Development of High Efficiency Variable Cylinder Rotary Compressor

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1. OUTLINE

Global environmental conservation is one of the major issues that we are being faced with today. The number of residences with high heat insulation has been increasing as an alternative solution for energy saving. In such a background, as requirements for air-conditioning system in near future, not only a high efficiency, but also attaining the setting temperature quickly and capability to operate continuously in low capacity range without intermittent running, are important toward energy savings and improvement of indoor comfort. For those aims, we have developed a unique rotary compressor which enables to be operated even in extreme low-load operation by having a mechanism to switch-off one of two cylinders. However, there were some problems in the conventional model, especially in efficiency dropping of 2-cylinder operation. We redesigned a mechanism drastically and developed a new system which could solve those problems. This new variable cylinder rotary compressor has higher efficiency across the entire operating range, and moreover, some advantages in resource-space saving.

2. DETAILS OF TECHNOLOGY

Fig.1 illustrates the variable cylinder mechanism of 2-cylinder rotary compressor. In 2-cylinder operation, the vane is pushed to the rolling piston by the force F which is generated by pressure difference between suction pressure at vane tip and discharge pressure at back side of the vane, thus builds a compression chamber inside the cylinder. If the force F is eliminated in an equilibrium pressure condition and at the same time the vane is held by a permanent magnet, it turns to make the cylinder working idle running condition. In conventional models, an idle running is gained by supplying the discharge gas into suction chamber by using a 3-way valve which is installed in the midway of suction pipe line. However, these compressor models utilizing with the mechanism as described above have some problems such as, efficiency dropping during 2-cylinder operation due to a large loss at suction line, space-consuming of pipe fittings including 3-way valve, and difficulty to adapt to 1-suction twin rotary compressor known as a high efficiency structure.

Fig.2 shows the switching operation of the newly developed model. In this model, a hermetic vane chamber is formed at the back of the vane. An idle running is created by changing the pressure inside the hermetic vane chamber from discharge pressure to suction pressure by using a 3-way valve. In this mechanism, suction pressure loss will not occur because there is no need to set a 3-way valve in the suction pipe line. Furthermore, it is applicable for the 1-suction twin rotary compressor because suction chambers are consistently filled with suction gas.

Compare to the best performance of the conventional model, the new model, as shown in fig.3, achieved more efficient 4-5% in rated COP, 1.5% in 1/4 rated COP, and this system also reduced pipe fitting quantity by half. In residential air-conditioner application, the new model performed 43% improvement in the average amount of power consumption in stable condition as compared with the non-variable model, and offered indoor environmental comfort by reducing temperature fluctuation.

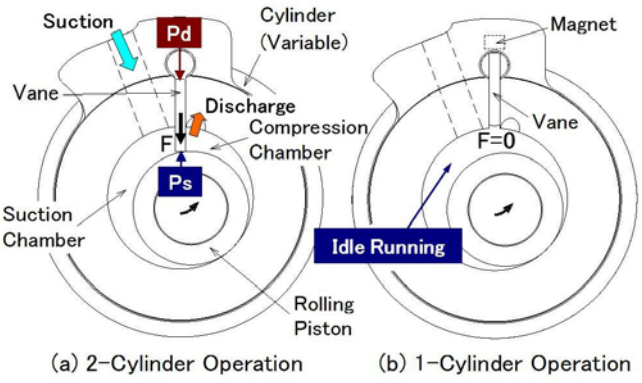

Fig.1 Illustration of variable cylinder mechanism

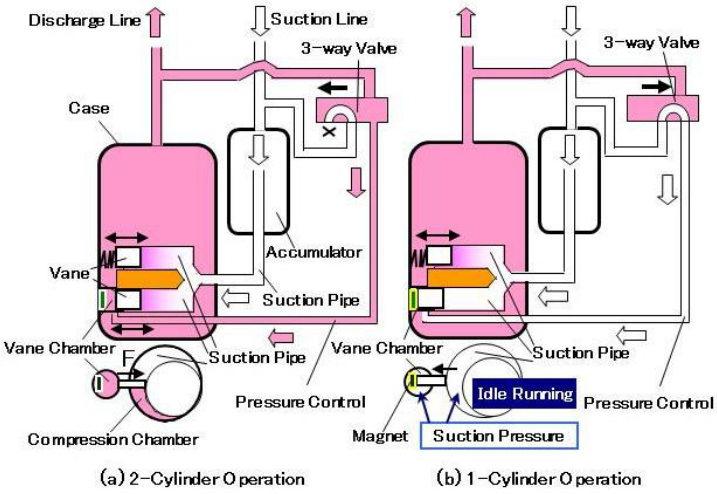

Fig.2 Switching operation of developed model

Fig.3 Developed model

3. SUMMARY

We have commercialized the new developed model for residential air conditioning since November, 2011, and have been offering lower power consumption and a comfortable indoor environment unique to the new variable cylinder mechanism. We will expand the range of technology application for more contributions in energy conservation and indoor environmental comfort.