

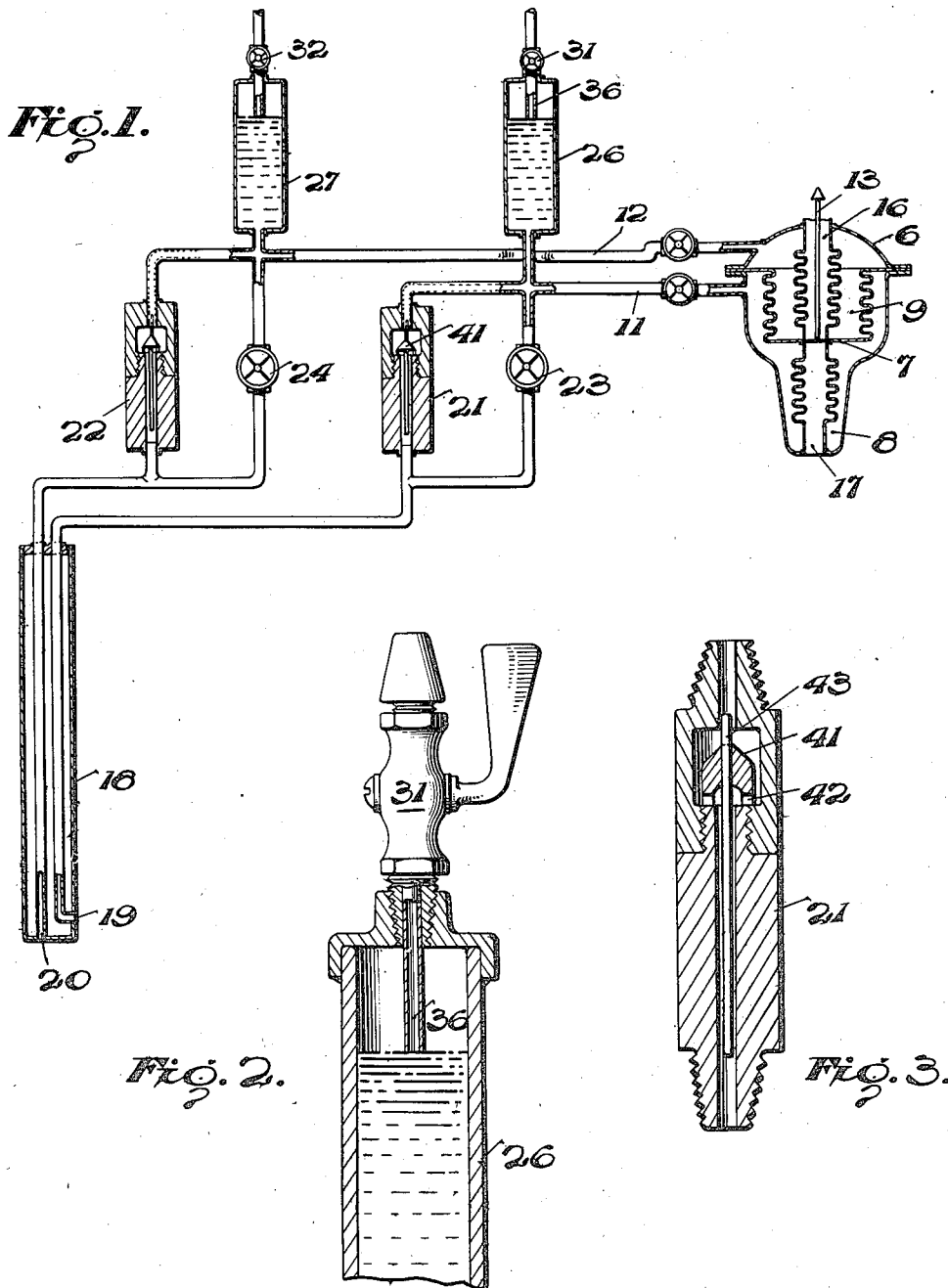
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HYDRAULIC SYSTEM

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HYDRAULIC SYSTEM

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8 Claims. (Cl. 137-78)

This invention relates to hydraulic systems, and particularly to the control of pressure surges to prevent damage to parts of such a system.

An object of the invention is to provide a novel method and means of absorbing a suddenly applied pressure impulse of abnormally great magnitude, such as might result from an explosion under the surface of a body of water in which is located a vessel, such as a ship or submarine carrying susceptible parts of a hydraulic system.

The invention is herein illustrated as applied to the protection of a hydraulic circuit which includes a bellows assembly of a character employed in marine measuring apparatus; but it is to be understood that the invention has broader application and that its scope is defined by the appended claims rather than by the illustrated exemplification thereof.

In the drawing:

Fig. 1 shows the invention applied to the protection of a bellows assembly, as above noted;

Fig. 2 is a more detailed showing of one of the control units of Fig. 1; and

Fig. 3 is a more detailed showing of another of the control units of Fig. 1.

As shown, the illustrated embodiment is applied to a bellows assembly 6, divided (by a diaphragm 7) into two chambers 8 and 9, the former receiving the "pressure" (Pitot) conduit 11 and the latter receiving the "static" conduit 12; the index actuating rod 13 being attached to the diaphragm 7 for operation of any associated measuring or other apparatus (as in Rydberg Patent No. 1,968,539, for example). The inner spaces 16 and 17 are exposed to the pressure of the atmosphere surrounding the unit 6, as is customary.

Numeral 18 designates a "rodmer," as it is termed in the art, having terminal openings 19 and 20 for the conduits 11 and 12, respectively; the said rodmer 18 being attached to the hull of the vessel, so that openings 19 and 20 are exposed to the open sea, as are openings 3 and 5 in Fig. 1 of the Rydberg patent, above identified. Numerals 21 and 22 designate automatic valve assemblies, and valves 23 and 24 are provided to permit temporary by-passing of the valves 21 and 22, respectively, during conditioning and servicing.

Air collectors 26 and 27 are provided in the lines 11 and 12, respectively; each air collector including a tube (as at 35) projecting externally and adapted to be vented to atmosphere, when desired, by opening of vent valve 31 or 32, as the case may be, and projecting internally sufficiently

to insure the trapping of a quantity of air at all times.

Operation

If the pressure increases suddenly due to the explosion of a depth charge, the entrapped air in collectors 26 and 27 is compressed by the inrush of water through the "snubber" valves 21 and 22. The piston 41 of each valve rises and closes off its upper orifice, thus blocking the further passage of water before the pressure applied has increased sufficiently to injure the bellows assembly 6. As soon as the pressure subsides, the pistons will drop due to gravity and the system will again be safe for normal operation.

Varying the volume of air trapped in the collectors will vary the amount of water flowing through the "snubber" valves for a given pressure difference. Changing the distance between each snubber orifice and its valve will determine the time required to effectively block the passage. These values can be determined experimentally and so fixed that normal changes in pressure due to diving or acceleration of the vessel will not actuate the snubbers, but any sudden increase will move the pistons 41 to the cut-off positions.

Each valve is slotted at its base, as indicated at 42 in Fig. 3, and each carries a rod or valve stem 43 to maintain it in seating relationship to its orifice 43.

What is claimed is:

1. A protective system including, in combination with liquid-filled line embodying a unit to be protected, pressure surge limiting means including a valve movable to shut off communication with said unit by flow resulting from sudden pressure surge application, and means located in said line between said valve and said unit for cushioning the shock of the sudden pressure surge application as said valve is moving to the shut-off position, said last-named means including a vessel in which air is trapped at one end and liquid is admissible at the other end to compress said air in response to a pressure rise at the point of liquid admission.

2. In a hydraulic system, in combination with a pressure responsive element and a liquid-filled conduit leading thereto, means in said conduit to cut off flow therethrough in response to flow resulting from pressure surge, and means located in said line between said cut-off means and said unit including an air-cushioned liquid container coacting with said cut-off means to thereby provide for movement of liquid in said conduit and movement of said cut-off means to the cut-off position.

3. In a hydraulic system having a liquid-filled line leading from a source of variable fluid pressure to a pressure-responsive device, valve means in said line automatically operable to shut off fluid flow by flow resulting from a sudden pressure surge of predetermined magnitude in said line from said fluid pressure source towards said pressure-responsive device; and resilient liquid-cushioning means, disposed in said line between said valve means and said pressure-responsive device, thereby providing for movement of liquid in said line and closure of said valve means in response to said sudden pressure surge, without injuring said pressure-responsive device.

4. In a hydraulic system having a liquid-filled line leading from a source of variable fluid pressure to a pressure-responsive device, resilient cushion means in said line operable to permit a sudden pressure surge in one part of said line without transmitting a corresponding sudden pressure surge to the line adjacent said pressure-responsive device; and valve means in said line between said cushion means and said source of variable fluid pressure automatically operable to cut off fluid flow by flow resulting from a sudden pressure surge of predetermined magnitude in said one part of said line, to thereby prevent sudden pressure surges originating at said source of fluid pressure from being transmitted to said pressure-responsive device.

5. The hydraulic apparatus defined in claim 4, wherein said valve means is operable to cut off liquid flow only in the direction of said pressure-responsive device.

6. The hydraulic apparatus defined in claim 4, wherein said line leading from said source of fluid pressure to said pressure-responsive device is normally completely filled with liquid, and said resilient liquid cushion means comprises a side branch in said line leading to a closed chamber partially filled with liquid and defining an air cushion.

7. In a hydraulic apparatus having conduit means leading from a source of variable fluid pressure to a pressure-responsive device and normally completely filled with liquid, valve means operably associated with said conduit means and automatically operable by flow resulting from hydraulic surges of predetermined magnitude, for cutting off communication between said source of pressure and said pressure-responsive device for protecting the latter against rupture; and means for adjustably predetermining the closing action of said valve means, comprising air cushion means communicating with said conduit means intermediate said valve means and said pressure-responsive device and embodying means for selectively varying the volumetric air capacity thereof.

8. In a hydraulic system of the type embodying conduit means leading from a source of variable fluid pressure to a pressure-responsive device, hydraulic cushion means operably associated with said conduit means between said source of fluid pressure and said pressure-responsive device for preventing sudden pressure surges from being transmitted undiminished in magnitude from said source of fluid pressure to said pressure-responsive device, comprising chamber means communicating adjacent its bottom with said conduit means and having air vent means adjacent the top thereof, said air vent means being operable to vent only a portion of the upper part of said chamber, whereby an air cushion of predetermined volume is maintained in said chamber at all times, and pressure-responsive valve means operably associated with said conduit means between said source of fluid pressure and said hydraulic cushion means and automatically operable to shut off fluid flow through said conduit means by flow resulting from a sudden pressure surge of predetermined magnitude in said conduit means.

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