

March 28, 1950

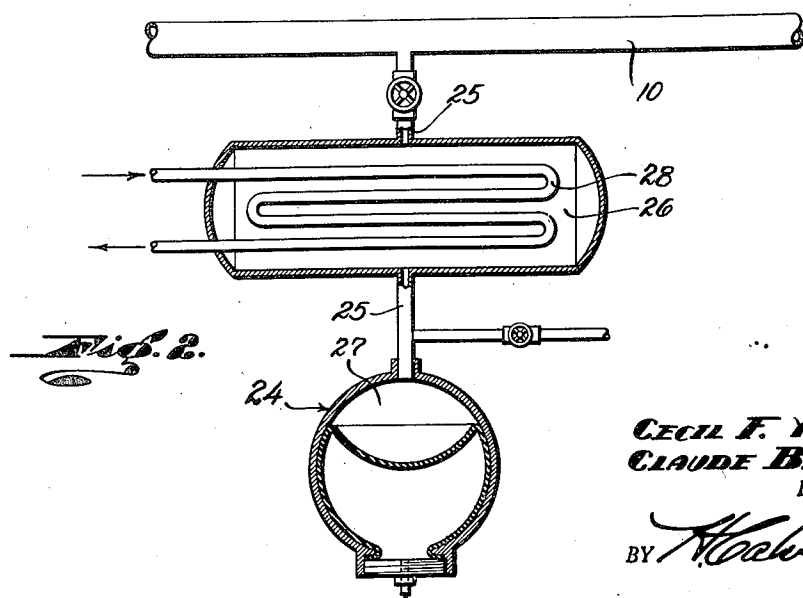
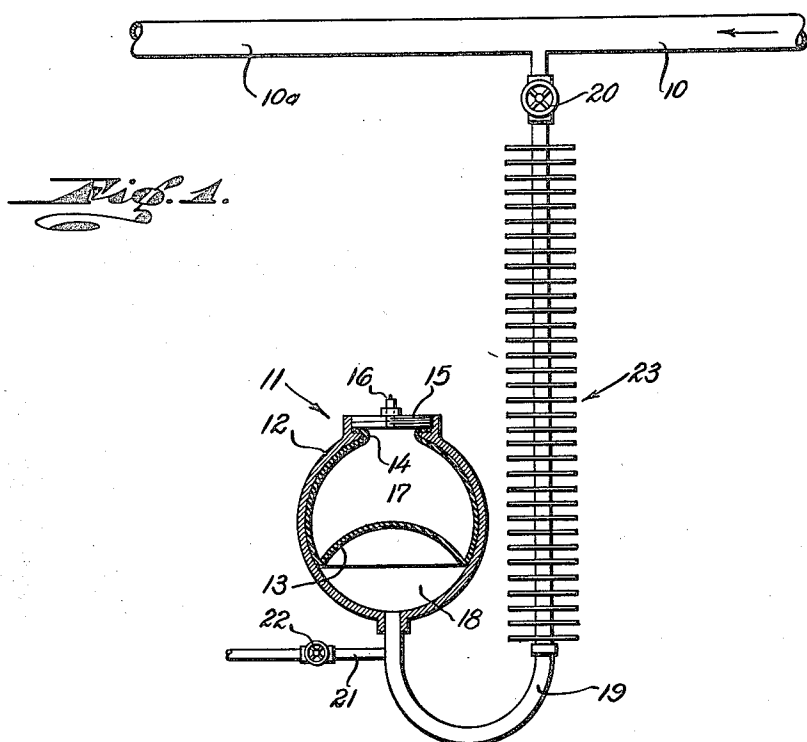
C. F. YATES ET AL

2,501,804

HIGH TEMPERATURE LIQUID PULSATION DAMPENER

Filed Aug. 3, 1946

2 Sheets-Sheet 1



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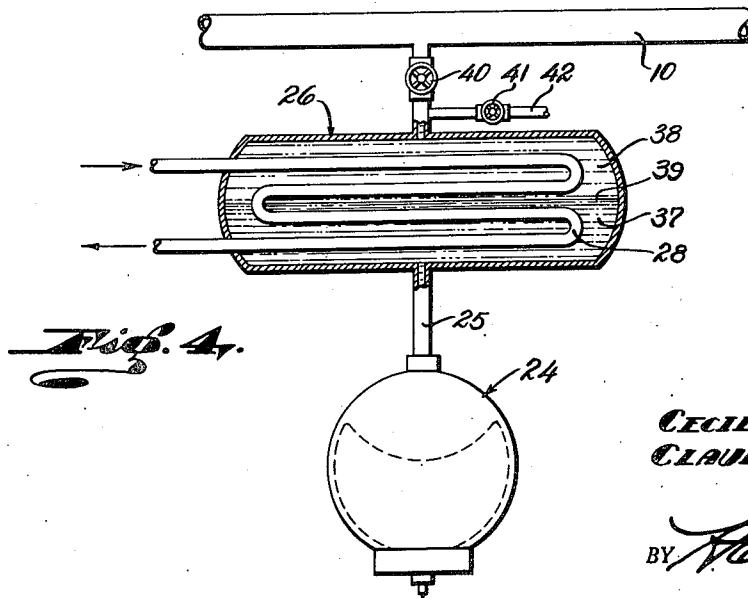
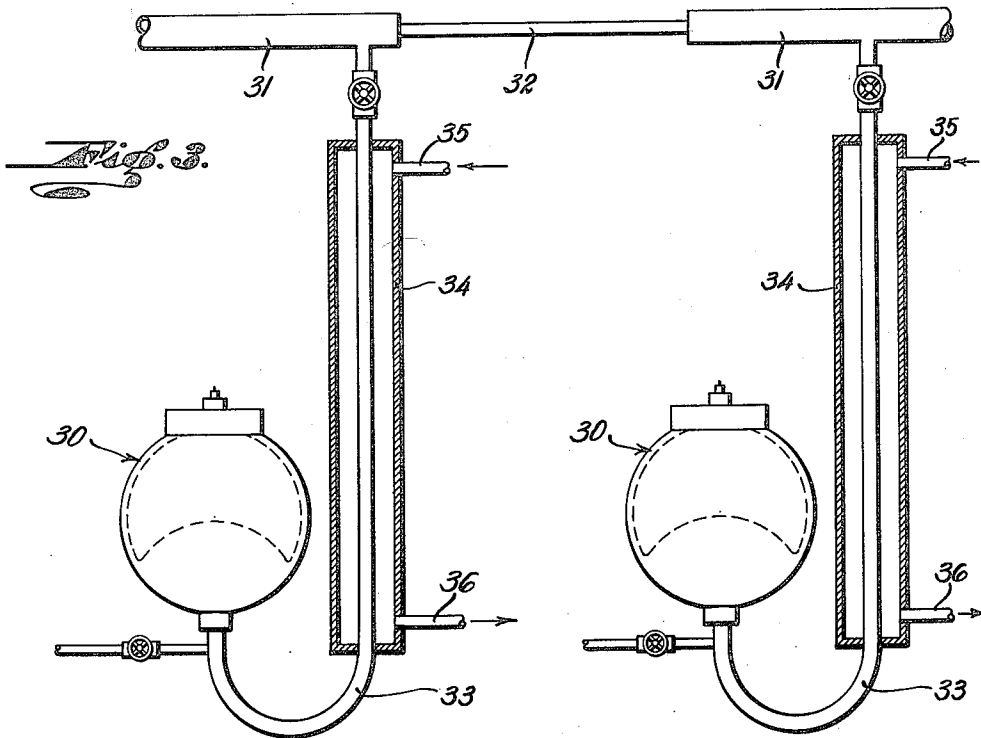
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HIGH TEMPERATURE LIQUID PULSATION DAMPENER

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2 Sheets-Sheet 2



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UNITED STATES PATENT OFFICE

2,501,804

HIGH-TEMPERATURE LIQUID PULSATION
DAMPENER

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Application August 3, 1946, Serial No. 688,243

3 Claims. (Cl. 138—30)

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This invention relates to improvements in apparatus for dampening pulsations in fluid streams, particularly high temperature liquid streams, which under normal circumstances might subject the pulsation dampener to injury by overheating.

The particular type of pulsation dampener contemplated by the invention is the one employing a pressure responsive diaphragm in pressure communication at one side with the liquid line, and subjected at its opposite side to gas pressure in a manner such that the gas undergoes compression and expansion, respectively, as increasing and decreasing pressures, created by the stream pulsations, are transmitted to the diaphragm. Under certain circumstances, where temperature reduction alone is to be considered, the diaphragm may be contacted directly by the line liquid itself. In other instances, where the line liquid may tend to impair or attack the diaphragm not only because of the liquid temperature, but also because of its chemical or solvent activity, the necessity arises for protecting the diaphragm against injury from both high temperatures and direct contact by the line liquid.

In accordance with the invention, the liquid transmitting the line pulsations to the diaphragm is prevented from overheating the diaphragm by subjecting such liquid to cooling, as may be effected, broadly considered, by any of various methods of cooling the surging body or column of liquid between the diaphragm and the line proper. Where the diaphragm is to be isolated from contact with the line liquid, the cooling likewise may be applied to a body or column of sealing liquid, different from the line liquid, interposed between the diaphragm and the line.

For more complete understanding of the contemplated type of pulsation dampener installation and the above mentioned provision for protecting the diaphragm, reference may be had to the accompanying drawing illustrative of certain typical forms, and in which:

Fig. 1 is a view, partly in section, illustrating one form of the invention;

Fig. 2 is a similar view illustrating a variational form;

Fig. 3 shows a further variational form employing plural capacitances; and

Fig. 4 is a view similar to Fig. 2 illustrating an additional variational feature of the invention.

Referring first to Fig. 1, the line 10 may be assumed to carry a liquid stream in a condition of pulsating flow, created for example by a piston

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type pump. The function of the pulsation dampener attachment, generally indicated at 11, is to dampen or substantially remove pulsations from the liquid reaching the down stream side 10a of the line. The dampener 11 comprises a vessel preferably in the form of a spherical shell 12, containing a bladder-like diaphragm 13 capable upon full distention of conforming to the spherical shape of the shell, but under normal operating conditions, assuming a deflected condition, substantially as shown. The neck 14 of the diaphragm is suitably clamped to the vessel as at the inside of a closure 15 carrying a valve 16 through which the diaphragm chamber 17 is charged with gas under determinable pressure.

Chamber 18 at the opposite side of the diaphragm is in communication with the line 10 through pipe 19, so that pressure surges occurring in the line are transmitted through pipe 19 to the diaphragm, resulting in its deflections, and consequent compression and expansion of the gas in chamber 17, all in a manner effecting a dissipation of the line pulsations. For further details concerning the theory and operation of this type of pulsation dampening system, reference may be had to copending application Ser. No. 631,192, filed November 27, 1945, on "Pulsation elimination in liquid streams," now Patent 2,474,512.

By closing valve 20, the pulsation dampener may be isolated from the line 10. At times, as when the chamber 17 initially is to be charged with gas at an accurately determinable pressure, it may be desirable to expel liquid from the chamber 18, permitting full distension of the diaphragm 13 into spherical contact with the vessel wall. Displacement of liquid from the chamber may be effected by closing valve 20 and opening the draw-off line 21 containing a normally closed valve 22.

Assuming the line 10 to carry a liquid heated to a temperature sufficiently high to cause injury to the diaphragm 13, the invention contemplates subjecting the liquid intermediate the diaphragm and the line, to cooling within a safe temperature range. Broadly considered, the fluid in line 19 may be subjected to cooling in any of various possible ways. As illustrative, where excessive cooling is not required, the line 19 may contain a finned tube section 23 from which heat radiation occurs at a rate sufficient for cooling of the liquid reaching the diaphragm.

In the system shown in Fig. 2, the diaphragm-containing vessel 24 is shown to be connected with the line 10 by way of a pipe connection 25 containing an enlarged chamber 26 through which

the line liquid passes to the diaphragm chamber 27. The liquid in chamber 26 may be subjected to whatever cooling desired, by passage of a refrigerant or cooling medium through the coil 28.

Fig. 3 shows a further variational form employing a pair of the diaphragm containing vessels 30 connected to the pulsating liquid line 31 at opposite sides of a resistance in the form of an elongated passage contained in a reduced diameter pipe 32. The theory of operation, by analogy to electrical filter systems, of the capacitances 30 in the illustrated relationship to the line restricting inductance passage 32, is more particularly dealt with in the copending application referred to above. Pipes 33 connecting the vessels 30 with line 31, may be suitably cooled, as by the described expedients, or by application to the pipes of jackets 34 through which cooling fluid is circulated by way of the inlet 35 and outlet 36.

Reference previously has been made to the desirability in some instances, of protecting the diaphragm not only against high temperatures, but also against attack by liquids having chemically reactive or solvent effects upon the diaphragm. Protection of the diaphragm under such condition may be accomplished by the use of an intermediary or seal liquid in any appropriate structural arrangement, as by introducing the sealing liquid to a structure of the type shown in Fig. 2. Referring to Fig. 4, wherein corresponding numerals are applied to the corresponding parts of Fig. 2, the diaphragm may be contacted by a protective liquid 37, heavier than and immiscible with the line liquid 38, the two liquids contacting at the inner face 39 within the chamber 26. By closing valve 40 and opening valve 41 in the draw-off line 42 positioned above the chamber, the protective seal liquid may be displaced from the vessel 24 into chamber 26 without loss of the liquid, since only the line fluid is expelled through pipe 42.

Any suitable liquid may be used as a sealing medium, if such be employed, to prevent the line or system liquid from contacting the diaphragm. Merely as illustrative, assuming the system liquid to be a hot oil, the seal liquid may consist of a heavier immiscible liquid such as mercury, water, glycerine, glycol, or an aqueous solution thereof. Where the system liquid is, for example, a hot aqueous solution, by proper arrangement of the gas-charged vessel permitting the sealing liquid to contact upwardly against the diaphragm, we may employ lighter sealing liquids such as a hydrocarbon or other oil.

We claim:

1. Apparatus for eliminating pulsations in a stream of heated fluid flowing through a line, comprising a vessel, a flexible diaphragm within said vessel, a heat exchanger providing a pressure transmitting connection between said line and the vessel at one side of the diaphragm and serving to cool the fluid in said connection below a temperature injurious to the diaphragm, gas pressure being maintained against the diaphragm so that the gas is compressed and expanded respectively in response to increases and decreases of said fluid stream pressure.

2. Apparatus for eliminating pulsations in a stream of heated fluid flowing through a line, comprising a vessel, a flexible diaphragm within the vessel, a heat exchanger providing a pressure transmitting connection between the line and said vessel at one side of the diaphragm, means for passing cooling fluid through said heat exchanger to maintain the fluid in said connection below a temperature injurious to the diaphragm, gas pressure being maintained against the diaphragm so that the gas is compressed and expanded respectively in response to increases and decreases of said fluid stream pressure.

3. Apparatus for eliminating pulsations in a stream of heated fluid flowing through a line, comprising a vessel, a flexible diaphragm within said vessel, a pressure transmitting connection between said line and the vessel at one side of the diaphragm, said connection containing a diaphragm protective liquid immiscible with the stream fluid and contacting the diaphragm, means for cooling the fluid in said connection below a temperature injurious to the diaphragm, gas pressure being maintained against the diaphragm so that the gas is compressed and expanded respectively in response to increases and decreases of said fluid stream pressure.

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