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DRY BACKFIRE ARRESTER  
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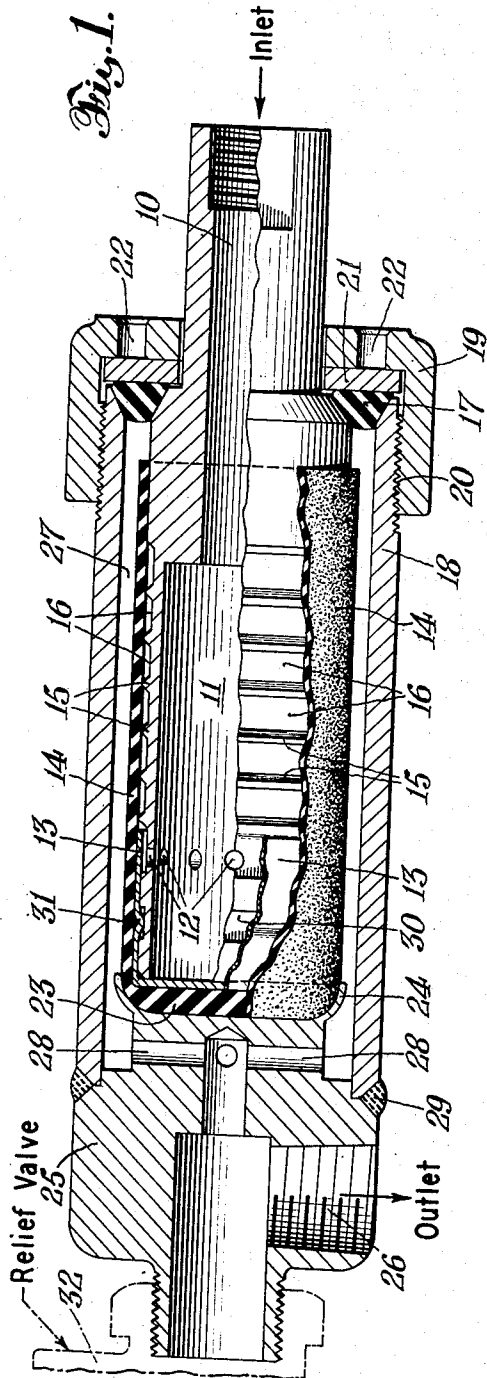
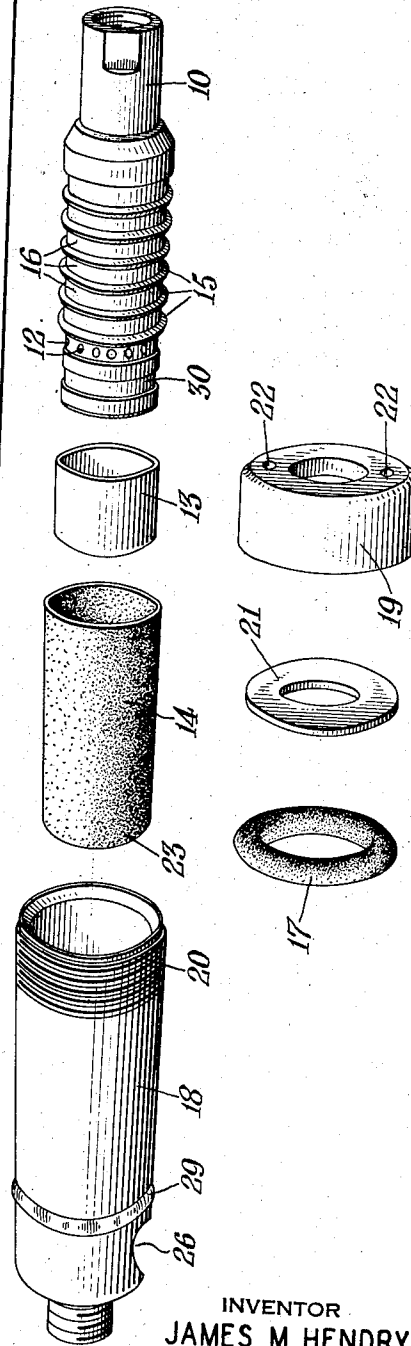


*Fig. 2.*



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## DRY BACKFIRE ARRESTER

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This invention relates to backfire arresters of a type for use with a fuel gas such as acetylene under medium pressure. An object of the invention is to provide a satisfactory yet inexpensive dry type of arrester. Another object is to improve a resilient sleeve type arrester. A further object is to provide an arrester in which a backfire pressure wave travels along a resilient sleeve or wall to press it against a foundation or abutment for closing the sleeve as a movable valve element in advance of the same wave tending to open it.

The ordinary check valve cannot be made to possess small enough inertia to act quickly and stop a rapidly moving explosive wave. It is known that a rubber or resilient sleeve is the one exception. Such a sleeve may close more quickly than the ordinary mechanical valve and may or may not be already stressed.

According to this invention, the resilient sleeve type valve has been improved to better adapt it for stopping a backfire wave. One feature is the doubling back of ordinary gas flow inside and outside the sleeve with the result an incoming explosive wave creates pressure closing the valve by clamping the sleeve against its foundation before such pressure tends to open the sleeve. Another feature is the provision of a number of peripheral grooves on the foundation against which the sleeve presses. At the time of backfire, these function somewhat as a series of labyrinth packing glands with the result pressure in the grooves is successively less from right to left in Fig. 1. A radial hole in the sleeve foundation has over it a stiff support for the sleeve to prevent the sleeve being pressed into the hole by a pressure wave. On the side of such perforation away from the direction of normal gas flow between the resilient sleeve and foundation, such sleeve is appropriately fastened to its foundation.

Referring to the drawings:

Fig. 1 is a longitudinal section through a preferred embodiment of this invention.

Fig. 2 is a perspective showing the elements of this invention in exploded relation prior to assembly.

Fuel gas such as acetylene or an explosive mixture is supplied to the inlet passage or pipe 10 or in the direction of the arrow shown at the right end of Fig. 1. The left portion of the pipe or foundation 10 is provided with an enlargement 11 on the inside and peripheral holes or perforations 12 in the cylindrical wall of this foundation or enlargement are provided, as illustrated in Figs. 1 and 2. The metal cup 13 has a base con-

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stituting an end wall or abutment for the inlet passage, and its side wall extends over the holes 12 and constitutes a support for the rubber sleeve or resilient wall 14 to prevent the sleeve 14 being forced into the holes 12 by external pressure. To the right of the holes 12 and the cup 13 a number of peripheral lands 15 are provided forming between them grooves 16. The lands 15 are of substantially the same height and are flush with the portion of the pipe 10 on which the right end of the sleeve 14 rests. The sleeve 14 is .06" thick over the lands 15 and is .010" greater in diameter than the foundation at the crest of the lands to form a check valve. Said sleeve is molded from milled rubber or is an anode dipped latex product. A tore shaped packing washer 17 closes the right end of the space between the pipe 10 and an outer metal casing 18 forming a part of the outlet passage. A cap 19 has a threaded connection 20 with the outer casing 18 and is normally adjustable by hand. A metal washer 21 in the base of the cap 19 presses against the packing washer 17 and presses it against the inclined bevelled portions of the casing 18 and the pipe 10 as illustrated. Perforations 22 in the base of the cap 19 permit the use of an appropriate wrench, when not adjustable by hand, for turning the cap in an emergency.

The rubber sleeve 14 is closed at its left end by a base portion 23 about .19" thick. A metal supporting flange 24 on the end plug 25 supports and centers the rubber cup shaped sleeve and the left end of the pipe 10. An outlet pipe is threaded into the outlet recess 26. Between the rubber sleeve 14 and the outer casing 10 is a longitudinal and peripheral outlet passage 27 along which gas normally moves to the left in Fig. 1 after passing around the free or right end of the elastic sleeve 14. A number of radial passages 28 in the casing plug 25 connect the passage 27 with the outlet recess 26. The outer casing 18 is preferably welded at 29 to the plug 25. Groove 31 in the cup 13 is formed after the cup has been placed in position on an end of the foundation 10. Groove 31 then cooperates with the side walls of groove 30 of the foundation to prevent the cup being accidentally slid off the pipe before the sleeve 14 and cup 13 have been received within the supporting flange 24. A relief valve 32 is connected in any appropriate manner to relieve excessive pressure which may develop from any cause, such, for example, as in case of a flashback, i. e., from sustained burning from a backfire.

In normal operation the incoming fuel gas or

explosive mixture enters the pipe 10; passes through the perforations 12 and, due to its slight pressure, may cause the rubber sleeve 14 to expand slightly, enabling the incoming gas to move across the lands and out from under the right end of the rubber sleeve shown in Fig. 1. The gas then normally moves to the left along the peripheral passage 27, thence radially inward through the holes 28 and out the outlet recess 26.

In the event of a high pressure explosive wave due to decomposition of the fuel gas or to the combustion of an explosive mixture, such explosive wave or backfire travels in the reverse direction to the normal movement of the gas, entering the recess 26, passing outwardly through the radial holes 28 and moving to the right along the peripheral passage 27. Such explosive wave is of high momentary pressure and moves at such a rapid rate that the ordinary ball or hinged vane type check valve possesses too great an inertia to effectively stop passage of such a backfire or explosive wave. However, due to the rubber sleeve 14 having a small clearance over the cup 13, lands 15, and the portion of the foundation 10 of maximum thickness, the device of the present invention is adequate to stop such a backfire or explosive wave. As the rapidly moving wave enters the left end of the peripheral passage 27 and moves to the right, it presses the sleeve 14 tightly against the foundation 10 and the lands 15 as well as the cup 13. In the event any portion of the backfire pressure should be able to enter the right end of the sleeve 14, it would get no further than the first few peripheral grooves 16. The series of lands and grooves thus is effective to function as a series of labyrinth packing grooves in which any backfire pressure is successively less in each groove moving toward the left. A rapidly moving explosive wave tends to press the sleeve 14 into the recess 31 of the cup over the groove 30 at the left end of the pipe 10, and this tends to raise the portion of the cup over the holes 12 and to reduce the tendency for the sleeve and cup over the holes 12 to be pressed toward the holes.

There is a possibility some portion of a backfire wave enters beneath the rubber sleeve 14 inasmuch as a carbon deposit has been found in the first few grooves from the right end in Fig. 1. The backfire pressure was probably successively less in each groove. One theory is that all of the gas may not be squeezed out from under the sleeve before the backfire arrives at the right end of the sleeve. Another view is that the inertia of the sleeve is not always overcome in time to stop the backfire at the first groove.

A feature of this invention resides in the necessity for any explosive wave having to double back on itself in order to enter the pipe 10 and the fact that the initial movement of such a pressure wave in the passage 27 presses the sleeve 14 against the lands 15. This may, if desired, be in addition to a slight normal resilient pressure of the sleeve against such lands. Another feature is the provision of the cup 13 to keep the sleeve 14 from being pressed into the holes 12 by impact or a pressure wave. Also, the cup base supports the sleeve base in event of mechanical impact of the backfire getting in between the flange 24 and the resilient base 23. Another feature of importance is the provision of the series of lands and grooves to effectively reduce any portion of an explosive wave which might enter within the sleeve 14 at its right or open end. The sleeve 14 being in cup shape is pre-

vented from being moved longitudinally. With a normal clearance of .005" between the sleeve 14 and the lands 15 a pressure drop of only one pound per square inch has been found with a flow of 250 to 300 cubic feet per hour when the arrester is made of the shape illustrated. The clearance is not critical. Smaller clearance means a larger normal pressure drop. Larger clearance distance may make it more difficult for a backfire wave to compress the sleeve as quickly and as far as desired. A snug fit of the sleeve on the foundation lands will offer greater backfire protection but increase the normal pressure drop through the arrester. Wherever a change in direction is necessary for a backfire entering the recess 26, moving centrally, then radially outward, and along the space 27, an impact receiving part is present to receive the blow of the backfire. The flange 24 is adapted to receive a portion of the backfire impact and keep it off the sleeve 14 close to the sleeve base 23. Shallow longitudinal grooves not shown may be placed beneath that portion of the foundation on which the right end of the sleeve 14 rests to reduce the normal pressure drop.

An advantage in having the base 23 of the sleeve 14 thickened, as illustrated, is to provide a certain indication after assembly that the sleeve is in place under normal tightness with which the parts are assembled. If the base 23 were not so thick, it would be more difficult to tell after assembly whether or not the sleeve were in place.

What is claimed is:

1. In an apparatus for suppressing a backfire wave, a longitudinal outlet passage, a fuel gas inlet passage, a check valve between said passages and the improvement for suppressing a backfire wave approaching said valve through said outlet passage, said improvement including said valve being of the type having a resilient wall one face of said resilient wall forming a portion of said outlet passage to a free end of said wall, a continuation of said outlet passage beyond the free end of said resilient wall extending around the free end of said resilient wall, the opposite face of said resilient wall forming a portion of said check valve, and a foundation to which the opposite end of said wall is secured, said foundation extending longitudinally adjacent said wall and being shaped to limit flexure of said wall by contact between said foundation and wall.

2. An apparatus according to claim 1 in which said foundation adjacent said resilient wall is shaped to provide a series of lands between which are grooves adjacent the end of said resilient wall around which said outlet passage extends.

3. An apparatus according to claim 2 in which said resilient wall normally has an inside diameter greater than that of said lands.

4. In a check valve having an inlet passage, an outlet passage, said valve being between said passages and of the resilient sleeve type, a foundation to the outside of which said sleeve is secured adjacent one end of the sleeve, the opposite end of said resilient sleeve being expandible, said inlet passage being an axial bore in said foundation, a normal gas flow passage between said sleeve and foundation, said foundation being provided with a perforation from said bore to said normal gas flow passage within said sleeve and outside said foundation to said expandible end of said sleeve, the combination therewith of the improvement adapting said valve for suppressing a backfire wave in a fuel gas, said improvement including a portion of said outlet pas-

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sage extending longitudinally from the expansible end of said sleeve along the outer surface of said sleeve beyond said perforation, and a metal support over a substantial portion of the area of said perforation.

5. In a check valve having an inlet passage, an outlet passage, said valve being between said passages and of the resilient sleeve type, a foundation to the outside of which said sleeve is secured adjacent one end of the sleeve, the opposite end of said resilient sleeve being expansible, said inlet passage being an axial bore in said foundation, a normal gas flow passage between said sleeve and foundation, said foundation being provided with a perforation from said bore to said gas flow passage within said sleeve and outside said foundation to said expansible end of said sleeve, the combination therewith of the improvement adapting said valve for suppressing a backfire wave in a fuel gas, said improvement including a portion of said outlet passage extending longitudinally from the expansible end of said sleeve along the outer surface of said sleeve beyond said perforation, and a series of lands and grooves on the outside of said foundation and inside of said sleeve adjacent the expansible end of said sleeve, the lands having their tops of a height to be contacted by the inner surface of said sleeve at least on passage of a backfire wave along the outside of said sleeve.

6. A check valve according to claim 5 in which said sleeve normally has an inside diameter greater than that of said lands by an amount about .005 of an inch.

7. An apparatus for suppressing a backfire wave in a fuel gas which comprises an outlet passage portion one wall of which is constituted by a longitudinally extending resilient wall, a foundation toward which said resilient wall is movable under the impetus of a backfire wave moving along the said wall, one end of said wall being secured to said foundation, the opposite end of said wall being expansible and contractible, said outlet passage extending around the expansible end of said wall, a check valve for obstructing said backfire wave moving between said resilient wall and foundation, said check valve including said resilient wall and foundation, and a series of labyrinth packing grooves on said foundation between it and said wall, said wall being flexible to engage said foundation, under pressure of a backfire wave, and to contact the portions of said foundation between said grooves under said pressure of a backfire wave.

8. A backfire arrester comprising an inlet passage for the normal flow of gas, an end wall across said inlet passage, a portion of the side wall of said passage before reaching said end wall being provided with a perforation, a resilient sleeve having one end free and its opposite end secured to said passage wall beyond said perforation in the direction of normal gas flow in said passage and extending from said secured end over and beyond said perforation in an opposite direction to the normal gas flow in said passage, normal gas flow from said perforation being between the sleeve and a side wall of the inlet passage in an opposite direction to normal gas flow in said inlet passage and around the free end of said resilient sleeve, an enclosed outlet gas passage from adjacent the free end of said sleeve back along the outside of said sleeve in the direction of normal gas flow within said inlet passage, whereby any backfire pressure wave entering said enclosed

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normal gas flow passage will travel along said resilient sleeve toward the free end thereof and press said sleeve against said inlet passage to prevent movement of the backfire wave into said sleeve between it and said inlet passage.

9. A backfire arrester according to claim 8 in which a metal support is provided for said sleeve over said perforation.

10. A backfire arrester according to claim 8 in which said outlet passage beyond said sleeve has a number of sharp right angled changes of direction in it whereby a backfire wave is subjected to a series of impacts before it moves longitudinally along said resilient sleeve.

11. A backfire arrester comprising an outer casing, an inner hollow foundation, a flexible resilient sleeve surrounding said foundation and closed at one end, its other end being expansible and compressible, a supply passage for gas leading longitudinally into said hollow foundation, then laterally outwardly through said foundation to the inside of said resilient sleeve, longitudinally between said sleeve and foundation to the open expansible end of said sleeve, thence around that end of the sleeve, longitudinally back over the outside of said sleeve between it and the casing with one wall of this portion of said passage being constituted by the outer surface of said sleeve, and an outlet passage leading out of said casing beyond the closed end of said sleeve, the space within said casing between it and said sleeve being closed at one end beyond said open end of said sleeve and at the other end said space being closed against leakage of gas to the atmosphere, whereby a backfire pressure wave entering said casing through said outlet passage moves along the outer surface of said resilient sleeve pressing it against said foundation and closing at least some of said supply passage between said foundation and the inner surface of said sleeve to movement of said backfire pressure wave there-through.

12. A backfire arrester according to claim 11 in which the foundation outer surface is provided with a plurality of lands and grooves, the resilient sleeve contacting said lands on movement of a backfire wave along the outside of said sleeve.

13. An arrester according to claim 12 in which a metal cup has its base contiguous the closed end of the resilient sleeve and the sides of said cup extend along the foundation to a position beyond the lateral portion of the supply passage for supporting said resilient sleeve over said passage against the resilient sleeve being pressed into said passage, the end edge portion of said cup and foundation being shaped to allow free flow of gas out of said lateral portion of the supply passage and toward the adjacent land whereby gas pressure within said sleeve may expand it to allow flow of gas over said lands and around the open end of said resilient sleeve.

14. A backfire arrester according to claim 11 in which said resilient sleeve is provided with a support over the lateral portion of the supply passage to prevent a backfire wave from pressing said sleeve into said lateral portion.

15. An arrester according to claim 11 in which its end adjacent the expansible end of said resilient sleeve has the space between said casing and foundation closed by an end wall threaded to said casing and clamping a packing ring at the adjacent end of said space between said casing and foundation.

16. An arrester according to claim 11 in which at least a portion of the outlet passage also ex-

tends laterally and longitudinally of the outer casing and within said foundation.

17. An arrester according to claim 16 in which said outer casing is cylindrical and in two parts, one part having therein the lateral portion of the outlet passage and the other part enclosing an end portion of the space between the casing and sleeve adjacent the expansible end of said sleeve.

18. A backfire arrester comprising a foundation in which is a supply passage, a casing outside said foundation, a movable valve member of resilient material for closing said passage to a backfire wave, one end of the valve member being secured to said foundation for seating thereon within the casing and with the opposite end of said valve member movable toward and from the foundation, said supply passage extending longitudinally in the foundation and being for the supply of gas, a transverse passage in said foundation leading from said supply passage to the outside of said foundation but to the inner side of said valve member, the supply of gas being from the transverse passage longitudinally between the foundation and valve member to the opposite or unsecured end of said valve member, and thence around the unsecured end portion of said valve member, the space between said valve member and casing constituting a longitudinal outlet passage leading to a transverse outlet passage beyond the place where the valve member is secured to said foundation, the space

within the casing between it and the valve member being closed beyond the unsecured end of said valve member, the opposite end of the same space, namely that beyond the secured end of said valve member being closed against leakage of gas to the atmosphere, whereby a backfire pressure wave entering said casing through said outlet passage may move along the outer surface of said valve member pressing it against the foundation and closing at least some of said supply passage between the foundation and the inner surface of said valve member to movement of a backfire pressure wave therethrough.

19. A backfire arrester according to claim 18 in which a plurality of lands and grooves are provided generally parallel to the unsecured end of said valve member on the outside of said foundation and beneath said valve member with the lands of a height to be contacted by the valve member.

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