Title
MULTIPURPOSE BALL VALVES

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ABSTRACT

Modifications of ball valves to permit new applications are described. The valves are of two basic types. One type has a relief valve in the ball for fail-safe operation, without a parallel-flow circuit. The second group incorporates various flow-control elements between the series ball seals. A side access port is provided to permit control-element removal without system shutdown.

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The conventional quarter-turn ball valve has been increasingly accepted by industry during the past 25 years. The quick-closing and straight-through features of this valve are desirable in fluid systems. The simplicity of the closing element has enabled manufacturers to produce ball valves comparable in cost with other types of valves. Quarter-turn closing makes ball valves particularly suitable for remote operation with electric or pneumatic actuators. Presently available designs provide helium-tight sealing at absolute pressures as low as 10^{-6} mm Hg and bubble-tight closure as high as 10,000 psi. Ball valves with Teflon seals are currently being used in cryogenic systems as low as -320° F, and with Graphitar seals in nuclear systems as high as 1000° F. A common ball valve is shown in Fig. 1.

Only a few of the ball-valve advantages are being used in present day valves, however.

A new fail-safe ball valve design is shown in Fig. 2. With the relief valve in the ball, the system is protected against excess pressure rise due to inadvertent closure. When the ball is open, two-way flow is possible. Closed, flow is permitted above a pre-set minimum in one direction and checked in the other. The operation is equivalent to conventional parallel arrangements, yet is compact and requires fewer units. In remotely operated systems, simpler electric or pneumatic control circuitry is possible because "loss of power" protection is designed into the valve.

The second group of modified ball valves is designed primarily to reduce system maintenance. This type has a side access port in the body of the ball valve. When the ball is closed, the control element may be removed without shutting down the system. A typical application would be a rupture-disk ball valve (Fig. 3).

A rupture or bursting disk is a thin foil safety device which is generally used in the vent of liquified-gas containers in parallel with other relief valves. In the event of system overpressure and relief-valve malfunction, the rupture disk is designed to break and vent the container. Because the rupture disk is a thin foil and is exposed to the elements on the atmospheric side, periodic maintenance in the form of inspection, testing, and/or replacement is required. With the rupture-disk ball valve this maintenance can be done at any time by rotating the ball to the closed position and replacing the disk through the side port. With two ball seals, purge fittings can be provided to eliminate air brought into the system as the disk is turned back into the line.

A somewhat similar ball valve, utilizing a strainer or cartridge filter or dryer, is shown in Fig. 4.

Figure 5 shows a relief (or check) ball valve. Maintenance, or spring or seal replacement, can be done by rotating the ball to the closed position in line with the access port. Relief pressure can be adjusted in the same manner.

Another application is the needle ball valve shown in Fig. 6. Good flow control of the needle valve is complemented here with quarter-turn closing of the ball valve. The stem and stem seals may be removed with the system up to pressure when the ball is closed. A slightly more involved design, with coaxial stems, would permit location of both handles on the same side of the valve.

Besides the fail-safe feature of the ball valve (Fig. 2), the main advantage of the other valves described is their ability to reduce maintenance and down-time. It is safe to assume that in many systems the cost of a shutdown will be much greater than the cost of a valve. Mass produced dual valves would be slightly more expensive than a single ball valve, but less expensive than the units they can functionally replace. A single filter or strainer ball valve, for example, could replace as many as three conventional units, if a shutdown is to be avoided, with initial investment savings in both equipment and space.

The valves shown in Figs. 3 through 5—, the rupture disk, strainer, filter, cartridge dryer, in-line check and relief ball valves—could all be produced with identical side-access valve bodies for a given size. Also, a coordinated approach to the design of the ball and inserts for these valves would permit interchangeability of the various inserts. Inventories could thus be reduced, because the standardized design would permit stocking of only the wear parts and the interchangeable ball inserts.

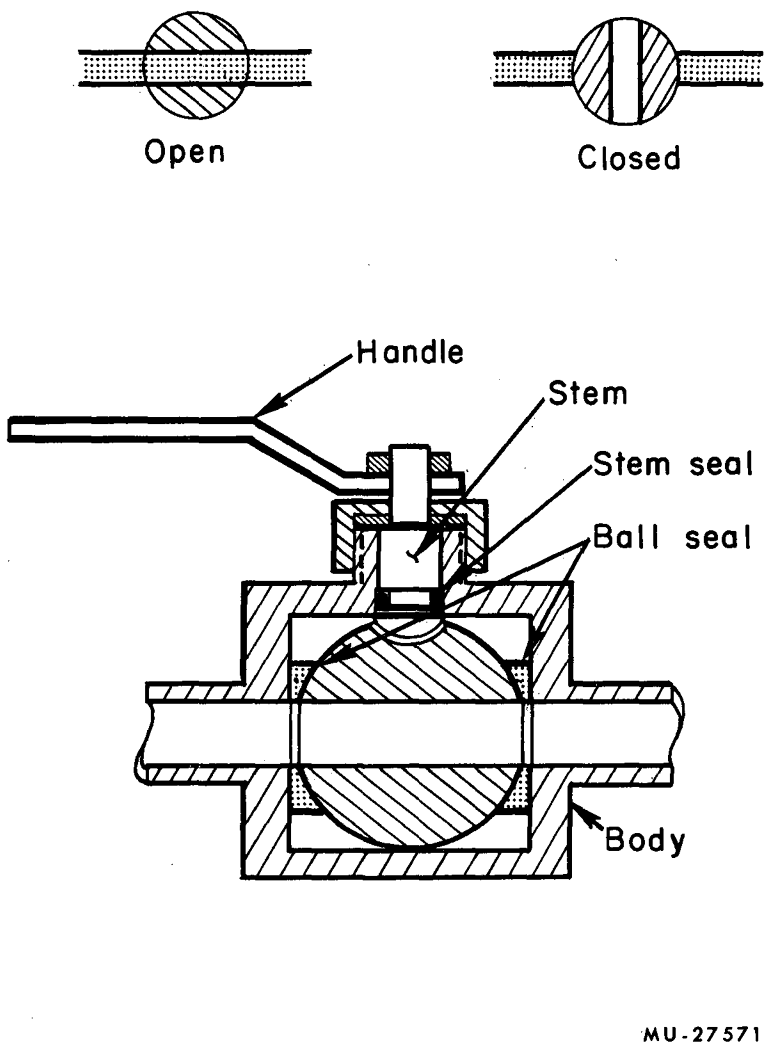

Fig. 1. Conventional quarter-turn ball valve.

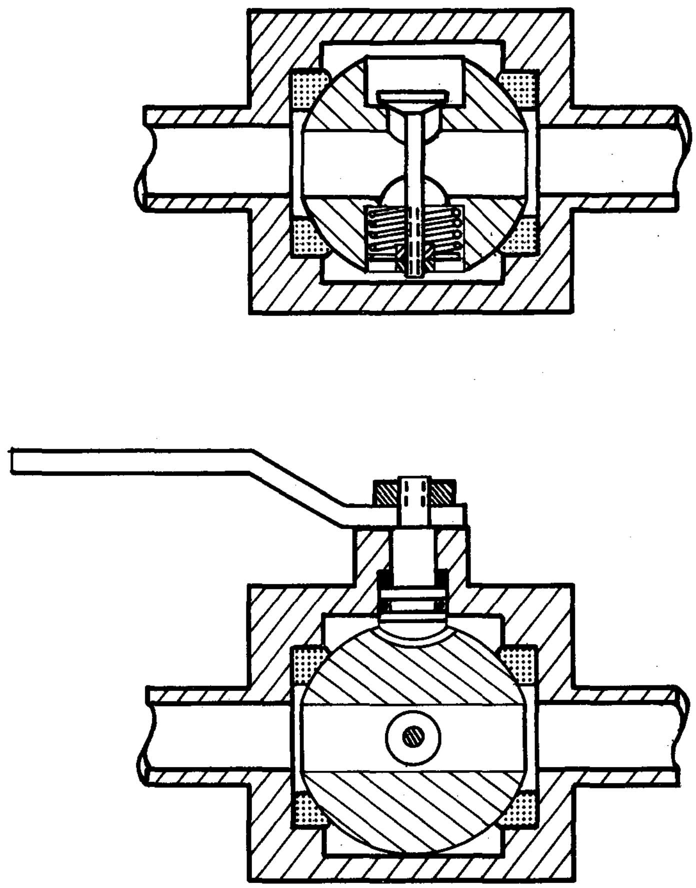

Fig. 2. Fail-safe ball valve.

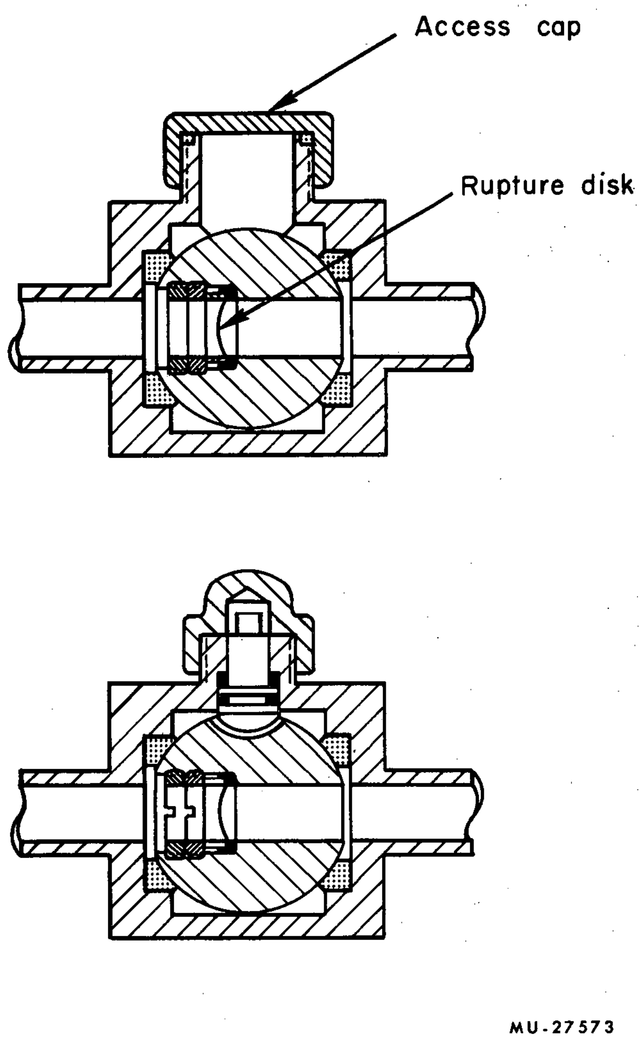

Fig. 3. Rupture-disk ball valve.

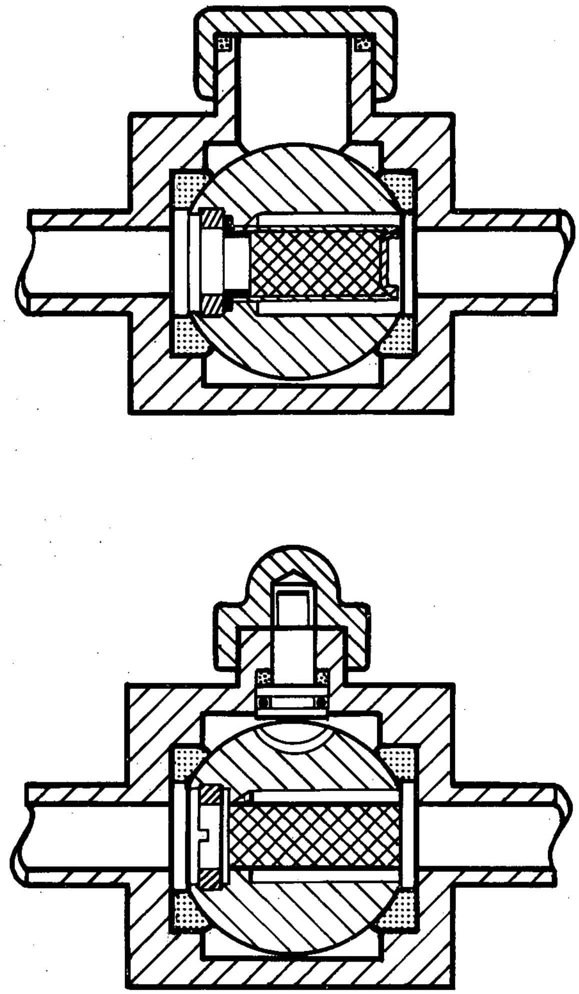

Fig. 4. Strainer or filter or dryer ball valve (strainer is shown).

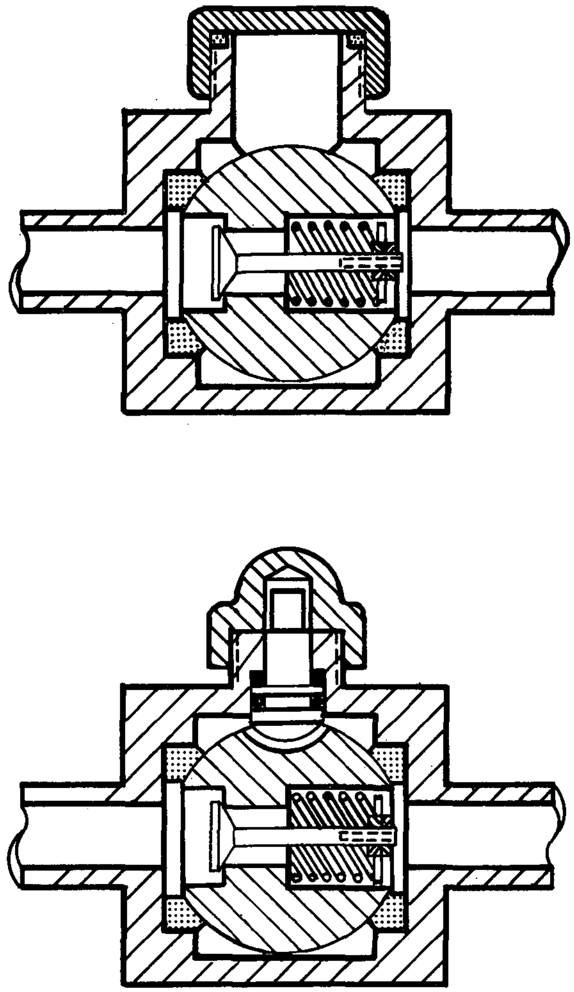

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Fig. 5. Relief (or check) ball valve.

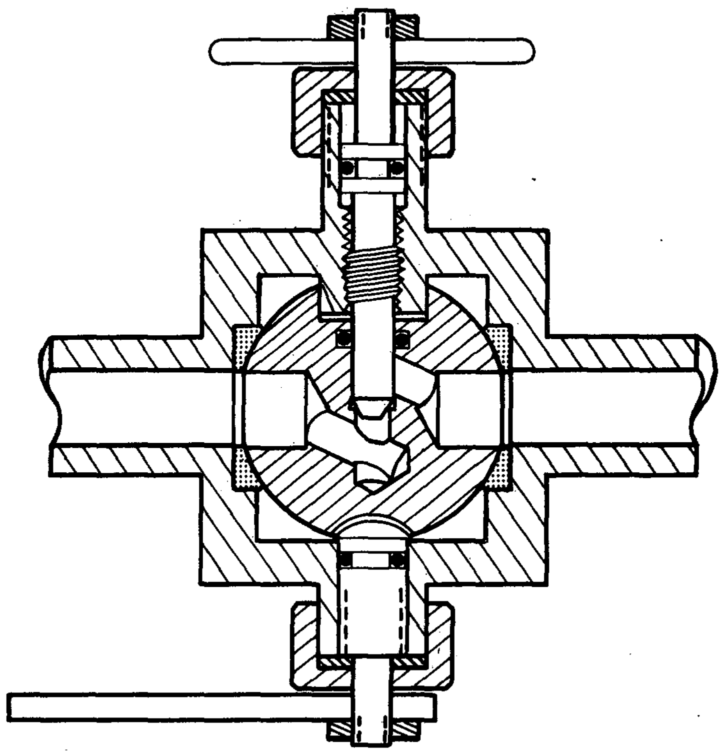

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Fig. 6. Needle ball valve.