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ENGINEERING JUSTIFICATION OF A ROTARY STAND FOR ENGINE REPAIR AND MAINTENANCE

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Abstract: *The paper presents the design and engineering justification of a stationary rotary stand for engine assembly and disassembly during repair operations. The stand provides secure mounting of the cylinder block, controlled rotation about a horizontal axis and convenient access to the lower, side and end surfaces of the engine. The proposed structure includes a welded frame, two uprights with reinforcing gussets, a worm geared drive, a bearing-supported rotary shaft,*

traverses and adjustable screw supports. Calculations were performed for an engine mass of 350 kg. The required torque, drive power, shaft diameter, traverse strength and stand stability were determined. The use of the stand is expected to reduce the labor input of lubrication-system repair by 15%.

Key words: *engine repair, assembly, disassembly, rotary stand, worm gearbox, cylinder block, traverse, stability, repair equipment.*

Engine repair frequently requires partial or complete disassembly to obtain access to the oil pan, oil receiver, oil pump, pressure-relief valve, lubrication channels and sealing surfaces. Without specialized equipment, a heavy engine has to be placed on worktables or temporary supports and repeatedly repositioned with lifting devices. This increases auxiliary time and creates additional safety risks. Specialized repair stands are therefore used to support and rotate power units so that the required working surface can be positioned conveniently [1, 2]. The developed stand is designed as a stationary rotary device. Its base is a welded steel frame carrying right and left uprights. Reinforcing gussets are installed between the frame and uprights to increase rigidity. The right upright carries the worm geared drive, while the left upright contains a rotary bearing unit. The use of a worm mechanism is appropriate for repair equipment because it provides a high reduction ratio, smooth positioning and resistance to reverse rotation of the mounted unit [2, 3].

The rotary unit on the left side consists of a housing and a shaft mounted in rolling bearings. The output shaft of the geared drive and the opposite rotary shaft are connected to two traverses. Each traverse has a cross-member and adjustable supports. The supports are made using square-section elements, front and rear plates and screw fasteners. This arrangement allows the cylinder block to be clamped securely and the support positions to be adapted to its technological mounting points. Similar requirements for reliable engine attachment, controlled rotation and safe fixing in different positions are characteristic of industrial engine repair stands [3, 4].

The rotary shaft is subjected to both torsion and bending. For a torque of 1290 N·m and an allowable shear stress of 40 MPa, the calculated solid-shaft diameter is 54.8 mm; a standard diameter of 60 mm is adopted. Under the assumed bending load,

the calculated bending stress for the 60 mm shaft is 72.9 MPa, which is lower than the adopted allowable value of 140 MPa. Increasing the base width to 1.1 m raises this coefficient to 1.50. For additional safety, the stationary stand is also intended to be fixed to the concrete floor with four M16 anchor bolts. The combination of a wider support contour and anchoring improves resistance to overturning during engine rotation. The use of the developed stand also improves the organization of repair work.

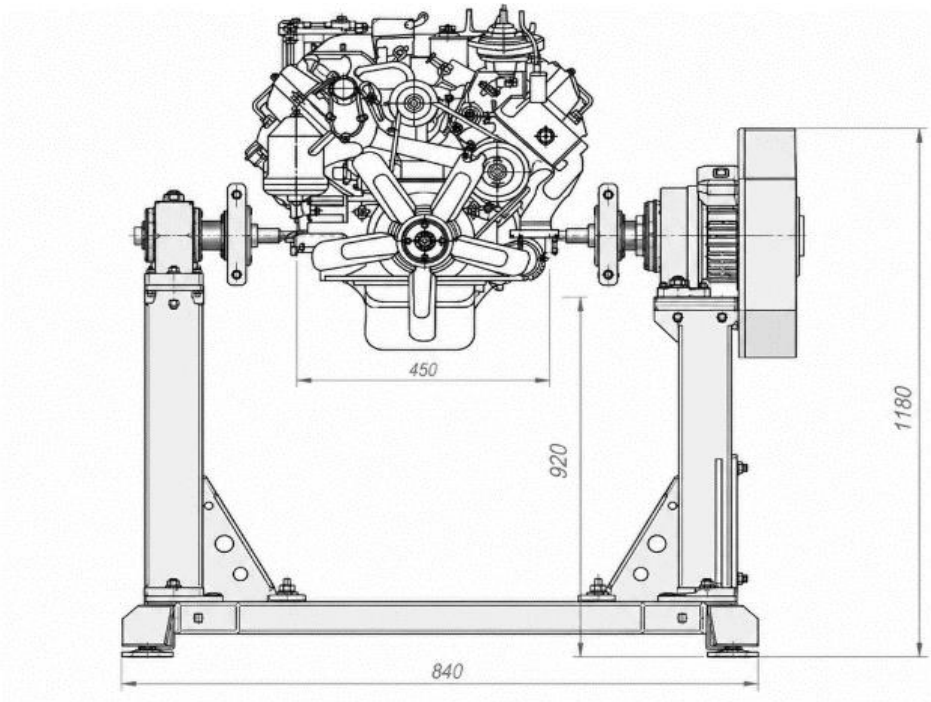


Fig. 1. General arrangement of the developed stand for engine assembly and disassembly

According to the source technological calculation, the labor input for lubrication-system repair decreases from 10.2 to 8.67 person-hours per engine, corresponding to a 15% reduction. The saving is 1.53 person-hours per engine; for an annual program of 180 engines, this amounts to approximately 275 person-hours per year. Thus, the proposed stand combines structural simplicity, controlled engine positioning and measurable reduction of auxiliary repair labor. The calculations confirm the feasibility of the proposed design for engines with a mass of up to 350 kg. The 0.37 kW geared drive provides slow controlled rotation, the 60 mm rotary shaft and 60 x 40 x 4 mm traverses satisfy the adopted strength conditions, and a 1.1 m base with anchor fixing provides the required stability. The design is suitable for

workshop manufacture from standard steel sections and can be used to improve engine disassembly, inspection and assembly operations.

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