Technical Brief

FLUID ROTARY UNIONS

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Document Number 300

A fluid rotary union (FRU) functions as a rotary interface for fluid carrying conduit between stationary and rotating equipment. The fluid being conveyed can be liquid, gas or vacuum. Applications vary from chemical injection on floating production storage and offloading (FPSO) vessels to air supply for divers to vacuum supply for clean-room robotics. FRU can be supplied as stand along units or combined with electrical slip rings and optical rotary joints. Applications, such as FPSO swivels, generally require larger slow rotating unions which are typically referred to as hydraulic utility swivels (HUS). Combinations of electric signal circuits and vacuum passes are typical for clean room robotics.

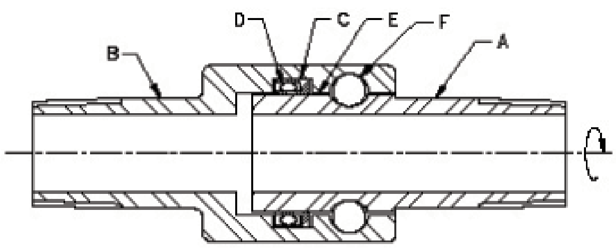

Figure 1 - Basic pipe swivel

How A Fluid Rotary Union Works

In each FRU, there is at least one sealing element acting between the rotating and stationary components. They prevent fluid from flowing from the high pressure side of the seal to the low pressure side. Figure 1 shows a pipe swivel or FRU in its simplest form. In this example 'B' is connected to the stationary equipment while 'A' is connected to rotating equipment. Rolling elements 'F' serve to align the swivel components and to resist separating forces exerted between 'A' and 'B' by the pressurized fluid. The seal 'C' is made from a material that provides a tight or leak free joint between components 'A' and 'B'; it must also withstand wear at the rotary interface, minimize resistance to turning with a low coefficient of friction, and resist extrusion at gap 'E'. A backup ring can be used with a seal to close the extrusion gap and allow higher system pressures to be sealed. Seals work by having a lip forced against each component and are designed to provide increased sealing forces as system pressures increase. Energizer 'D' provides initial sealing when system pressure is not present. A tight or leak free rotating joint is a relative term as some seepage will occur and can be desirable to provide lubrication to the sealing element. Seal leakage rates vary, primarily with material selection, and can be almost undetectable. Materials are selected based on chemical compatibility, design pressure, design temperature, required service life and acceptable leakage rate. Rotary seal leakage collection can also be provided for environmental protection. This feature is commonly selected for HUS.

Multipass FRU's

A single pass FRU is quite simple in design; however, many applications require multi-pass unions. Most of our FRU's function as multi-pass pipe swivels (see Figure 2).

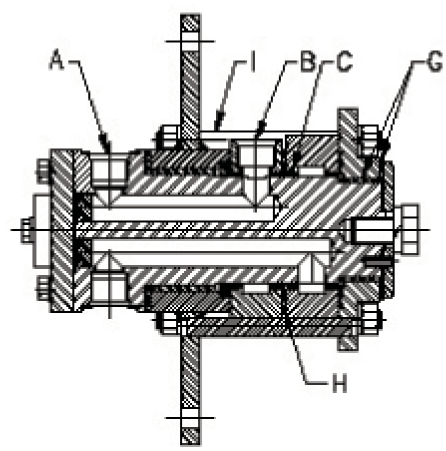

Figure 2 - Two pass Model 70 fluid rotary union

The designs comprise a central shaft 'A' that contains multiple fluid passages running axially

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through it. Each fluid passage is routed radially to the outside diameter of the shaft at a given position along the shaft. At each position where a passage exits the shaft radially, a housing 'B' encircles the shaft. Each housing has an annular passage with a seal 'C' on either side of the passage to provide an uninterrupted passage around the shaft. A radial port through each housing completes the fluid passage from the end of the shaft to the outer diameter of the housing. In this design, system pressure creates radial forces that are resisted by the housings and axial forces, against the seals, that are resisted by clamping forces through tie bars 'I' rather than through rolling elements 'F' as in Figure 1. Component alignment and resistance to external forces is achieved by use of bearings 'G'.

Large FRU's

Larger FRUs present unique design challenges. A twenty-one pass HUS is shown in Figure 3 that is rated for 5000 psi on five passes and 7500 psi on 16 passes. These HUS can be subject to very large forces due to system pressures acting on large areas. In addition, the central shaft 'A' can be quite long. Where a sufficient thermal gradient exists through the shaft, because of differing fluid temperatures, the shaft can deflect causing binding between the housings 'B' and shaft. In the design shown, the seals 'C' are inserted into each housing. The housings are designed to resist both radial forces and axial forces from system pressure. Each housing is free to float radially with the shaft if shaft deflection does occur. Galling and wear between the shaft and housings are minimized by applying a carbide coating to the shaft. Small changes to the extrusion gap, due to component strain, are controlled by careful selection of the seal and backup ring combination. An outer sleeve 'J' in conjunction with blocks 'K' holds the housings in axial position and resists torque applied to the housings as the shaft is rotated. A bearing 'L' located at the top of the HUS supports and aligns

the housings via the sleeve. The lower bearing 'M' resists external forces applied to the unit through the torque arms. Other configurations are used but each one functions generally as described above.

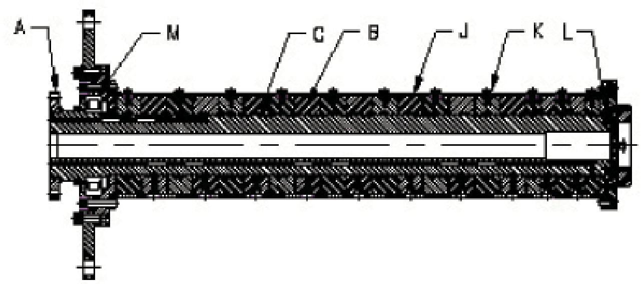

Figure 3 - Twenty one pass hydraulic utility swivel

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