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Design of Small Mud Pump Drive System

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Abstract: A mud pump is a machine that delivers mud, clean water, or some other flushing liquid to the hole during the drilling process. Its main role is to pump mud through the drill bit into the well during the drilling process, cooling the drill bit, cleaning the drill bit, fixing the borehole wall, driving the drilling, and transporting the broken rock fragments to the ground through the action of the water stream.The drive system design of the slurry pump involves a simple selection of the motor, through the knowledge of the mechanical design, mechanical principles, mechanical design and manufacturing foundation, mechanical system design, etc., to the pump crankshaft, connecting rod, plunger, crosshead A simple design is performed to obtain the preliminary dimensions; the designed parts are checked by the knowledge of the learned mechanics, and finally the modeling is done by AUTOCAD. Soliderworks performs three-dimensional modeling and engineering of the designed parts[1]. The production of the final simulation simulation of the main parts in order to be closer to the real work process.
Keywords: Mud pump, transmission system, strength check, dynamic simulation.

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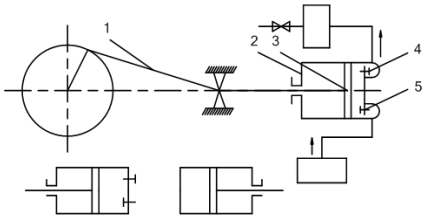
1. OVERALL DESIGN

The mud pump working principle diagram of this design is shown in Figure 1 below:



1-Crankshaft linkage; 2-cylinder; 3-plunger; 4- exhaust valve; 5-inlet valve

Fig 1. Slurry pump working principle

The working process of the mud pump drives the crank connecting rod mechanism to make a circular motion. The connecting rod and the crank pin on the crank are connected. Finally, the connecting rod is connected with the plunger through the cross head connection to convert the circular motion into a reciprocating straight line movement.

2. TRANSMISSION SYSTEM AND COMPONENT DESIGN

In a reciprocating pump, the crankshaft is one of the important components for converting the rotational motion of the prime mover into the reciprocating motion of the piston. When working, it will withstand periodic alternating loads, produce alternating torsional stress and bending stress, and is therefore the most important force component in the crank linkage mechanism, requiring high rigidity and impact toughness, and its shape and size Axis-based, rough shape is more complex, usually 45 steel.

2.1 Structure design of the crankshaft

The structure of the crankshaft is shown in Figure 2 below:

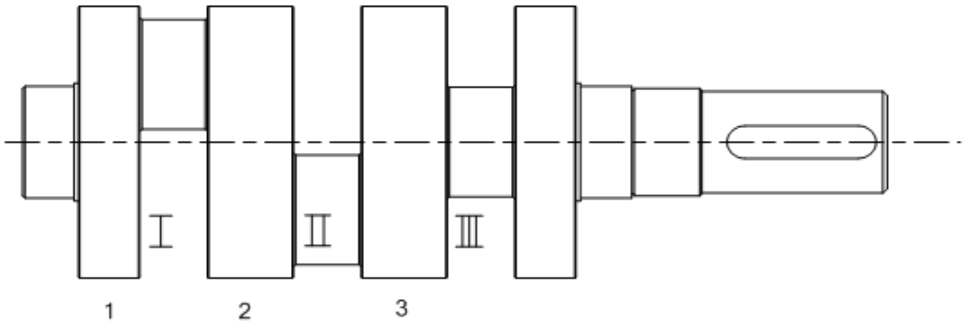


Fig 2. crankshaft structure

Crankshaft layout and crank angle selection:

For triple-acting single-acting pumps, the crank offset angle should be: if the first crank is approaching the input end and clockwise calculated on the basis of it, the misalignment of the second crank and the first crank is taken, the third crank and the first The wrong angle of the crank is such that the deformation (tilt angle) of the main journal is facilitated, and the crankshaft is often used for various reciprocating pumps with different number of linkages and sizes. Therefore, a three-turn two-supported crankshaft can be used.

Crankshaft support and bearing selection:

The rigidity of the crankshaft with two supporting three turns is poor, but the inclination angle of the neck deformation at the main bearing of the small mud pump is small, so the main bearing can be used as a sliding bearing[2].

2.2 Structural design of connecting rod

The link structure is shown in Figure 3:

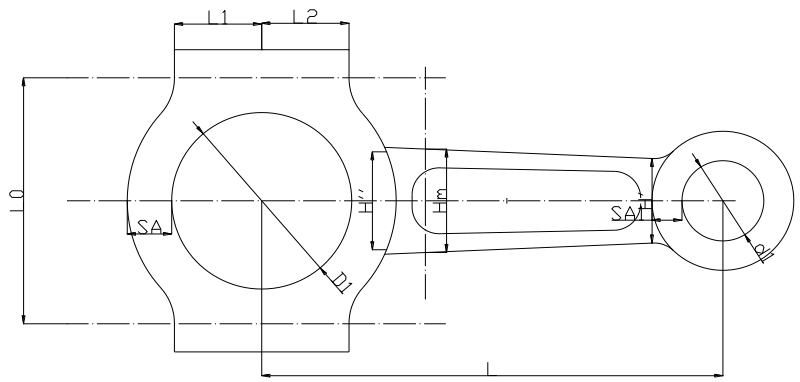


Fig 3. Connecting rod structure

General design requirements：

The connecting rod should have sufficient rigidity and strength, and it should not be broken or bent during work;

(2)The large and small head structure is reasonable, and it can be used to fit bearing bushes or bearings with sufficient bearing capacity;

(3)Under the above conditions, we should try our best to select the appropriate shape, section size, and reduce the weight, which can reduce the movement quality as well as processing and manufacturing.

2.3 Cross head structure design

General design requirements：

(1)The guide performance is good and the working surface must have sufficient wear resistance and bearing capacity;

(2)To meet the stiffness and strength, the weight should be as light as possible;

(3)The structure should be simple to find, and the piston rod (plunger), connecting rod small head should be solid and reliable, easy to disassemble and repair.

2.4 The structural design of the plunger

The basic requirements for the plunger:

(1)There is enough rigidity and strength;

(2)Smooth surface, high hardness, good wear resistance;

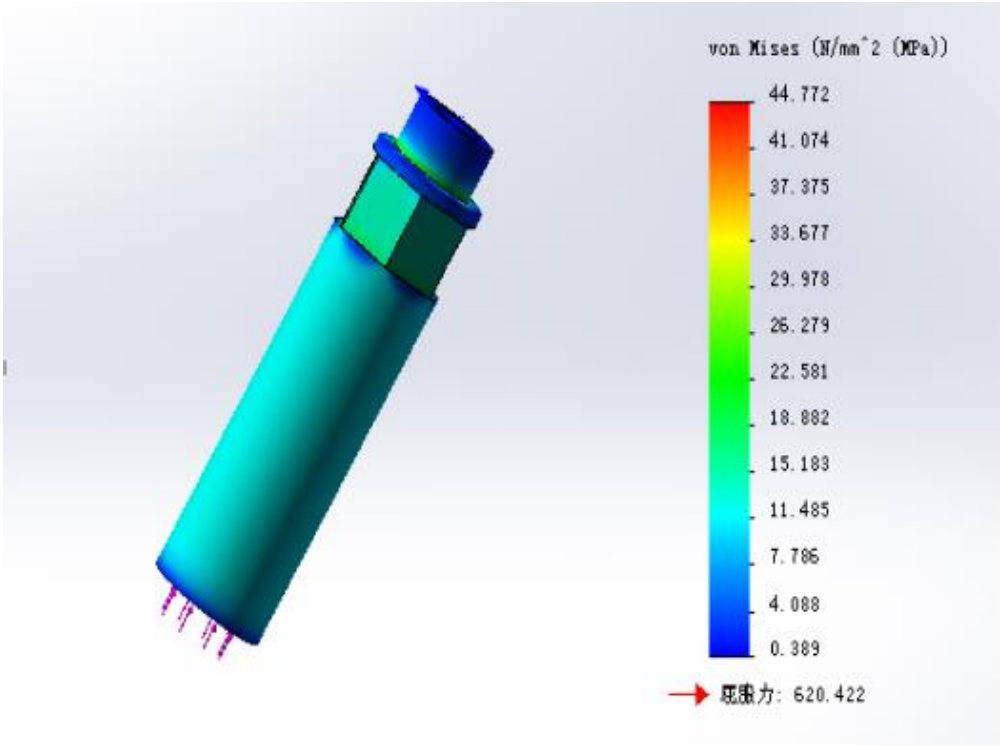
(3)The plunger has good corrosion resistance when transporting corrosive media.

3. FINITE ELEMENT ANALYSIS

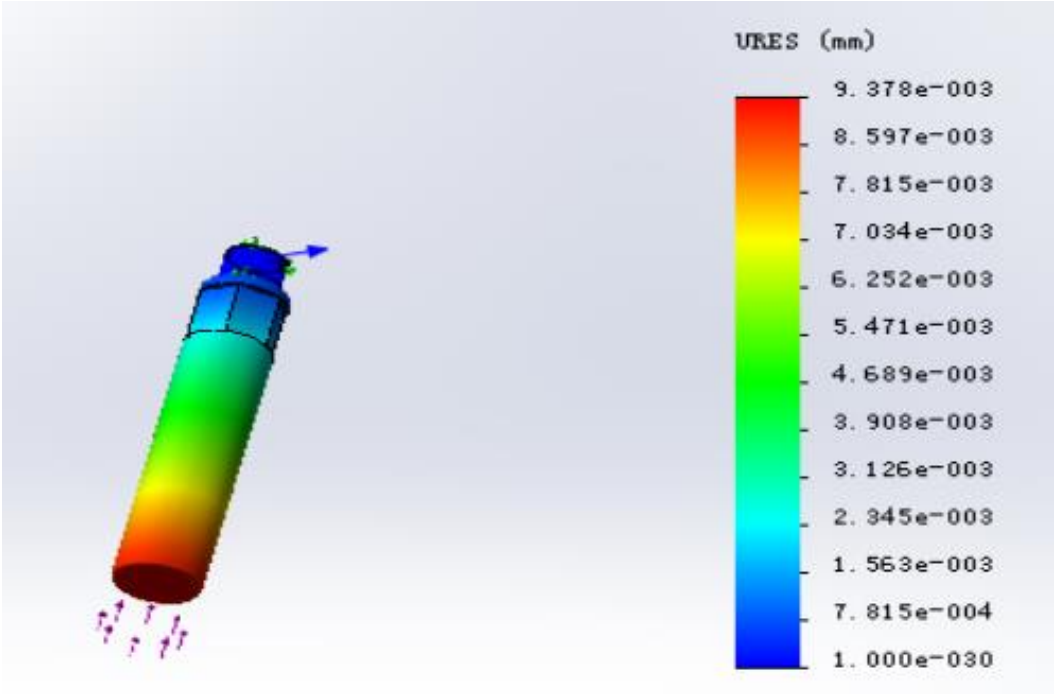
In the mud pump system designed this time, the main components of the transmission system are the crankshaft, connecting rod, crosshead, pin and plunger[3]. Among them, the safety factor of the crankshaft connecting rod is relatively high, so during the design process, The plunger is connected to the outside world and connected to the internal components of the transmission system[4].

(1) Define the material properties, define the connecting rod material as alloy steel, the elastic modulus is G=206GPa, the Poisson's ratio is u=0.2, the mass density is p=7700kg/m^3.

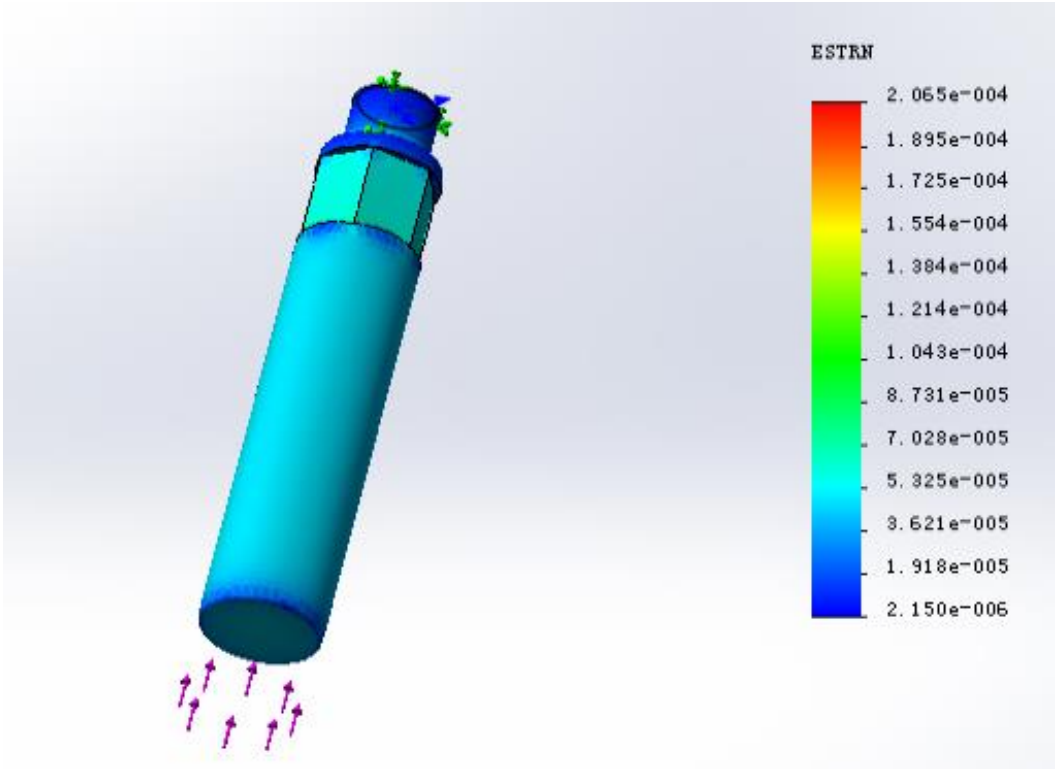
(2) Adding a fixed restraint to the plunger limits the freedom of the plunger in space;
(3)Add load to the plunger end face;
(4)Mesh the plunger;
(5)Run analysis to get analysis results.
The analysis results are shown in Figure 4 below:



a. Stress



b. Displacement



c. Strain

Fig 4. Finite element analysis atlas

Through the finite element analysis results of the plunger can be seen that when the plunger works, the stress on the plunger is far less than the required stress of the plunger, the plunger's strain and displacement when the plunger is stressed Within the scope of the material's permission, so meet the load requirements during normal work.

Summary: This time the design of the small mud pump, respectively, the crankshaft, connecting rod, plunger, crosshead of the transmission system is designed. After the dimensions of the parts are obtained, the parts are modeled by Soliderworks and the preliminary parts drawing is obtained[5].In the assembly through the observation of whether there is interference between the parts, and finally through the simiulation of the key components of the finite element analysis.

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