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Substabtiating Application of the Highest Kinematic Pairs in the Crank-and-rod Mechanism of the Piston Pump

Crank-and-rod mechanism (CRM) is used in the units (combustion engine, piston-type compressor, piston pipe). Crank-and-rod mechanism is intended to convert alternative motion of the piston into rotational motion of the crank with the help of the lowest kinematic pairs “piston-piston rod” and “piston rod-shaft”, and vice versa.

This type of joint increases labor intensity of assembling operations and, correspondingly, demands for accuracy also increase as while assembling unit (mechanism) it is often necessary to perform labor intensive manual adjustment that is weakly capable to mechanical operations. Especially it’s very hard to perform assembling when defect of the units forming kinematic pairs while connecting can be folded up.

In the process of mechanism maintenance the sizes of the units can be changed due to the wearing problem and adjustment of the gap of kinematic pairs, elastic deformations, expansion by heat , faults while repairing and assembling. Therefore, it is very important to choose mechanism diagram so that requirements to the unit precision would not be too large. Statically indentified mechanisms,i.e. mechanisms without excessive (passive) links units of which are self-adjusted meet this requirement. Usually the number of excessive links for the most mechanisms is equal to the number of sizes required to the precise fulfillment. Sometimes this number is considerably more than the number of excessive links.

Furthermore, if mechanism is statically identified , the sizes of the links practically don’t influence on transmitted forces and dimension limits can be very large. If mechanism is not statically indentified, transmitted forces also depend on link deformation. In this case friction considerably increases and coefficient of efficiency is reduced. Thus, one may say that to guarantee reliable mechanism operation with the wide range of limits on the sizes of the links there should not be unreasonably great number of excessive links.

It is very important to design mechanisms without excessive links the part of which operates in conditions of high temperatures, as it reduces friction within kinematic pairs and increases the reliability of mechanism operation.

The aim of the paper is to find out the ways of increasing reliability of crank-and-rod mechanism operation. It can be done by the replacement of the lowest kinematic pair “piston-piston rod” for the highest one.

Working conditions and character of loading the links of CRM depend on the manufacturing accuracy. When the gap of the rod head and the pin is increased, the life time of the mechanism is reduced in a whole.