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DESIGN IMPROVEMENT OF A HYDRAULIC STAND FOR COLD STRAIGHTENING OF TRUCK FRONT AXLE BEAMS

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Abstract: *The paper presents the design and operating principle of an improved hydraulic stand intended for cold straightening of truck front axle beams. Particular attention is paid to the arrangement of the load-bearing frame, supports, fixing and clamping devices, hydraulic cylinders, pump unit, distributor, high-pressure pipelines and measuring devices. The hydraulic drive provides smooth and controllable application of the straightening force without heating the beam. The*

main design parameters of the stand and the sequence of the restoration operation are substantiated.

Key words: *front axle beam, cold straightening, hydraulic stand, frame, hydraulic cylinder, fixing device, repair, restoration.*

Front axle beams of trucks operate under considerable vertical, longitudinal and lateral loads. Impact loads caused by uneven roads, obstacles, abrupt braking, overloading and improper load distribution can result in residual bending, twisting and displacement of seating surfaces. Such defects affect the geometry of the steered wheels and may lead to deterioration of vehicle handling, increased tire wear and additional loading of steering components. Cold straightening is therefore of practical interest because it enables the geometrical shape of the beam to be restored without thermal influence on the metal [1].

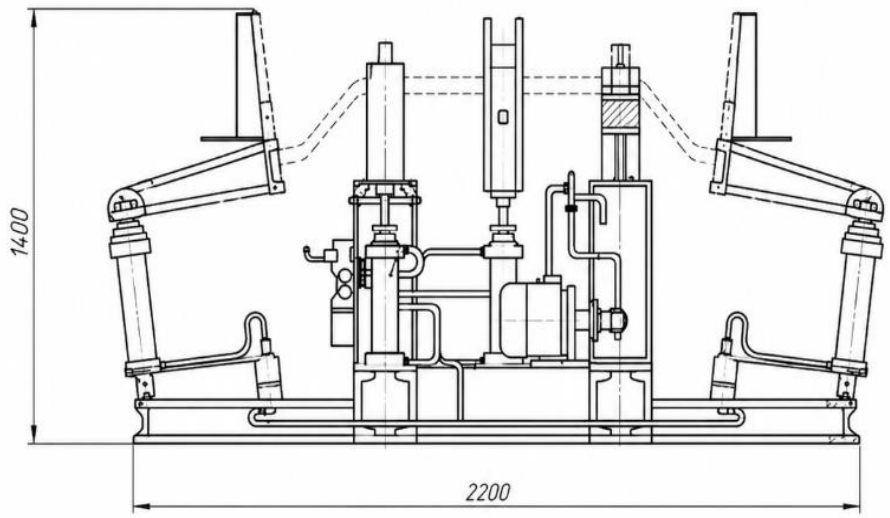


Fig. 1. Main structural elements of the improved stand for cold straightening of the front axle beam

The use of universal hydraulic presses is limited by the considerable dimensions and complex shape of front axle beams. Reliable basing of the part, correct direction of the applied force and intermediate geometrical control are difficult to ensure with non-specialized equipment. For this reason, the proposed design is based on a specialized stand that combines a rigid supporting structure with adjustable positioning and hydraulic loading elements [2, 3].

Structurally, the stand consists of a rigid welded metal frame, support elements for installing the front axle beam, fixing devices, clamping elements, power hydraulic

cylinders, a pump unit, an electric motor for driving the pump, a working-fluid distributor, flexible high-pressure pipelines, a pressure gauge, beam-position adjustment elements, devices for checking geometrical parameters, support shoes and fastening elements. The load-bearing frame receives the main reaction forces arising during straightening and must therefore have sufficient strength and rigidity. The supports provide correct basing of the beam, while the fixing and clamping units prevent displacement of the part during loading.

During operation, the pump supplies working fluid through the distributor to the selected hydraulic cylinder. The cylinder rod moves and applies a controlled force to the deformed section of the beam. The hydraulic drive ensures gradual loading, reducing the risk of cracks, local damage or excessive bending [4]. Straightening is carried out step by step. After each loading stage, the beam position is checked using control rulers, templates, displacement indicators or other measuring devices. If the required geometry has not been restored, the operation is repeated with an adjusted force, point of application or support position.

The strength of the stand frame was checked for a support spacing of 1200 mm. The maximum bending moment is 24.23 kN·m. The calculated required section modulus is 151 cm^3; with the adopted strength reserve, the load-bearing elements should have a section modulus of at least 230 cm^3. The resulting frame stress is 105.3 MPa and does not exceed the allowable stress of 160 MPa. Thus, the selected frame parameters provide the required rigidity and strength during application of the straightening force [5].

The proposed arrangement provides mechanized cold straightening, reliable beam positioning, controlled force application and intermediate checking of geometrical parameters [6]. The use of hydraulic cylinders improves process controllability compared with manual devices, while adjustable supports and fixing elements make the stand suitable for front axle beams of different truck models. The direct labor input of the cold-straightening operation is estimated at 2.3 person-hours. The design can therefore be used to improve the efficiency and quality of repair operations at transport and agricultural enterprises [7].

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