

Twin Seal Orbit Plug Valve, Double Seal Plug Valve, General Valve (reduced bore)

双密封轨道式旋塞阀、双密封旋塞阀、将军阀（缩径）

型号/Model:GDX43X



用途/Applications

双密封导轨阀门适用于：航空煤油、原油、轻质油、天然气、液化气、管道煤气、化工介质等管道上，作为截断介质的理想装置。

The double seal rail valve is applicable as an ideal device for cutting off media in pipelines of aviation kerosene, crude oil, light oil, natural gases, liquefied petroleum gases, pipeline coal gases, chemical media, etc.

特点/Characteristics

- 1、阀门在开关过程中，阀体密封面与滑片密封面没有任何接触，因此，密封面无摩擦、磨损、阀门的使用寿命长，开关力矩小；
- 2、阀门在维修时，不需将阀门从管线上拆下，只需将阀门底盖拆开，调换一对滑片即可，维修十分方便；
- 3、阀体及旋塞为全通径，介质在通过阀门时无流阻，并且可通过对管道进行清洗，克服了缩径阀门的缺点；
- 4、阀体内腔镀有硬铬，密封区域坚硬光滑；
- 5、滑片上的弹性密封采用氟橡胶，并且模压成型在滑片表面沟槽中。具有防火功能的金属对金属的密封作为弹性密封的背衬；
- 6、阀门具有自动泄放装置(备选)，在阀门完全关闭后，防止阀腔异常升压并检验阀门的效果；
- 7、阀门开关指示器与开关位置同步，可以准确显示阀门的开关状态。

1. In the valve's opening/closing process, there is no contact between the sealing surfaces of the valve body and the vane, so the sealing surfaces suffer neither friction nor wear, contributing to the valve's long service life and small opening/closing torque;
2. For the valve's maintenance, there is no need to remove the valve from the pipeline but just remove its bottom cover to replace the vane pair, thus very easy for the maintenance;
3. The valve's body and plug are full-bore so that the medium can flow through the valve without any flow resistance, and it's also possible to clean the pipeline to overcome the shortcomings of the reduced bore valve;
4. The valve's cavity is plated with hard chrome and the sealing area is hard and smooth;
5. The elastic seal on the vane is made of the fluorine rubber and molded and formed in a groove of the vane surface. The fireproof metal-to-metal seal is used as the backing of the elastic seal;
6. The valve is provided with an automatic bleed device (optional) which can prevent the abnormal pressure rise of the valve cavity and check the valve's effect after the valve is completely closed;
7. The valve's opening/closing indicator is in sync with the opening/closing position and can accurately display the valve's opening/closing status.

编制规范说明/Description of specifications

阀门的设计与制造按API6D规定；
 法兰连接尺寸按ANSI B16.5、JB79、HG20592、GB/T9113的规定；
 阀门的结构长度按ANSIB16.10及GB12221-89、JB/T5298的规定；
 阀门的检查与试验按API 598及API 6D的规定；

The valve is designed and manufactured as per API6D；
 The flange connection size is as per ANSI B16.5, JB79, HG20592 and GB/T9113；
 The valve's structural length is as per ANSIB16.10, GB12221-89 and JB/T5298；
 The valve is checked and tested as per API 598 and API 6D.

压力试验/Pressure test

压力级	Pressure class	150Lb	1.6MPa	300Lb	25MPa	600Lb	40	900Lb	64
强度试验	Strength test	3.0MPa	2.4MPa	7.5MPa	3.75MPa	15.0MPa	6.0MPa	22.5MPa	9.6MPa
高压密封试验	High pressure seal test	2.2MPa	1.76MPa	5.5MPa	2.75MPa	11.0MPa	4.4MPa	17.5MPa	7.0MPa
低压密封试验	Low pressure seal test	0.6MPa	0.6MPa	0.6MPa	0.6MPa	0.6MPa	0.6MPa	0.6MPa	0.6MPa

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双密封导轨阀的功能及适用性分析（缩径）/Functions and Applicability Analysis of Double Seal Rail Valve (Reduced Bore)

工作原理/Working Principle

双关断阀及泄放功能阀门的工作原理关键是安装在旋塞上的两片密封滑片的动作。

The action of two sealing vanes mounted on the cock is the key to the working principle of the double block and bleed valve.

阀门关闭/Close the valve

阀门关闭时，先旋转手轮，将旋塞及密封滑片旋转90°，然后旋塞向下移动，随着旋塞的运动时推动密封滑片向阀体内腔封面直至弹性密封圈被均匀的挤压到阀孔上下端，形成密封。

To close the valve, first rotate the handwheel to rotate the cock and the sealing vanes by 90°; then the cock will move downwards; the moving cock drives the sealing vanes to the sealing surfaces of the valve cavity until the elastic gasket ring is uniformly pressed to the upper and lower ends of the valve bore to achieve sealing.

阀门开启/Open the valve

阀门开启时，先旋转手轮提升旋塞，将密封滑片从阀体两侧密封面拉回。当滑片完全收回脱离阀体密封面后，继续转动手轮，使旋塞及密封滑片旋转90°，阀门处于开启位置。

To open the valve, first rotate the handwheel to lift the cock to pull back the sealing vanes from the sealing surfaces on both sides of the valve body. When the vanes are completely withdrawn and disengaged from the sealing surfaces of the valve body, continue to rotate the handwheel so as to make the cock and the sealing vanes rotate by 90°, and the valve will be on the open position.

关于密封/About sealing

弹性密封圈是模式压成型在滑片的沟槽中，随着密封滑片向阀门的进出口移动，密封圈子也逐渐被压入沟槽中，经过机械加工的滑片表面与阀体内腔形成二级金属对金属密封防止弹性密封圈子继续被压，并且具有防火功能。

The elastic gasket ring is molded and formed in the groove of the vanes, and as the sealing vanes move to the valve's inlet and outlet, the gasket ring is also gradually pressed into the groove. The machined vane surface forms a secondary metal-to-metal seal with the valve cavity which can prevent the elastic gasket ring from being further pressed and also have a fireproof function.

双关双断阀及泄放/Double block and bleed valve

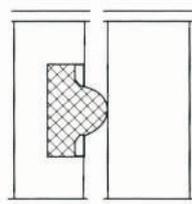
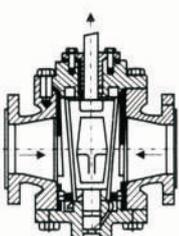
这是一种通过两个切断阀和一个在中间的泄入阀达到完全隔断两端管线目的的方式——关闭两主要阀门，关开启泄放阀可提高被系统的安全性。如果第一个阀门泄漏，泄漏的介质可由开启的泄放阀导出。

This is a way to achieve complete containment of both ends of the pipeline with two block valves and one bleed valve in between. When the two main valves are closed, closing/opening the bleed valve can improve the system's safety. If the first valve leaks, the leaked medium can be led out by the opened bleed valve.

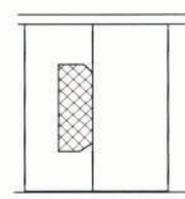
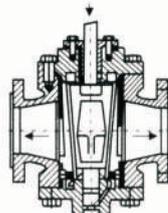
双密封方式/Double sealing mode

两个独立的密封滑片在阀孔-上下端压紧（双关断），当阀门关闭时，泄放阀被打开，检验密封效果（泄放）。

The two separate sealing vanes are compressed on upper and lower ends of the valve bore (double block), and when the valve is closed, the bleed valve will be opened to check the sealing effect (bleed).



弹性密封圈
被压缩之后
After the elastic
gasket ring is
compressed



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一、双密封导轨阀的结构/Structure of Double Seal Rail Valve

双密封导轨阀的基本结构主要由以下两部分组成（见图1）

介绍一种——双密封导轨阀的结构及工作原理，该阀的密封性能和使用寿命优于普通的闸阀和球阀。具备防火、在线维修、双关断及泄放、中腔泄压、内检漏等功能，结合实例说明了双密封导轨阀在油气储运系统的功能及应用，开辟了油气储运系统的工艺设计新的发展空间，解决了管道设计中遇到的很多问题，既优化了管道设计，提高了产品质量，又节约了管道运营成本。

The basic structure of the double seal rail valve mainly consists of the following two parts (see Fig. 1)

Introduce a double seal rail valve's structure and working principle. The valve is superior to common gate and ball valves in terms of its sealing performance and service life. The valve has the functions of being fireproof, on-line maintenance, double block and bleed, cavity pressure relief, internal leak detection and others. Illustrate the double seal rail valve's functions and applications in the oil and gas storage and transportation systems in combination with examples, which has opened new development potential for process design of oil and gas storage and transportation systems and solved many problems encountered in pipeline design. It has not only optimized the pipeline design and improved the product quality but also saved the pipeline operation costs.

1. 阀体/Valve body

阀体的主要零部件有阀体、阀芯、阀瓣（嵌主密封圈）、端盖、底盘、填料等。阀芯与阀瓣是阀体部分的核心。阀芯通过上、下耳轴固定于阀体内，中间为流道口，两侧为斜楔面，在该楔面上铣有燕尾导轨同左右两片阀瓣相连。阀瓣是主密封件，阀瓣的表面为圆柱面，可达到B级硬密封精度，在该圆柱面上铣有一圈棱形槽，采用模压硫化的方法在其中永久嵌有主密封圈（氟化橡胶或丁腈橡胶等），当阀门关闭时可形成硬密封。

The valve body includes such main parts as body, spool, discs (embedded with main gasket ring), end caps, chassis, packing, etc. The spool and the discs are the core of the body part. The spool is fixed inside the body with upper and lower trunnions. With the flow channel mouth in the middle and the wedge faces on both sides. The wedge faces are milled with dovetail guide which is connected to two discs on both sides. The discs are the main sealing element and have cylindrical surfaces, which can reach a precision up to the B class hard seal. The cylindrical surfaces are milled with a prismatic groove, into which a main gasket ring (fluorinated rubber or nitrile rubber, etc.) is permanently embedded with the molding vulcanization method, contributing to hard and soft sealing when the valve is closed.

2. 操纵器/Manipulator

操纵器的主要由指示标记牌、手轮、主轴、轴套、球头销，支架等组成，固定在端盖上、通过连接销与阀芯杆相连。操纵器部分是动作的执行机构，当阀门由开启→关闭时，按顺时针转动手轮，阀芯先作90°旋转运动，带动阀瓣转到阀体流道口位置，然后阀芯作向下直线移动，驱动阀瓣径向扩张，向阀体内壁贴近，直到软密封被压入凹槽，使阀瓣表面与阀体内壁接触，完成关闭过程。

当阀门由于关闭开启时，按逆时针转动手轮，阀芯先作向上直线移动，到一定位置后作90°旋转运动使阀门处于导通状态。

当阀门处于关闭状态时，阀体上、下游流道口均被阀瓣密封，即双密封，同时每个阀瓣的密封面又能形成软、硬两种密封，确保了阀门的零泄漏。当阀瓣旋转时，软密封与阀体不接触，无摩擦，硬密封对软密封可起到保护作用，并具有防火功能。

从图1可以看出，阀芯与耳轴（阀杆）的结构是一体的，上、下耳轴与端盖、底盘的配合部位有滑动轴承(DN ≥ 500的双密封导轨阀采用滚动轴承)。

采用这种结构不仅可以减小摩擦阻力，而且便于实现精加工，以保证软密封的旋转间隙。另外，由于阀芯整体性结构以及滑动轴承的存在，确保了阀瓣的密封免受介质压力的影响，即阀门关闭后两侧产生的压差不影响阀门的密封性，这与普通的球阀和闸阀靠压差来实现密封有所不同。

The manipulator mainly consists of indication sign, handwheel, main shaft, bushing, ball pin, bracket and other components, and is fixed on the end cap and connected to the spool bar with a connecting pin. The manipulator part is an actuator for actions. To close the valve from the open position, turn the handwheel clockwise, and the spool will rotate by 90° first to drive the disc to turn to the position of the flow channel mouth of the valve body. Then the spool will move straight downwards to drive the disc to expand radially and get close to the inner wall of the valve body until the soft seal is pressed into the groove so that the disc surface contacts the inner wall of the valve body to complete the closing process.

To open the valve from the closed position, turn the handwheel counterclockwise, and the spool will move straight upwards first, and after it reaches to a certain position, it will rotate by 90° so that the valve can be in a conducting state.

When the valve is in the closed state, both upper and lower flow channel mouths of the valve body are sealed with discs, namely double seal, and meanwhile two kinds of sealing, soft and hard, can come into being on the sealing surface of each disc, thus ensuring zero leakage of the valve. When the valve disc is rotating, the soft seal does not contact the valve body, contributing to zero friction, while the hard seal can protect the soft seal and also functions for fire prevention.

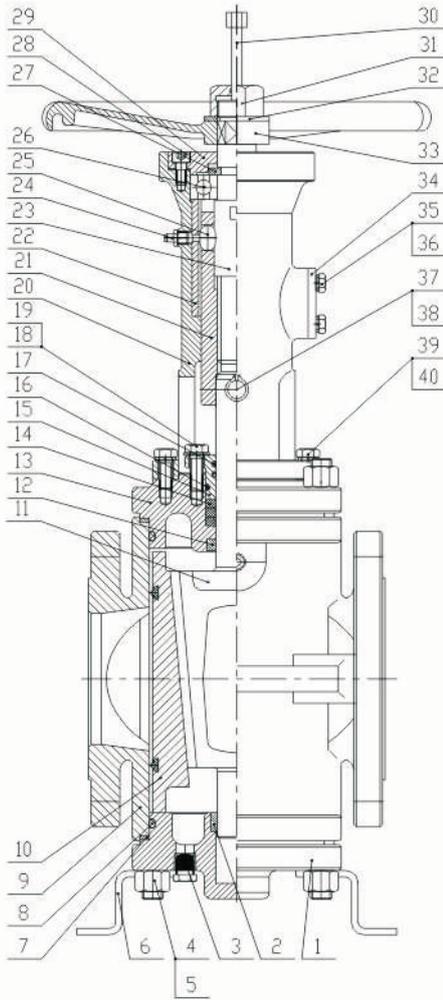
It can be seen from Fig. 1 that the spool and trunnion (stem) structure is integrated, and there are sliding bearings on fitting parts between upper and lower trunnions and the end cap and the chassis (rolling bears are used for those double seal rail valves with DN ≥ 500).

Such a structure can not only reduce the friction resistance but also facilitate precision machining to ensure the soft seal's rotation clearance. In addition, the integrated structure of the spool and the presence of the sliding bearings ensure to protect the disc seal from the impact of the medium pressure, that is, the pressure difference generated from both sides after the valve is closed has no impact on the valve's sealing performance, which is different from the common ball and gate valves which rely on the pressure difference for sealing.

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主要零部件材料/Materials for main parts

部件号 Part No.	名称 Name	材料 Material
1	底盖 Bottom cover	A216 WCB
2	轴套 Bushing	C28000
3	排污阀 Blowdown valve	SS304
4	螺柱 Stud	A193 B7
5	螺母 Nut	A194 2H
6	支撑脚 Supporting foot	Q235A
7	缠绕垫片 Spiral wound gasket	SS304+Graphite
8	O型圈 O-ring	Viton
9	阀体 Valve body	A216 WCB
10	滑片 Vane	QT500-7+Viton
11	旋塞 Cock	A216 WCB
12	轴套 Bushing	C28000
13	阀盖 Bonnet	A216 WCB
14	填料 Packing	Flexible graphite
15	填料压盖 Packing gland	A216 WCB
16	O型圈 O-ring	Viton
17	O型圈 O-ring	Viton
18	外六角螺栓 Hex bolt	8.8
19	平垫圈 Flat gasket	A3
20	支架 Bracket	A216 WCB
21	传动套 Drive sleeve	QT500-7
22	定位套 Locating sleeve	1045
23	传动轴 Drive shaft	A182 F6a
24	油杯 Oil cup	M10X1
25	滚动销 Rolling pin	T10
26	深沟球轴承 Deep groove ball bearing	GCr15
27	对开圆环 Split circular ring	A276 410
28	内六角螺钉 Hex socket head cap screw	8.8
29	轴承压盖 Bearing gland	Q235A
30	指示杆 Indicator rod	Q235A
31	压套螺母 Gland nut	1035
32	碟形弹簧 Disc spring	65Mn
33	手轮 Handwheel	QT400-18
34	导向销 Guide pin	A276 410
35	外六角螺栓 Hex bolt	8.8
36	弹垫 Spring washer	65Mn
37	销轴 pin shaft	A276 410
38	挡圈 check ring	65Mn
39	外六角螺栓 Hex bolt	8.8
40	弹垫 Spring washer	65Mn

二、双密封导轨阀的功能/Functions of Double Seal Rail Valve

1. 防火功能及密封性/Fireproof function and sealing performance

油气储运系统中的介质均为易燃、易爆品。防火是油气储运装置在设计和选用时重点关注的问题，其装置不仅要求密封性要好，而且在现场发生火灾的情况下还具备一定的密封性能。

双密封导轨阀的密封形式均采用软、硬密封结合，其中包括阀瓣及端盖、底盘等结构。软密封可以保证在正常运行状态下零泄漏，当现场发生火灾时，软密封有可能遭到破坏，这时硬密封将起主密封作用，可防止介质大量泄漏。相比较而言，闸阀采用硬密封，防火功能较好，但密封性能不容易得到保证，长期使用难以保证零泄漏；球阀采用软密封，其使用寿命较长，但不具备防火功能。

The media in oil and gas storage and transportation systems are all flammable and explosive. Being fire-proof is a key focus in designing and selecting an oil and gas storage and transportation unit which should not only have a good sealing performance but also can have a certain sealing performance even when there is fire on the site.

The double seal rail valve all adopts a soft-hard sealing mode, including discs, end caps, chassis and other structures. The soft seal can ensure zero leakage in the normal working state, but when there is fire on the site, the soft seal may be destroyed, thus the hard seal will function as a primary seal to prevent massive leakage of the medium. Instead, the gate valve has an unreliable sealing performance and it's difficult to ensure zero leakage during long-term service though it has a good fireproof function with its hard seal; and the ball valve, with its soft seal, has a long service life, but it's not fireproof.

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2.具有在线维修功能/It has an online maintenance function

当阀瓣上软密封因某种原因受损造成内漏或操纵器（执行机构）出现故障时，不必将阀门从管道上拆下便可进行更换或维修，操纵器的维修也可在管道不停压的状态下进行。而闸阀或球阀密封部分受损时，必须将阀门从管道上拆下才能进行维修或更换，甚至直接将阀门报废。

When the soft seal on the disc is damaged for a certain reason, resulting in internal leakage or manipulator (actuator) malfunction, it's not necessary to remove the valve from the pipeline for replacement or maintenance; instead, the manipulator's maintenance can also be done when the pipeline pressure is not stopped. However, the gate valve or ball valve must be removed from the pipeline for maintenance or replacement and even the valve may be just scrapped.

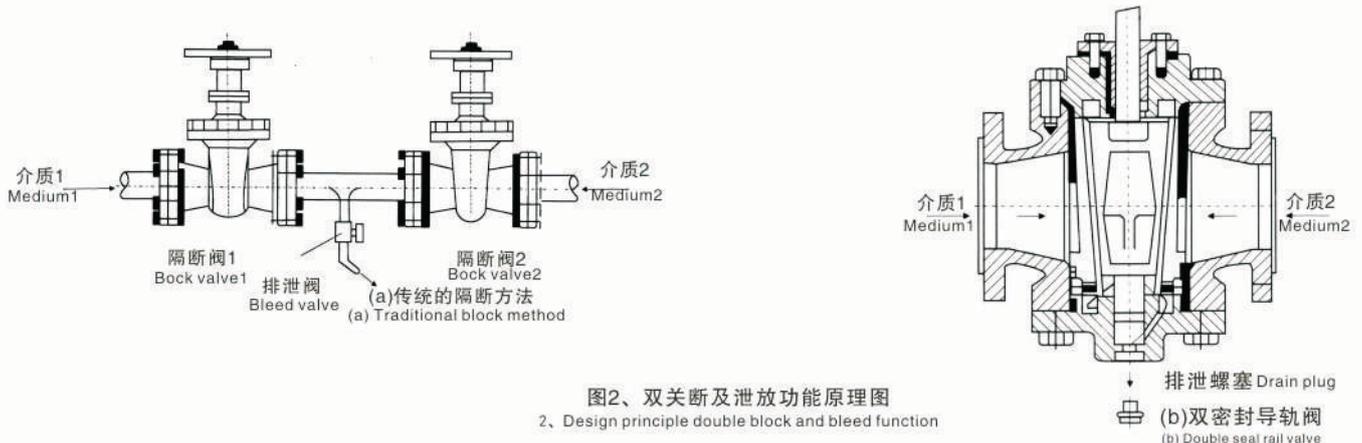
3.具有双关断及泄放功能/It has a double block and bleed function

如图2(a)所示，采用两个隔断阀（闸阀或球阀）来隔断介质，并在这两个隔断阀之间安装一排泄阀，当隔断阀发生内漏，所泄漏的介质将通过排泄阀排出，这样就不会造成两种介质的掺混。

若采用双密封导轨阀，仅需一个阀就可实现上述功能(见图2(b))，双密封导轨阀的底部有一排泄螺塞，当阀门关闭后，可取出该螺塞。若有一侧阀瓣产生内漏，则漏出的介质通过螺塞孔排出，从而避免两种介质掺混现象的发生。当输送介质较脏时，可定期通过排泄螺塞将沉淀物排出；当管道需要检修时，可通过排泄螺塞排出残存在低处的介质。在冬季，可通过排泄螺塞排出内腔积水，以防冻坏阀门。

As shown in Fig. 2(a), two block valves (gate or ball valve) are used to block the medium, and a bleed valve is mounted between the two block valves. When the block valves have any internal leakage, the leaked medium will be bled through the bleed valve, thus the two media will not be mixed.

If the double seal rail valve is used, only one valve can achieve the above functions (see Fig. 2(b)). There is a drain plug at the bottom of the double seal rail valve. After the valve is closed, this plug can be removed. If internal leakage occurs on one disc side, the leaked medium can be bled through the plug hole, thus avoiding mixing of the two media. When the working medium is dirty, the sediment can be bled through the drain plug on a regular basis; when the pipeline needs to be overhauled, the medium residual in the lower part can be bled with the drain plug. In winter the accumulated water in the cavity can be bled with the drain plug to prevent the valve from being frozen and destroyed.



4.具有中腔泄压功能/It has a cavity pressure relief function

API 6D规范规定“对于所有双密封的阀门，当在液体介质中使用，必须具有压差泄放功能”，泄放的压差是因环境温度的变化产生的。在关闭状态下，双密封阀门中腔压力会因温度升高而快速增加，该压差如不及时泄放，对阀门的操作将产生严重影响。

手动操作的双密封导轨阀通常有以下两种泄压系统。

It's stipulated in API 6D: "All valves with double seal must has a pressure difference relief function when used in a liquid medium". The relief pressure difference is generated from the changes in the ambient temperature. In the normally-closed state, the cavity pressure of the valve with double seal can increase rapidly due to the temperature rise, and if such a pressure difference is not bled promptly, it can have a serious impact on the valve's operation.

Generally, the double seal rail valve with manual operation has the following two pressure relief systems

Twin Seal Orbit Plug Valve, Double Seal Plug Valve, General Valve (reduced bore)

双密封轨道式旋塞阀、双密封旋塞阀、将军阀（缩径）

型号/Model:GDX43X

(1)手动泄压系统：手动泄压系统通常为—安装在端盖上的针形阀（见图1）。当介质为可以少量向大气中排泄的液体时，可以配备此种泄压系统。

(2)差热式泄压系统：差热式泄压系统是一种带有单向阀的管路系统（见图3）。图3中针形阀1三通1、单向阀1、三通2和针形阀3构成了差热式泄压系统。在该系统中，针形阀1常闭、针形阀3常开。当介质为不可以向大气中排泄的液体时，需配备此种泄压系统（一般是向上游管道中泄压）。

(1) Manual pressure relief system: The manual pressure relief system is generally a needle valve mounted on the end cap (see Fig. 1). When the medium is a liquid which can be slightly bled into the atmosphere, it can be equipped with such a pressure relief system.

(2) Differential thermal pressure relief system: The differential thermal pressure relief system is a pipeline system with a one-way valve (see Fig. 3). In Fig. 3, the needle valve 1, the tee 1, the one-way valve 1, the tee 2 and the needle valve 3 make up the differential thermal pressure relief system. In the system, the needle valve 1 is normally-closed and the needle valve 3 is normally-open. When the medium is a liquid which cannot be bled into the atmosphere, it shall be equipped with such a pressure relief system (generally pressure relief to the upstream pipeline).

5.具有检验内漏功能/It has an internal leakage detection function

当普通阀门处于关闭状态时，其密封效果的检测比较困难，而双密封导轨阀的检测则很容易，只要在关闭状态下打开泄压系统与端盖相连的针形阀即可，阀瓣若有内漏，介质就会通过针形阀流出。若介质不便于向大气排放，则可在针形阀上接—压力表，通过观察表压的变化来判断有无内漏。

When a common valve is closed, it's difficult to detect its sealing effect, while it's easy to detect the double seal rail valve, just by mean of opening the needle valve connecting the pressure relief system to the end cap in the closed state. If the disc has any internal leakage, the medium will flow through the needle valve. If it's not convenient to discharge the medium into the atmosphere, a pressure gauge can be mounted on the needle valve to judge whether there is any internal leakage by means of observing the gauge pressure changes.

6.独特的管道减压功能/Unique pipeline pressure reduction function

管道减压是储罐区管汇设计中需要重点考虑的问题，即当罐前阀关闭后，管网中仍然充满了介质；随着环境温度的升高，管网中介质的压力会迅速增大；当温差变化较大时，增加的压力会超过管道的承受能力，容易造成管道泄漏。因此，管道应配备减压设备。

管道减压设计如图4(a)所示，在主切断阀的上，下游之间连接管道减压系统，该系统由两个切断阀（闸阀、球阀或截止阀）及这两个切断阀之间的一个减压阀组成。该套系统成本高，而且占用空间，不方便现场管理。

主切断阀选用双密封导轨阀的管道设计原理如图4(b)所示，减压系统附在主切断阀上，其设计结构简单，占用空间小，且成本低廉。

Pipeline pressure reduction is a key consideration in the design of manifolds in the storage tank area, that is, the pipe network is still full of the medium even after the valve before the tank is closed; as the ambient temperature rises, the pressure of the medium in the pipe network will increase rapidly; when the temperature difference fluctuations are substantial, the increased pressure will exceed the pipe's withstanding ability, which may easily lead to pipeline leakage. Therefore, the pipeline should be equipped with a pressure reduction device.

The pipeline pressure reduction design is as shown in Fig. 4 (a): a pipeline pressure reduction system is connected between upper and lower reaches of the main block valve, and this system consists of two block valves (gate, ball or globe valve) and a pressure reduction valve between the two block valves. The system is costly and takes up too much room, not easy for site management.

The main block valve adopts the pipeline design principle of the double seal rail valve, as shown in Fig. 4(b), and the pressure reduction system is attached to the main block valve, with a simple design structure and being space-effective and low-cost.

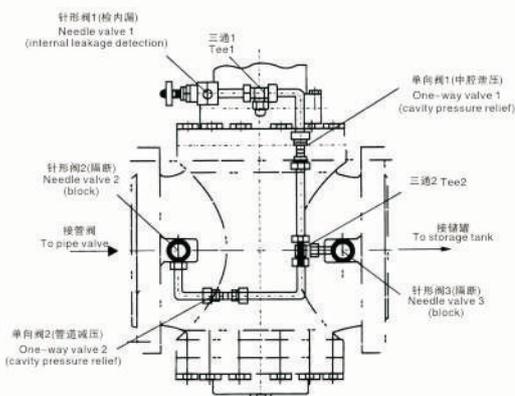


图3 差热式泄压及管道减压综合图

Fig. 3 General View of Differential Thermal Pressure Relief and Pipeline Pressure Reduction

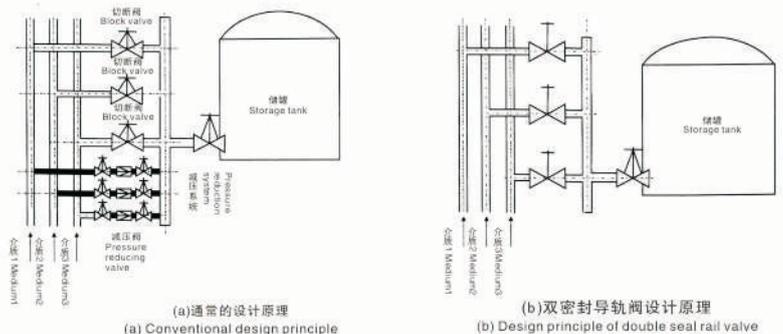


图4 管道减压原理图 Fig. 4 Schematic Diagram of Pipeline Pressure Reduction