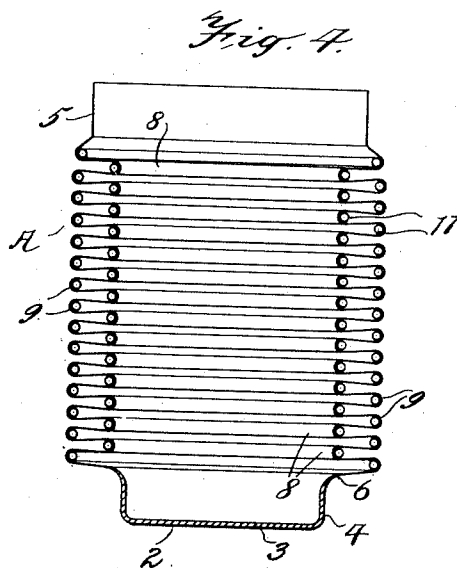
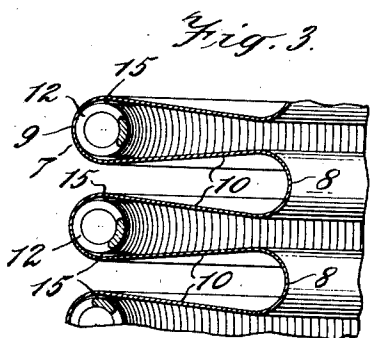
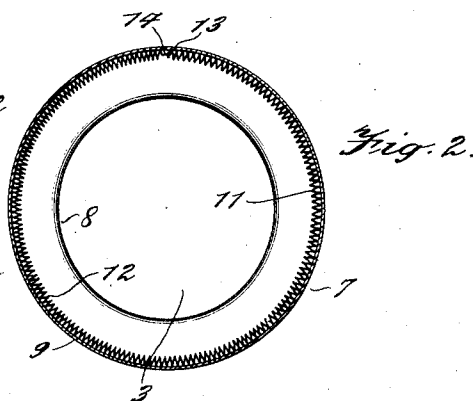
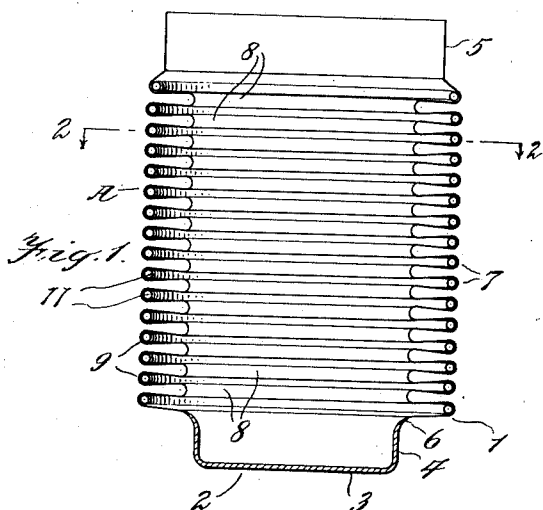
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G. B. DUFFIELD

1,661,131

EXPANSIBLE COLLAPSIBLE ELEMENT

Filed April 29, 1926



INVENTOR.
George Bethune Duffield
BY *[Signature]*
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UNITED STATES PATENT OFFICE.

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EXPANSIBLE-COLLAPSIBLE ELEMENT.

Application filed April 29, 1928. Serial No. 105,408.

My invention relates to new and useful improvements in expansible-collapsible elements, and particularly of that general character or type adapted to be subjected to pressure or thermostatic conditions, for the purpose of operating a desired device or mechanism, or as a packing or seal for rods, valve stems, and the like, or as a flexible coupling between tubes, and consisting generally of an annular or tubular shell of thin metal formed with parallel circumferential corrugations comprising inner and outer bends joined by intermediate wall portions which extend in a general direction transversely of the element, whereby the latter is rendered expansible and collapsible longitudinally, and may be flexed laterally of its longitudinal axis.

It sometimes occurs that elements of the character mentioned are rendered inactive or inoperative, due to the fact through continuous use, or from being subjected to excessive pressures, the metal of the bends of the corrugations becomes fatigued to a point destroying or impairing the resilience of the bends, which results in permanent collapse of the element at one or more points, thus reducing its life or impairing its operation.

One object of the invention is to provide means which will obviate the objectionable results just stated, and contemplates improved means for limiting collapse of the bends of the corrugations to any such extent as might result in destruction or reduction of the elasticity or the resilience of the element.

A further object of the invention is to provide such an element with improved means for limiting the collapsing movement thereof, so as to prevent the bends from being collapsed or flexed beyond a point which would result in the metal of the bends being subjected to overstrains, which would result in a permanent set or fatigue of the metal.

A further object is to provide improved reinforcing means for the purposes above stated, which may be readily applied to the element.

Other objects and the attending advantages will be apparent from the description to follow hereinafter.

The invention consists in the improvements to be more fully described hereinafter,

and the novelty of which will be particularly pointed out and distinctly claimed.

I have fully and clearly illustrated my invention in the accompanying drawings to be taken as a part of this specification, and wherein—

Figure 1 is a longitudinal sectional view through a structure embodying my invention;

Fig. 2 is a section on the line 2—2 of Fig. 1;

Fig. 3 is an enlarged detail sectional view of a portion of the wall shown in Fig. 1;

Fig. 4 is a view similar to Fig. 1, showing another embodiment or application of the same invention;

Fig. 5 is an enlarged detail view similar to Fig. 3, but showing a portion of the embodiment shown in Fig. 4, and

Fig. 6 is a detail view of the reinforcing element.

Referring to the drawings by characters of reference, A designates a preferred form of an expansible-collapsible element, consisting of a tubular metal shell 1, substantially cylindrical in general contour. The shell 1 may be and preferably is closed at one end by an integral head 2, preferably in the form of a boss consisting of a transverse wall member 3 having a circumferential cylindrical portion 4, joined at its edge with the cylindrical shell 1 of the element. The opposite end of the element is provided with a longitudinal cylindrical extension or flange 5, by which the element is adapted to be secured or attached to any suitable element or support, not shown. The head 2, heretofore mentioned, is preferably of thicker metal than that composing the cylindrical shell 1, and the annular portion 4 tapers into the metal of the shell, as indicated at 6. The element in its preferred form is composed of a suitable metal alloy, for example, copper, or alloy of copper and zinc, which, in its preferred embodiment, is drawn by suitable die mechanism to a thickness of approximately .007 of an inch. The body of the element is provided with circumferential corrugations 7, by which the element is rendered longitudinally expansible and collapsible. The corrugations 7 comprise alternate inward, flexible and resilient bends 8 and outward flexible and resilient bends 9,

connected by intermediate wall portions 10, the latter extending in a general direction transversely of the element. These corrugations 7, including the bends 8, 9, and the depth of the walls 10, are preferably proportioned according to the diameter of the element. For example, in an element of $2\frac{7}{8}$ inches outside diameter, the inside diameter of the element may be approximately 1.72 inches, and the depth of the corrugation .344 inch, the bends of the corrugations being curved and struck on a radius of approximately .045 inch.

It will be understood, that while I show and describe a specific form of corrugated, expandable-collapsible element as being one to which my invention is readily applicable, I wish it understood that the invention is not limited thereto, the same being shown and described only for the purpose of disclosing a preferred embodiment.

The element is adapted to be subjected to either internal or external pressure, and is either collapsed or expanded, as the case may be, to actuate a desired device or mechanism, and the corrugations are so spaced that they will have the necessary resilience to give the element the desired extent of movement when actuated, the resilience of the metal in the bends 8, 9 acting to return the element to a normal position or condition of rest. In practice it sometimes occurs that the element is collapsed to such an extent as to flex the bends beyond their point of resilience, which results in fatiguing the metal, and either causing the device to take a permanent set, or impairing its resilience.

According to my present invention, I provide improved means whereby the element is prevented from being collapsed to a point beyond the normal limit of resilience of the bends, thereby preventing continued use or excessive pressures from fatiguing the metal to the objectionable extent above mentioned.

In the preferred embodiment, this means consist of an annular member 11 arranged in the bend of a corrugation, and maintained in contact with the central portion of the bend, as clearly shown in Figs. 3 and 5. This member 11 preferably consists of an annulus or ring, consisting of a flexible helix made from a wire coil 12, the ends of which are provided respectively, with a hook 13 and an eye 14, by means of which the ends of the helix may be connected to each other to form the ring.

The helix is uprepreferably made of a body diameter less than the transverse width of the bend of the corrugation, so that clearance spaces 15 are provided between the opposite sides or faces of the ring and the inner faces of the side portions of the bends 8, 9. The body thickness of the helix is preferably such that upon collapsing movement of the side portions of the bends, the inner

faces of the latter will contact the opposite sides of the ring within the limit of resilience of the bend, whereby excessive collapse of the corrugation, and consequently of the expandable-collapsible element, and fatigue of the metal in the bend, are prevented. It will be understood that the body thickness of the helix will be proportioned in accordance with the internal diameter of the bend of the corrugation to which the helix is applied. For example, in an element of the size heretofore mentioned, namely, $2\frac{7}{8}$ inches, wherein the bend is formed on a radius of approximately .045 inch, the body of the helix is formed on a radius of approximately .040 inch, whereby the helix is of a diameter approximately .080 inch.

The helix may be made of any suitable material which will give the same sufficient transverse rigidity to resist or limit the collapsing movement of the bend of the corrugation. In the preferred form the helix is made of a suitable metal wire, which when coiled will assure the helix being circumferentially resilient or elastic, so that the helix may be stretched.

In the forms shown wherein the reinforcing member is applied within the inner bends 8, the wire of the helix is coiled in such manner that the helix may be stretched to enlarge its diameter sufficiently to pass over the element, and then contracts to such diameter as will cause it to snugly seat within the bend against the central portion thereof, as clearly shown in Figs. 4 and 5. In the case just stated, the diameter of the helix is so determined that when it is in place within the inner bends 8, it will be held in the position stated by its own resiliency. In forming the helix for the inner bends 8, it is made of such diameter that when it is adjusted in position, as shown in Fig. 5, the transverse diameter of the helix will be such, as to bear the proportions heretofore stated, and provide the proper clearance spaces 15, as described.

In the case where the helix is to be applied to the inner faces of the outer bends 9, as shown in Figs. 1 to 5, inclusive, it may be of the same general form as heretofore described, but is made of such a transverse overall diameter as to be slightly greater in diameter than the diameter of the element between opposite points on the inner faces of a bend, and the strand of wire is so coiled as to leave sufficient space between the turns to permit the turns to be resiliently collapsed toward each other. When the helical ring is to be applied to the inside of the outer bend or corrugation, the helix may be collapsed or flexed in any direction to permit it being entered within the opening of the bend, and it then is moved outward within the bend until it contacts the central portion thereof, as shown in the drawings. When in position

within the bend, the helix is held under compression, that is, is tending to expand, due to the proportions and coil arrangement above mentioned, and is thereby held against the central portion of the bend to provide the clearance spaces 15 above mentioned.

From the foregoing it will be seen that when the coil is to be applied to the bend of the inner corrugations 8, it is made sufficiently elastic as to tend at all times to contract, so as to grip the bend, but when it is to be applied to the inside of the outer bends or corrugations 9, it is made so as to be under compression, and therefore tending at all times to expand. However, in either case, that is, whether applied to the bends of the inner corrugations or of the outer corrugations, the helical reinforcing member takes such position as to automatically set itself in proper position, and prevents such collapse of the side portions of the bends as might result in impairment of resilience, or fatiguing of the bend.

What I claim and desire to secure by Letters Patent of the United States is:—

1. An expansible-collapsible element comprising a tubular metallic shell having circumferential corrugations formed of inward and outward bends connected by intermediate transverse wall portions, and means located in certain of said bends to limit collapse thereof in a direction longitudinally of the shell, said means comprising a flexible and longitudinally resilient helix arranged in engagement with the inner face of a bend.

2. An expansible-collapsible element comprising a tubular metallic shell having circumferential corrugations formed of inward and outward bends connected by intermediate transverse wall portions, and means located in certain of said bends to limit collapse thereof in a direction longitudinally of the shell, said means comprising a helical annulus arranged in engagement with the inner face of the bend.

3. An expansible-collapsible element comprising a tubular metallic shell having circumferential corrugations formed of inward and outward bends connected by intermediate transverse wall portions, and means located in certain of said bends to limit collapse thereof in a direction longitudinally of the shell, said means comprising a helix arranged in engagement with the inner face of the bend, said helix being of such thickness in a direction lengthwise of the element as to provide clearance spaces between the helix and the lateral portions of the bend, but adapted to be engaged by said lateral portions within the limit of resilience of the metal of the bend.

4. An expansible-collapsible element comprising a tubular metallic shell having circumferential corrugations formed of resilient inward and outward bends connected by

intermediate transverse wall portions and means located in certain of said bends to limit collapse thereof in a direction longitudinally of the shell, said means comprising an annular member in the form of a helix arranged in engagement with the middle portion of the inner surface of the bend, said member being of such thickness lengthwise of the element as to provide clearance spaces between the said member and the lateral portions of the bend, but adapted to be engaged by said lateral portions within the limit of resilience of the metal of the bend.

5. An expansible-collapsible element comprising a tubular metallic shell having circumferential corrugations formed of resilient inward and outward bends connected by intermediate transverse wall portions, and means located in certain of said bends to limit collapse thereof in a direction longitudinally of the shell, said means comprising an annular member in the form of a helix engaging the inner face of the bend, the radius of the curve of the bend being greater than the radius of the cross-section of said member.

6. An expansible-collapsible element comprising a tubular metallic shell having circumferential corrugations formed of inward and outward bends connected by intermediate transverse wall portions, and means located in certain of said bends to limit collapse thereof, said means comprising an annular member in the form of a helical wire coil arranged in engagement with the inner face of a bend, said coil being circumferentially resilient.

7. An expansible-collapsible element comprising a tubular metallic shell having circumferential corrugations formed of inward and outward bends connected by intermediate transverse wall portions, and means located in certain of said bends to prevent collapse thereof longitudinally of the shell, said means comprising an annular member in the form of a helical wire coil engaging the inner face of a bend, said member being resilient circumferentially and exerting its resilient force to hold it in position in engagement with the inner face of the bend.

8. An expansible-collapsible element comprising a tubular metallic shell having circumferential corrugations formed of inward and outward bends connected by intermediate transverse wall portions, and means located in certain of said bends to prevent collapse thereof in a direction longitudinally of the shell, said means comprising a flexible and resilient wire coil held by its resilience in engagement with the middle portion of the inner surface of the bend, and said coil being of such thickness lengthwise of the element as to provide clearance spaces between the coil and the lateral portions of the bend.

9. An expansible-collapsible element comprising a tubular metallic shell having circumferential corrugations formed of inward and outward bends connected by intermediate transverse wall portions, and means located in certain of said bends to prevent collapse thereof in a direction longitudinally of the shell, said means comprising a helical coil engaging the inner face of the bend, and being circular in cross section, the radius of the curve of the bend bearing the proportion to the radius of the cross section of said helical member of approximately .045 inch to .040 inch.
10. An expansible-collapsible element comprising a tubular metallic shell having circumferential corrugations formed of inward and outward bends connected by intermediate transverse wall portions, and means located in certain of said inward bends and in certain of said outward bends to prevent collapse thereof in a direction longitudinally of the shell, the means in said outward bends comprising a helical resilient annulus under circumferential compression whereby its resilience is exerted to hold it in position in engagement with the inner face of the outer bend, and said means in the inner bend consisting of an annular resilient helix exerting its resilience by contraction to hold it in engagement with the outer face of the inner bend.
11. An expansible-collapsible element comprising a tubular metallic shell having circumferential corrugations formed of inward and outward bends connected by intermediate transverse wall portions, an annular freely flexible spring member comprising a plurality of spaced apart interconnected coils, said member being positioned within an outer bend of said element and being of normal length greater than the circumferential length of said element at said bend, whereby said member is under circumferential compression and exerts a force radially of said element to maintain the member in engagement with the shell, and a second annular freely flexible member comprising a plurality of spaced apart interconnected coils, said second member being positioned within an inner bend of said element and being of normal length less than the circumferential length of said element at said inner bend whereby said member is under circumferential tension and exerts a force radially of said element to maintain the member in engagement with the shell.
- In testimony whereof I have hereunto subscribed my name.
- GEORGE BETHUNE DUFFIELD.