

Sept. 16, 1958

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2,852,033

ANTI-SURGE ASSEMBLY

Filed June 19, 1956

2 Sheets-Sheet 1

FIG-1

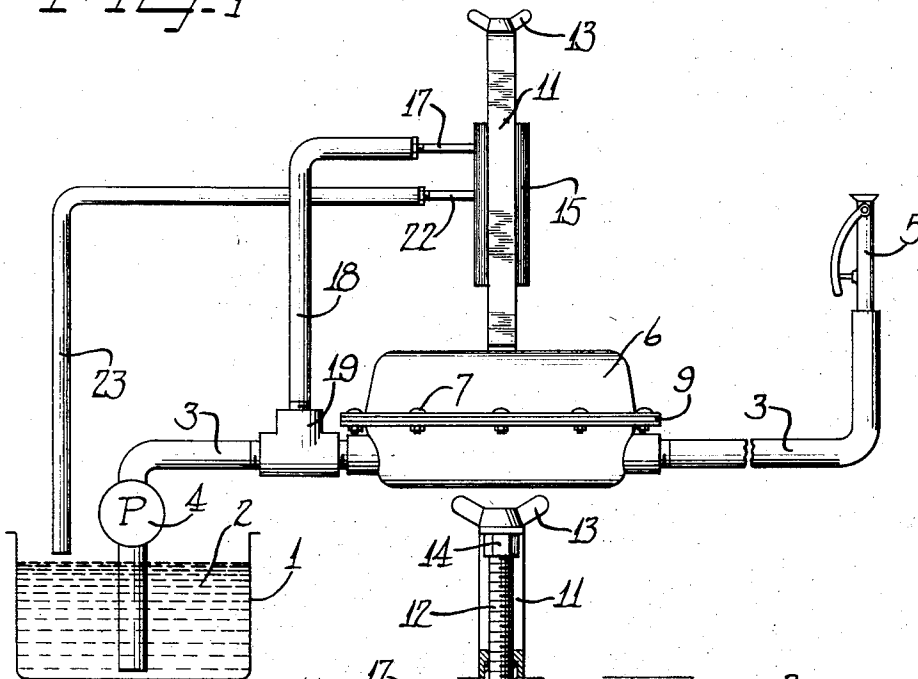
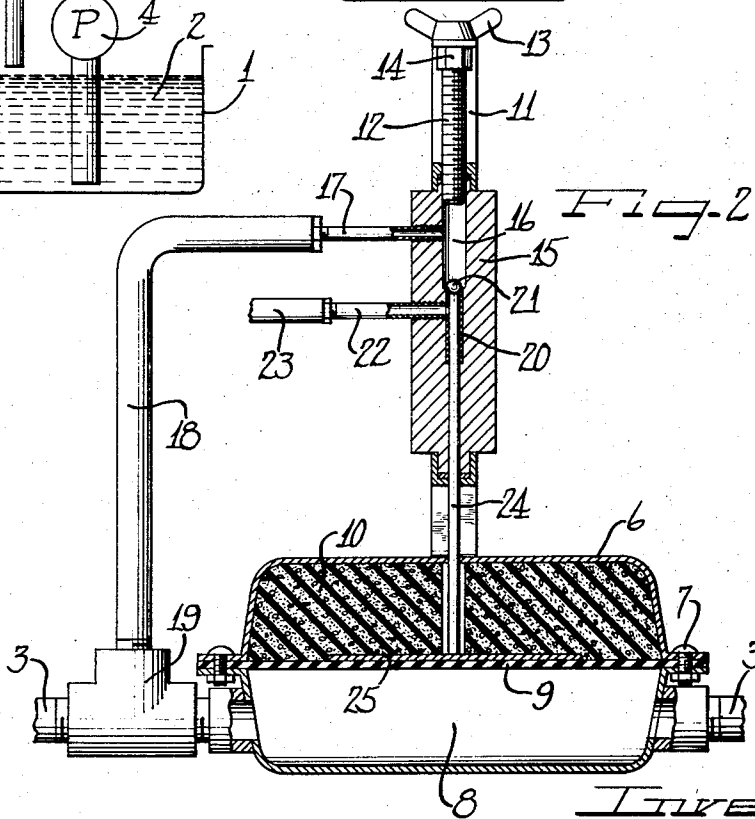


FIG-2



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2 Sheets-Sheet 2

Fig. 3

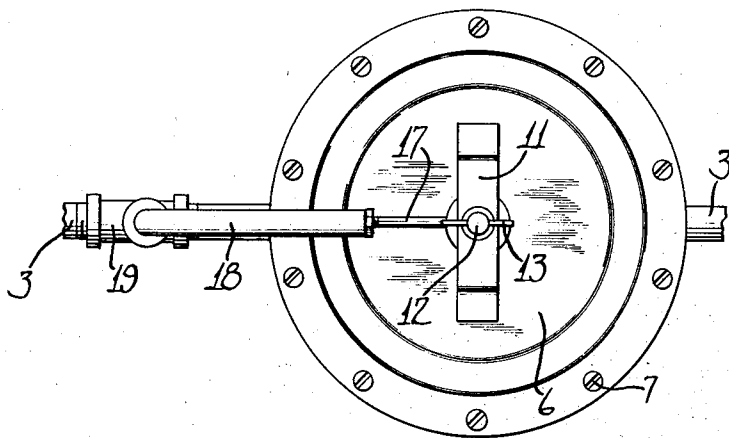
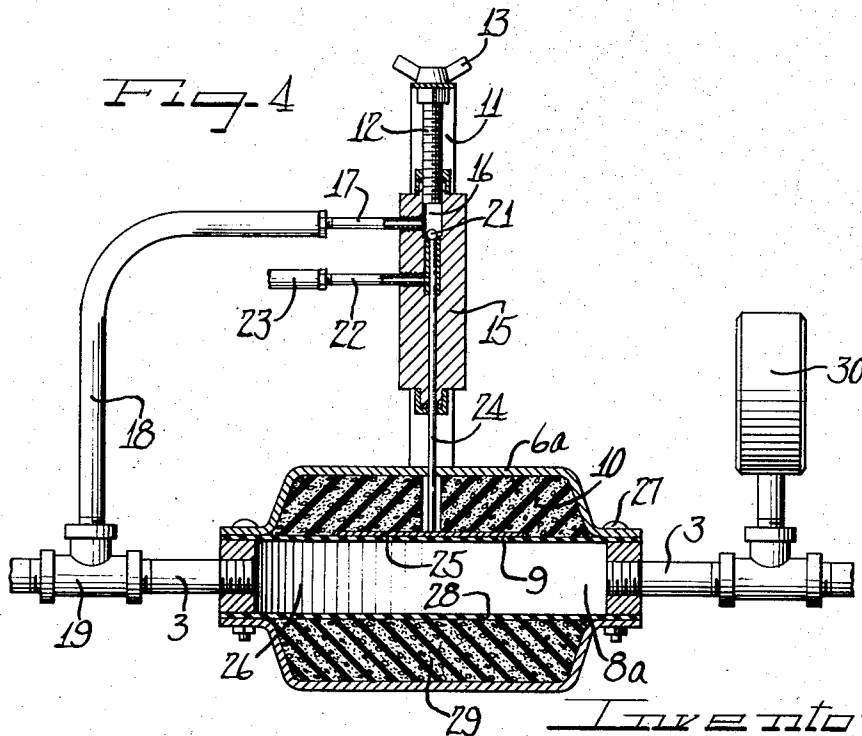


Fig. 4



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2,852,033

ANTI-SURGE ASSEMBLY

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Application June 19, 1956, Serial No. 592,296

11 Claims. (Cl. 137—108)

This invention relates to an anti-surge assembly, and more particularly to an anti-surge assembly readily connectable in a pipe line through which a fluid is forced for the purpose of eliminating surging and pulsation, the assembly being highly desirable for use in connection with liquid spraying apparatus, although the invention will obviously have other uses and purposes as will be apparent to one skilled in the art.

In the past, anti-surge assemblies have been developed, and in most instances the casing of the anti-surge device has been filled with air. These devices have proven objectionable in that they become liquid-logged by virtue of the fact that the air escapes gradually along with the liquid entering and leaving the anti-surge compartment or casing, and eventually the entire casing becomes filled with liquid rather than air and all anti-surge properties of the device have been eliminated. In other cases various means have been employed in an endeavor to not only eliminate surge characteristics of fluid being forced through a pipe line, but also to eliminate the effect of pulsations by virtue of a pump. This was particularly true when a single cylinder pump is utilized, whereupon surging and pulsation is perhaps at its highest. These formerly known devices, however, were expensive in construction, difficult to install in the respective pipe lines, and possessed relatively short lives. In most instances, also, if they effectively took care of pulsations, they did not take care of surges, and if they took care of surges to a reasonable extent, pulsations were still effective.

With the foregoing in mind, it is an important object of the instant invention to provide an anti-surge assembly which is simple in construction, readily and easily mounted in a pipe line, and which effectively eliminates not only the adverse effects of surging, but also the effects of pump pulsations.

It is also an object of this invention to provide an anti-surge assembly highly desirable for eliminating the adverse effects of pulsations even from a one cylinder pumping unit.

A further object of the invention resides in the provision of an anti-surfing device which does not depend upon an air chamber, but in which the chamber is filled with an elastomer, exceptionally long lived, and which need not be replaced until after many hours of operation, far beyond the time in which the customary air chamber becomes fluid logged.

Still a further feature of the invention resides in the provision of an anti-surge assembly readily connectable in a pipe line through which fluid is forced under pressure, and which assembly incorporates by-passing means substantially instantly operable so that when unexpected surges occur by-passing is immediately effective to neutralize the adverse surge condition.

It is a further feature of the invention to provide an anti-surge assembly embodying by-pass means for almost instantly by-passing fluid upon a surge beyond a predetermined amount, and which by-pass means are adjustable relatively to the surge controlling means so as to provide

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a selective adjustment of the pressure necessary to properly actuate the by-pass means.

Still a further feature of the instant invention resides in the provision of an anti-surge assembly including a casing having a flow passage therethrough partially defined by a flexible diaphragm, with an elastomer or elastomeric means disposed between the diaphragm and the adjacent casing wall, the elastomeric means yieldingly resisting a movement of the diaphragm in a direction to expand the size of the flow passage, so that the effect of surges and pulsations are absorbed by the diaphragm and elastomeric means.

Still a further object of the instant invention resides in the provision of an anti-surge assembly of the character just above mentioned in the preceding paragraph with which by-pass means are associated, so that upon a surge of predetermined pressure, liquid is by-passed from the flow passage and the adverse effects of the surge are instantaneously eliminated.

Still another feature of the instant invention resides in the provision of an anti-surge device embodying a casing having a flow passage therethrough which is partially defined by opposed diaphragms of flexible material, which diaphragms may, if so desired, be backed with elastomeric means yieldingly resisting movement of the diaphragm in a direction to enlarge the flow passage, whereby the movements of the diaphragms effectively eliminate the adverse effect of pulsations in the fluid line with which the casing is associated.

Still another feature of the invention resides in the provision of an anti-surge assembly of the character described in the preceding paragraph, wherein one of the diaphragms is connected to by-pass actuating means so that a surge of predetermined pressure will result in a by-passing of fluid around the passage through the casing and thus the adverse effect of the surge is eliminated almost instantly.

While some of the more salient features, characteristics and advantages of the instant invention have been above pointed out, others will become apparent from the following disclosures, taken in conjunction with the accompanying drawings, in which:

Figure 1 is a fragmentary side elevational view of an anti-surge assembly shown connected in operative relationship in a forced fluid system;

Figure 2 is a fragmentary part vertical sectional, part elevational view, enlarged, illustrating more particularly the anti-surge assembly itself of Fig. 1;

Figure 3 is a fragmentary top plan view, enlarged, of the structure shown in Fig. 2; and

Figure 4 is a fragmentary part vertical sectional, part elevational view, of an anti-surge assembly of somewhat different construction.

As shown on the drawings:

In that illustrated embodiment of the instant invention seen in Figs. 1 to 3 inclusive, there is shown an anti-surge assembly operatively connected to a pipe line for a liquid spraying apparatus. The entire structure includes a tank 1 which may be considered a source for a supply of spraying liquid 2. A pipe line 3 enters into the tank 1 and liquid is forced from the tank through the pipe line by means of a pump diagrammatically indicated at 4. Connected within the pipe line 3, which ultimately reaches a spraying nozzle or the equivalent 5, is a casing 6 which preferably is formed in two complementary half portions which are secured together by means of a series of bolts 7 or in an equivalent manner.

The casing 6 is so designed as to provide a flow chamber or passage 8 therein, preferably in alignment with the pipe line 3, so that liquid entering the passage 8 at one side flows out of the passage 8 at the opposite side of the casing. Defining at least a part of the flow passage

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or chamber within the casing is a diaphragm 9 of flexible or resilient material such as synthetic rubber. As illustrated, the diaphragm 9 may be held in position by the bolts 7 between the two halves of the casing, and obviously this diaphragm itself will function as a suitable gasket for the two casing sections.

Preferably between the dry side of the diaphragm 9 and the casing wall is a mass of elastomer or elastomeric means 10. This mass is preferably a closed cell gas expanded elastomer which is characterized by having excellent restorative powers along with being very highly resilient. The elastomer may be satisfactorily composed of sponge rubber; synthetic rubber, a suitable plastic sponge-like substance, and one satisfactory example of the elastomer is a product now known to the trade as "Hycar" sponge. It may be desirable for the elastomeric means to have a skin over the outer surface thereof which is impervious to either gas or liquid, so that the elastomer cannot act as a sponge and absorb either a gas or liquid, although the diaphragm 9 itself may be effective to prevent contact of either liquid or gas with the elastomer 10. The elastomeric means present a yielding resistance to movement of the diaphragm in a direction tending to enlarge the size of the fluid passage or chamber 8. In other words, as seen in Fig. 2, the elastomeric means yieldably resist movement of the diaphragm toward the upper casing wall.

With the instant assembly, by-passing means are also preferably provided. In the illustrated instance, the by-passing means are supported by the aforesaid casing 6 by way of a U-shaped bracket 11, disposed in inverted position, and with its legs firmly secured such as by spot welding, brazing, or the like, to the upper section of the casing. Through the yoke or upper portion of the bracket 11 a threaded stud bolt 12 is positioned, with the upper end thereof fixedly connected to a wing nut 13 or the like. A conventional nut 14 is secured to the underside of the yoke, so that when the wing nut is turned, both it and the bolt 12 move relatively to the bracket and nut 14.

The lower end of the bolt 12 is engaged with a by-pass fitting 15 having a flow passage 16 therein. As seen best in Fig. 2, a pipe 17 extends through the wall of the fitting to communicate with the flow passage 16, and this pipe 17 may be connected to a flexible tube such as a rubber or synthetic rubber hose 18 which is in turn connected by way of a T 19 to the pipe line 3 in advance or on the upstream side of the casing 6. The fitting 15 is bored from the passage 16 clear to the end thereof, and in a portion of this bore a sleeve 20 is inserted which is made arcuate at the top to accommodate a check valve in the form of a ball 21. Another pipe 22 extends through the fitting and communicates with the interior of the sleeve 20, and this pipe 22 has its other end connected to a flexible tubing or the equivalent 23 which leads back to the source of fluid or tank 1. Consequently, when the ball 21 is elevated fluid may be by-passed through the tube 18 and pipe 17, the passage 16, and the pipe 22 and tube 23 back to the source of supply.

In order to actuate the ball and effect such by-passing of fluid upon a surge of predetermined pressure, a valve actuating rod 24 extends through the fitting 15 and into the sleeve 20 beneath the ball 21. This valve actuating rod has its lower end connected to a relatively large plate 25 which is disposed between the elastomer 10 and the diaphragm 9. Consequently, when sufficient pressure is urged upon the diaphragm to compress the elastomer a predetermined extent, the rod 24 is moved upwardly unseating the ball 21, and allowing the by-passing of fluid. This occurs almost instantaneously with a predetermined pressure surge in the chamber or passage 8, and consequently the adverse effects of such surge are eliminated from the pipe line 3 on the opposite side of the casing 6 from the pump.

Turning the thumb nut 13 results in moving the en-

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tire by-pass fitting 15 relatively to the rod 24, and in that manner a selective variation may be made insofar as the pressure required to actuate the by-pass valve is concerned, so that the amount of pressure may be altered at will before by-passing is effected.

Now in operation, the instant invention as above described is extremely simple and effective. It is, of course, desirable to have a constant spray from the spray nozzle 5 under a predetermined and substantially constant pressure. With the pump 4 in operation, fluid is pumped to the spray nozzle 5 and this fluid passes through the chamber or passage 8 in the casing 6. In the event the pump is a single cylinder pump, or a pump of some other character causing pulsations, those pulsations will be absorbed by the diaphragm and elastomer 10, and it is not necessary that the pulsations be of sufficient amount to actuate the check valve 21. However, when a surge occurs or a building up of pressure beyond a predetermined amount, the rod 24 will be elevated removing the ball 21 from its seat and permitting the by-passing of fluid almost instantaneously with the surge in pressure. Accordingly, the pressure at the nozzle 5 will remain substantially constant. The elastomeric material 10 is long lived, highly resilient, and has remarkable restorative powers so that by-passing of fluid, absorption of pulsations, and the like, are automatically compensated for almost immediately with the increase in pressure at any interval. Further, the entire structure is extremely economical to manufacture, easy to install, and highly economical to use when the beneficial effects thereof are considered.

In Fig. 4 I have shown a slightly different construction of the instant invention which may be more desirable for the absorption of pulsations. In this instance, the same general pipe line apparatus is disclosed, but the anti-surge element itself comprises a casing 6a made in two sections with an annular spacer 26 disposed between those sections and the casing sections are held together by means of an annular series of bolts 27 or the equivalent, which bolts extend through the spacer ring 26. In this instance, there is a passage 8a through the casing 6a connected within the pipe line 3, and on one side this passage is partially defined by means of a diaphragm 9 backed with an elastomer 10, as above described. The valve actuating rod 24 and plate 25 are associated with the diaphragm 9 and elastomer 10 as above described.

In this instance, however, there is another diaphragm 28 opposed to the diaphragm 9, and also partially defining the opposite side of the passage 8a. This diaphragm 28 may also be backed up with an elastomer 29 of the same character as above described, but there is no valve actuating rod connected with this particular assembly of diaphragm and elastomeric means.

With the arrangement disclosed in Fig. 4, pulsations will be absorbed conjointly by both diaphragms 9 and 28, and with ordinary pulsations no actuating of the by-pass valve 21 should result, since the diaphragms with the elastomer backing means are sufficient to compensate for such pulsations without moving the rod 24 any material extent. However, should there be a sudden increase in pressure such as a surge of predetermined amount, the control rod 24 will be elevated sufficiently to unseat the ball check valve 21 and allow by-passing, notwithstanding the fact that some of the surge will be absorbed by the diaphragm 28 and elastomer 29.

With the exception of its greater ability to absorb pulsations without by-passing, the structure shown in Fig. 4 functions in the same general manner as above described in connection with the structure shown in Figs. 1 to 3 inclusive.

As indicated in Fig. 4, a pressure gauge 30 may be mounted in the pipe line 3 preferably on the downstream side of the casing 6 or 6a as the case may be.

It will be understood that modifications and variations may be effected without departing from the scope of the novel concepts of the present invention.

I claim as my invention:

1. In an anti-surge and anti-pulsating assembly, a casing for connection in a pipe line to which liquid is forcibly pumped, said casing divided into two compartments by flexible diaphragms, one of said compartments having an inlet and outlet opening for liquid and forming a liquid passageway therethrough, an elastomer in the other of said compartments and completely filling said compartment between the diaphragm and the wall of the casing, said elastomer being a one-piece resilient member, a by-pass means for connection to said pipe line on the upstream side of said casing and to the liquid source, and a connection between said diaphragm and said by-pass means to actuate the latter by the former upon a pressure surge of liquid, whereby actuation of said by-pass means eliminates surging of the liquid and the resiliency of said elastomer eliminates pulsating of the liquid before leaving the liquid passageway.

2. In an anti-surge and anti-pulsating assembly, a casing for connection in a pipe line to which liquid is forcibly pumped, said casing divided into two compartments by a flexible diaphragm, one of said compartments having an inlet and outlet opening for liquid and forming a liquid passageway therethrough, an elastomer in the other of said compartments and completely filling said compartment with the diaphragm and the walls of the casing, said elastomer being a resilient one-piece member, a by-pass fitting supported on said casing and having a liquid passage therein, a check valve controlling flow through the by-pass passage, and an actuating element extending through an opening in said elastomer and between said diaphragm and said check valve whereby movement of the diaphragm on a pressure surge of liquid actuates said check valve; whereby actuation of said check valve eliminates surging of the liquid and the resiliency of said elastomer eliminates pulsating of the liquid before leaving the liquid passageway.

3. In an anti-surge and anti-pulsating assembly, a casing for connection in a pipe line through which liquid is forcibly pumped, said casing divided into two compartments by a flexible diaphragm, one of said compartments having an inlet and outlet opening for liquid and forming a liquid passageway therethrough, an elastomer in the other of said compartments and completely filling said compartment between the diaphragm and the wall of the casing, said elastomer being a resilient one-piece member having a central bore extending between the upper and lower surfaces thereof, a by-pass fitting supported on the exterior of said casing and having a liquid passage therein, a check valve controlling flow of liquid through the by-pass passage, an actuating rod extending through said bore in said elastomer and between said diaphragm and said check valve whereby movement of the diaphragm on a pressure surge of the liquid in the liquid passageway actuates said check valve, and whereby actuation of said check valve eliminates surging of liquid and the resiliency of said elastomer eliminates pulsating of the liquid before leaving the liquid passageway.

4. In an anti-surge and anti-pulsating assembly for a pipe line, a hollow casing divided into three compartments by a pair of parallel flexible diaphragms spaced apart and extending transversely of said casing, the intermediate compartment having inlet and outlet openings for liquid and forming a liquid passageway therethrough, a one-piece elastomer arranged in the second of said compartments, a one-piece elastomer with a central bore therein arranged in the third of said compartments, said elastomers being resilient and each filling the entire space in each of said compartments between the diaphragm adjacent thereto and the walls of said casing, a by-pass fitting supported upon the exterior of said casing adjacent the wall forming part of said third compartment, said by-pass fitting having a liquid passage therein, a check valve controlling flow of liquid through the by-pass passage, an actuating rod extending through said bore in said

elastomer in said third compartment and between said diaphragm and said check valve whereby movement of the diaphragm adjacent said actuating rod due to a pressure surge of the liquid in the liquid passageway actuates said check valve, and whereby actuation of said check valve allows the liquid to flow through the by-pass passage eliminating surging of liquid and the resiliency of both of said elastomers eliminates pulsating of the liquid in the liquid passageway between the diaphragms before the liquid leaves the liquid passageway.

5. In an anti-surge and anti-pulsating assembly for a pipe line, a casing having a fluid passage therethrough, a fluid inlet and an outlet on opposite sides of said casing, a pair of vertically spaced flexible diaphragms transversely assembled in said casing defining therebetween a part of said fluid passage, said diaphragms responsive to pressure surges of liquid flowing through said passage, a preformed elastomer assembled between each of said diaphragms and the wall of the casing adjacent thereto, said elastomers being resilient and completely filling the space between the dry side of the diaphragms and the casing walls, a by-pass controlling means assembled vertically and centrally above said casing and secured thereto, said by-pass means having a valve therein controlling flow of fluid through said by-pass, a control rod extending from the dry side of the upper diaphragm through the elastomer and exterior casing wall above said diaphragm and into said fitting to actuate said valve; said control rod movable with said upper diaphragm and the yielding of the elastomer adjacent thereto, whereby actuation of said by-pass control means eliminates surging of fluid and the two elastomers eliminate pulsations of the liquid before leaving the liquid passageway.

6. In an anti-surge and anti-pulsating assembly for a pipe line, a casing having a fluid passage therethrough, a fluid inlet and an outlet on opposite sides of said casing, a pair of vertically spaced flexible diaphragms transversely assembled in said casing defining therebetween a part of said fluid passage, said diaphragms responsive to pressure surges of fluid flowing through said passage, a preformed elastomer assembled between each of said diaphragms and the wall of said casing adjacent thereto, said elastomers being resilient and completely filling the space between the dry sides of the diaphragms and the casing walls, a by-pass controlling means assembled vertically and centrally above said casing and secured thereto, said by-pass means having a valve therein controlling flow of fluid through said by-pass, a control rod extending from the dry side of the upper diaphragm through the elastomer and exterior casing wall above said diaphragm and into said fitting to actuate said valve, said control rod movable with said upper diaphragm and the yielding of the elastomer adjacent thereto, and adjustable means for moving said by-pass means relative to said central rod to selectively vary the pressure necessary to actuate said valve, whereby said by-pass means eliminates surging of the liquid and the resilient elastomers on the dry sides of each diaphragm resisting movement thereof in a direction toward enlargement of said passage.

7. In an anti-surge and anti-pulsating assembly for a pipe line, a casing having a fluid passage therethrough, a flexible diaphragm defining a part of said passage and responsive to pressure surges in the fluid flowing through said passage, a by-pass fitting supported on said casing exteriorly thereof, said fitting having a by-pass therein, a valve controlling flow through said by-pass, a control rod extending from the dry side of said diaphragm through said casing and into said fitting to actuate said valve to prevent surging of the fluid flowing through said fluid passage, and a preformed one-piece elastomer completely filling the cavity between the dry side of said diaphragm and the casing wall to yieldingly resist valve actuating movement of said diaphragm and to prevent

pulsating of the fluid flowing through said fluid passage-way.

8. In liquid spraying apparatus, a source of liquid, a pipe line from said source, a pump in said line, a casing in said line having a flow passage therethrough, a pair of vertically opposed flexible diaphragms in said casing and defining therebetween a part of said flow passage, the upper diaphragm defining the bottom wall of an upper cavity in said casing, the lower diaphragm defining the upper wall of a lower cavity in said casing, a pre-formed elastomeric means filling the entire cavity on the dry side of each diaphragm and yieldingly resisting movement of the diaphragm in a direction to enlarge said flow passage, a by-pass fitting connected to said source and to said pipe line between the pump and said casing, valve means controlling flow through said fitting, and a control rod for said valve means leading from the upper diaphragm to said fitting through the elastomer means in the upper cavity for response to the movement of said upper diaphragm, whereby said by-pass eliminates surging and said two elastomeric means yieldingly resisting diaphragm movements and tending to eliminate pulsations of the fluid passing through said flow passage.

9. In an anti-surge and anti-pulsating device comprising a hollow casing formed in three sections, said sections embodying a mid-section and a wall section assembled in opposite sides thereof, a flexible diaphragm disposed between each of said wall sections and said mid-sections, means for securing the three sections and said diaphragms together, a one-piece resilient elastomer disposed within each wall section and filling the entire area thereof, each of said resilient elastomers in contact with one of said diaphragms, means for connecting the mid-section in a pipe line through which liquid is forcibly pumped, a by-pass fitting supported on the exterior of one of said wall sections and having a liquid passage therein, a check valve controlling the flow through the by-pass passage, and a controlling rod actuated by one of said diaphragms when actuated by liquid passing through said mid-section, said resilient elastomers yieldingly, resisting movement of said rod and the diaphragms by pressure surges of liquid in said mid-section, whereby actuation of said check valve permits by-passing of liquid and eliminates surging of the liquid while the elastomers eliminate pulsating of the liquid before said liquid leaves said mid-section.

10. In an anti-surge and anti-pulsating device for spraying apparatus, a source of liquid, a pipe line from the source, a pump in the line, a hollow casing in said line, a casing formed in a plurality of sections, said sections including a mid-section embodying a substantially vertical wall closed by an upper and lower wall formed of flexible diaphragms assembled therewith, means for connecting said mid-section in said pipe line through which liquid is forcibly pumped, a top pan shaped section secured above and to said mid-section, a bottom pan shaped section secured below and to said mid-section, each of said pan

sections filled with a flexible preformed pan-shaped elastomer, a by-pass fitting on the exterior surface of said top section, and a by-pass fitting connected to said source of the liquid and to said pipe line between the pump and said casing, valve means controlling flow of liquid through said by-pass fitting, a control rod for actuating said valve extending through said upper section and the elastomer therein and contacting and movable with said diaphragm forming the upper wall of said mid-section, both of said elastomers resisting movement of said diaphragms by pressure surges of the liquid passing through said mid-sections, and adjustable means for moving said fitting relative to said control rod to selectively vary the pressure necessary to actuate said valve means; whereby said by-pass fitting and said elastomers in each of the top and bottom sections will prevent surging and pulsations of the liquid leaving the mid-section.

11. In a liquid spraying apparatus, a source of liquid, a pipe line from said source, a pump in said line, a hollow casing in said line having a flow passage therethrough, said casing consisting of three parts, two parts substantially pan shaped and a third part formed with vertical side walls, each of said pan shaped parts formed with a peripheral flange, said third part formed with a peripheral flange at each end thereof, a flexible diaphragm disposed between each of said pan shaped parts and said third part and each diaphragm having its peripheral flange clamped between the peripheral flanges of said parts, means passing through the flanges to secure the diaphragms and parts together, a pan shaped elastomer disposed in each of the pan shaped parts and adapted to fill the space therein and be in contact with one of said diaphragms, a by-pass fitting mounted upon the external surface of one of said pan shaped parts and connected by flexible tubes to said source of liquid and to said pipe line between the pump and said third part of said casing, valve means controlling flow of liquid through said by-pass fitting, a control rod for actuating said valve extending through said pan shaped part supporting said by-pass fitting and through the elastomer in said part and said rod contacting and movable with the diaphragm associated with said part, both of said elastomers resisting movement of said diaphragms by pressure surges of the liquid passing through said third part; whereby said by-pass fitting and said elastomers in the dry parts will prevent surging and pulsating of the liquid leaving the wet third part of the hollow casing.

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