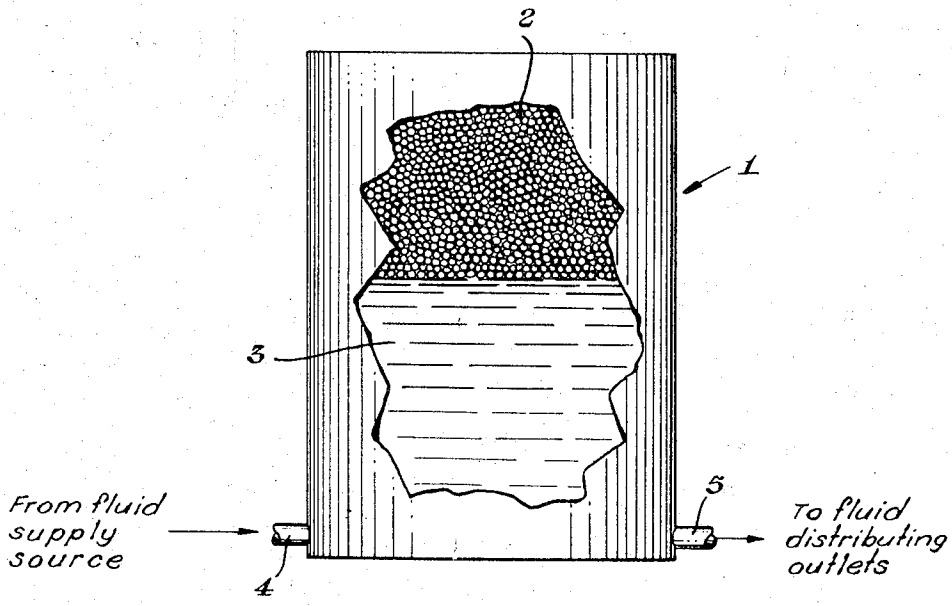
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PRESSURING MEANS FOR FLUID DISTRIBUTING SYSTEMS

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PRESSURING MEANS FOR FLUID DISTRIBUTING SYSTEMS

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This invention relates to an improved means for pressuring fluids, particularly liquids, to supply them at more uniform and equalized rates of flow and is especially concerned with a superior means for uniformly supplying or meeting surge demands for water in distributing systems therefor and to an enhanced surge tank or the like apparatus for such purpose. The attainment of these and associated ends in a simple, expeditious, economical and otherwise generally beneficial manner is among the principal objectives of the present invention.

In fluid distributing systems to which the fluid is furnished from its source at a relatively constant rate per unit time in order to meet or supply substantially non-uniform and varying demands it is the conventional practice to utilize an intermediate storage facility or surge tank. A supply of the fluid is maintained pressurized in the intermediate installation by or under a yieldably resilient means so that it may be distributed to outlets upon demand under a relatively uniform pressure head. In such systems, as is well known, the fluid may be originally furnished under a fluctuating pressure and for discontinuous periods to accommodate requirements. And, of course, its flow to the distributing outlets is usually not continuous but intermittent in nature. In liquid systems, a gas cushion (generally air) is commonly utilized as the resilient pressuring means for the supply in the surge tank. Such an air cushion is predominantly relied upon, especially in domestic installations, as the normally accepted means for pressuring water systems, including potable water systems, from wells and other pumped sources of supply.

Certain difficulties, however, are involved in the practice of the known fluid pressuring techniques, particularly the air cushioning means in surge tanks for water systems. Thus, an air cushion in a water system surge tank may cause oxidation and contaminating precipitation of certain metals, especially iron, that may be present in the distributing apparatus that is utilized for the system and, in addition, the head-providing air cushion tends to undergo a slow process of dissolution so that its presence in an effective volume is ultimately dissipated and unavoidably lost. Expandable bladders or inner tube-like devices for containing the yieldably resilient or compressible supply of air under pressure and segregated in the surge tank from contact with the water or other fluid have been devised with the intention of overcoming the mentioned difficulties in distributing systems. The use of such affairs has not become widespread since they must ordinarily be fitted in specially designed tanks. Quite often, this is due to the impossibility of satisfactorily installing them in existing surge tanks and the like intermediate storage and pressuring facilities.

Advantageous improvement over the known techniques and procedures may be achieved by practice of the pressuring means of the present invention which comprises employment of a yieldably resilient pressuring cushion consisting of a mass of cellular or expanded elastomeric polymeric particles, in an intermediate storage facility

or surge tank in a fluid distributing system of the described type. Particular advantage may be derived in a system handling such liquids as water. The mass of cellular or expanded particles of elastomeric polymeric material, which beneficially may be foamed or expanded beads of polyethylene, provide a particularly effective yieldably resilient pressuring means which does not involve the difficulties that are ordinarily encountered with air cushions and which can easily be installed or furnished in any existing apparatus or surge tank facility.

In the accompanying drawing there is schematically illustrated a surge tank, indicated generally by the reference numeral 1, broken out partially in section to expose the pressuring cushion packing 2 of yieldable resilient cellular or expanded particles of elastomeric polymeric material that is utilized to pressurize the fluid, indicated as the liquid 3, being intermediately stored in the tank. The fluid, such as water from a well, is pumped or otherwise supplied to the surge tank through the inlet conduit 4 from a supply source not shown in the drawing. It is withdrawn under the desired uniform pressure to meet demands at various distributing outlets (not shown) through the outlet conduit 5.

At least a portion, and most advantageously the entire volume, of the surge tank or other intermediate pressuring storage facility is packed at a lower pressure than the intended operating pressure with the yieldably resilient mass of cellular particles of elastomeric polymeric material in an uncompressed conditon. Of course, in systems operating at subatmospheric pressure the mass is best packed under a suitably reduced pressure to accommodate the anticipated requirements. While the minimum proportion of the cellular particles that may be effectively utilized may vary somewhat with its resilient compressibility and with the pressure head that is desired to be maintained for the system (taking peak demand requirements into account) it is usually preferable to pack an intermediate storage facility to at least about half its volume under non-compressing conditions with the pressuring cushion-providing cellular particles. Thus, in systems intended to be operated under superatmospheric pressure, the full or at least half-full packing of the yieldably resilient mass may be conveniently accomplished at atmospheric pressure. Of course, a greater differential between the operating pressure and the pressure under which the mass is packed provides a more vigorous cushioning effect.

While the present invention may be beneficially practiced with any fluid, including gases (provided the cellular or expanded products are obtained with gas impervious surface structures) it is, as has been indicated, particularly adapted for use with liquid distributing systems, especially water systems. In this connection, it is usually desirable for the cellular particles to be buoyant with respect to or lighter than the liquid being pressured so that the cushion tends to float on the liquid supply in the intermediate storage facility. In water system surge tanks, for example, it is particularly desirable for the cellular, yieldably resilient particles to have a bulk density that is between about one and six pounds per cubic foot.

The cellular or expanded elastomeric polymeric particles that are utilized as the pressuring cushion in the practice of the invention should have good flexibility and elastic recovery and high resistance to fatigue upon repeated flexing, a characteristic that may be referred to as high flex strength, so that they may remain effective for prolonged periods (during which they may be compressed and compacted to varying degrees with intervening expansions) to the fluctuating pressure conditions which may obtain in the system. The cellular particles should, as mentioned, also be quite impervious to the particular fluid that is being pressured. And, as is obvious,, they must be of a closed-cell structure. A variety of cellular or

expanded foam elastomeric polymeric materials are especially adapted for such purpose, especially in water systems, such as foam particles of natural or synthetic rubbers, including polyisobutylene, cellular polyurethane particles, expanded beads and the like of various elastomeric haloethylene polymers including certain of the various sarans, plasticized polyvinylchloride compositions and other equivalent elastomeric polymeric materials. As has been indicated, foamed or expanded particles or beads of polyethylene are particularly advantageous for employment in the practice of the invention. Such cellular products may be prepared according to various known techniques including, for example, by the incorporation and release or expansion at thermoplastic temperatures of blowing agents or propellants according to commonly utilized techniques.

Care should be exercised in the selection of the elastomeric polymeric material that is employed to ensure its having the requisite indicated properties appropriate to a suitable practice of the invention. Polystyrene foam, for example, is generally too inflexible and brittle for satisfactory utilization. Little criticality is involved in the size of the cellular, yieldably resilient particles that are employed or in their precise shape or outline. For many purposes, however, especially in water systems, bead-like foamed or expanded particles of approximately spheroidal or ellipsoidal shape that have an average minimum dimension greater than about one-quarter inch and an average maximum dimension less than about on inch may be found eminently suitable and quite easy to handle during their installation. Particles that are too small are generally best avoided to preclude their becoming entrained in the liquid and swept into the distributing system and to avoid extensive precautionary screening or sieve arrangements. Too large particles may sometimes be awkward or inconvenient to handle or install during the packing operation of the mass of particles in the intermediate storage facility.

By way of further illustration, a steel pressure vessel was packed at atmospheric pressure with expanded polyethylene foam beads or granules having a density of about 1.8 pounds per cubic foot and an average minimum and maximum particle size at atmospheric pressure between about one-quarter and three-eighths of an inch, respectively. The vessel was provided with a valved inlet supplied with water under a pressure of about forty pounds per square inch (gauge) and a valved outlet to the atmosphere. By alternately opening and closing the inlet and outlet control valves, water was run into the vessel to the maximum pressure and released to the atmosphere. A 50 cycle per minute pattern was established in this manner and maintained for a several hour period. After successive hours of such service, the polyethylene beads were removed from the vessel and measured to determine their density. The results are set forth in the following tabulation:

Measurement of bead density after service of:	Density of beads in pounds per cubic foot
One hour	2.01
Two hours	2.08
Three hours	2.21
Four hours	2.19

As is apparent, the foamed polyethylene beads became physically stabilized and remained substantially unaltered after having experienced a slight initial compressive deformation. They remained in such condition throughout the balance of the test which obviously was under much more severe cycling conditions than are encountered in the usual service. The degree and relative uniformity of pressure control that is provided by such a pressuring cushion is at least commensurate with that which may be obtained with conventional air cushions.

The present invention provides a dependable and effective means for pressuring fluid distributing systems that encompasses many ameliorations over conventional practice.

What is claimed is:

1. In combination with a surge tank in a fluid distributing system, a pressuring cushion packed in said tank consisting of a yieldably resilient mass of a plurality of individual and separate, closed-cell, cellular, expanded foam, elastomeric polymeric particles that are impervious to the fluid intended for employment in said system; the enclosed volume and dimensions of said tank being greatly larger than the individual volume and dimensions of any of the cellular particles in said mass and the uncompressed pressure within said elastomeric polymeric particles being at a lower pressure than the operating pressure anticipated for said system.

2. The combination of claim 1, wherein said cushion mass of particles is packed to substantially fill said tank.

3. In combination with a surge tank in a water distributing system, a pressuring cushion packed in said tank consisting of a mass of a plurality of individual and separate, closed-cell, foamed polyethylene beads having a bulk density between about one and six pounds per cubic foot and which are uncompressed under atmospheric pressure.

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