



## Pressure-Energized Seal Rings To Better Withstand Flows

Exposed lips that can be grabbed by flows would be eliminated.

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Pressure-energized seal rings intended to withstand flows better than do conventional pressure-energized seal rings have been conceived. The concept applies, more specifically, to seal rings used on some valve stems, pistons, and the like. A conventional pressure-energized seal ring generally has a U-shaped cross section and consists of an elastomer or other suitable polymer with an embedded metal energizing spring (see Figure 1). The working fluid from the high-pressure side that one seeks to seal is allowed into the U-shaped cavity, so that the pressure pushes the sides of the seal ring tighter against the gland and body sealing surfaces, thereby increasing the degree of sealing. Unfortu-

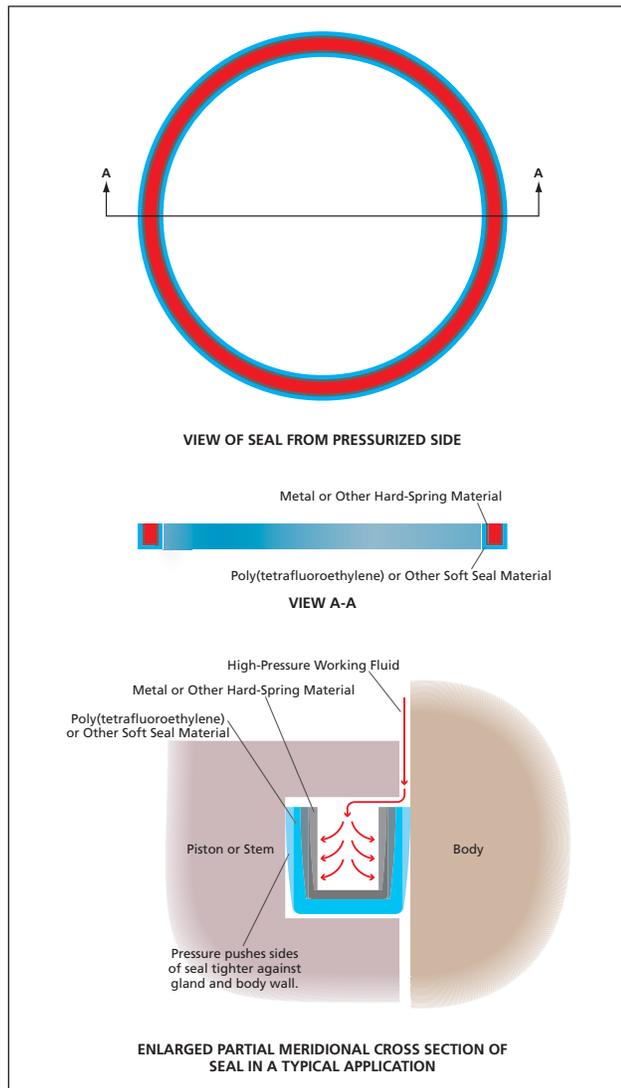


Figure 1. A **Conventional Pressure-Energized Seal Ring** is pushed directly against two sealing surfaces by the pressure in the working fluid.

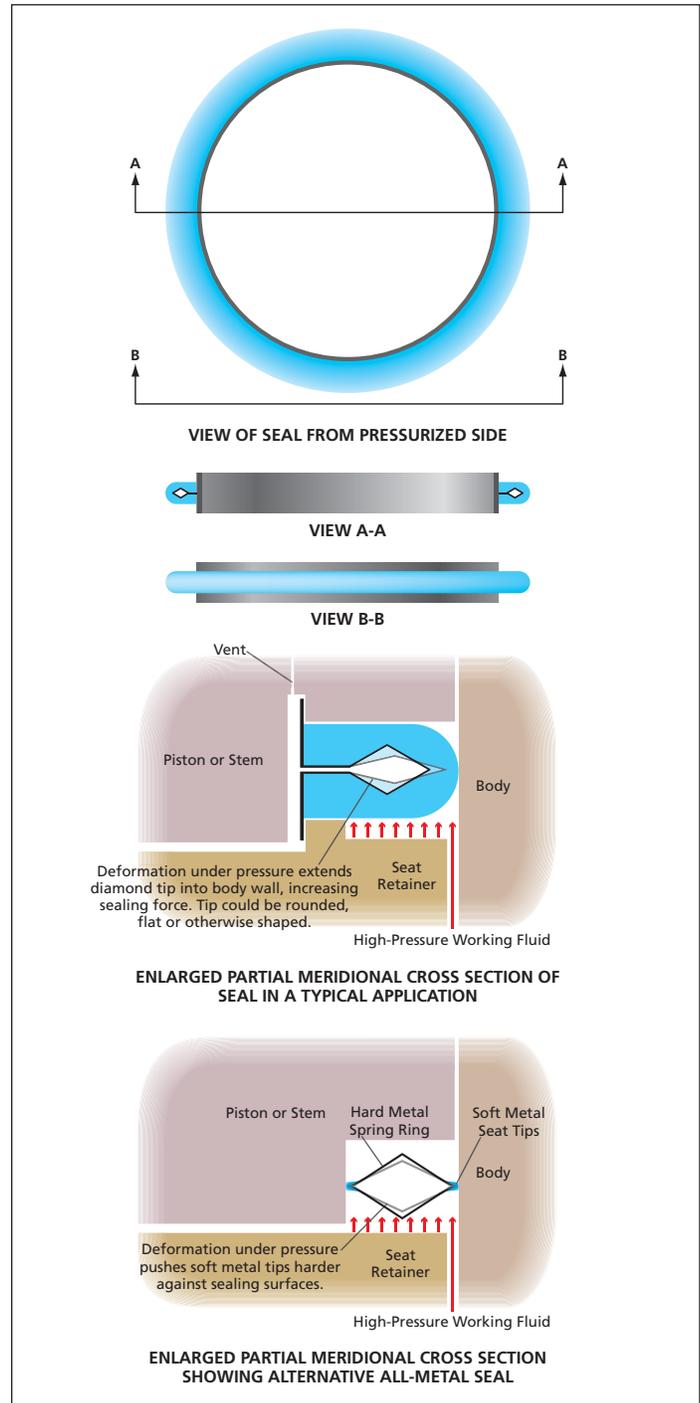


Figure 2. A **Conceptual Pressure-Energized Seal Ring** would be directly pushed axially (vertically in this view) against a gland sealing surface but would be indirectly pushed radially against the body sealing surface through squashing.

nately, when the seal ring is exposed to flow of the working fluid, under some conditions, the flow grabs the lip of the U-shaped cross section and ejects or deforms the seal ring so that, thereafter, a proper seal is not obtained.

Figure 2 depicts one of several alternative seal rings according to the present concept. One element of the concept is to modify the U-shaped cross section from that of the corresponding conventional seal ring to eliminate the exposed lip and prevent entry of the working fluid into the U-shaped cavity. Unlike in the conventional seal, pressurized fluid would not push the seal ring directly against the both gland and body sealing surfaces. Instead, the pressure would directly push the seal ring against a gland sealing surface only. In so doing, the pressure would squash the seal ring into a smaller volume bounded by the gland and body sealing surfaces, and would thereby indirectly press the seal ring more tightly

against the body sealing surface.

To enhance the desired squashing deformation, a spring having an approximately parallelogram cross section would be embedded in the modified U-shaped cavity. As the pressure pushed two corners of the approximate parallelogram closer together along the axis of the seal ring, the other two corners of the approximate parallelogram would be pushed farther apart along a radius of the ring, thereby causing the polymeric ring material to push radially harder against the body sealing surface. From the radially innermost corner of the approximate parallelogram, the spring material would extend radially, then axially into recesses in the seal gland. These extensions would help to restrain the seal ring against ejection.

A seat retainer would hold the sealing ring in the gland and form a mechanical compression seal to prevent or at least reduce leakage of pressurized fluid into the cavity behind the seal. However, be-

cause there would likely be a little leakage, the cavity behind the seal should be vented to the low pressure side to prevent buildup of pressure in the cavity over time; otherwise, the built-up pressure could cause ejection of the seal ring when the pressure on the high-pressure side was reduced.

Polymeric seal-ring materials may not be able to withstand working conditions in applications that involve abrasive and/or hot working fluids. For such applications, all-metal seal rings may be preferred. The bottom part of Figure 2 shows one example of an alternative gland configuration with an all-metal seal ring.

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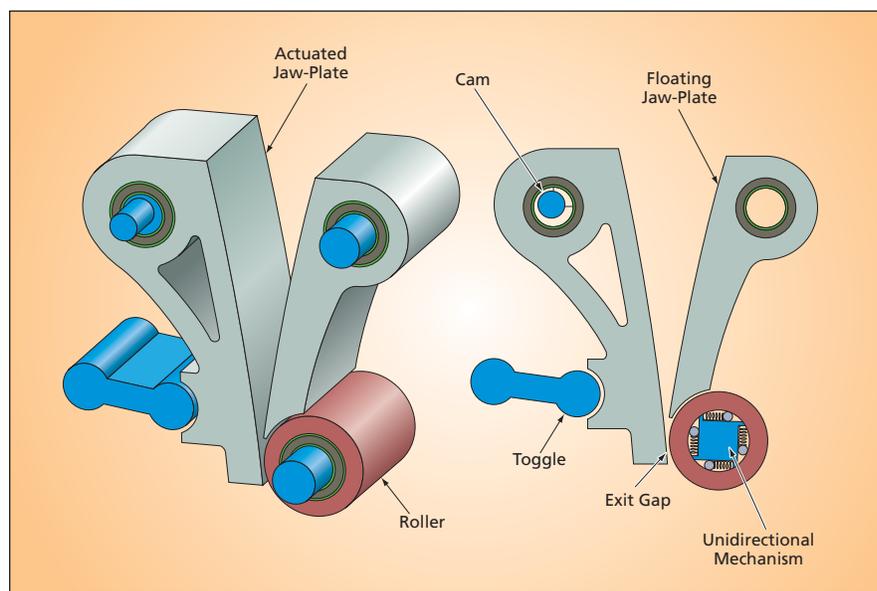
## ⚙️ Rollerjaw Rock Crusher

**The main advantages would be reduced weight and less complexity.**

*NASA's Jet Propulsion Laboratory, Pasadena, California*

The rollerjaw rock crusher melds the concepts of jaw crushing and roll crushing long employed in the mining and rock-crushing industries. Rollerjaw rock crushers have been proposed for inclusion in geological exploration missions on Mars, where they would be used to pulverize rock samples into powders in the tens of micrometer particle size range required for analysis by scientific instruments. On Earth, scaled-up rollerjaw rock crushers could be used in mining and rock-crushing operations in which jaw crushers followed by roll crushers or roll mills have traditionally been used. A single rollerjaw rock crusher would be less complex and would weigh about half as much as does an equivalent conventional combination of a jaw crusher and a roller crusher.

In the mining and rock-crushing industries, it is widely recognized that in order to reduce the particle size of minerals, it is often necessary to employ a succession of comminution machines. Jaw crushers are generally used for coarse crushing, cone crushers for intermediate crushing, and roll crushers for producing finer particles. Ball mills and other mills are sometimes used to effect further particle size reduc-



A **Rollerjaw Rock Crusher** would be a single machine that would perform functions heretofore performed by a conventional combination of a jaw crusher, a conveyor, and roll crusher.

tion. In addition, it is sometimes necessary to provide conveyors for transporting crushed rock between successive comminution machines.

A rollerjaw rock crusher (see figure) would include a single actuator and pro-

cessing wedge gap to perform the functions of a jaw crusher and a roll crusher. The wedge gap would be formed between an actuated jaw-plate and a floating jaw-plate equipped with a roller at its lower end. The single actuator would consist of a