International Journal of Research in Engineering and Science (IJRES)
ISSN (Online): 2320-9364, ISSN (Print): 2320-9356
www.ijres.org Volume 4 Issue 6 ǁ June. 2016 ǁ PP.37-42

Review of development and status of a rotary joint

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Abstract: Rotary joint industrial development has become indispensable mechanical connectors, which consists of three parts, namely, the rotating part of the sealing portion and the stationary portion. The most important part is sealed. In the mechanical seal rotary joints usually divided into contact and non-contact mechanical seal mechanical seals, rotary joint domestic universal use with contact seals, simple structure and low cost. While most non-contact mechanical seal technology conventional rotary joint, using a fluid film to achieve, even though it can effectively reduce friction and wear, but there are two problems: one can not take the initiative to adjust the gap between the seal faces; the second is the sealing gap Room size and the end of the fluid film stability is heavily dependent on plant conditions and medium conditions. So a new generation rotary joint development ideas are: a modern product design simulation, virtual technology applications under achieve green manufacturing exquisite appearance, light weight, standardized, modular, Compact size and other characteristics of the new structure, high reliability under seal in order to adapt the product working conditions, high stability, strong follow capability, long life and other high-quality, low-cost competition in the market needs.

Keywords: *Rotary joint mechanical seals contact non-contact*

I. INTRODUCTION

Rotary joint since 1931 by the American company Johnson successfully developed and production has been 80 years of history. Application of the rotary joint domestic production also has 30 years of history [1]. In almost all industrial fields, as long as between the fixed member and the rotating machine presence liquid and gaseous media to be transferred, it is bound to use the rotary joint connection. For example, special machine tools, deep hole drilling machine, glass machinery. Growing in the metallurgical industry, high-pressure, high-speed rotary joint has become increasingly widespread. Wherein the application in sheet mill unwinding machine, high-pressure, high-speed rotary joint in a classic example of the metallurgical industry applications [2]. Rotary joint in different applications, its structure is different, but no matter how the structure changes, includes three parts, namely, the rotating part of the sealing portion and the stationary portion. Rotating portion of the rotary chamber is connected to a stationary part connected with the stationary chamber, a complete fluid passage between the two parts; the sealing portion of the fluid is sealed to prevent fluid medium collusion, leaks and outside debris into the working medium, to eliminate contamination save energy [3]. In the rotary joint, the sealing portion is the most important. So the joint seals used in selection, and research new sealing method, would be to improve the efficiency of the rotary joint eternal theme. A rotary joint shown in Fig.1.

Fig.1 Rotary joint

II. MECHANICAL SEALS OF ROTATING JOINT

Mechanical seal is an end face of at least one pair perpendicular to the axis of rotation, under the action of the compensation element and the medium pressure sealing means to prevent fluid leakage, also known as seal. It is a fluid machinery and power machinery indispensable components [4]. Mechanical seals has experienced a hundred years of research and development, has formed a small amount of leakage, reliable performance, long life cycle and low power consumption characteristics, it is widely used in the reactor, compressors, centrifugal pumps and other equipment and industrial production in. According to relevant statistics, foreign chemical industrial processes, mechanical seal rotating machinery and equipment accounted for 95%, and its purpose is to prevent the axis of rotation between the body and the fluid media leaks [5]. In view of the mechanical seal technology, its scope is constantly expanding, at present, the nuclear industry and aerospace and other industries have been successfully applied mechanical seal technology.

Mechanical seal patented technology first appeared in the late 18th century, it came to be applied to the bearing seal. Early 19th century, mechanical manufacturing relatively simple mechanical seal appeared. With the development of the oil industry in 1913 with the double mechanical seal patent, in 1919 there has been a single mechanical seal patent [6]. During World War II, due to the need of military production, chemical pump mechanical seal has been applied . After World War II, mechanical seals rapidly growing popularity in the US chemical industry, the 1840s and 1950s Britain and France and other European countries began widely used mechanical seal. During this period, due to the friction material has been greatly improved, such as graphite, ceramics and other materials applied to the mechanical seal. In 1975, the United States designed to produce welded metal bellows mechanical seal and put it to use in the aerospace field. Mechanical seal technology in China started late, but the development of faster the late 1950s the introduction and use of mechanical seal technology, development and production of its own later, the last century the late 1990s, China's medium-sized series of pump mechanical seal has been designed The basic catch of similar foreign products [7].

With the improvement of material and processing technology, and now, the mechanical seal has been widely used in petroleum, chemical, metallurgy, machinery, aerospace and atomic energy and other industrial equipment. The mechanical seal from the initial development of a single multi-way seal type, now more research is non-contacting mechanical seal, the trend study has two main directions: First, the basis of theoretical and experimental study of the mechanical seal to expand in depth, di mechanical seal application technology research, and in particular for the mechanical seal failure analysis [8].

III. COMMON CONTACTLESS ROTARY JOINT

The first is DQTT type, graphite is used as stanch element, its structure diagram shown in Figure 2. This is on the market a relatively mature product, but the rotary joint has a big disadvantage, as is the use of the spring as a pressure stanch element, therefore, as the pressure increases, when in the face of pressure operating pressure exceeds the maximum stress in the spring when the leak. Further material graphite sealing element subject to wear, as time increases, wear increases, and the compression spring as the length becomes longer, more and more small deformation, pressure is also getting smaller and smaller, so the maximum useful life of such joint only half a year, sometimes two to three months to begin to leak [9]. The second way is the most used form was rotary joint, the structure diagram shown in Figure 3. This rotary joint depends mainly on both sides of the rubber ring seal head to achieve, but prolonged use, wear rubber will soon appear leakage. However, due to its low cost, simple structure, the country is still a large number of applications. Are two ways of fitting contact stanch its fatal weakness is the low life, unstable. Since the sealing mechanical seal face contact exists friction, wear, power consumption and heat than the larger, so in the case of high speed, high pressure, and its use has been limited [10].

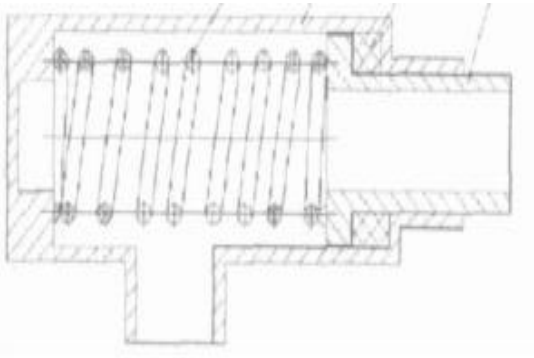

Fig.2 Rotary joint of DQTT

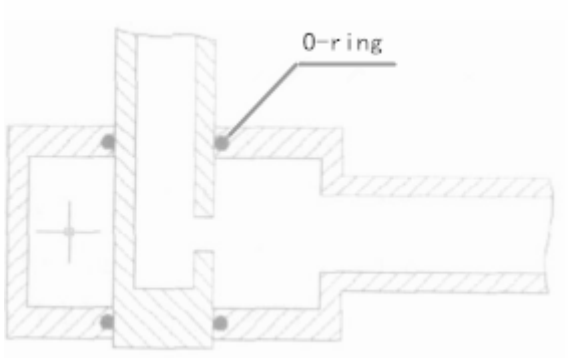

Fig.3 O-ring

IV. Non-contact rotary joint

4.1 Non-contact seal Theory

At present, the research and application of non-contact mechanical seal Dry Gas Seal is common. The mid-1980s, Etsion Israel first proposed the non-contact zero leakage mechanical seal concept, which for the mechanical seal can not reach the traditional concept of zero leakage is a new breakthrough [11]. Shortly thereafter, the United States A.Lipschitz in this proposed based on zero leakage seal film concept and invented the radial straight blade slot zero leakage mechanical seal [12]. 1993, USA T. Lai et successfully developed a non-contact without leakage spiral groove seal, and a year later published the sealing structure of the article, the paper introduces the herringbone groove, Y-shaped groove, and other shapes flow channel structure, and these flow grooves compared with each other [13]. The early 21st century, China's wood Ming He summarizes the flow upstream pumping mechanical seal groove structure, and detailed analysis of the concept of zero and zero leakage to escape [14].

Non-contact seal is produced by the pressure difference in a sealing fluid to achieve the purpose of sealing and to allow minimal amount of leakage through a gap, without affecting the system's rotational movement of the moving member. Non-contact seal can effectively maintain the pressure within the system and outside the system between the poor atmospheres, the pressure seal leakage of fluid through the throttling effect of the formation. Seal and friction between the moving parts do not exist in the non-contact seal, so there is no wear. The seal design has a simple structure, durable, reliable operation characteristics, and require little maintenance. In order to achieve the exact flow restrictor, requiring a minimum flow, so take non-contact seal system can not be achieved completely fluid leak (except ferrofluid seal), must allow a certain amount of leakage, but in the design due minus a small amount of leakage [9].

4.2 Seal gap theory

Gap seals seal mechanism is set in advance a small annular gap between the active surface of the fixing member and the moving parts of the fluid through the system at the time of this annular gap, due to the throttling effect and reduce leakage. Narrow passage of fluid formed an effective constraint, and because of the fluid viscous friction caused by large pressure drop, and produces a very high speed. Seal friction is kinetic works by viscous fluid consumption. The flow of fluid in the gap impedance flow rule as follow.

A non-contact gap seal rotary joint specific forms shown in Fig. 4, its working principle is: the oil medium into the channel, and full of floating ring gap between the shell to form the outer surface of the floating ring pointing the center of the radial pressure, while oil is not out to seal the leaking seals; floating in between the ring and the rotor design can produce a film seal small gaps, the oil medium during operation of the rotary joint will penetrate the gap and produce bearing oil film, thereby forming on the inner surface of the floating ring away from the center of the radial pressure. Floating ring under internal pressure and seals the outer surface of the elastic film supporting role in the balance of power, the balance of power in the rotor oil film force and unbalanced force, floating ring by dynamically adjusting the rotor seal film pressure and support force to maintain concentricity and the media were not compromised seal film, shown in Fig. 5 [15].

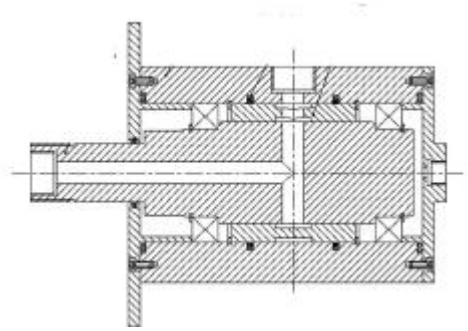

Fig.4 A non-contact gap seal rotary joint

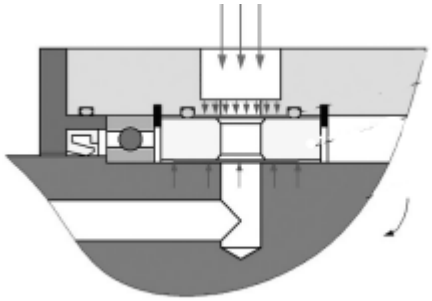

Fig.5 Seal ring

The existing non-contacting mechanical seal technology is the use of a fluid film to achieve, even though it can effectively reduce friction and wear, but there are two problems: one can not take the initiative to adjust the gap between the seal faces; because the sealing system and the interference from the outside world such as: axial movement, face wear, pressure fluctuations, as a result of improper operation conditions fluctuations, the inability to seal clearance active control, sealing stability may be affected. Second, the stability of the fluid film between the sealing gap size and the end is heavily dependent on plant conditions and media conditions, particularly unit speed; the higher the relative speed of the sealing surface is conducive to greater fluid film bearing capacity and stiffness, but given speed units often can not be changed or can only be varied within a certain range, which greatly limits the high-performance end surface of the fluid film is formed, resulting in performance and scope of the mechanical seal is restricted, such as reactor and other low-speed devices If speed

is too low, between opening force and stiffness of the fluid film is too small, it can not properly seal face separation, leading to seal failure.

Non-contact connector is the trend, but there is still not enough, so the new non-contact seals used in rotary joint urgent manner, non-contact magnetic seal is developed on the next quest. Iron magnetic seal can effectively improve the system fluid leak.

V. CONCLUSION

Hydraulic, hydraulic, pneumatic system with a rotary joint with the development of the national economy, a substantial increase in machinery and equipment and improve industrial automation level, gradually expanding the scope of application, applications require higher and higher. Especially high-performance hydraulic system, hydraulic pneumatic machinery and equipment on the quality of the rotary joint requires a higher [1]. Faced with this embarrassing situation market need for next-generation rotary joint development of ideas is a modern product design simulation, virtual technology applications under achieve green manufacturing exquisite appearance, light weight, standardization, modularity, compact size and other characteristics of the new structure to meet the high reliability seal products under working conditions, high stability, strong follow capability, long life and other high-quality, low-cost competition in the market needs. To be more efficient and more non-contact rotary seal introduced rotary joint (such as a magnetic non-contact seal), thus the future of the rotary joint design and determine the key parameters derived with more guiding significance conclusion, let zero leakage and zero Plaza a [16] the concept of reality as soon as possible, so that the rotary joint in various fields to develop more efficient.

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