

COLD DRIVING TEST STAND

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Keywords: shaft, universal joint transmissions, stand, bearing units.

Abstract. An overview of the construction of the stand for testing the universal joint transmissions, such as a stand for the cardan bearing tests. The objective of the study is to create of new constructions of test stands, allowing to carry out research at low temperatures close to operational.

СТЕНД ДЛЯ ИСПЫТАНИЙ КАРДАННЫХ ПЕРЕДАЧ ХОЛОДОМ

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Ключевые слова: вал, карданная передача, стенд, подшипниковые узлы.

Аннотация. Приведен обзор конструкции стенда для испытания карданных передач, таких как стенд для испытаний карданных подшипников. Задачей исследования является создание новых конструкций испытательных стендов, позволяющей проводить исследования при пониженных температурах, близких к эксплуатационным.

Bearing units are the main structural elements of machines that make up the bulk of friction units. Failure often occurs due to the failure of bearing nodes, limiting the durability of machines. Even with a fairly high-quality production of parts bearing nodes, such as needle bearings rolling, the characteristics of the carded transmission are poor, and there will be an unforeseen failure. By this failure it is necessary to understand that workers (rubbing) surfaces will not necessarily collapse - failure may be the release of one of the characteristics of bearing nodes beyond the allowed limits [1].

The durability of individual parts of bearing units, which is confirmed by tests on the stand, does not guarantee sufficient durability of the entire unit. The last circumstance is due to the fact that the loads that act in the node and the actual temperature can differ significantly from the bench. In addition, the assembly and installation change the gaps, tension and shape of the friction surfaces of bearing units. Especially visible are the contradictions between the quality of bearing units and the bearing itself, which manifests itself in units with rolling bearings [2-5].

In the stands used for testing the cardan gears of machines, the rotation of the cardan shaft is carried out according to the accepted scheme of transport and technological machines, and the regulation is carried out by means of reducers. There are many stands for testing cardan gears [6-9], based on similar principles, but with a big difference, as well as its advantages and disadvantages.

The cardan gear test bench consists of an electric motor mounted on the main frame, a manual transmission connected to the input shaft of the tested cardan gear, the output shaft of which is connected to the loading device via a transfer reducer. The loading device is made in the form of a hydraulic pump, the shaft of which is connected to the output shaft of the distributing reducer, the input channel of the hydraulic pump is connected to the hydraulic tank, and the output channel is connected to the inlet of the throttle with a regulating element, the output of which

through the heat exchanger is connected to the hydraulic tank, withal, between the output channel of the hydraulic pump and a entrance throttle and a safety valve and pressure gauge calibrated in units of brake torque. The loading device is equipped with automatic control system, which consists of a control unit, consisting of the algorithm of functioning, item comparison, the automatic control device, the signal amplifier, pressure sensor and temperature sensor, installed between hydraulic pumps, throttle inlet with control element and connected to the element comparison, termoklapan with a regulatory element that is installed between the outlet throttle with the regulating element and the heat exchanger, and also connected through the position sensors of the control element position sensorswith the comparison element, respectively, the throttle and the thermal valve. The regulating elements of the throttle and thermal valve are equipped with execution mechanisms connected to the output of the signal amplifier to control their position, each of which contains a stepper electric motor and a reducer. The technical result is to provide a stable braking torque.

One of the main disadvantages of the design is the inability to test cardan transmissions at low temperatures, which is one of the most important problems, without which scientific and technological progress cannot be achieved. Until now, many questions have not yet received a clear answer due to unexplored or lack of the necessary amount of research

Since the refrigerating machines of both stages are filled with various refrigerating agents, the pressure in them can be adjusted by selecting one or another refrigerant. This is a great advantage. The disadvantages of multistage refrigerating machines include the presence of a temperature difference between the refrigerating agents of the upper and lower cascades in the evaporator-condenser [9-12].

For testing driveline had stands were developed for testing [13-16]. Stand for testing driveline (Fig. 1) consists of an electric motor 1, the output end of which is connected to the technological transmission 2, connected to the tested cardan transmission 3, which is installed in the cooling sleeve mounted on the main frame 4. The output shaft of the cardan transmission 3 is connected to the input shaft of the distributing reducer 5, mounted on an additional frame 6. The loading device is hydraulic and is a hydraulic pump 7, the shaft of which is attached to the output shaft of the transfer distributing reducer 5. The input channel of the hydraulic pump 7 is connected to the hydraulic tank 8 with the working fluid, and its output channel is connected to the input channel of the throttle 9, regulating the load. Between the throttle and the hydraulic pump, a pressure gauge 10 is installed, calibrated in units of brake torque and a safety valve 11 for releasing excess pressure into the hydraulic tank 8. The output channel of the throttle is connected to the hydraulic tank, through a heat exchanger 12. Two compressor machines colds 13 together with the cooling sleeve 3, inside which is mounted a shaft drive, radiator 14 and process chamber 15 allow to test the driveline at low temperatures.

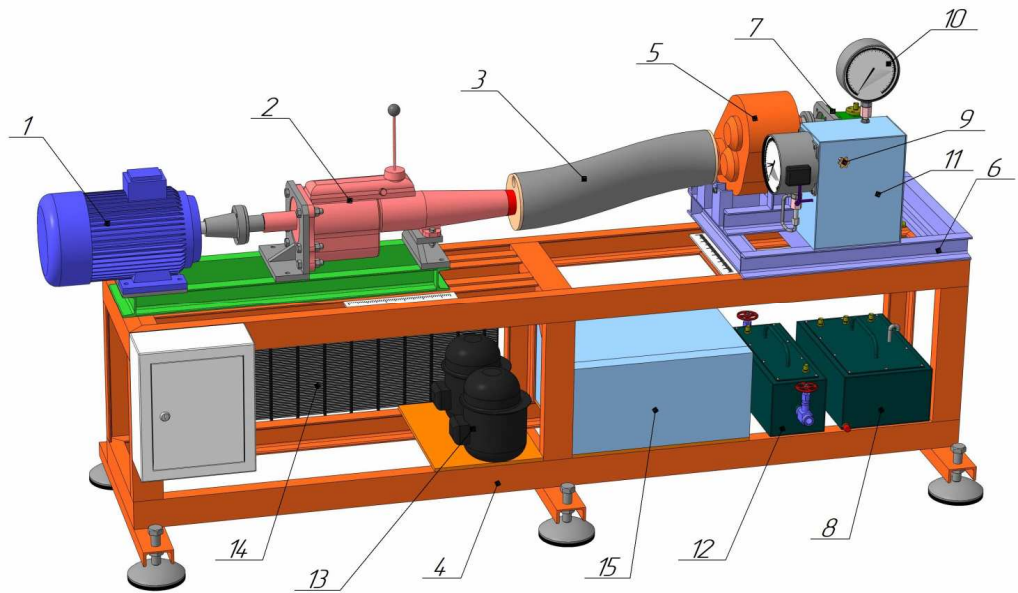


Fig. 1. Stand for testing propeller gear (Hydraulic system hoses, water supply, wiring, refrigeration machine tubes are not shown)

The scheme of the two-stage refrigeration machine is shown in figure 2. The evaporator IV of the lower stage machine produces low-temperature cold by when boiling low-boiling refrigerant in the process. The formed vapors are pumped out and compressed in the compressor of the lower stage I, from where they are fed to the evaporator-condenser of the cascade refrigeration machine II. Here their condensation occurs due to the cold produced by the refrigeration machine of the upper stage. Thus, the evaporator-condenser of the cascade refrigeration machine II is a condenser for the lower cascade machine and an evaporator for the upper cascade machine. Next, the refrigerant is throttled and again enters the evaporator of the lower cascade. The cycle closes. Refrigeration machine is the top of the cascade operates at a high-boiling cooling agent. Evaporated in the evaporator-condenser II, the freon is evacuated and compressed in the compressor V of the upper cascade, where applied to the condenser VI machine the top of the cascade, where condensed, throttled and fed back to the evaporator-condenser.

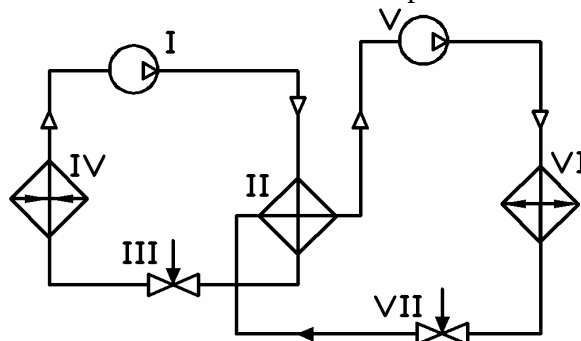


Fig. 2. Scheme of two-stage refrigeration machine

The main advantages of the use of multistage refrigeration machines are the absence of high pressure in the condenser and large pressure drops. For testing driveline, consider a two-stage low-temperature chamber, where low-temperature cold is obtained in the evaporator of the lower stage of the refrigeration machine, while the evaporator of the second stage produces cold for condensation in the machine of the previous stage. We also need the cooling temperature of the cardan transmission to -60 degrees, which will allow us to test the cardan transmissions in the temperature conditions of the far North and the Arctic.

Modern methods of scientific research allow to study structural elements at the design stage [10-12], which can be applied, in particular finite element analysis, in the design of the necessary equipment. Cardan mechanisms are widely used in engineering, including outdoors, at negative temperatures. The aim of our research is to develop the design of the test bench for cardan transmissions, allowing to conduct research at low temperatures close to operating. To do this, it is necessary to change the climatic conditions that will affect the gimbal transmission. Climate chambers are widely used to test the resistance of different types of materials to heat, cold, dehydration and humidity. These chambers are capable of simulating environments with varying temperatures and relative humidity ranging from -50 °C to +50 °C and 10-98%, respectively. But the use of a climate chamber for this test bench is impractical due to a number of reasons: First, there is no need to cool the entire test bench, as this will affect the operation of all its components. Second, the existing climate chambers have low efficiency. Therefore, local cooling of the investigated gimbal mechanism is necessary by placing it in a thermally insulated chamber (pipe) and forced cooling. This method may have its drawbacks: insufficient insulation of pipes leads to heat loss, which will not allow enough to cool the cardan transmission. Condensation is also possible, which can clog the pipe, reducing the cross-section and making it difficult for air to pass.

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