The Research Of Design and Modify Optimization Of 440t Self-made Horizontal Type Oil Press Hydraulic System

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ABSTRACT

This article introduces the operating principle of 440t self-made oil press and presents the methods of resolution after having analyzed the serious noise problem in the adjustment process. In this paper, we propose to choose a high flow capacity overflow valve to replace the two same type overflow valves; to make far distance between the fluid influx site and outlet of pumps; to install a standpipe at the return line entry of overflow valve; to adapt low noise overflow valve. The noise is obviously lower than the past after the modification and the system is operated normal.

KEY WORDS

Modification of 440t self-made oil press, Resonance, Noise

PREFACE

In the late of 1980s and early of 1990s, the demand of aluminum section materials shot up due to the quick development of construction industry. And the section materials demand exceeds supply in China. Against the backdrop a certain alloy manufacturer made over a 1970s' water press only used to produce copper tubes. Since this water press has been operated for almost two decades, its failure rate is high and production efficiency is low. So the manufacture decided to modify it to 440t horizontal type oil press by itself to produce the aluminum section materials and copper tubes.

THE TECHNOLOGICAL PROCESS OF SECTION MATERIAL PRODUCTION

Generally, the first step is to heat a bar stock to the extrusion temperature in the heating furnace in the technological process of section material production, and
then transfer heated bar stock to an ingot supplier. The ingot supplier sends the bar stock and extrusion backing to the extrusion machine center line. The extrusion rod is pushed by the piston in the main cylinder, then pushes the bar stock to the extrusion cylinder towards to the model entry. With high pressure in the main cylinder the extrusion starts. When the extrusion is completed, the section material product is separated from the remnant material by the cutter. At last every part of the extrusion machine come back to the initial position and prepare for the next operation.

THE MAIN PARTS OF THE OIL PRESS HYDRAULIC SYSTEM AND OPERATION PRINCIPLE

The load character of the 440t oil press is shown in figure 1. When the main cylinder is in piston operation stroke, the load is almost constant and the load character approach horizontal line.

![Figure 1: Load-time character curve of the 440t oil press](image)

The hydraulic system is composed of the adjusting pressure return line of oil-in, the control return line of the main compress machine, the return line of the auxiliary machine, self-loop cooling and filtrating system. The structure is shown in figure 2.

The major system parameter: (Only No.2 and No.3 group of pumps are used in aluminum section materials process.)

The operating pressure: \( P = 0-18 \text{MPa} \), the quick forward speed: \( v = 195 \text{mm/s} \), the extrusion speed: \( v = 0.3-39 \text{mm/s} \), the extrusion capability: full tons 440 tons.

THE DESIGN FEATURE

Three groups of pumps are adopted in the design that the 440t horizontal water press is modified into 440t horizontal oil press. The oil is supplied by two same type and parallel connected piston pumps that are driven by electric motor in every group. The oil flows into the manifold through the check valve in every group. There is electric and hydraulic overflow valve that adjust pressure and unload safely in every pump outlet to meet the flow capacity. The operating process: the main cylinder advances quickly when filling valve is opened and two pumps supply oil to the cylinder at the same time in the non working process. The filling valve is closed and two parallel connecting pumps supply oil to meet the need of the main cylinder working flow capacity and pressure. The superimpose integrated block is adopted in the design. So the most valves are arranged in three superimpose blocks. This makes the installation, adjustment and maintenance convenient.

THE PROBLEM IN THE DESIGN

In the pressurization of operating process, the return line of two combined pumps is adopted in the original design. The two pumps are all 160scy14-18 type and the overflow pressure is 18MPa. There is serious noise in the actual operating process. The reason is the disturbance between two pressure lines due to the same 18MPa pressure of two pumps. The noise is induced by the resonance of two overflow valves under the action of fluid.

THE ANALYSIS

Only in the extrusion process (two overflow valves unload at the same time constant pressure) is there serious noise. And the noise level is lower when only one pump and one overflow valve is in operation. This condition shows that the serious noise is caused by the resonance of two overflow valves under the action of fluid.
The overflow valve is a part that is very easy to induce noise. Besides the swinging pressure induces the pressure to fluctuate and serious noise, the high speed flow, cavitations and vortex in the main valve core and the opening of the valve seat, the noise is mainly caused by them. When the high pressure fluid flow through the overflow valve, the pressure energy is changed into the kinetic energy and heat energy. The main valve opens slightly, but the pressure differential is very high between two sides. So fluid speed is too high and the high speed spurt itself always comes with some noise of flow. And in this condition, the fluid speed is too inhomogeneous to induce vortex or cut the fluid, so noise gives off. We analyze this from the hydrodynamics view: the fluid has high pressure potential energy in front of the valve. When it flows through the valve, the fluid speeds up. Then the potential energy is changed into the kinetic energy and meanwhile a part of the energy is changed into the acoustic energy to radiate as noise. Especially in high pressure and high flow capacity condition, the fluid speed and overflow valve opening is too high. If there is some air in the oil and the fluid speed is too high at the valve opening, the pressure will be too low or even negative pressure. So the air will separate from the oil and produce much air bubble. But when the oil returns to the oil sump, its speed slows down, the pressure goes up,
and then the air bubble breaks up. After these the vibration and noise are induced. There is noise in the all process of the air bubble coming into being, developing and breaking up. The air bubble noise gives off mainly in the late period of breaking up. And the acoustic pressure order of magnitude can reach over 100db.

In this mentioned system the pressure oil of two pumps is confluent after flowing through the check valve. The noise will give off when two pumps supply oil at the same time because the outlet of two pumps is close to the confluence tube. The pumped out fluid is turbulent current at the outlet and it can produce a great deal of vortex. When two turbulent currents are confluent, the intense noise is induced. At the same time it can also cause the vibration of the overflow valve. Because the structure, spec and the adjustment pressure of both overflow valves are all the same, the free frequency of two valve cores is the same, so it is very easy to induce the resonance of two overflow valves and pressure oil tubes. And abnormal noise is given off.

THE DESIGN MEANS OF MODIFICATION

Choose a high flow capacity overflow valve to replace the two same type overflow valves. So the resonance source is gotten rid of. (Fig.2)

To prevent the influent noise, the influent site is moved far from the outlet of pumps and the pipeline transits smoothly. So the vortex probability is lower.

Install a standpipe at the return line entry of overflow valve (Fig.2). The perpendicularly installed standpipe is made of rubber (Fig.3) and artificially filled some air in it. The interface contacted with air must be higher than the tanked oil. The standpipe character: facility to manufacture, low inertia, reaction sensitivity, small floor area, and no friction loss.

Low noise overflow valve is adopted to abate the noise caused by the big pressure differential.

The noise is lower obviously after the modification and the system is operated normal.

The cause of hydraulic system noise is a complicated problem. It is affected not only by the system design, but also by the component machining, assemblage, the system structure, operation and maintenance. Therefore, we should care about some concerned factors other than select logical design project, in order that the system will have good operation performance, long operation life, safety and reliability.

REVELATION

This case reminds us that we should avoid to adopt pressure adjustment return line of two parallel connected and same pressure overflow valve to avoid the resonance and noise when we design the pressure control return line. At the same time to prevent influent noise, we should calculate logically the length of the two pumps outlet to transit smoothly. At last we should select low noise overflow valve as possible as we can.

REFERENCE