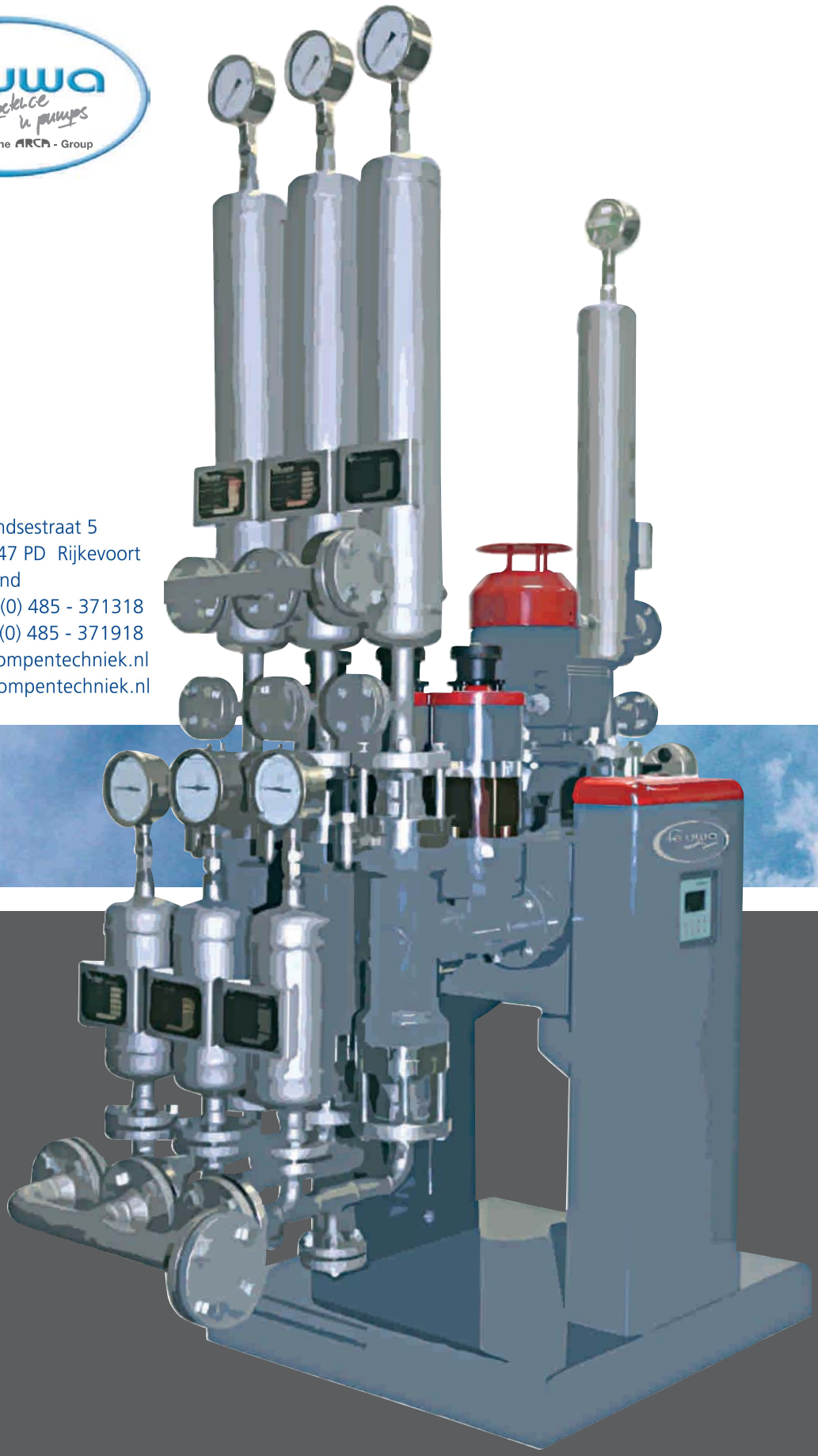
feluwa
Competence in pumps
A member of the ARCA - Group



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EVOLUTION

of MULTISAFE Hose-Diaphragm Process Pump

With the development of its Hose Diaphragm Piston Pump more than 30 years ago, FELUWA has been countering the disadvantages of traditional diaphragm and diaphragm piston pumps. It provides for the hermetic separation of conveyed fluid from the hydraulic system by means of a combination of flat diaphragm with an additional hose-diaphragm. In the process, the conveyed fluid is led in a linear flow path through the hose-diaphragm and is in contact solely with the inside of the hose-diaphragm and check valves.

Although hose diaphragm piston pumps already represent significant advantages over diaphragm pumps with several thousand units being well proven, consistent further development has been pursued with the MULTISAFE double hose-diaphragm pump.
Basically, it is a hermetically sealed, leak-proof, oscillating displacement pump with double sealing of the fluid chamber from the environment. The flat diaphragm is fully abandoned.

Two hydraulically coupled and synchronously operating hose-diaphragms once again provide for the linear flow path of the fluid and prevent settling of solids. Should one of the hose-diaphragms fail, pump operation can still be continued until the next planned shut-down of the unit. Since the conveyed fluid, even in such a scenario, will not come into contact with the casing, the necessity of expensive special materials, chemically compatible with the fluid can be avoided.

Comparison with Traditional Designs

With diaphragm piston pumps, the conveyed fluid and hydraulic drive system are separated by a flat diaphragm. The conveyed fluid is both in contact with the diaphragm and the pump casing. In the event of damage (diaphragm failure) conveyed fluid, that is in many cases of an aggressive nature, is introduced into the hydraulic control area and causes considerable financial expense, as well as pump downtime to clean and repair.

Double diaphragm pumps have been developed with two hydraulically coupled flat diaphragms to prevent such damage. The design and working principle is identical to that of the diaphragm piston pump, however, with double diaphragm pumps the conveyed fluid is in direct contact with both the flat diaphragm and the pump casing. As a result of this construction, the casing must be resistant to the conveyed fluid. Moreover, solids may settle around the diaphragm damping mechanism causing damage due to abrasion that ensures shorter diaphragm life.

Fig. 1
Middle-hose-diaphragm during suction stroke
Right-hose-diaphragm during discharge stroke
(max. contraction)

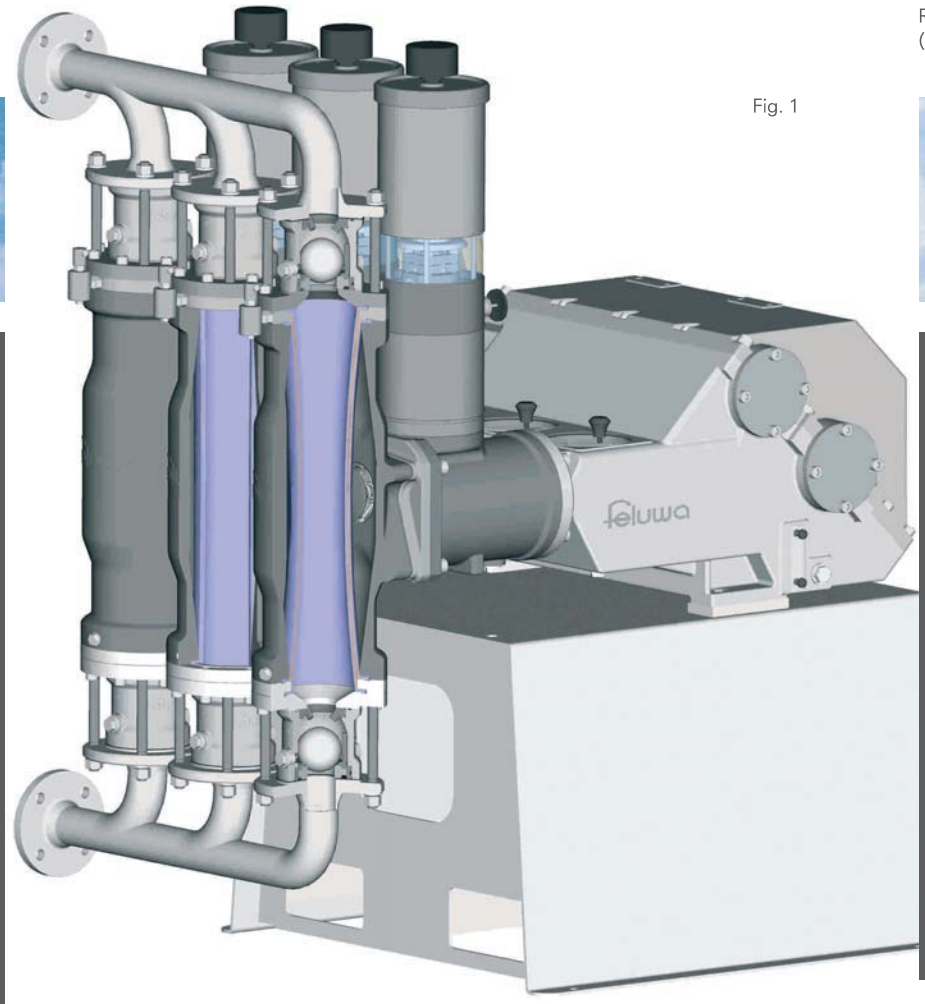


Fig. 1

BIONICS

Implementation of Natural Analogies

Development of MULTISAFE hose-diaphragm pump has essentially mimicked the use of the perfect mechanism of the human heart by the principle of contraction and release of veins via variable speed. This action provides the entire human body with blood. Venous valves thereby prevent reflux of conveyed blood.

The MULTISAFE hose-diaphragm pump is based on the same well proven working principle: At the heart of this pump are two hose-diaphragms, which are arranged one inside the other and fully enclose the conveyed fluid. In step with the piston stroke, they are subject to pulsating action, comparable with that of a human vein, and pump the fluid through the pump body in a linear flow path. Check valves prevent reflux of displaced fluid. The double pump vein makes the machine virtually invulnerable. In the event of injury of one of the veins (hose-diaphragms), it reliably prevents leakage of fluids.

Heart rate varies between 50 and 80/min. Under load it can even increase to 200/min. When considering an average pulse beat of 65/min. and a lifetime of 70 years as an example, this makes a total of 2.391.480.000 load changes for heart and veins (hose-diaphragms).
MULTISAFE hose-diaphragm pumps have been designed for a service life of 30 years. Under continuous operation at a stroke rate of 65/min. they would be subject to a total of 1.024.920.000 load-cycle changes. Compared to the biological concept, MULTISAFE hose-diaphragm pumps thus dispose themselves of considerable safety reserve.

4 in 1 Diagnostic System

MULTISAFE hose-diaphragm pumps utilise an overall diagnostic system for permanent condition monitoring of:

- Primary and secondary hose-diaphragms
- Check valves (FELUWA Valve Performance Monitoring System – FVPMS)
- Suction pressure
- Hydraulic and gearbox temperature

For condition monitoring, various means are available for an optimum link to process control systems, such as communication via Foundation Profibus or Fieldbus. (see separate data sheet) (see Fig. 2)

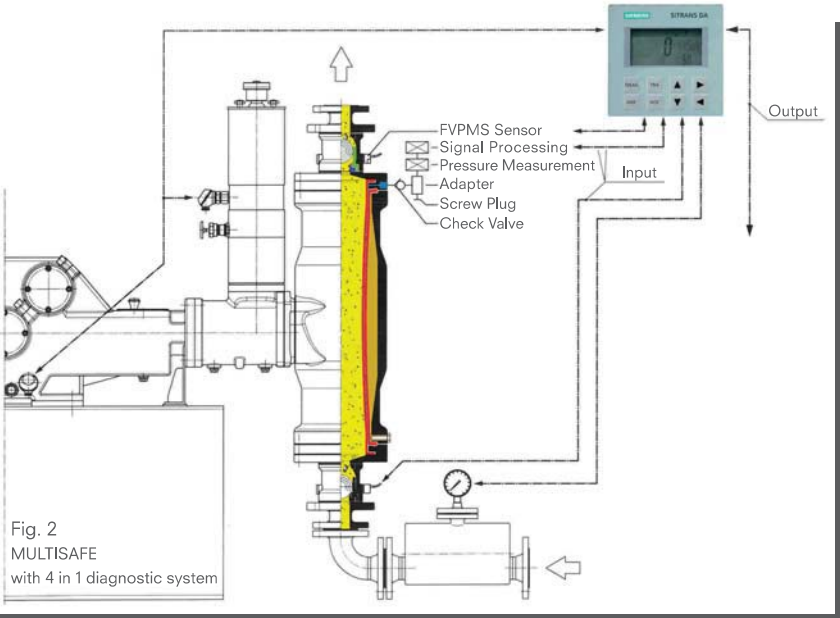


Fig. 2
MULTISAFE
with 4 in 1 diagnostic system

WORKING PRINCIPLE

An innovative Realisation

By means of a crank drive, the rotary driving motion of the pump reduction gearbox is converted to reciprocating action of the cross head.
The rotary driving motion of the pump reduction gearbox is converted to reciprocating action of the cross head by means of the crank drive. The crosshead is connected to the piston. By means of hydraulic fluid the piston actuates both hose-diaphragms, which do not only enclose the conveyed fluid in a linear flow path, but simultaneously provide double hermetic sealing from the hydraulic drive end (see Fig. 1). For general process engineering applications the hydraulic fluid normally consists of hydraulic oil. For aseptic process applications, non-compressible fluids with physiologically harmless lubricants that are compatible with the conveyed fluid, are applied. Pumping action is effected by displacement of the inside volume resulting from contraction of the hose-diaphragms.

Unlike so-called peristaltic hose pumps with mechanical drive, hose-diaphragms of MULTISAFE double hose-diaphragm pump are not squeezed. In step with the piston stroke, they are only subject to slight movement, comparable with that of a vein (see Fig. 1). Elastic distortion of hose-diaphragms is path-controlled and effected in a concentric manner due to their inherent construction. As a result of hydraulic support they are subject to little load even under higher working pressures. Design provisions ensure synchronous movement of hose-diaphragms and piston both under excess pressure and vacuum conditions.

The service life of hose-diaphragms is considerably extended beyond that of traditional flat diaphragms and reflected in very good MTBF (mean time before failure) and MTBR (mean time before repair) values.

Check Valves

A multiplicity of ball, cone or plate valve designs is available for optimum adaptation to the conveyed fluid (see separate data sheet). All variations are of cassette design, easily removed and refitted by means of jacking screws without prior dismantling of piping (see Fig. 3).

Pulsation Dampeners

With high-pressure applications, state-of-the-art hose-diaphragm pulsation dampeners with automatic filling device reduce pulsation to an absolute minimum
(see Fig. 4).

Fig. 3
Check valve and hose-diaphragm condition monitoring unit

Fig. 4
Hose-diaphragm pulsation dampener with accumulator

Fig. 3

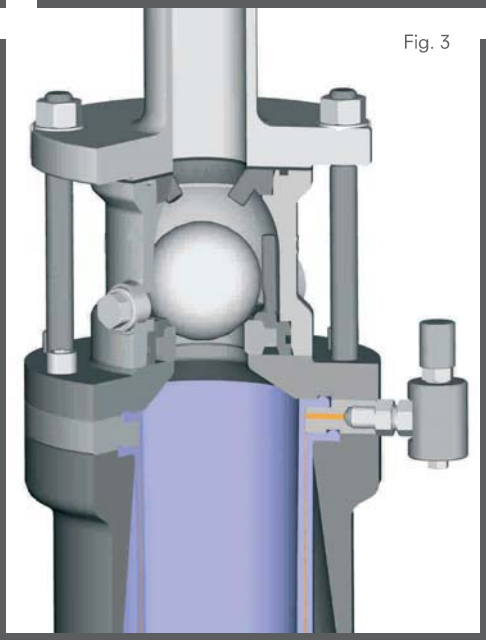
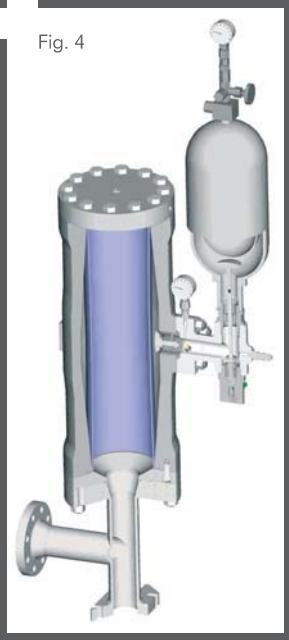


Fig. 4



ADVANTAGES

Characteristics of the Highest Level

- Hermetically sealed displacement pump, also for highest of pressures
- Modular design
- Especially conducive to the handling of aggressive and/or abrasive fluids and slurries of different viscosity
- Double sealing of the fluid chamber (double safety)
- Modification of flat diaphragm into a hose-diaphragm
- Hose-diaphragms reach considerably longer service life than flat diaphragms
- Reasonable redundancy of hose-diaphragms replaces interval, or repair based corrective maintenance
- Minimum number of fluid wetted parts and volume of hydraulic chambers
- Unique economical quality rating, relative to other designs, since the fluid is in contact with hose-diaphragm and check valves only
- Even if one of the hose-diaphragms fails, the slurry will not contact the pump casing
- Linear flow path of the conveyed fluid without deviation
- Smooth pump chamber, easy to clean
- 4 in 1 diagnostic system for permanent condition monitoring of
    1. Primary and secondary hose-diaphragms (instantaneous recognition of the smallest leak)
    2. Check valves (acoustic leak control)
    3. Suction pressure
    4. Hydraulic and gearbox temperature (see page 3)
- Check valves in cassette design; easy removal by means of jacking screws
- Excellent efficiency
- High reliability and availability due to careful selection, fabrication and quality control