# PUMP SHAFT SEALS

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Various seals for pump shafts have been developed and incorporated into production at the Karaganda synthetic rubber plant; these seals are designated as: 1V-0.9, 1.5V-1.3, 2V-1.6, 1.5K-6, 2K-6, 3K-9, 1.5STsV, 2STsV, 3STsV, LK5/15, 2LK20/22, 5NK, 4NK, 6NF, and others.

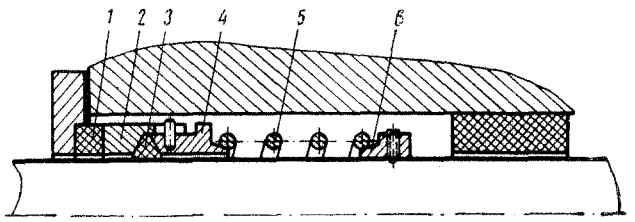


Fig. 1. End seal for shafts of "K," "V," "NK" type pumps: 1) rotating ring; 2) fixed AG-1500-B83 graphite ring; 3) ring seal; 4) lock bushing; 5) spring; 6) stop bushing.

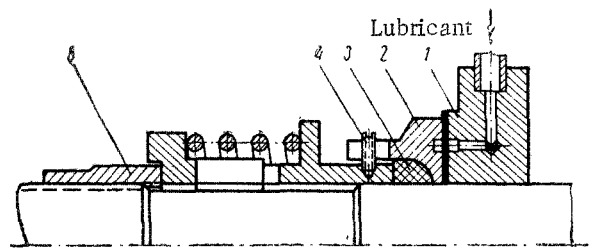


Fig. 2. Pump shaft end seal, for pumps moving corrosive fluids: 1) sormite-faced outer frame; 2) rotating ring of hardened 45 steel; 3) stuffing box; 4) guide pin; 5) bushing.

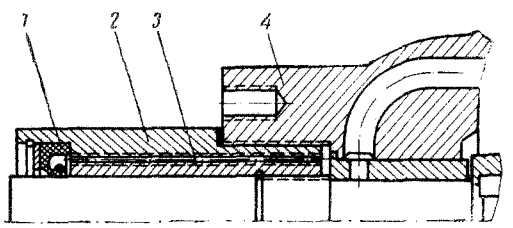


Fig. 3. Helical packing in 3K-9 pumps: 1) collar; 2) fixed bushing; 3) rotating bushing; 4) frame.

Figure 1 shows a variant of an end seal mounted on "K," "V," and "NK" type pumps. The seal has been in operation for two years on pumps delivering softened water, divinyl, alpha-methylstyrene, and other products under pressures to 9 atm. The following materials are used for the friction pair in the seal, depending on the properties of the medium and on operating conditions: AO-1500-B83 graphite, U10A steel (to hardness HRC45); graphite steel with sormite hardfacing; textolite steel; bronze steel; teflon [ftoroplast-4] steel, and other materials. Various brands of rubber are the usual choice in the fabrication of a wedge gasket providing a seal along the shaft. But rubber with a synthetic SKN-40 base* swells disconcertingly in alpha-methylstyrene, so that a movable bushing will become wedged in, or large leakage of product through the seal will result. When 20-25% teflon powder is introduced into the rubber as filler, swelling is reduced by several times and greater thermostability is acquired.

In pumps operating on corrosive products, an external end seal (Fig. 2) with lubricant forced into the contacting zone is installed, and the spring is controlled by a threaded bushing.

Figure 3 shows a helical packing installed in 3K9 pumps. The packing consists of two bushings with trapezoidally cut threads running in opposed directions, one of which mates with the seal while the other, not free to rotate, holds to the frame. The clearance between the bushings is 0.3-0.4 mm, the bushing length is 82 mm and the pitch of the thread is 4.2 mm.

Stuffing boxes or cupped packing working under pressures to 3.5 atmos are installed to the seal the shaft when the pump is stopped.

*A. N. Shalashnikov, Khim. mashinostroenie, No. 2, 1964.

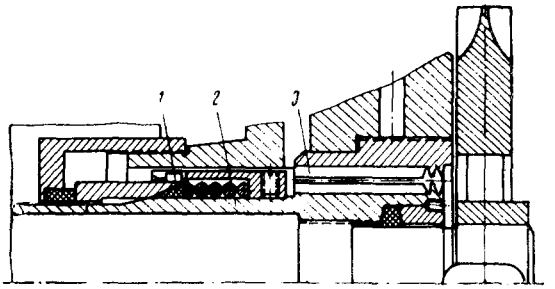


Fig. 4. Combined seal for "LK" type pumps: 1) ring seal; 2) bushing; 3) fixed bushing of helical packing.

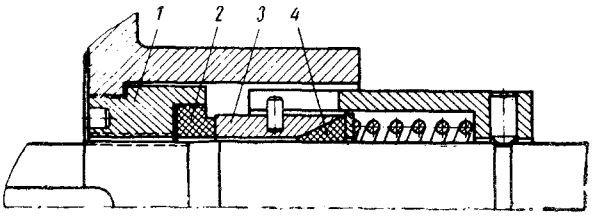


Fig. 5. Combined packing in 4NF pump: 1) fixed bushing of helical packing; 2) fixed ring of end seal; 3) rotating ring of end seal; 4) ring seal.

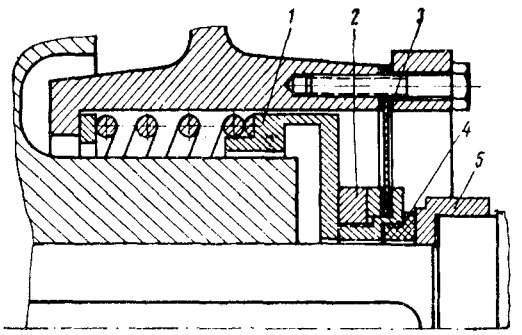


Fig. 6. Teflon membrane seal in 6NF pump; 1) adapter; 2) fastening bushing; 3) membrane; 4) fixed ring; 5) rotating ring.

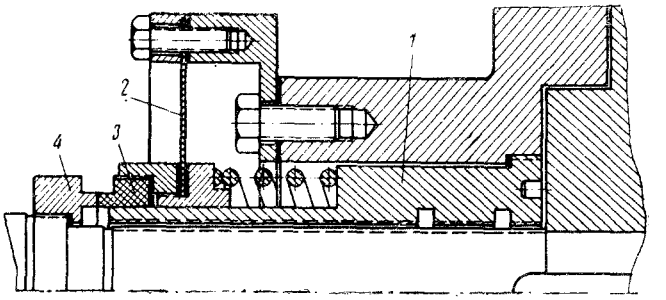


Fig. 7. Combined packing in 4NF pumps: 1) fixed bushing of helical packing; 2) membrane; 3) fixed ring of end seal; 4) rotating ring of end seal.

Figure 4 shows a combined shaft end-helical packing for "LK" type pumps operating under pressures to 9 atm. A tapered teflon ring serves as the sealant along the shaft. The seal is mounted on the bushing, which allows for ease of removal without having to take the pump apart.

2.5NF, 4NF, and 6NF pumps with stuffing boxes are used in ethyl acetate production, and these stuffing boxes can become inoperative in as little as one to 1.5 h of service, with the result that the ethyl acetate product will contain abrasive particles of unreacted catalyst. The stuffing gland in the 4NF pump can be replaced by a combined end-helical packing in which the sealant along the shaft is a tapered teflon ring with a taper angle of 25°. A trapezoidal thread pitched at 4.3 mm was cut directly on the shaft. This seal provided much longer service than the stuffing gland (300 h), but wear on the graphite and steel bushings put this one out of service too. One typical feature was that the steel bushing suffered the greatest wear on account of the presence of abrasive particles in the pumped medium, while the graphite bushing showed a clearly defined limit of penetration to abrasive particles.

Excellent results in service in an abrasive medium are had with the internal end seal in 6NF pumps using a teflon membrane 1.5-2 mm thick (Fig. 6). The spring of this seal passes through an adapter 1 to exert a tightening action on a steel bushing 5 rotating in unison with the shaft, through a graphite ring 4 and the membrane 3 fixed to the pump housing by means of the bushings 2. The elasticity of the membrane is used to compensate wear on the graphite ring. This seal is capable of protracted service, since wear on the sealing rings will be no greater than the wear suffered in nonabrasive media.

A combined helical-end seal with a teflon membrane is now being used in 4NF pumps (Fig. 7), the design being aimed to prevent abrasives from getting into the friction zone of the end seal. Pumps sealed in this can operate for 1500-2000 h of service without overhaul.