Application of ALPHA6000S Frequency Converter in Hydraulic Press

I. Description

The hydraulic press enjoys a wide range of application. It is suitable for bending, flanging, drawing, forming, cold extruding, and other stamping processes. However, current hydraulic press has the following shortcomings.

1. A hydraulic press requires different flow and pressure in different processes, so proportional flow valves and pressure valves are required for flow and pressure regulation.

2. Since the output power of the metering pump is unadjustable, excess energy is consumed by the baffle, oil leakage, and oil temperature rise. This exacerbates the wear of various valves and results in high oil temperature, loud motor noise, and shortened mechanical life.

3. The designed motor capacity is much higher than what is really needed, thus causing energy waste.

Applying a frequency converter in a hydraulic press can not only save energy but also achieve digital servo control of hydraulic press.

II. System Configuration
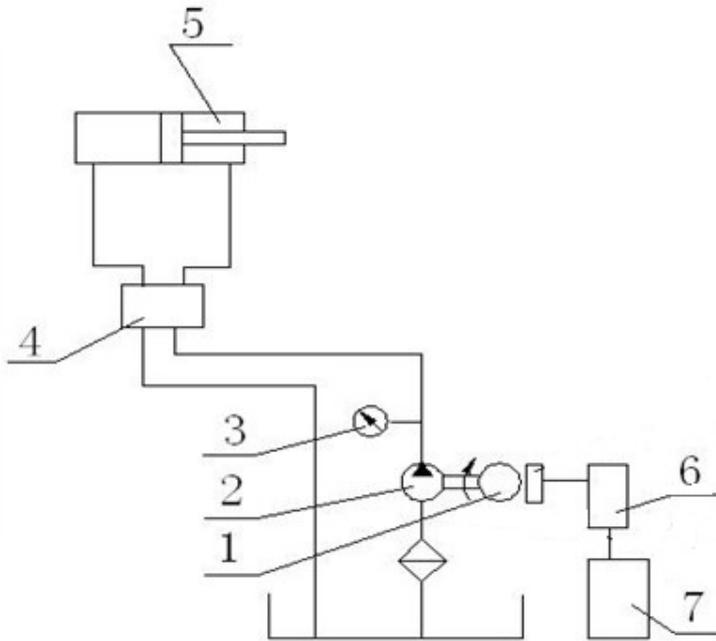
1. Motor 2. Hydraulic Pump 3. Pressure Gauge 4. Reversing Valve 5. Hydraulic Cylinder 6. Frequency Converter 7.PLC

From the picture above, it can be seen that the structure of this hydraulic press is motor plus hydraulic pump plus reversing valve plus hydraulic cylinder. Relief valve and throttle are removed. The frequency converter directly drives the pump which then drives the cylinder for working. According to the hydraulic transmission calculation principle,

◆ Displacement $\quad s = \dfrac{\alpha q}{A}$

◆ Velocity $\quad v = \dfrac{nq}{A}$

◆ Pressure $\quad p = \dfrac{2\pi\eta}{q} M$

in which q denotes pump displacement, A is the working area of hydraulic cylinder, n represents motor speed, and M stands for motor output torque.

It can be learnt from the above formulas that the working speed of the hydraulic cylinder can be altered by just changing the current speed of the pump motor and the working pressure of the cylinder can be changed by altering the output torque of the motor.

The ALPHA6000S current vector frequency converter is used. It has the following advantages.

1. Under speed mode, the torque can be limited to output, thus meeting the requirements of this working condition.

2. A 32-bit CPU dedicated to motor is used. It boasts fast processing speed.

3. Current is regulated in real time and dynamic response is fast.

4. Our frequency converter adopts advanced software algorithms and it shows high control precision.

5. The device is equipped with sound fault protection functions.

6. Made by excellent manufacturing process, this frequency converter is able to adapt to harsh industrial environments.

The schematic diagram of transformation is shown below.
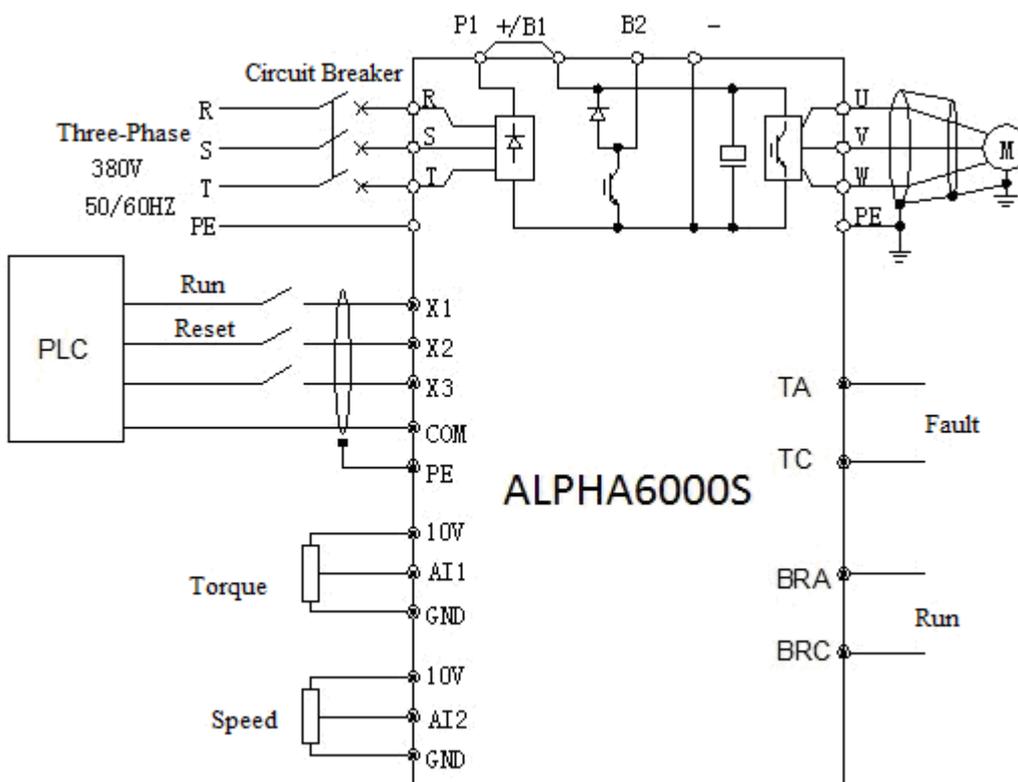
A PLC is used to replace the time relay and intermediate relay in the original electrical system to achieve logic control of the whole hydraulic press. Fault output signal of the frequency converter is fed back to the PLC. When the frequency converter fails, the PLC stops working and outputs failure indication to inform the operator. By adjusting the speed

potentiometer, the working speed of the cylinder can be regulated. By adjusting the torque potentiometer, the maximum output torque can be changed, thus achieving the purpose of controlling the maximum working pressure of the cylinder.

III. Parameter Testing

Control mode	P0.01	1
Frequency setting 1	P0.03	3
Frequency setting 2	P0.04	2
Run command control mode	P0.07	1
X2 terminal function	P3.02	6
Relay 1 (TA/TB/TC)	P3.24	19
Relay 2 (BRA/BRB/BRC)	P3.25	1
Upper torque limit	P8.11	1

IV. System Advantages

1. Due to the removal of relief valve and throttle, the whole system is made simpler and fault point is reduced.

2. The adjustment of flow and pressure is more convenient. If used in conjunction with the recipe function of the upper computer, this system can fully realize the automation required by different processing technologies.

3. The operation of oil pump is set according to the actual process requirement, so there is no excess oil flowing through relief valve to the oil tank, thus reducing oil temperature and extending the service time of the oil.

4. The motor is stopped during workpiece replacement. This reduces power consumption.