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DESIGN AND OPERATION FEATURES OF REDUCERS

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A mechanical reducer is a mechanism for transmitting and changing torque with one or more mechanical gears [3, p. 2]. The main characteristics of a mechanical reducer are efficiency, gear ratio, transmitted power, maximum angular speeds of shafts, number of driving and driven shafts, type and number of gears and stages.

Reducers use gears to convert rotational motion from one axis to another. When the wheel on the input shaft interacts with the gear on the output shaft, the rotation speed decreases and the torque increases. This allows machine operators to convert high-speed motor rotation into higher output torque. Usually, a reducer is a device that converts high revolutions of the input shafts into lower revolutions of the output shafts, increasing the torque. A reducer that converts low revolutions to higher ones is usually called a multiplier. A reducer with a stepwise change in angular velocity is called a gearbox, and a reducer with a stepless change in angular velocity is called a variator.

Reducers can be of different types, each of which is designed for specific purposes. We can classify reducers depending on the type of gears used in the kinematic scheme, number of stages and relative position of the geometric axes of the input and output shafts. Depending on the gears used, the following types of reducers are distinguished: cylindrical, conical, conical-cylindrical, worm, cylindrical-worm or worm-cylindrical, planetary, cylindrical-planetary, conical-planetary, worm-planetary and wave [2, p. 2–3]. And this whole structure is usually enclosed in some kind of rigid body.

According to the shape of the gear, it can be divided into cylindrical gears, bevel gears and bevel-cylindrical gears. The transmission can be divided into expansion type gearboxes, direct-flow and with simultaneous shaft input. Reducers can also be divided into single-stage and multi-stage depending on the number of transmission stages. Some reducers

can be used to transmit or redirect rotational motion in the opposite direction. This is necessary for most mechanisms, especially in vehicle systems and industrial equipment. Reducers can help in load balancing in mechanical systems and provide overload protection.

The high torque and low speed are ideal for transporting heavy loads or preventing overloading. Reducers have a number of advantages: increased torque, the ability to operate at lower speeds, better ability to withstand mechanical loads, increased energy efficiency (efficiency of about 98%), high load capacity (they can transmit high power with almost no loss), weak heating (due to the high efficiency, all energy is transferred to its intended purpose and it does not dissipate and does not turn into heat), high reliability, high kinematic accuracy due to the low backlash of the output shaft. These advantages make gear reduction motors ideal for industrial machines, conveyor belts, heaters and many other devices.

In addition to the advantages, they also have some disadvantages: the design of reducers in some cases can complicate and weigh down the system (increased radial and axial loads, as a result of which the mechanism transmits less power), they may require additional maintenance.

Reducers, also known as gear reduction motors, are modular combinations. They combine a motor and gearbox. Reducers are important connecting elements to ensure the compatibility of motors and mechanical systems used in various industries [1, p. 111].

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