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Finding globally optimal combinations of cranes drive mechanisms by the method of exhausting alternative design structures of mechanisms

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Abstract: During certain crane operations: hoisting or lowering the payload connected with a slewing jib, generated are Euler and Coriolis forces whose impacts should be minimized already at the stage of selection of the system parameters and mechanism structure. The Machine and Mechanism Theory provides a method of exhausting kinematic chains which involves identification of all possible alternatives of kinematic structures with respect to the required number of degrees of freedom and field of work. This article outlines a methodology of selecting optimal structure from a set of possible solutions. Optimization of a multi-drive machine, needs to take into account the interactions between cooperating mechanisms By introducing a certain quality criterion, a set of parameters optimized for the full range of motion is determined for each structure. Accordingly, each structure is assigned a value of the optimum quality index. The method was illustrated for a one-link crane with lever mechanisms, and comparison was made with ropes mechanisms. Optimization tasks were formulated assuming the ideal stiffness of the structure in quasi-static conditions. Effectiveness was verified under dynamic impact conditions, taking into account rope flexibility. Finding globally optimal design solution it comes to the best combination of different mechanisms allows the dynamic overload values to be significantly reduced at the stage of design of the steel structure.

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