Oct. 28, 1941. F. H. HOPKINS 2,261,028

PULSATION DAMPENER

Filed Dec. 16, 1939

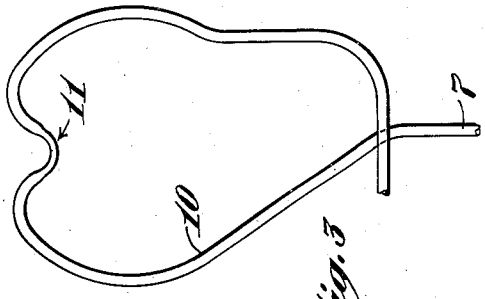


Fig. 3

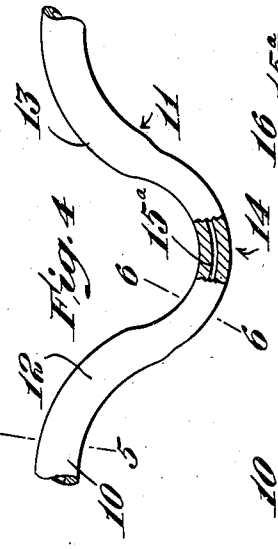


Fig. 4

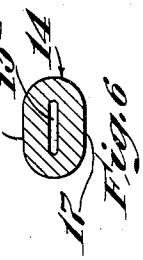


Fig. 6

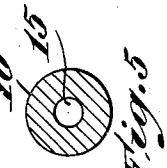


Fig. 5

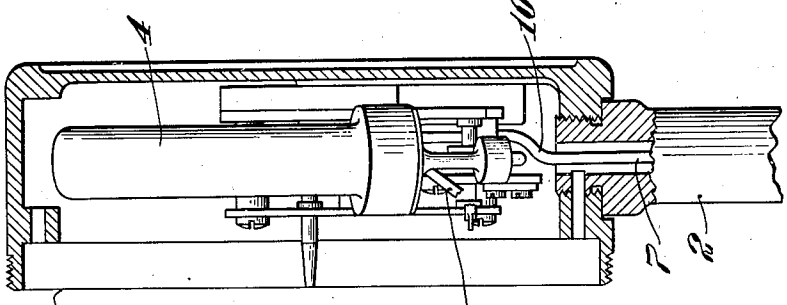


Fig. 2

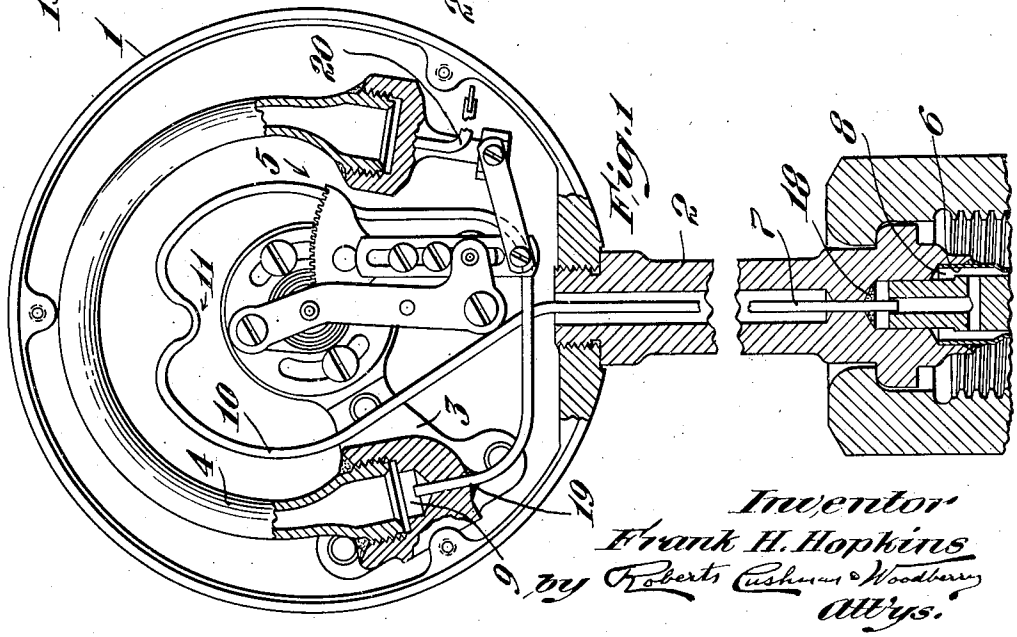


Fig. 1

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2,261,028

PULSATION DAMPENER

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Application December 16, 1939, Serial No. 309,579

5 Claims. (Cl. 138—26)

This invention pertains to apparatus useful in indicating the pressure of fluid, and relates more particularly to a pulsation dampener designed to be interposed between the source of pressure and the indicating or recording instrument.

As more fully pointed out in my copending application for Letters Patent, Serial No. 204,220, filed April 25, 1938, it is sometimes necessary to employ a pressure gauge or other pressure-responsive instrument in connection with apparatus wherein fluid pressure pulsates or fluctuates rapidly within the working range, for instance when a gauge is directly connected to the delivery pipe of a reciprocating pump. To avoid the resultant flutter of the index needle and to make it possible to obtain a true reading of the average working pressure, it has been proposed to interpose a flow-restricting element between the source of pressure and the pressure-responsive element of the instrument so as to damp out rapid variations in pressure while permitting relatively slow changes in pressure to affect the instrument in the usual manner.

In my aforesaid application for Letters Patent I disclose certain very desirable forms of fluctuation dampener which accomplish the desired purpose in an effective way and which are applicable to instruments of the class described under most conditions of use. However, certain, at least, of the fluctuation dampeners therein disclosed necessitate the provision of a fitting independent of the gauge and which, when applied to the gauge, occupies additional space and presents an exposed surface of substantial extent.

In the processing of food products, for example in pasteurizing milk, sanitary requirements are very rigid, and the exposed exterior surfaces of all appliances used in the process, as well as the interior surfaces which actually contact the milk or other food product, must be kept clean and sterile. Thus it is highly desirable to make such apparatus as simple and free from external angles, protuberances, and irregular surfaces as is possible.

The present invention has for one of its objects the provision of a pulsation dampener of a nature such that it may be housed within the usual case of the instrument, so that the space required for the instrument and its associated pulsation dampener is not any greater than though the dampener were not used, and no additional or unusual part is exposed for contact with the material being processed. In accomplishing this desirable result, advantage is taken of the fact that instruments of this general class, when used in processing foodstuffs, are commonly provided with guard devices to prevent entrance of the material being processed into the interior of the instrument, and thus the only liquid which directly contacts the pulsation dampener is one which is always mobile and free from suspended solids or other substances which might easily clog a canal of small transverse dimensions.

It has heretofore been proposed to dampen pulsations in an instrument of the class referred to by using a tube of small transverse area to conduct the pressure fluid to the Bourdon tube or equivalent element and by flattening the tube intermediate its ends to form a constriction in the passage such that surface viscosity and/or capillary effect substantially prevent rapid transmission of differences in pressure from one side to the other of the constriction. However, so far as is known to me, all such prior devices have placed the constriction in a substantially straight length of the tube. With such an arrangement, the effect of increase in pressure within the tube is to tend to return the flattened section to a circular contour and the higher the pressure the greater is this tendency to swell the tube and increase the area of the canal at the constricted portion. Thus the dampening effect gradually diminishes as the pressure increases, so that at the higher range of operation the pulsation dampener may be wholly ineffective, and subjection to such high pressure may totally and permanently eliminate the constriction.

A further object of the present invention is to provide a pulsation dampener of the simple type just referred to, to wit, a tube flattened to form a constriction in its bore, but so devised that it effectively resists deformation in response to internal pressure and thus functions with substantially the same efficiency whether the pressure be small or great.

Other and further objects and advantages of the invention will be pointed out in the following more detailed description and by reference to the accompanying drawing, in which

Fig. 1 is a front elevation, partly in vertical section, of a Bourdon tube pressure gauge having the present invention embodied therein, the gauge dial and cover being removed and the gauge being shown as provided with a protective device (shown broken away) to prevent entrance of the pressure fluid into the gauge itself;

Fig. 2 is a fragmentary vertical section in the plane of the index staff of the gauge of Fig. 1;

Fig. 3 is a fragmentary elevation of the pulsation dampener of the present invention removed

from the gauge and with the pipe of which it forms a part broken off;

Fig. 4 is a fragmentary elevation, to larger scale and partly in vertical section, of the pulsation dampener of the present invention;

Fig. 5 is a section on the line 5—5 of Fig. 2; and

Fig. 6 is a section on the line 6—6 of Fig. 4.

Referring to the drawing, the numeral 1 designates the case of an instrument, for instance a pressure gauge, in which the pulsation dampener of the present invention is embodied. While this instrument is shown as a pressure gauge of the Bourdon tube type, it is to be understood that such a pressure gauge has been chosen merely for convenience in description and that the invention is applicable to other instruments of this general class, and whether the pressure-sensitive element be a Bourdon tube or some other device having the same general purpose.

As here shown, the case of the gauge is provided with and supported by a tubular rigid stem 2, and a bracket 3 fixedly secured to the rear wall of the case forms an anchorage for one end of the hollow Bourdon tube 4. The bracket 3 also constitutes a support for the gauge movement 5 which may be of any desired or conventional type and which is actuated by the movable end of the Bourdon tube.

A pipe or tube 7, for example of hard copper or brass and of small diameter, for instance $\frac{1}{8}$ inch internal diameter, and preferably having a heavy wall, for instance of a thickness substantially equalling the diameter of its passage or bore, has one end arranged to communicate with the space or chamber 8 within a "pressure flask" or gauge protector 6. This pressure flask or gauge protector may be of any desired type, for instance of one of the kinds more fully disclosed in the copending application of Frank H. Hopkins, Serial No. 134,312, filed April 1, 1937. As illustrated, this gauge protector 6 is a metallic bulb having its upper part fitted within a suitable socket in the lower end of the stem 2 of the gauge and permanently united to the latter by means of solder, welding, brazing or the like. This protective device or pressure flask 6 has its exterior surface exposed to the fluid whose variations in pressure are to be indicated by the gauge, but since this protective device is impervious to the pressure fluid, the latter is unable to enter the gauge.

As described in the application above referred to, the chamber 8 of the protective device 6, the interior 9 of the Bourdon tube, and the passage in the pipe 7 and other communicating spaces are completely filled with a mobile, substantially incompressible liquid which transmits any changes in pressure of the fluid surrounding the device 6 to the Bourdon tube, thus causing the tip of the latter to move and thereby actuate the gauge movement and the index or pointer.

Since the pressure fluid external to the protective device 6 is unable to enter the pipe 7, and since the liquid within the latter thus cannot be contaminated with solids or other substances contained in the pressure fluid, it is possible to use a pipe 7 of small diameter without substantial danger that it will be clogged during use, and furthermore, to employ a constriction of capillary dimension in this pipe as a pulsation dampener.

As here illustrated, the pipe, after entering the gauge, forms an elongate, more or less pear-shaped loop 10, having its larger, upper part disposed within the curve of the Bourdon tube and encircling the gauge movement, there usually being a free space at this part of the instrument which is availed of in accordance with the present invention to accommodate the pulsation dampener.

Referring to Figs. 3 to 6 inclusive, this pulsation dampener consists of a more or less U-shaped downwardly directed sharp bend 11 in the upper part of the loop 10 of the pipe 7. This U-shaped bend comprises the downwardly concave, curved legs 12 and 13 which merge with the upwardly concave arc 14.

The main body of the pipe 7 may conveniently be made of ordinary drawn tubing having the substantially circular passage or bore 15, but where the pipe forms the U-shaped bend 11, the pipe is flattened, for example by applying pressure in the vertical direction, so that its upper and lower surfaces 16 and 17 (Fig. 6) become substantially flat and parallel, thus imparting to this portion of the pipe a more or less elliptical transverse section, as illustrated in Fig. 6, with the major axis of the ellipse substantially perpendicular to the plane of the arc 14. In thus flattening the pipe, the bore 15a becomes very narrow vertically; for example, this bore may be of the order of 0.004 inch in vertical height and of narrow more or less elliptical or even substantially rectangular transverse section.

After the gauge has been assembled with the dampener 6 (the opposite ends of the pipe 7 being welded in place as indicated at 18 and 19, respectively), the space within the Bourdon tube, the pipe 7 and the protective device 6 may then be filled through a suitable filling tube 20 secured to the free end of the Bourdon tube. After the space has been completely filled, the outer end of this tube 20 is sealed so that the liquid cannot escape from the enclosed space. In thus filling the spaces in the tube and protective device, the liquid also fills the pipe 7, including not only the circular bore 15 but also the narrow constriction 15a. If now the exterior surface of the protective device 6 be subjected to a pressure which pulsates rapidly, as for example if the device be mounted so as to be exposed to the fluid in the delivery pipe of a reciprocating pump, the liquid in the lower part of the pipe 7 is subjected to a rapid series of pressure pulsations. While a slow increase in pressure will make itself felt throughout the entire length of the pipe 7, including the constriction 15a, rapid pulsations in pressure are damped at the constriction 15a so that they are not manifest at the interior of the Bourdon tube. Thus, although the index of the gauge may indicate the average pressure at any given time, it is not caused to flutter rapidly by pulsations in the pressure fluid since, as just stated, such pulsations find a barrier at the constriction 15a in the tube where surface tension or capillary action strongly oppose rapid movement of the liquid.

As above noted, since the liquid in the pipe 7 is protected from grit or other contaminating substances, and since the liquid chosen for the purpose may be very light, non-viscous, and freely flowing in character, it is possible to use a single very constricted passage to constitute the pulsation dampener without danger that it will become clogged during use.

As will be noted by consideration of Figs. 4 and 6, the constriction 15a occurs in a downwardly arched portion of the pipe. At the inner or upper side of this arch the material forming the wall of the pipe has already been compressed by

the bending operation, while the material at the lower or outer side of the arch has been stressed by tension in bending it. Thus although the internal pressure within the flattened or constricted part of the pipe may be very great, for example of the order of 10,000 to 15,000 pounds per square inch, nevertheless the tendency of such internal pressure to restore the pipe to circular contour is strongly resisted by the arch-shape of the pipe. Any tendency to restore the pipe to circular form means a substantial further stressing of the metal, and such stressing, particularly at the inner side of the curve, would be a compressive stress which would meet very strong resistance through the bridging or arching effect of the metal forming the wall of the tube.

It is thus possible by disposing the constriction within an arched part of the tube to ensure proper and uniform action of the pulsation dampener even when the device is designed to work at a very high pressure range. It should be noted that the pulsation dampener as thus constructed is wholly within the gauge itself so that it does not expose additional surfaces required to be cleaned; it does not occupy additional space; it does not necessitate a change in the construction of the gauge itself; and furthermore, it is of very simple and inexpensive type adding but little to the cost of the gauge with which it is associated.

For convenience in description, reference has been made to the "upper" and "lower" parts of the pipe loop 10 and of the bend 11 in the pipe, but it is to be understood that the invention is not limited by any such terms since the direction of the bend 11, whether up or down, or the location of the loop or coil 10 with reference to the other parts of the gauge or the position of the gauge itself is wholly immaterial so far as the function of the pulsation dampener is concerned.

While one desirable embodiment of the invention has been shown by way of example, it is to be understood that the invention is not limited thereto but is to be regarded as inclusive of any modifications coming within the scope of the appended claims.

I claim:

1. A pulsation dampener for use in a fluid pressure supply line, said dampener consisting of a length of pipe having a U-bend therein, the pipe being of normally circular, transverse section and being so flattened at the bend as to constrict the passageway therethrough to a narrow elliptical transverse sectional contour with the major axis of the ellipse perpendicular to the plane of the U-bend.

2. A pulsation dampener for Bourdon tube gauges or the like to which pressure fluid is supplied by a pipe of normally circular cross section having walls of a thickness approximating the diameter of the normal passageway through the pipe, said dampener consisting solely of a constriction in said passageway occurring in a U-bend in the pipe, the pipe being flattened for constricting the passage so that the transverse section of the passageway is narrowly elongate with its longer dimension substantially perpendicular to the plane of the U-bend.

3. A pulsation dampener for Bourdon tube gauges or like instruments to which pressure fluid is supplied by a pipe of small internal diameter, said dampener consisting solely of a constriction in the passageway through the pipe, said constriction occurring in a curved portion of the pipe, the transverse contour of the pipe where so constricted being substantially elliptical with the major axis of the ellipse perpendicular to the plane of curvature of the pipe.

4. A pulsation dampener for a Bourdon tube gauge having a supply pipe of normally circular transverse section which connects the Bourdon tube to a source of variable fluid pressure, said pulsation dampener comprising a constriction in the passageway through said pipe intermediate the ends of the latter, the wall of the pipe at said constriction being deformed from the normal circular contour and the pipe being so arched at the region of said constriction as to oppose the tendency of internal pressure to restore the deformed part of the wall of the pipe to normal circular contour.

5. A pulsation dampener for a Bourdon tube gauge having a supply pipe of normally circular transverse section which connects the Bourdon tube to a source of variable fluid pressure, said pulsation dampener consisting solely of a constriction in the passageway through the pipe resultant from an abnormally close approach of the oppostie walls of the pipe, said constriction occurring in a portion of the pipe which is so bent as to provide an arch effect resistant to internal stress tending to separate said abnormally close walls.

FRANK H. HOPKINS.