A synchronization of the movement of two pneumatic cylinders in rehabilitation devices.

Abstract

Analysis of various rehabilitation processes, in particular lower limbs showed the usefulness and importance of exercises requiring simultaneous movement of both limbs. A research hypothesis has been adopted that rehabilitation devices based on this type of exercises may use pneumatic cylinders. In this aspect, the problem has emerged of the necessary synchronization of the movement of two piston rods of pneumatic cylinders, which would correspond to the movement of lower limbs. The doctoral dissertation presents a new constructional solution that can be used in such rehabilitation devices. It is a system of two pneumatic cylinders with a designed MZ_SYNCH element synchronizing the movement of piston rods of pneumatic cylinders. Such a system can be applied at the same and different values of piston rod loads, which often occurs in the process of human service and rehabilitation of the lower limbs.

The work of this element in double acting pneumatic cylinders over the whole range of piston rod movement length has been experimentally tested. The load values were determined on the basis of literature human biomechanical data. In order to perform the necessary measurements, not only the MZ_SYNCH element was designed and manufactured, but also the test stand.

The aim of the experimental investigations was to obtain the displacement graphs and speed of two actuators with the use of a synchronizing element. A comparative analysis of these characteristics was carried out and the criterion of possibility to use the synchronizing element MZ_SYNCH.

Analysis of the obtained results concerning the extension and return stroke of the piston rods of two pneumatic cylinders allowed to draw the hypothesis.

The dissertation presents two rehabilitation devices MZ_REHAB1, MZ_REHAB2 which can be used in the movement of lower limbs. The author also made a prototype of the rehabilitation device MZ_REHAB.