

CANNED MOTOR

When centrifugal pump is in running operation, problem sometimes rises on the leakage of liquid flowing inside, caused by its defective mechanical seal. If the leakage of liquid does not cause any trouble in operation, it does not matter. But, in the case that it causes some trouble, good mechanical seal must be required. For example, the leakage of corrosive liquid corrodes surrounding metal parts, the liquid easy to gasify much decreases in its volume because of its rapid gasification at leakage point, and the more leakage occurs in the case of high pressure liquid.

If the liquid is expensive, the loss caused by its leakage cannot be overlooked. The leakage of radioactive liquid cannot be allowed positively. For the use of these purposes more simple and reliable protection against leakage is taken out by such a way that the pump chamber and inside of motor is made into a common unit allowing the invasion of liquid into periphery of the rotor of motor and the leakage of liquid is protected with motor casing.

If the liquid is not harmful against motor winding insulation and core plate and is not so high temperature and high pressure, stator winding as well as rotor winding can be also dipped in the liquid just like as submersible pump motor which has rather simple structure. However, in general, as stator winding cannot be dipped in the liquid, the motor having such a construction is adopted that a metallic partitioning plate which encloses the stator is set inside surface of stator core, and only the rotor part is dipped in the liquid. The motor having such a construction is called canned motor.

Our company has manufactured canned motors for circulating pump of freon for refrigerator. Since freon gasifies at normal pressure, it is necessary to be maintained in high pressure. In this case usual pumps produce much leakage of liquid, so we adopted the canned motor for this purpose.

Pumps are manufactured by Ebara Mfg. Co., Ltd. As the completion of this canned motor has significant meaning for the various demand in future and we have got instructive data from various tests, we would like to introduce the outline of the canned motor in the following columns.

The specification of the canned motor and pump

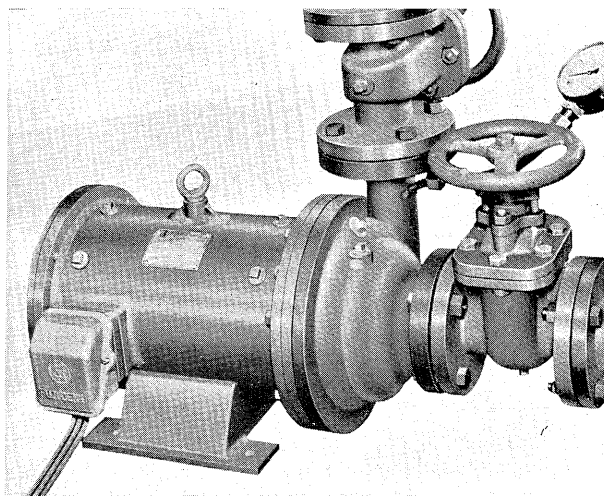


Fig. 1. Canned motor pump

is as follows :

Totally-enclosed cage rotor type 2-pole 3-phase induction motor.

Output : 2.2 kW

Voltage : 200/200 V-220 V

Frequency : 50/60 c/s

Speed : 3,000/3,600 rpm

Permissible max. pressure

of motor inside : 15 kg/cm²

Liquid flow of pump : 200 l/min.

Head of pump : 25 mAq

Fig. 1 shows the outside view of the canned motor under testing using freon liquid. Stator core and winding are separated from rotor shaft with a liner (stator can) and rotor part is filled with the liquid. The liquid is led to the rotor part from delivery side of pump through side way, then passes through air gap cooling the heat generated by the loss at the stator can, lubricates the bearings, passes through inside the shaft and at last discharged into the suction side of pump. Many characters are required on the stator can because it is set in the air gap. That is, to decrease the loss generated in the can, large specific resistance, thin thickness and small permeability are required on the can. While mechanically, such a construction is required as not to be strained by high liquid pressure, to be free from leakage of liquid and to withstand fully against

corrosion.

As electrical requirement and mechanical requirement are contrary to each other in its thickness, it is necessary to determine carefully the suitable thickness. Our company had experimented and checked the various kinds of material for the abovementioned characters and we adopted stainless steel as we found that stainless steel was most suitable for this purpose in the view point of characters, manufacturing process and economics. Actually, excellent result could be obtained by using stainless steel as a can.

The leakage of liquid to the stator part and the strain of the can under high internal liquid pressure are not allowed positively. For the leakage, X-ray examination and pressurized leakage test were conducted several times in the process of manufacturing and after completion another leakage test was conducted. For the strain of can, in the condition of setting the can on inner surface of the stator core, many strain gauges are fitted on the surface of the can and stress measurement and strain examination are conducted increasing the internal pressure up to the specified pressure. The result showed little strain and it was understood that the can had an ample safety factor against the service pressure, after calculating the stress concentration of the can by the result of stress measurement.

Laminated steel sheet is used for the rotor core, and aluminium casting is made on the rotor to rise the electrical characteristics. And rotor is covered with stainless steel can like as stator can to withstand corrosive liquid. As the welding technics of stainless steel has been much progressed recently, it is worked easily and surely that the rotor core is covered with stainless steel. Fig. 2 shows the completed rotor of canned motor.

Bearings have the load of rotor weight, pump

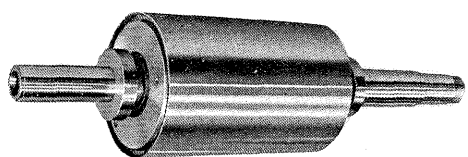


Fig. 2. Rotor of canned motor

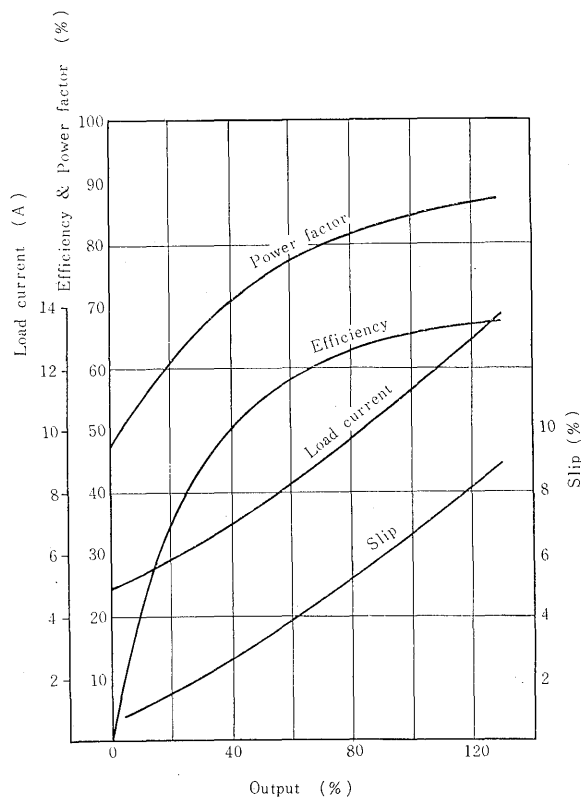


Fig. 3. Load characteristic curve of 2.2 kW canned motor at 200 V 50 c/s

runner weight and pump thrust and as lubricant pumping liquid is used, so that they are not so good condition for the bearing materials. Fortunately our company has much experiences in manufacturing submersible pump motor and from the rich experiences of bearing materials we adopts graphitor for the bearing bush.

To obtain the motor characteristics, various tests were carried out supplying water in the rotor part. The result is shown in Fig. 3.

In this article the canned motor for freon liquid was introduced. This construction can be only applied for the liquid of low temperature, but our company are further studying on the canned motor for other many special services.

(By Rihi Ano, Rotary Machine 1 Sect., Design Dept.)