Nov. 15, 1955 J. H. WIGGINS ET AL 2,723,908

DRY SEAL PRESSURE TYPE GAS HOLDER

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FIG. 1.

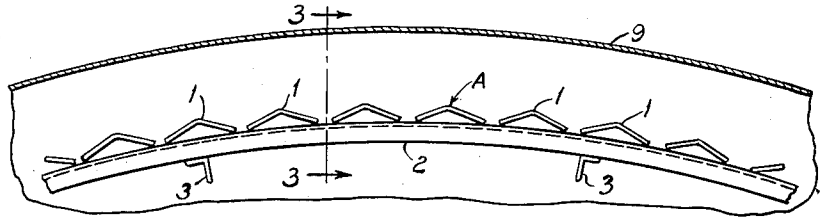
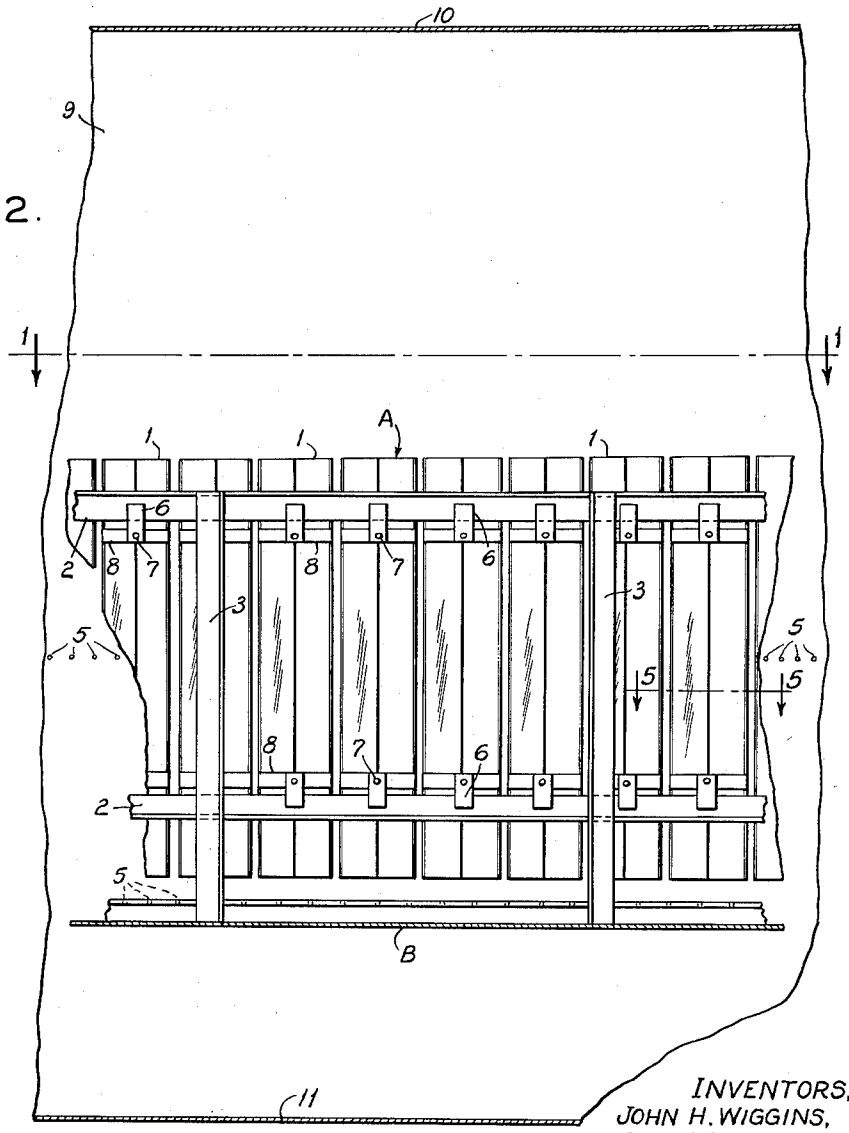


FIG. 2.



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FIG. 3.

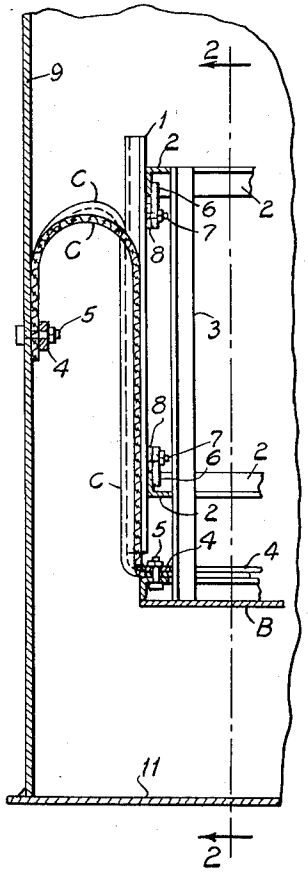


FIG. 4.

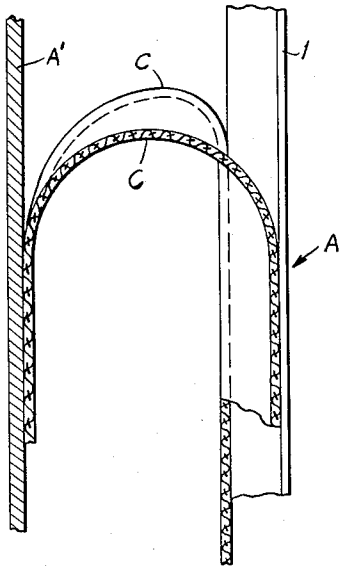
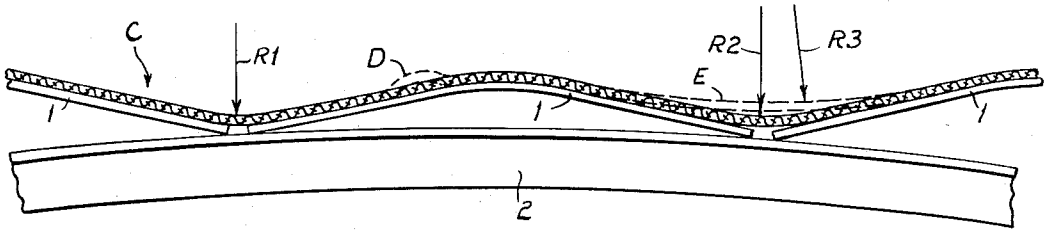


FIG. 5.



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DRY SEAL PRESSURE TYPE GAS HOLDER

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8 Claims. (Cl. 48—178)

This invention relates to dry seal, piston type gas holders and other fluid storage apparatus, of the particular type or kind that comprise a container provided with a cylindrical side wall, a vertically movable piston in said container that forms the top wall of the gas storage space of the apparatus, a seal for the space between the piston and the container side wall made of gas tight fabric and constructed in the form of a flexible curtain suspended between and attached to the piston and to the container side wall and proportioned so as to provide for the rise and fall of the piston, and back up members or abutment surfaces disposed in such relationship with said curtain like fabric seal that during the cycle of operations of the piston said abutment surfaces function as back stops that absorb pressure exerted on said seal by the gases confined in the storage chamber of the apparatus. Generally the portion of the container side wall located above the point where the fabric seal is attached to said wall is used to constitute an "outer" back stop that is located at the outer edge of said seal and which absorbs pressures exerted on said seal during the upward stroke of the piston, and one or more vertically movable "inner" back stops or abutment members of tubular or cylindrical form are arranged inside of said outer back stop in spaced, concentric relation with same so as to absorb pressure exerted on the fabric seal during the downward stroke of the piston. If the fabric seal is constructed in the form of a relatively long or deep cylinder attached at one of its ends to the "outer" back stop formed by the container side wall and attached at its other end to the piston, the "inner" back stop will be formed by a tubular or cylindrical member rigidly combined with the piston and projecting upwardly from same, and if the fabric seal is composed of two cylindrical sections one of which is attached to the container side wall and the other attached to the piston, an additional vertically movable back stop of tubular or cylindrical form will be arranged between the piston and the container side wall and attached to said two sections of the seal in such a way that during the cycle of operations of the piston said additional back stop will coact with the back stop on the piston to back up the inner seal section (the one nearest the piston), and said additional back stop will coact with the abutment surface on the container side wall to back up the outer section of the seal (the one nearest the container wall), as disclosed in U. S. Patent No. 2,606,824, dated August 12, 1952, to John W. Allen.

Gas holders of the general type or kind above referred to are built for pressures up to 20 inches of water which is 104 pounds per square foot and the fabric seals of such gas holders vary in height or depth from fifteen feet to fifty feet or more. We have found that when the piston moves vertically a relatively great distance, there is a tendency for the fabric seal to move circumferentially in places. The result is that normal sized wrinkles which develop in portions of the fabric seal in contact with the inner back stop or abutment surface get larger and larger and finally become converted into a fold com-

posed of three thicknesses of fabric lying one on top of the other in superimposed relation and pressed tightly against the back stop by the gas pressure. During the upward travel of the piston the fabric seal is progressively stripped off the inner back stop and progressively applied to the outer back stop and in instances where folds of the kind mentioned have formed in the fabric the layers of the folds remain in superimposed relation even after the seal has come in contact with the outer back stop, due to the fact that the circumferential tension of the fabric is not great enough to straighten out the fabric and destroy the above mentioned folds. The result is that the seal is effectively shortened and hence becomes subjected to strains which stretch it. This process continues until there are enough folds formed with time, that the seal may be stretched until it fails from excessive circumferential tension.

One object of our invention is to provide a dry seal pressure gas holder of the general type or kind previously mentioned, which is of such design or construction that destructive wrinkles or folds will not form in the fabric seal when said seal is in contact with the inner back stop or abutment member of the apparatus.

Another object is to provide an efficient means of simple design and inexpensive construction for eliminating circumferential creepage of the fabric seal of an apparatus of the general type or kind previously referred to.

Other objects and desirable features of our invention will hereinafter be pointed out.

We have herein illustrated our invention embodied in a cylindrical abutment member or back stop carried by the piston of a pressure type gas holder whose sealing fabric is constructed in the form of a relatively long or deep cylinder attached at its outer end to the side wall of the container of the apparatus and attached at its inner end to the piston adjacent the lower end of the back stop carried by the piston, but we wish it to be understood that our invention is applicable to any kind of a back stop or abutment surface employed in a dry seal pressure type gas holder to absorb pressure exerted by the gases on the fabric seal and to assist in controlling the approximate shape or form of said seal when the apparatus is in use.

Fig. 1 of the drawings is a fragmentary horizontal sectional view taken through the side wall of the container of the apparatus on approximately the line **1—1** of Fig. 2, looking downwardly onto the upper end of the inner abutment member carried by the piston, the fabric seal being omitted so as to more clearly show the shape or form of said abutment member.

Fig. 2 is a fragmentary elevational view, taken on approximately the line **2—2** of Fig. 3, looking in the direction indicated by the arrows.

Fig. 3 is a fragmentary vertical sectional view showing the container side wall, the piston, the inner abutment member and the sealing fabric, the point at which said view is taken being indicated by the line **3—3** of Fig. 1.

Fig. 4 is an enlarged view of some of the parts shown in Fig. 3, illustrating how the fabric seal lies against the fluted or serpentine surface of the inner abutment member carried by the piston, and

Fig. 5 is an enlarged, fragmentary horizontal sectional view, taken on the line **5—5** of Fig. 2.

In the drawings the reference character **9** designates the cylindrical side wall of the container of a dry seal, piston type gas holder and the reference characters **10** and **11** designate the roof and bottom respectively of said container. The piston B is spaced away from the container side wall and the space between the piston and said side wall is sealed by a flexible gas tight fabric seal C constructed in the form of cylinder attached

at one end to the peripheral portion of the piston and attached at its other end to the side wall 9 of the container adjacent the center or middle portion of said side wall. Any suitable means can be used to produce a gas tight joint between the seal C and the parts to which it is attached such as seal bars 4 held in position by bolts 5. As is usual in dry seal pressure gas holders of the general type mentioned, rigid back stops or abutment members are arranged adjacent the path of movement of the fabric seal C so as to control the shape or form of said seal and absorb some of the pressure exerted by the gases on said seal during the rise and fall of the piston. In the particular form of our invention herein illustrated there are two back stops or abutment members of the kind just mentioned, to wit a vertically movable back stop A of cylindrical or tubular form carried by the piston and projecting upwardly from the peripheral portion of same, and a stationary back stop A' of cylindrical or tubular form that surrounds the back stop A and is arranged in spaced, concentric relation with the same, said stationary back stop A' being formed by the portion of the container side wall 9 located above the point where the seal C is attached to said wall. When the piston is in its lowermost position the pressure of the gases in the storage chamber of the apparatus presses the seal C tightly against the back stop A and during the upward movement of the piston said seal is progressively stripped off the inner back stop A and progressively applied to the outer back stop A'. During the downward stroke of the piston the seal C is progressively stripped off the outer back stop A' and progressively applied to the inner back stop A.

Our invention consists in constructing the inner back stop A in such a manner as to (*a*) prevent wrinkles or folds of objectionable size from forming in the seal C when said seal lies against the inner back stop A, and (*b*) prevent the seal C from creeping circumferentially around the gas holder. In this way we eliminate undue circumferential stretching of the fabric from which the seal C is constructed and thus effectively prevent said seal from tearing or rupturing. Briefly stated we attain these highly desirable results by providing the inner back stop A with a substantially fluted, corrugated, scalloped or sinuous shaped seal contacting surface whose circumferential length is substantially the same as the circumferential length of the surface of the outer back stop A'. It is not essential that the above mentioned two surfaces be of exactly the same circumferential length for in some instances we may provide the inner back stop with a sinuous or serpentine seal contacting surface whose total circumferential length is from 1% to 2% longer than the circumferential length of the seal contacting surface of the outer back stop. Accordingly in the specification and claims where we refer to the seal contacting surface of the inner back stop or abutment member being of "substantially the same circumferential length" as the seal contacting surface of the outer back stop or abutment member, we mean to include a structure in which the circumferential length of the fluted, scalloped or serpentine surface of the inner back stop A is either the same or slightly longer than the length of the seal contacting surface of the outer back stop A'. So far as our basic idea is concerned it is immaterial how the back stop A is constructed so long as the surface of same against which the seal is pressed by the gases is provided with raised portions and depressions that increase the circumferential length of the portion of said back stop engaged by the seal, and tend to retard circumferential creepage of the seal. In the form of our invention herein illustrated the seal contacting surface of the back stop A is composed of a series of vertically disposed parallel plates 1 of substantially segment shape in horizontal cross section, arranged with their convexed surfaces presented outwardly as shown in Fig. 1. Said plates 1 are mounted on a

supporting structure carried by the piston B and herein illustrated as being composed of a plurality of vertically disposed uprights 3 on the piston that carry two horizontally disposed annular shaped members 2 to which the plates 1 are attached, preferably in such a way that said plates can be easily detached from said supporting members 2 and also adjusted laterally relatively to each other. We have herein shown the plates 1 as being clamped to the horizontal supporting members 2 by vertically disposed clamps 6 at the upper and lower ends of the plates 1, each of said clamps 6 being held in overlapping relation with the member 2 which it engages by means of a fastening device 7 engaged with a horizontally disposed cross piece 8 that is permanently attached to the back face or rear side of the plate 1, all as clearly shown in Figs. 2 and 3.

The fluted, corrugated or sinuous shaped surface of the inner back stop A is substantially the same cumulative length circumferentially as the inside surface of the outer back stop A'. Thus when the seal C lies on the fluted surface of the back stop A there are no wrinkles in the seal, even though the average radius of the scalloped or curved parts of said surface is smaller than the radius of the cylindrical outer back stop A'. We have discovered that the previously mentioned circumferential creep or lateral shift of the seal C is partly due to change in radius, locally, of the outer back stop A' and inner back stop A. In order to clearly demonstrate how the scalloped or fluted surface of the back stop A limits or prevents a progressive and continuing creep of the seal C, we direct attention to Fig. 5 of the drawings. Suppose the gas pressure is 20" H 20 or 104# per square foot. The circumferential tension due to radius 1" is $\frac{1}{12}$ ft. $\times$ 104# or 8.66# per foot. Now if there is a side creep or lateral shift of the seal so as to try to create a wrinkle like D, shown in dotted lines in Fig. 5, then the portion of the seal in the right hand scallop will be shortened between peaks, so that it is pulled outwardly a little away from the seal contacting surface of the back stop as indicated by the dotted line E in Fig. 5. If this tries to occur, the radius R^3 in Fig. 5 becomes immediately many times larger than radius R^2 for say $\frac{1}{8}$" side shift to the left in the adjacent scallop. Say radius R^3 is six inches. Then it is readily seen that the tension in portion E is 6×8.66# per foot or 52# per foot. The result is that the seal is pulled back into its proper scallop before it can be pulled out. As soon as a condition tries to move the seal sidewise in the scallop, forces are immediately set up in an adjacent scallop to prevent that movement. We also point out that if a wrinkle such as D in Fig. 5 should start to form, the pressure of the stored gas sets up forces in the wrinkle D that tend to push the extra fabric toward the portion designated E. Thus the tension of E and the push of D, work together to keep the seal properly in the scallop of the back stop A where it belongs. We prefer to make the distance between peaks of the scallops approximately ten inches or more, and have the scallops vary in depth from about one inch to about two inches, but of course these dimensions will vary according to the size of the gas holder. In referring to a fluted, corrugated, scalloped or sinuous shaped surface we mean to include any surface made up of alternating ridges and valleys disposed vertically or longitudinally of or parallel to the direction of travel of the piston.

As previously mentioned it is immaterial what means or detail of design is used to obtain or produce the fluted, scalloped, sinuous or corrugated shape of the surface on the inner back stop A that backs up the seal C, but one desirable feature of the particular construction herein illustrated wherein convexed or segmental plates are clamped in operative position on a supporting structure carried by the piston, is the ease with which said plates 1 can be removed for inspection of the seal. Also with such a construction it is not necessary to bodily remove all of

the plates 1 in order to thoroughly inspect the seal, for after one of the plates 1 has been bodily removed from the supporting structure, the clamping devices for the remainder of the plates 1 need only be loosened sufficiently to permit a plate to be moved laterally in one direction to expose a portion or section of the seal and then moved back to its former position after the inspection has been made, thereby providing for inspection of the seal around its entire circumference with the complete removal and subsequent replacement of only one of the series of plates 1 that constitute the seal contacting surface of the back stop A.

Having thus described our invention, what we claim and desire to secure by Letters Patent is:

1. In a dry seal pressure type gas holder, the combination of a container having a side wall, a vertically movable piston in said container, a curtain like fabric seal attached to the piston and to the container side wall, and a member adapted to serve as a back stop for said seal, provided with a substantially fluted, scalloped, sinuous shaped or corrugated surface against which said seal is pressed by the gases in the storage chamber during the cycle of operations of the piston.

2. A gas holder of the kind described in claim 1 in which the ridges and valleys in the seal contacting surface of said back stop member are disposed lengthwise of or parallel to the direction of travel of the piston.

3. In a dry seal pressure type gas holder, the combination of a container having a side wall, a vertically movable piston in said container, a sealing means for the piston, at least a portion of which is formed by a curtain like flexible, gas tight element, and a back stop or abutment member provided with a substantially fluted, scalloped, sinuous shaped or corrugated surface against which said flexible element is adapted to be pressed by the gases confined in the holder.

4. A dry seal pressure type gas holder as set forth in claim 3, in which the ridges and valleys of said fluted surface are disposed lengthwise of the back stop.

5. In a dry seal pressure type gas holder, the combination of a container having a side wall, a vertically reciprocating piston in said container, a flexible, gas tight fabric element that forms at least a portion of the sealing means for the piston, and two cylindrical shaped abutment surfaces for said fabric element arranged in concentric relation with each other and with said fabric element interposed between the same, said abutment surfaces being so disposed that one of said surfaces backs up said fabric element during the stroke of the piston in one direction and the other abutment surface backs up said fabric element during the stroke of the piston in the opposite direction, the innermost abutment surface having alternating ridges and valleys that extend substantially lengthwise of the direction of travel of the piston.

6. In a dry seal pressure type gas holder, the combination of a container, a vertically movable piston in said container, a sealing means for the piston comprising a flexible, gas tight element, and coacting abutment surfaces made of rigid material and arranged in opposed relation so as to back up said flexible element during the rise and fall of the piston, one of said abutment surfaces being substantially sinuous shaped and having vertically disposed flutes or corrugations for the purpose described.

7. In a dry seal pressure type gas holder, the combination of a vertically reciprocating piston that forms the top wall of the gas storage chamber of the holder, a sealing means for said piston comprising a flexible, curtain like element constructed of gas tight fabric, and two cylindrical concentrically arranged abutment surfaces disposed in such relationship with each other and with said flexible element that the gases in the storage chamber press said flexible element into tight engagement with said abutment surfaces during the cycle of operations of the piston, one of said abutment surfaces having ridges and valleys arranged in alternating relationship and disposed substantially lengthwise of or parallel to the direction of travel of the piston.

8. A dry seal, pressure type gas holder of the kind described in claim 7, in which the circumferential length of both of said abutment surfaces is substantially the same.

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