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A NEW TYPE OF CNG REFUELING SYSTEM AND EQUIPMENT

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ABSTRACT

A new type of CNG refueling system has been developed by Zhejiang Qiangsheng Compressor Manufacture Co,Ltd. according to the market demand. The system can be applied in both CNG normal fueling station and daughter fueling station. It runs well in practical application. What's more, a Chinese Patent has been granted on this product. This system has also passed the appraisal of new products of Zhejiang province.

1. INTRODUCTION

Natural gas has been accepted extensively as a kind of substitute fuel for gasoline. Therefore, CNG fueling stations are developed rapidly in the worldwide. CNG normal fueling station is usually built in the place closing to the civil natural gas pipeline network. Natural gas can be extracted from the network directly. If we want to build a CNG fueling stations where there is no natural gas pipeline network, MD fueling station is a way to supply natural gas. A gas booster station, namely the mother station, is built near the backbone network before the pipe accesses to the city. The gas (pressure 0.8MPa~1.5MPa) extracted from the backbone network is compressed to above 20MPa. The compressed gas is filled into gas cylinders which are then transported to the secondary fueling station, namely daughter station. The gas can be injected into either gas storage of the station or vehicle gas cylinder directly.

However, the CNG normal fueling station may not run in China, due to the low gas pressure in the pipeline network. The pressure is usually very low at the cooking time in the noon and evening or heating time in winter. It is difficult for the station working normally. It will cause economic loss to fueling station owners. If we transport the gas from the mother station to the daughter fueling station at this moment, the daughter fueling station will run normally. So it is required that the normal fueling station can be operated like a daughter station. The new system has been developed according to the above market demand.

2. THE NEW CNG REFUELING SYSTEM

The flow chart of the normal fueling station compatible with the daughter station is show in Fig.1. When the system works as a normal fueling station, the gas extracted from the network (0.15MPa-0.2MPa, gauge pressure) is boosted above 20MPa via a four-stage compressor. Then the compressed gas is filled into gas storage. When the system works as a daughter station, the first and second stage of the above compressor will not run. The gas pipeline between the second and third stage is obstructed. The gas from the tank truck is filled into daughter station's gas

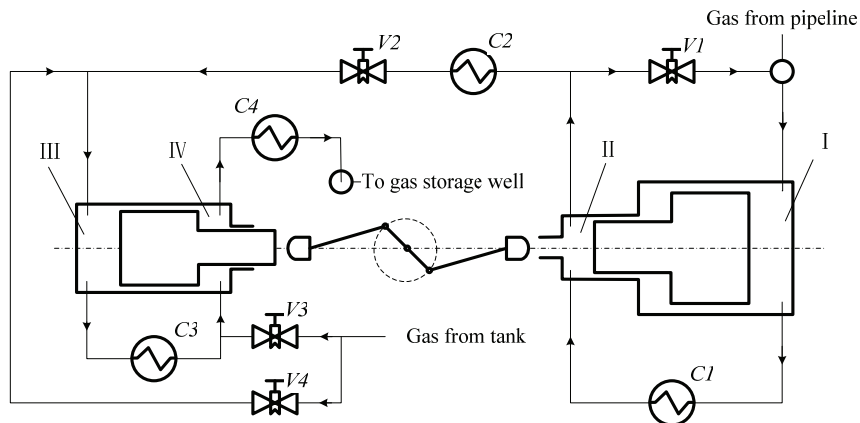


Figure 1: Normal filling station compatible with daughter filling station Structure
 I、II、III、IV—Compression stage, C1、C2、C3、C4—intercoolers and after cooler,
 V1、V2、V3、V4—Check valve, —→Gas path

cylinder after slight compression at the fourth stage of the compressor. As the gas is filled into the vehicles continuously, the pressure of the cylinders comes down. The third stage of the compressor begins to work when the pressure decreased to a certain point. The gas is filled into gas storage of the station or directly sent to CNG dispenser through the third and fourth stage compression.

It only needs conduit change when the system works as a daughter station in a short time. While it is required to work for a long time, a balance block should be installed substituting for the first and second stage pistons in order to reduce wear of the piston rings and friction power loss.

3. SYSTEM STRUCTURE OF THE COMPRESSOR

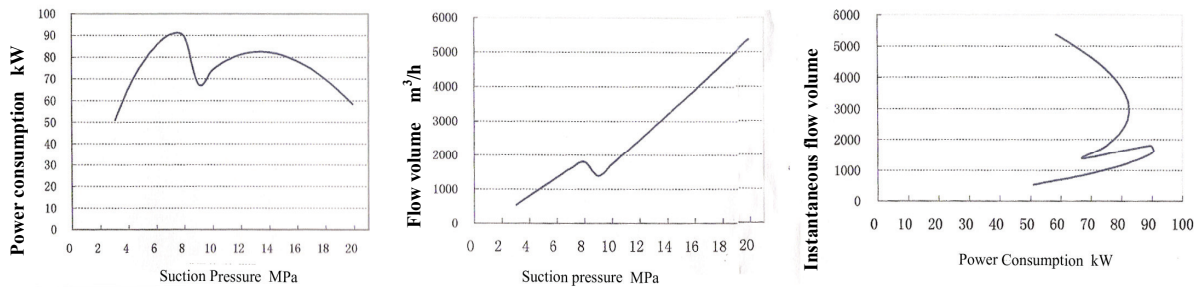
The compressor is a two-throw balanced opposed type compressor. Both of two throws are inversion grading structure. One row consists of the first and the second stage, the other is made up of the third and the fourth stage. Inversion grading structure simplifies the cylinder greatly. Furthermore, it makes the disassembly of piston easy to replace piston ring and packing. It only needs to open cylinder head in order to remove of piston instead of disassembly of small cylinder and relevant pipe first. It is very convenient for the fueling station owners.

It dispenses with oil injector, lubricating oil for cylinder and packing, and oil-gas separation device since non-oil lubrication is applied for the cylinder. The operation economy of the fueling station is increased. However, it is tough to design and manufacture the packing seal working at the pressure above 20MPa.

It has great difficulty in designing the charge and discharge valve too, since their work condition changes greatly for high pressure stage. The parameter is quite different when the system works under different patterns. The valve spring force is very hard to be determined accurately while the inlet pressure changes continuously. The most suitable valve can't be designed according to the common way.

The system has an advantage of high automation. PLC control system is applied for the compressor. The temperature and pressure can be controlled automatically too.

The compressor runs well although the inlet pressure varies in a large range when the system works as the normal fueling station. The actual operation shows that it can work varying from 0.08MPa to 0.22MPa.



4. THE CHARACTERISTICS OF THE SYSTEM WORKING AS A DAUGHTER STATION

Only the third and fourth stage cylinders come into operation under this pattern. The working performance varies with inlet pressure are shown in Fig.2~Fig.4. Fig.2 shows the compressor power consumption changes with the inlet pressure decreased from 20MPa to 3MPa continuously, while the outlet pressure is 25MPa. Only the first stage works at the beginning. The power consumption increases with the inlet pressure drop. While the power reaches peak, then it will go down with the inlet pressure drop accordingly. When the inlet pressure decreases to the set pressure, the second stage will work too. The power will be raised when the inlet pressure drops. When the power reaches to the second peak, it will go down with the pressure decrease. The gas supply curve is almost linear, shown as the Fig.3. Fig.4 is the instantaneous gas supply changes with the instantaneous power consumption. This kind of daughter station has the similar performance.

5. CONCLUSIONS

The system has shown high adaptability during the one year in-service running. And it has good reliability in the two year continuously working with no less than 12 hours a day. Meanwhile, the system has been widely accepted by Chinese user.

References

Chinese Patent (NO:ZL200520079788.6).
Yongzhang Yu. et al. 2000 , “*Technical manual of positive displacement compressor*”, China Machine PRESS, Beijing,.

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