Research on the master pump of piston type plastic clutch with displacement switch

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Abstract: At present, the clutch master cylinders used in most manual transmissions at home and abroad are constructed of cast iron or cast aluminum without electronic displacement sensing. This type of product is susceptible to problems such as rusting or uneven wear and poor vehicle handling performance. This study describes a plastic clutch master pump with displacement switch, which can light the structure under the same displacement and stroke and add displacement switch structure. It can provide injection data to ECU, prevent manually shifting car from stalling and improve vehicle operation performance. The part of the clutch hydraulic system, the light weight part of the clutch pump, the displacement switch part and so on are analyzed and discussed respectively.

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1. Introduction
With the improvement of the living standard, the car has entered the ordinary people's family, which provides convenience to our life and promotes the development of the society. At the same time, the control performance of the car is also more and more high. The general structure of the general clutch pump is heavy and unable to realize the function of electronic automation.

In view of the continuous improvement of vehicle handling performance, the general pump of plastic clutch with position switch function is developed. The new product adopts the lightweight design of the plastic structure and increases the output piston displacement signal function. The product is suitable for the hydraulic clutch system of all vehicles, and is especially suitable for the passenger car clutch system with high comfort requirements.

2. Piston type plastic clutch master cylinder with displacement switch
Figure 1 is the principle diagram of the total pump structure, the hydraulic working part and the displacement switch part of the piston type plastic clutch of the car with the displacement switch.
The components shown in Figure 1: plastic displacement switch clutch pump composed of a pump body 1, displacement switch 2, 3, 4, the main magnet piston apron 5, oil sleeve 6 and a pair of leather ring 7, O ring 8, 9, 10, a guide sleeve holder 11 push rod assembly parts. The product is mainly composed of two parts: pump body 1, piston 3, main apron 5, sub leather 7 and other parts to form hydraulic work parts; displacement switch 2 and magnet 4 constitute the displacement switch part.

2.1 displacement switch part

Figure 3 displacement switch structure, displacement switch part by chip 2.1, pins 2.2, displacement switch shell 2.3, a magnet 4. The displacement switch 2 outputs the switch signal by sensing the magnetic field change of the magnet 4 embedded in the piston 3 through the chip 2.1.

The chip of the displacement switch can be divided into two types: the dry reed tube and the Holzer chip. The chip 2.1 is the Holzer chip used in this structure. Its principle is to use the magnet 4 to form a linear trapezoid magnetic field. The displacement of Holzer 2.1 in the linear magnetic field is in accordance with the change of the magnetic field intensity. The formation of Holzer potential is proportional to the displacement, thus the Holzer potential can be obtained, thus the measurement of the Holzer potential can be obtained. The size of the displacement is measured.

Figure 2 relation diagram of displacement switch signal and total pump stroke. The displacement switch has 5 connections with the external connection, which are PIN1 for hard line access body, PIN2 as 75% position signal line, PIN3 as PWM signal line, output 10%-90% signal range, PIN4 as 25% position signal line, PIN5 as 25% position signal power line.
2.2 clutch master pump part

The entire working cavity of the clutch general pump is composed of the oil storage cavity and the pressure building chamber. The oil storage cavity does not bear the liquid pressure, and the oil is mainly supplied to the pressure building chamber. The whole hydraulic working chamber consists of the pump body 1, the plunger 3, the main ring 5, the accessory leather ring, and so on.

The liquid in the oil cup before work flows into the hydraulic working chamber through the oil hole, and then fills the entire working cavity through the annular evenly distributed oil hole on the plunger 3. During the product operation, the driver transfers the clutch pedal force to the push rod assembly 11 by driving the clutch pedal to a certain lever ratio, and drives the plunger 3 to move forward axially. When the plunger 3 passes over the 5 lip of the main ring, the pump body 1, the main skin ring 5 and the plunger 3 form a pressure build-up cavity connected to the outlet. When plunger 3 continues to move, the volume of the pressure chamber gradually decreases, and at the same time, the pressure in the pressure chamber increases gradually, forcing the liquid to flow to the hydraulic line and the clutch sub pump from the liquid outlet, so as to achieve the establishment of hydraulic function. At the same time, as the plunger end with 3 magnets with 4 forward axial movement of the plunger 3, displacement switch changes through the magnetic field strength, the formation of the on-off signal, accurate location information to provide working stroke clutch pump to ECU, to determine the engine oil spray data. Thus, the stability of the clutch is improved and the transmission system can work properly and reliably. The whole working process of the product is to transform the thrust of the driver to the clutch pedal by a certain lever ratio to the liquid pressure, and then pass it to the clutch pump through the hydraulic pipeline, so as to push the pulling fork into mechanical energy and realize the separation function of the clutch.

3. Conclusion

At present most of the domestic and foreign general clutch pump adopts the design of cast iron material or Aluminum Alloy material, the whole structure is relatively heavy, the internal common piston structure, size precision and the surface of the inner hole of the pump body hole roughness is not easy to control, easy to cause the product movement seizure and intensified seal wear ring lip skin, affect the product service life. The innovative material of the total displacement pump with displacement switch clutch is made of modified alloy nylon material, and the inner structure is plunger structure. It is more easy to guarantee the accuracy of products and improve the service performance of products.
Because the application market of this product is very extensive, it can not only improve the working stability of the hydraulic clutch system, but also bring considerable economic benefits for the company.

Reference
[1] Yu.Zhang. Auto Engineering Handbook. People's transportation press, 2001.
[2] Qibai.Li. Hydraulic components. Handbook of Metallurgical Industry Press, mechanical industry press.1999.
[3] Jiaqing. Wang, Guowei. Zhao, Jiwang.Yang and so on. A plastic clutch general pump with displacement switch. China, 201720688721.5 2017-6-14.
[4] Yugui, Yang. Engineering mechanics. Machinery Industry Press, 2001.
[5] Ruxin, Ning.CAD/CAM technology [M]. Machinery Industry Press.2010.
[6] Yingda. Tang. Hydraulic cylinder design and manufacture. Chemical Industry Press.2017.
[7] Jiaxiu, Hu. Fundamentals of mechanical design mechanical industry press.2003.
[8] Kun, long.Pro/ENGONEER wildfire 3 example practice [M]. Tsinghua University press, 2006.