前言

GC 系列船用齿轮箱包括 GCS 和 GCH 两种传动型式，是本公司在从原西德罗曼—斯托尔福特公司引进许可证生产的 GC 系列产品的基础上采用先进的最优化模件设计而成的。其中 GCS 型是垂直偏置，GCH 型是水平偏置，两种型号均可加装辅助功率输出轴（PTO）。

GC 系列齿轮箱按中心距可分为 14 种型号，广泛用于电力推进船舶、豪华邮轮、运输船、公务船、滚装船、散货船等，具有体积小、重量轻、传动效率高、寿命长、操作维护方便等特点。

GC 系列齿轮箱传扭能力范围大，当齿轮箱速比从 2 至 4.5，输入转速从 220r/min 至 1000r/min 时，其传扭能力可从 1kW/r/min 至 30.8kW/r/min。（齿轮箱传扭能力的确切数值由中心距和减速比决定）

Preface

The GC series marine gearboxes, comprising two transmission types—GCS and GCH—are developed by our company using advanced modular optimization design. These designs are based on the GC series products originally licensed from the former West German company Lohmann & Stolterfoht. The GCS type features a vertical offset configuration, while the GCH type employs a horizontal offset. Both models can be equipped with an auxiliary Power Take-Off (PTO) shaft.

The GC series gearboxes are available in 14 models categorized by center distance. They are widely used in various vessels, including electric propulsion ships, luxury cruise liners, transport ships, official vessels, Ro-Ro ships, and bulk carriers. These gearboxes are characterized by their compact size, light weight, high transmission efficiency, long service life, and ease of operation and maintenance.

The GC series offers a broad range of torque transmission capacities. With gear ratios ranging from 2 to 4.5 and input speeds between 220 r/min and 1000 r/min, the torque transmission capacity spans from 1 kW/(r/min) to 30.8 kW/(r/min). (The specific torque transmission capacity of a gearbox is determined by its center distance and reduction ratio)

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主机旋转方向（面对飞轮向前看）

船级社

船厂

船号

1.2 齿轮箱参数

产品编号

型号和规格：GC

齿轮箱速比：i=

冷却水量：V=m^3/h（立方米/小时）

冷却水入口温度：t≤32℃

重量（公斤）：G=kg（公斤）

润滑油容量（升）：L=L（升）

润滑油类型：CD30，CD40

1. List of Technical Data

1.1 General Parameters

Engine Manufacturer

Engine Model

Rated Engine Output (kW)

Gearbox Input Speed (r/min)

Engine Rotation Direction (as viewed from the flywheel side)

Classification Society

Shipyard

Hull Number

1.2 Gearbox Parameters

Serial No.

Model & Specification: GC

Gear Ratio: i =

Cooling Water Flow: V = m^3 /h;

Cooling Water Inlet Temperature: t ≤ 32° C

Weight: G = kg

Lubricating Oil Capacity: L = L

Lubricating Oil Type: CD30, CD40

2. 齿轮箱简介

GC 系列船用齿轮箱是采用表面硬化、磨齿的单斜齿齿轮的单级减速装置，有左、右机之分，通常左右机对称布置，GCS 和 GCH 系列齿轮箱布置型式分别如下图 1 与图 2 所示。

2. Gearbox Introduction

The GC series marine gearbox is a single-reduction unit utilizing case-hardened, ground, single-helical gears. It is produced in both clockwise and counter-clockwise rotation versions, typically arranged symmetrically for port and starboard engines. The arrangement diagrams for the GCS and GCH series gearboxes are shown in Figure 1 and Figure 2 respectively.

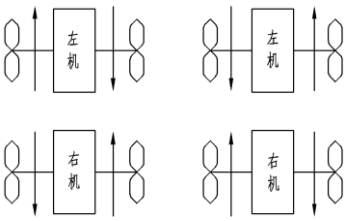


图 1 GCS 系列齿轮箱机舱布置型式图

Figure 1: Engine Room Arrangement Diagram for GCS Series Gearbox

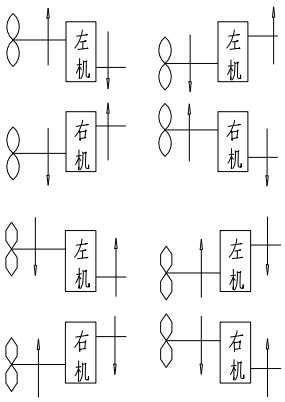


图 2 GCH 系列齿轮箱机舱布置型式图

Figure 2: Engine Room Arrangement Diagram for GCH Series Gearbox

GC 系列船用齿轮箱有 2 个系列，分别为 GCS 和 GCH，其结构特征列述如下：

GCS 型：

1 级减速，输入和输出为垂直异心，运转方向相反，无离合器；输出垂直方向上方可以带辅助功率输出（PTO）。

GCH 型：

1 级减速，输入和输出为水平异心，运转方向相反，无离合器；输出水平异侧可以带辅助功率输出（PTO）。GCS

The GC series marine gearbox comprises two main series, GCS and GCH, whose structural characteristics are described below:

GCS Type:

Single-stage reduction; vertically offset input and output shafts; opposite rotation directions between input and output; no clutch; an auxiliary Power Take-Off (PTO) can be equipped on the top side of the vertical output direction.

GCH Type:

Single-stage reduction; horizontally offset input and output shafts; opposite rotation directions between input and output; no clutch; an auxiliary Power Take-Off (PTO) can be equipped on the opposite side of the horizontal output direction

箱体

该系列齿轮箱的箱体采用铸造箱体或用 Q235A 钢板焊接而成，在受力较大部位均设有加强筋，箱体在安装径向轴承和推力轴承处都作了特别处理。

减速比

根据不同要求，该系列齿轮箱速比为 2:1~4.5:1。如需更高的速比，请提出特别说明。

齿轮

输入及输出齿轮均为单斜齿，选用高级合金钢（17CrNiMo6 或 20CrMnMo）制成。用沉切大圆弧滚刀滚齿，齿面经渗碳淬火处理后在专用齿轮磨床上精磨加工。齿轮强度可满足 CCS、ABS、GL 等多家船级社的要求。

Gearbox Housing

The gearbox housing for this series is either cast or fabricated from 20-gauge steel plates. Reinforcing ribs are incorporated in areas subject to high stress. The sections of the housing that accommodate the radial and thrust bearings receive special treatment.

Reduction Ratio

The gear ratio for this series ranges from 2:1 to 4.5:1, adaptable to various requirements. For higher reduction ratios, a special request must be submitted.

Gears

Both the input and output gears are single-helical gears manufactured from high-grade alloy steel (17CrNiMo6 or 20CrMnMo). The teeth are cut using an undercut full-radius hob, followed by carburizing, quenching, and finally precision grinding on dedicated gear grinding machines. The gear strength complies with the requirements of major classification societies such as CCS, ABS, and GL.

轴和轴承

输入齿轮轴选用高级合金钢（20CrMnMo）制成，输出轴选用高级合金钢（42CrMoA）制成。

输入轴端有标准锥度用以安装输入法兰，输出法兰与输出轴整体锻造为一体。

轴由径向滚动轴承或滑动轴承支撑，中心距 560mm 以下的，采用滚动轴承；中心距在 600mm 及以上的，采用滑动轴承；螺旋桨推力由带斜面的自位扇形块组成的推力轴承承受。

供油系统

齿轮箱不需在船上另设油箱。为减少搅油损失，齿轮箱装有整体式防溅槽；齿轮箱设有备用泵进出油接口；在管路上有调节油压的溢流阀和预防油回流的单向阀。

Shafts and Bearings

The input pinion shaft is made from high-grade alloy steel (20CrMnMo), while the output shaft is manufactured from high-grade alloy steel (42CrMoA).

The input shaft end features a standard taper for mounting the input flange. The output flange is integrally forged with the output shaft.

The shafts are supported by either radial rolling element bearings or plain bearings. Models with a center distance below 560 mm utilize rolling element bearings, whereas those with a center distance of 600 mm and above employ plain bearings. Propeller thrust is absorbed by a thrust bearing composed of self-aligning segment pads with inclined surfaces.

Lubrication Oil Supply System

The gearbox does not require a separate oil tank onboard. To minimize churning losses, the gearbox is equipped with an integrated oil splash guard. It features inlet and outlet connections for a standby pump. The oil circuit includes a relief valve for pressure regulation and a check valve to prevent oil backflow.

油泵和润滑

齿轮箱一般情况下采用机带油泵和备用油泵配合使用，在齿轮箱开启前或机带油泵损坏后可用备用油泵。

油冷却器和过滤器

采用管壳式冷却器或板式冷却器，冷却器有足够的面积，以保证滑油能有效地冷却。冷却水压力≤0.2MPa，有淡水冷却和海水冷却之分。

油滤器采用 SPL 型双筒网片式油滤器或 SBL 型半自动清洗油滤器。滤器上可配置压差报警装置，当滤器前后压力差达到规定值时，报警装置报警。

管系

齿轮箱上配置的管系附件，如油泵、阀件、油冷却器、过滤器及内部管路均由无缝钢管相连通，自成闭式循环系统。外部冷却水管路的接口出厂时需密封，同时未安装在齿轮箱上的备用泵进出口接口也需密封，以便运输。

Oil Pumps and Lubrication

The gearbox typically operates using a combination of a gearbox-mounted pump and a standby pump. The standby pump can be used before starting the gearbox or in the event of a failure of the gearbox-mounted pump.

Oil Cooler and Filter

The system uses either a shell-and-tube cooler or a plate-type cooler. The cooler provides sufficient surface area to ensure effective lubrication oil cooling. The cooling water pressure should be ≤ 0.2 MPa, and systems are available for either freshwater or seawater cooling.

The oil filter is either an SPL type duplex strainer filter or an SBL type semi-automatic self-cleaning filter. A differential pressure alarm can be fitted to the filter. This alarm activates when the pressure differential across the filter reaches a preset value.

Piping System

The ancillary components mounted on the gearbox—such as oil pumps, valves, the oil cooler, filter, and internal piping—are interconnected via seamless steel tubes, forming a self-contained closed-loop system. The interfaces for the external cooling water pipes are sealed at the factory for shipment. Similarly, the inlet and outlet ports for the standby pump (if not mounted on the gearbox) are also sealed to facilitate transport.

3. 齿轮箱的交货条件

1. 齿轮箱在无油状态下交货。

2. 齿轮箱内部用防锈油保护。在常温条件下，油封有效期为 6 个月。齿轮箱壳体外表面涂漆，箱体外部的法兰、轴端及接合面涂防锈油。

3. 与外部相通的接头，均用盲板或螺塞密封。

4. 齿轮箱的可调节部件（如溢流阀）在出厂时均已调好，一般情况下不需再调，但根据实际情况，可在装船后作进一步调整。

5. 如齿轮箱存放在露天处，则必须加盖或天蓬。

3. Delivery Conditions of the Gearbox

1. The gearbox is delivered without lubrication oil.

2. The gearbox interior is protected with anti-corrosion oil. Under normal ambient conditions, the effective preservation period is 6 months. The exterior housing surfaces are painted, while external flanges, shaft ends, and mating surfaces are coated with anti-corrosion oil.

3. All external connections are sealed with blind flanges or threaded plugs.

4. All adjustable components on the gearbox (such as the relief valve) are pre-set at the factory and generally require no further adjustment. However, they may be fine-tuned after installation onboard based on actual conditions.

5. If the gearbox is stored outdoors, it must be covered with a weatherproof covering or canopy.

4. 齿轮箱的安装

4.1 安装说明

为便于换油和清洗，在设计齿轮箱的安装机座时，应考虑在放油塞下面留一安装放油盘的空间。箱体上部的吊耳只能用来起吊上箱体，若要起吊整台齿轮箱，则必须使用下箱体上的吊耳（如图 2）。4. Gearbox Installation

4.1 Installation Instructions

To facilitate oil changes and cleaning, the design of the gearbox foundation should allow space beneath the drain plug for installing a drip pan.The lifting lugs on the upper housing are only for lifting the upper housing. To lift the complete gearbox unit, the lifting lugs on the lower housing must be used (as shown in Figure 2).

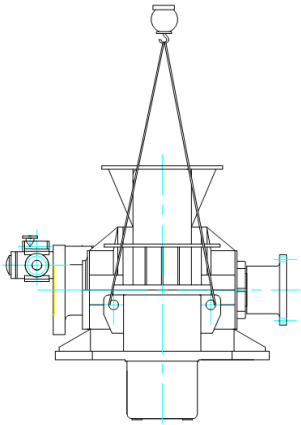


图 2 箱体起吊图

Figure 2: Housing Lifting Diagram

齿轮箱油底壳无法承受整个齿轮箱的重量，在运输和吊装过程中需临时停放时，也应搭建临时基座让齿轮箱底座承受整个齿轮箱的重量。

The gearbox oil pan cannot support the full weight of the unit. If temporary support is required during transport or lifting, a temporary foundation must be constructed to allow the gearbox base to bear the entire weight.

齿轮箱在实船上找正安装，必须在船下水后进行，而且船底不允许与海底（或河底）接触。安装时齿轮箱箱体不允许变形，其输入输出端必须准确找正。

由于螺旋桨轴轴承、轴系中间轴轴承、齿轮箱、主机的工作温度通常远高于找正时的环境温度，因而在工作温度下，各自的轴心位置会发生变化。同时，由于螺旋桨轴轴承，中间轴轴承，齿轮箱、主机的轴承存在间隙，其轴心位置在静态和动态亦不相同。所以，轴系找正安装时应注意将齿轮箱、主机的轴心位置作一修正。

轴系安装时应综合考虑柴油机、尾轴和齿轮箱的补偿。

The final alignment and installation of the gearbox onboard must be carried out after the vessel has been launched, and the hull must not be in contact with the seabed (or riverbed). During installation, the gearbox housing must not be distorted, and the input and output ends must be precisely aligned.

Because the operating temperatures of the propeller shaft bearing, intermediate shaft bearings, gearbox, and main engine are typically much higher than the ambient temperature during alignment, the respective shaft centerlines will shift under operating conditions. Furthermore, due to clearances in the propeller shaft bearing, intermediate shaft bearings, gearbox, and main engine bearings, the shaft centerline positions differ between static and dynamic states. Therefore, during shaft alignment, compensation must be applied to the shaft centerline positions of the gearbox and main engine.

Shaft system installation must comprehensively account for the compensation for the diesel engine, stern shaft, and gearbox.

4.2 齿轮箱安装

（1）找正完毕，用压板或螺栓固定齿轮箱，齿轮箱支座与船底机座同铰并安装铰制孔螺栓。

（2)所用螺栓强度等级最低为8.8级，抗拉强度800MPa，屈服强度640 MPa。螺栓拧紧力矩见下表：（单位：N•m）

4.2 Gearbox Installation

(1) Upon completion of alignment, secure the gearbox using hold-down plates or bolts. The gearbox foundation and the ship's base should be co-reamed, and fitted bolts (reamed hole bolts) should be installed.

(2) The minimum strength grade for all bolts used shall be Grade 8.8, with a tensile strength of 800 MPa and a yield strength of 640 MPa. The bolt tightening torques are specified in the table below: (Unit: Nm)

规　格 (Specification)	Dr	Schl	规　格 (Specification)	Dr	Schl
M12	76.4	71.5	M30	1215	1137
M14	114.6	107.8	M33	1686	1539
M16	176.4	166.6	M36	2127	1970
M18	250.8	233.2	M39	2754	2568
M20	357.7	333.2	M42	3391	3146
M22	480	441	M45	4263	3969
M24	617	568	M48	5145	4782
M27	902	843	M52	6615	6174

Dr—— 用扭力扳手的力矩

Dr—— Torque for use with a torque wrench

Schl——用冲击传动扳手（风动扳手）的力矩

Schl——Torque for use with an impact wrench (pneumatic wrench)

本表的力矩值适用于清洁，加有少许油的螺栓。

The torque values in this table apply to clean, lightly oiled bolts.

（3）安装所用垫块的大小、厚度、材料应符合验船部门的有关要求。

(3) The size, thickness, and material of the chocks (shims) used for installation must comply with the relevant requirements of the Classification Society.

（4）齿轮箱的安装工艺应提交验船部门，以取得验船部门认可。

(4) The gearbox installation procedure must be submitted to the Classification Society for review and approval.

5. 初始运转

交货的齿轮箱的内部零件的油封用油不影响齿轮箱的性能，不必清除。

首次运转前，必须用规定的清洁油从加油孔加入合格润滑油。

油位可以由量油尺（图 3）测得，尺上有“静止”和“运转”两个刻度。

齿轮箱停止时，油位在两“静止”刻度之间；齿轮箱运转时，油位在两“运转”刻度之间。

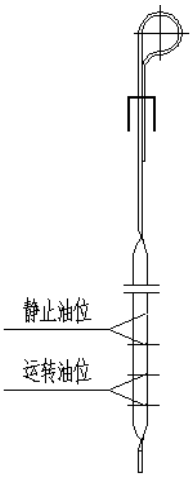


图 3 油标尺

Figure 3: Dipstick

油位太低，油泵有吸空造成断油的危险；油位太高，将使齿轮浸没过深，造成发热。

为便于运输，排气孔可能是封闭的，因而在开机前应打开它。

启动主机前，先启动备用泵给齿轮箱预供油约 5 分钟（此时滑油压力应≥0.05MPa）。启动主机，空负荷运转齿轮箱。

5. Initial Commissioning

The preservation oil applied to the internal components of the delivered gearbox does not affect its performance and need not be removed.

Before initial start-up, fill the gearbox with the specified, qualified lubricating oil through the filler opening, ensuring the oil is clean.

The oil level can be checked using the dipstick (Figure 3), which is marked with two sets of level indicators: "STATIONARY" and "OPERATING".

When the gearbox is stopped, the oil level should be between the two "STATIONARY" marks. When the gearbox is running, the oil level should be between the two "OPERATING" marks.

An oil level that is too low risks the oil pump drawing air, leading to an interruption in oil supply. An oil level that is too high causes excessive immersion of the gears, resulting in overheating.

For transport, the vent hole may be sealed; therefore, it must be opened prior to starting the equipment.

Before starting the main engine, initiate the standby pump to pre-lubricate the gearbox for approximately 5 minutes (the lubricating oil pressure should reach at least 0.05 MPa during this phase). Subsequently, start the main engine and run the gearbox under no load.

齿轮箱空负荷运转大约 5 分钟后，应再检查一次油位，必要时，应注油到正确油位。

当达到工作温度后，要再一次检查齿轮箱及管系是否有泄漏以及滑油压力是否正常。

如若滑油压力不正常，应作进一步的调整。调整时，拆下溢流阀的后盖（如图 4），取出弹簧后，拿出弹簧垫块，改变弹簧垫块的厚度，直到油压理想为止。增加弹簧垫块厚度时，油压增高；减小弹簧垫块厚度时，油压降低。

After the gearbox has operated under no load for about 5 minutes, check the oil level again. If necessary, add oil to bring it to the correct level.

Once operating temperature is reached, re-check the gearbox and piping system for any leaks and ensure the lubricating oil pressure is normal.

If the lubricating oil pressure is abnormal, further adjustment is required. To adjust, remove the rear cover of the relief valve (as shown in Figure 4), take out the spring, and then remove the spring spacer. Change the thickness of the spring spacer until the desired oil pressure is achieved. Increasing the spacer thickness raises the oil pressure; decreasing the spacer thickness lowers the oil pressure.

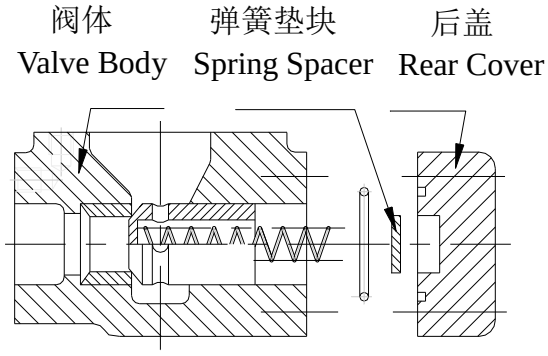


图 4 溢流阀

Figure 4: Relief Valve

滤器必须定期清洗、检查，使其保持正常。当压差达到 0.15MPa 时（报警）必须清洗。

待齿轮箱的各种参数正常后，进行全负荷运转。

全负荷运转 10 分钟后，检查包括地脚螺栓在内的所有齿轮箱螺栓、螺钉是否松动，必要时拧紧。

应特别注意！在下列情况下，必须使用备用油泵以润滑齿轮箱：

（1）齿轮箱开启前；

（2）齿轮箱运转后临时停车时间大于 5 分钟；

（3）拖桨航行时；

（4）滑油压力降到规定的下限值时。

The filter must be cleaned and inspected regularly to maintain proper function. It must be cleaned when the pressure differential reaches 0.15 MPa (as indicated by an alarm).

After all gearbox parameters have stabilized within normal ranges, proceed with full-load operation.

After 10 minutes of full-load operation, check all gearbox bolts and screws, including the foundation bolts, for looseness and tighten them if necessary.

Special Attention! The standby oil pump must be used to lubricate the gearbox under the following circumstances:

(1) Before starting the gearbox;

(2) After the gearbox has been stopped temporarily for more than 5 minutes;

(3) During towed propeller operation;

(4) When the lubricating oil pressure drops below the specified minimum limit

6. 维护保养

6.1 日保养

（1）检查油位；

（2）检查齿轮箱的泄漏情况；

（3）检查滑油压力是否正常。

6.2 周保养

（1）检查滤器；

（2）从滤器排污孔排出污垢，全面清洗并检查之。每清洗一次，滤器元件都应注意密封；

（3）检查滑油中的水份。

6.3 年保养

（1）检查齿轮箱外部所有螺栓连接是否可靠；

（2）检查冷却器是否工作正常。

6.4 换油

在正常使用情况下，大约 250 小时后进行第一次换油，以后的换油间隔时间为 2000 小时，最长不得超过 12 个月。

装新油前，应先把齿轮箱油底壳冲洗干净并按规定注新油。

6. Maintenance

6.1 Daily Maintenance

(1) Check the oil level.

(2) Check the gearbox for any leaks.

(3) Check that the lubricating oil pressure is normal.

6.2 Weekly Maintenance

(1) Inspect the filter.

(2) Drain contaminants from the filter drain port, then thoroughly clean and inspect it. After each cleaning, ensure the filter element is properly sealed.

(3) Check for water content in the lubricating oil.

6.3 Annual Maintenance

(1) Check all external bolts on the gearbox for secure connection.

(2) Inspect the cooler to ensure it is functioning correctly.

6.4 Oil Change

Under normal operating conditions, perform the first oil change after approximately 250 hours. Subsequent oil changes should be carried out at intervals of 2000 hours, which must not exceed 12 months.

Before filling with new oil, the gearbox oil sump must be flushed clean. Then, refill with new oil as specified.

7. 修理说明

7.1 更换输出轴扇形推力块

（1）卸去螺栓，垂直吊起轴承盖；

（2）吊起上中箱体(GCS)/上箱体(GCH)、径向轴承上半部；

（3）把推力块和支承盘上半部一起吊起；

（4）借助沿园周分布的孔转动支承盘下半部并吊起；

（5）取下旧推力块，换上新推力块；

（6）按以上程序的逆过程重新装好。

7.2 更换滑动轴承

更换滑动轴承，按下列方法进行：

（1）拆开外部连接管路；

（2）拆开箱体及端盖；

（3）垂直吊起滑动轴承上半部；

（4）吊出径向轴承下半部，修理旧轴承或更换新轴承；

（5）按以上步骤的逆过程重新装好。

7. Repair Instructions

7.1 Replacing the Segment Thrust Pads of the Output Shaft

(1) Remove the bolts and hoist the bearing cover vertically.

(2) Hoist the upper intermediate housing (for GCS)/upper housing (for GCH), along with the upper half of the radial bearing.

(3) Hoist the thrust pads together with the upper half of the support disk.

(4) Rotate the lower half of the support disk using the tapped holes distributed around its circumference, then hoist it away.

(5) Remove the old thrust pads and install the new ones.

(6) Reassemble by following the reverse sequence of the above steps.

7.2 Replacing the Plain Bearings

Replace the plain bearings by proceeding as follows:

(1) Disconnect the external piping connections.

(2) Dismantle the relevant housing and end cover.

(3) Hoist the upper half of the plain bearing vertically.

(4) Lift out the lower half of the radial bearing. Then, repair the old bearing or install a new one.

(5) Reassemble by following the reverse sequence of the above steps.

8. 故障排除

故障原因　解决方法

8.1 温度过高

（1）油位过高　降低油位

（2）滑油压力过低　调节油压

（3）齿轮箱过载　降低输入功率

（4）油泵压力过高　清洗滤器

（5）密封环过紧　放松密封环

（6）轴承回油不通畅　重新安装端盖或轴承盖，疏通油路

（7）轴承损坏　更换损坏了的轴承

8.2 油压不足

旋转方向错误　改变输入转向

（1）吸油管阻塞　清洗吸油管

（2）滤器阻塞　清洗滤器

（3）油位太低　加油到规定油位，并找出失油原因

（4）油粘度太低　换装新的规定用油

（5）油温过高　见“温度过高”

（6）压力调节阀出故障　更换出故障的零件或整个阀

（7）油泵运转不稳定　更换传动装置

（8）油泵磨损　更换油泵

8. Troubleshooting

| Fault Cause | Solution |

| 8.1 Overheating | (1) Oil level too high | Reduce oil level to the specified range. |

| | (2) Lubricating oil pressure too low | Adjust the oil pressure. |

| | (3) Gearbox overload | Reduce input power. |

| | (4) High oil pump pressure / Clogged filter | Clean the filter. |

| | (5) Sealing rings too tight | Loosen the sealing rings. |

| | (6) Restricted bearing oil return flow | Reinstall the end cover or bearing cover to clear the oil passage. |

| | (7) Bearing damage | Replace the damaged bearing(s). |

| 8.2 Insufficient Oil Pressure | Incorrect rotation direction | Change the input rotation direction. |

| | (1) Suction pipe blockage | Clean the suction pipe. |

| | (2) Filter blockage | Clean the filter. |

| | (3) Oil level too low | Add oil to the specified level and identify the cause of oil loss.

| | (4) Oil viscosity too low | Change to the new, specified oil. |

| | (5) Oil temperature too high | Refer to "Overheating" section above. |

| | (6) Malfunctioning pressure relief valve | Replace the faulty component(s) or the entire valve. |

| | (7) Unstable oil pump operation | Check and replace the drive mechanism if necessary. |

| | (8)Worn-out oil pump|Replace the pump.

8.3 漏油

（1）放油塞没拧紧　换垫片并拧紧放油塞

（2）冷却器泄漏　换冷却器

（3）润滑系统泄露　拧紧渗油的连接件

（4）油底壳结合面泄漏　换垫片并拧紧连接螺栓

（5）轴段的密封有泄漏　①更换密封环

②检查密封盖，使轴承回油通畅

8.4 螺旋桨不能达到其正常转速

（1）中间轴或艉轴的轴承被磨损　修理或更换已磨损的轴承

（2）齿轮箱轴承损坏　更换已坏的轴承

8.5 齿轮箱噪音

（1）齿轮箱在临界转速范围内　使齿轮箱转速避开临界转速范围

（2）输入法兰松动　紧固法兰

（3）油位太低（泵吸油噪音）　加油使油位恢复正常

（4）吸入管不紧（泵吸入空气）　紧固吸油管所有接头

（5）滤器阻塞（达到极限压差）　清洗滤器

（6）油泵转动不平稳（齿轮损坏或松动）　修理或更换零件

（7）发动机与齿轮箱找正误差太大　重新找正

8.3 Oil Leakage

| | (1) Loose drain plug | Replace the gasket and tighten the drain plug. |

| | (2) Cooler leakage |Replace the cooler. |

| | (3) Lubrication system leakage | Tighten the leaking connections. |

| | (4) Sump joint surface leakage | Replace the gasket and tighten the connecting bolts. |

| | (5) Leakage at shaft seals | ① Replace the sealing rings.
② Check the seal cover to ensure unobstructed bearing oil return. |

8.4 Propeller Fails to Reach Normal RPM

| | (1) Worn intermediate shaft or stern shaft bearing | Repair or replace the worn bearing(s). |

| | (2) Damaged gearbox bearing(s) | Replace the damaged bearing(s). |

8.5 Gearbox Noise

| | (1) Operation within critical speed range | Alter the gearbox operating speed to avoid the critical range. |

| | (2) Loose input flange | Tighten the flange. |

| | (3) Oil level too low (pump cavitation noise) | Add oil to restore the correct level. |

| | (4) Loose suction pipe (pump drawing air) | Tighten all suction pipe connections. |

| | (5) Clogged filter (reaching maximum pressure differential) | Clean the filter. |

| | (6) Unstable oil pump operation (damaged or loose gears) | Repair or replace the components. |

| | (7) Excessive misalignment between engine and gearbox | Realign the engine and gearbox. |

9. 标准附件

9.1 冷却器

冷却器采用筒式冷却器或板式冷却器。

（1）筒式冷却器（图 5）

筒式冷却器体积小、安装及拆换都很方便，采用锌块防腐，应定期检查锌块，必要时应予更换。

若滑油进出口温差偏高或水管进出口温差偏低，则水管有被阻塞的可能。

拆检、清洗时，注意不要碰伤管子外的散热片。

重新装配冷却器时应注意密封，以防冷却水进入滑油中。若密封垫有损坏，应予更换。

去污垢可用蒸汽蒸煮法。

若在海水腐蚀后，漏水、漏油的情况下，必须整体更换。

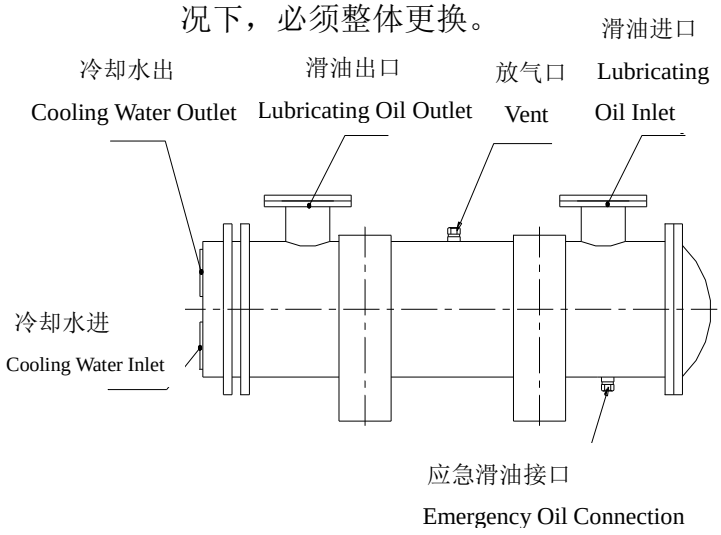


图 5 筒式冷却器

Figure 5 Shell-and-Tube Cooler

9. Standard Accessories

9.1 Cooler

The gearbox utilizes either a shell-and-tube cooler or a plate cooler.

(1) Shell-and-Tube Cooler (Figure 5)

The shell-and-tube cooler features a compact design, facilitating easy installation and replacement. It is protected by zinc anodes against corrosion. These anodes should be inspected periodically and replaced when necessary.

If the temperature difference between the oil inlet and outlet becomes excessively high, or the temperature difference between the water inlet and outlet becomes unusually low, it may indicate a blockage in the water tubes.

During disassembly, inspection, and cleaning, take care not to damage the fins on the exterior of the tubes.

When reassembling the cooler, ensure all seals are proper to prevent cooling water from leaking into the lubricating oil. Replace any damaged gaskets.

For deposit removal, the steam cleaning method can be employed.

If the cooler suffers from corrosion (e.g., in seawater service) leading to water or oil leaks, the entire unit must be replaced.

（2）板式冷却器（图 6）

它具有结构紧凑、传热效率高、操作方便等优点，并具有处理微小温差的能力。它是由传热板片、密封垫片、框架、导杆和夹紧螺杆等主要零部件组成。传热板片安装在固定板体和活动板体之间，有时在板片的中间要装上中间隔板，板片由吊钩或本身的缺口悬挂在导杆上，密封垫片贴在板片上，用夹紧螺栓及螺母将设备夹紧使之成为一个整体，从而达到密封和形成介质通道。换热介质在相邻的通道内交错流动，进行充分的热交换。

①板式冷却器设备结构简图如下：

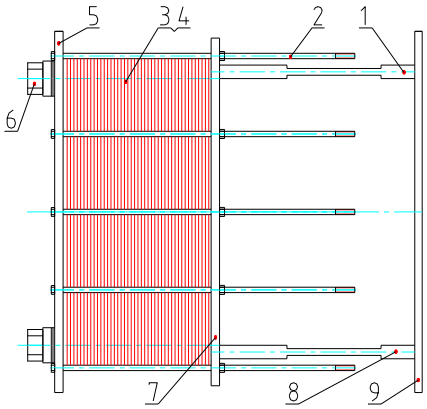


图 6 板式冷却器

Figure 6 Plate Cooler

1. 上导杆
2. 夹紧螺栓
3. 固定板体
4. 密封垫片
5. 板片
6. 接管
7. 活动压紧板
8. 下导杆
9. 前支柱

(2) Plate Cooler (Figure 6)

The plate cooler offers advantages such as compact structure, high heat transfer efficiency, ease of operation, and the ability to handle small temperature differences. Its main components include heat transfer plates, sealing gaskets, frame, guide rods, and tightening bolts.

The heat transfer plates are installed between the fixed frame plate and the movable pressure plate. Sometimes, an intermediate partition plate is installed among the plates. The plates are suspended from the guide rods by hooks or their own notches. Sealing gaskets are attached to the plates, and the entire assembly is compressed into a single, sealed unit with defined flow channels by tightening bolts and nuts. The heat exchange media flow alternately through adjacent channels, enabling full heat transfer.

①A simplified diagram of the plate cooler assembly is shown below:

1. Upper Guide Rod
2. Tightening Bolt
3. Fixed Frame Plate
4. Sealing Gasket
5. Plate
6. Connection Nozzle
7. Movable Pressure Plate
8. Lower Guide Rod
9. Front Support Pillar

②故障及处理

设备经长期运行后，一旦发生故障，一般有下列可能：

a. 压降逐步增大。造成原因多为介质在板片内结垢使流道减小或堵塞。

b. 介质混合。造成原因多为板片被腐蚀穿孔。

c. 介质泄漏。造成原因多为密封垫片老化或材质选用不合适；也可能是各夹紧螺杆的螺母松脱。

凡出现上述情况，设备需停止运行，等冷却至室温后再行检查、修理。如属情况 a 时，可松开夹紧螺母取下夹紧螺杆并将活动板体移到支柱端，取下板片用清水冲洗或用肥皂水冲洗，如有固着物可用棕刷除去（设备无故障，长期运行后也可用此法清洗）；如属情况 b 时，可检查更换被腐蚀的板片；如属情况 c 时，应先检查夹紧螺杆的螺母是否松动及夹紧尺寸是否与安装图相符，如螺母松动则夹紧尺寸偏大，可重新拧紧夹紧螺母使夹紧尺寸与图纸相符，若仍然泄漏则需更换密封垫片。

②Malfunctions and Remedial Actions

After prolonged operation, potential malfunctions generally include the following:

a. Gradual increase in pressure drop.This is mostly caused by scaling or blockage inside the plates, which reduces the flow passage.

b. Media mixing. This is typically due to plates being corroded and perforated.

c. Media leakage. This is often caused by aging sealing gaskets, unsuitable gasket material, or loosened nuts on the tightening bolts.

Should any of the above situations occur, the unit must be shut down. Allow it to cool down to ambient temperature before inspection and repair.

For case a: Loosen the tightening nuts, remove the tightening bolts, and move the movable pressure plate to the end of the support pillars. Remove the plates and rinse them with clean water or a soap solution. Any adhering deposits can be removed with a soft brush. (This cleaning method can also be used for regular maintenance after prolonged operation, even without a malfunction).

For case b: Inspect and replace the corroded and perforated plates.

For case c: First, check if the nuts on the tightening bolts are loose and whether the clamping dimension matches the installation drawing. Loose nuts will result in a clamping dimension that is too large. Re-tighten the nuts to achieve the clamping dimension specified in the drawing. If leakage persists, replace the sealing gaskets.

③密封垫片的更换

a. 取下板片，拆下密封垫片，用汽油将垫片槽内的残胶浸泡一小时后，擦净残胶。

b. 除去新垫片上的脏物。

c. 用毛刷将粘结剂均匀地涂于板片的垫片槽内（不宜过多），按所需的 A 板及 B 板的数量帖上密封垫片，叠放平整并在上面压上适当的重物，经六小时后即可干固。

④设备的重新装配

经拆卸、清洗后的板片需重新装在机架上，板片的排列需按随机所带流程图的顺序依次挂在导杆上，此时需切记 A 板与 B 板一定要交替排列。A 板与 B 板的区分在于：面对板片的正面（帖胶垫的一面），介质由右上角流进或流出为 A 板；介质由左上角流进或流出为 B 板。

各组螺栓应水平地均匀、成对拧紧。装配完成后，应按设计压力的 1.25 倍单侧交替打压，保压 30 分钟设备无泄漏为合格。切记：打压时压力应缓慢上升。

③Seal Gasket Replacement

a. Remove the plates and detach the old seal gaskets. Soak the gasket grooves in solvent for about one hour to soften any residual adhesive, then thoroughly wipe it clean.

b. Remove any contaminants from the new gaskets.

c. Using a brush, apply adhesive evenly into the gasket grooves of the plates (avoid excessive application). Affix the new gaskets onto the required number of Plate A and Plate B types. Stack the plates neatly, apply appropriate weight on top, and allow at least six hours for the adhesive to cure completely.

④Unit Reassembly

After disassembly and cleaning, the plates must be reassembled onto the frame. The plate arrangement must follow the sequence shown in the supplied flow diagram, hanging them sequentially onto the guide rods. It is crucial that Plate A and Plate B types are arranged alternately. Plates are distinguished as follows: facing the front side of the plate (the side with the gasket):Plate A: The medium flows in or out from the upper right corner. Plate B: The medium flows in or out from the upper left corner.

Tighten all bolt sets evenly, in pairs, and horizontally. After assembly, the unit must undergo a pressure test: apply a test pressure equal to 1.25 times the design pressure alternately to one side at a time, hold for 30 minutes. The unit is qualified if no leakage is detected. Important: During pressure testing, the pressure must be increased gradually.

9.2 油滤器

油滤器采用 SPL 型双筒网片式油滤器或 SBL 型半自动清洗油滤器。

SPL 型双筒网片式油滤器，主要由壳体、滤芯组件、阀壳及锥阀组成。双筒壳体下侧各有一个装有螺塞的排污孔，转换手柄必须对准左开或右开的位置以保证油路在锥阀和阀壳中畅通无阻。

SBL 型半自动清洗油滤器，主要由本体、壳体组件、滤芯组件、滤芯座、导油座、转换阀、阀盖、转换手柄等组成。

9.2 Oil Filter

The oil filter is either an SPL type duplex strainer filter or an SBL type semi-automatic self-cleaning filter.

The SPL type duplex strainer filter primarily consists of a housing, filter element assembly, valve housing, and cone valve. Each lower side of the dual housings has a drain hole fitted with a plug. The diverter handle must be aligned with either the fully left or fully right position to ensure an unobstructed oil path through the cone valve and valve housing.

The SBL type semi-automatic self-cleaning filter mainly comprises a body, housing assembly, filter element assembly, element seat, oil guide seat, diverter valve, valve cover, and diverter handle.

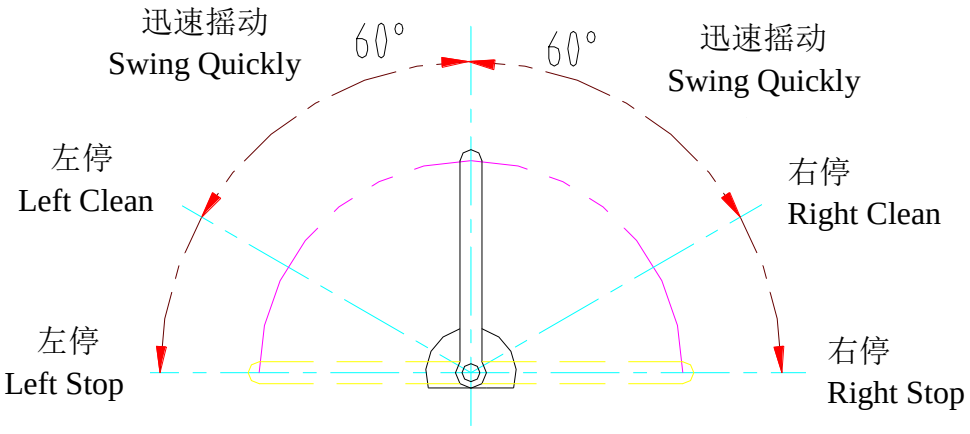


图 7 油滤器工作原理

Figure 7 Oil Filter Work Priciple

以下详细介绍 SBL 型半自动清洗滤器。

（1）工作原理

压力油从滤器的进口经转换阀流入壳体内，经滤芯组件过滤后的清洁油，从本体出口流出，达到滤清的目的。正常工作时，转换手柄呈垂直位置（图 7），此时两腔同时工作。

当滤器压降达到规定值时，滤芯必须清洗。方法如下：

①. 左侧清洗：手柄从垂直位置向左转动 60°（见图 7），瞬时冲洗 1-2 秒，再转回到垂直位置。

②. 右侧清洗：手柄从垂直位置向右转动 60°（见图 7），瞬时冲洗 1-2 秒，再转回到垂直位置。

The following section provides a detailed description of the SBL type semi-automatic self-cleaning filter.

(1) Operating Principle

Pressurized oil enters the filter inlet, flows through the diverter valve into the housing, and is filtered by the filter element assembly. The cleaned oil then exits through the body outlet, achieving the purpose of filtration. During normal operation, the diverter handle is in the vertical position (Figure 7), and both chambers work simultaneously.

When the pressure drop across the filter reaches the specified value, the filter elements must be cleaned. The procedure is as follows:

①. Clean Left Side: Rotate the handle 60° to the left from the vertical position (see Fig. 7), momentarily flush for 1-2 seconds, then return the handle to the vertical position.

②. Clean Right Side: Rotate the handle 60° to the right from the vertical position (see Fig. 7), momentarily flush for 1-2 seconds, then return the handle to the vertical position.

当滤芯需拆下清洗时，手柄从垂直位置向左转动 90°（见图 7），则左停机，右侧正常工作，此时左侧滤腔可拆下进行清洗；手柄从垂直位置向右转动 90°（见图 7），则右停机，左侧正常工作，此时右侧滤腔可拆下进行清洗。

（2）滤器的使用

滤器已按规定装在系统管路中（进出口已连接好），滤器开始通油时，应开启放气阀，待油液充满滤腔排尽空气后，立即关闭放气阀，以免油液外溢。在工作过程中，当滤器的压降超过规定值时，必须及时清洗滤器。

（3）故障与维修

SBL 半自动清洗滤器虽然能经常连续进行反冲洗，但是由于过滤介质中总含有一定量的杂质且具有相当的胶粘性，滤器中的烛式滤芯仍会随着时间的增加而逐渐堵塞。

When a filter element needs to be removed for cleaning, rotate the handle 90 ° to the left from the vertical position (see Fig. 7). This stops the left side, while the right side continues normal operation, allowing the left filter chamber to be disassembled and cleaned. Conversely, rotate the handle 90 °to the right from the vertical position (see Fig. 7) to stop the right side, leaving the left side operational, enabling the right filter chamber to be disassembled and cleaned.

(2) Filter Operation

The filter, havig been installed in the system pipeline as specified (with inlet and outlet connected), should have its air vent valve opened when oil begins to flow through. Once the filter chamber is completely filled with oil and all air is expelled, close the air vent valve immediately to prevent oil spillage. During operation, if the filter's pressure drop exceeds the specified value, the filter must be cleaned promptly.

(3) Malfunctions and Maintenance

Although the SBL semi-automatic self-cleaning filter can perform backflushing regularly and continuously, the candle filter elements will still gradually clog over time. This is because the filtered medium always contains a certain amount of impurities with considerable adhesive properties.

长期堵塞会缩短冲洗周期间的时间间隔，同时易使过滤元件损坏，所以必须定期进行检查和维修，堵塞的滤芯可以用清洗汽油加以清洗。

下列情况必须清洗：

①滤器在工作了 500 小时后应拆卸滤芯检查。将过滤元件从壳体中取出，拆下的滤芯可放在合适的洗涤剂中清洗检查，或用软毛刷清洗烛式滤芯表面的污物颗粒。然后用清洁油清洗并用压缩空气吹干，如发现滤芯有损坏或因使用时间长而难以清洗干净时则应更换滤芯，同时检查密封元件是否有损坏，如有损坏也应更换之。

②当冲洗周期间间隔时间缩短应检查滤芯并清除污物，而当冲洗周期间隔时间突然变长则应检查滤芯是否破损。

③滤器在进行大修时应更换所有密封元件。滤器的大修期为每使用两年进行一次。

Persistent clogging will shorten the intervals between flushing cycles and can easily damage the filter elements. Therefore, the filter must be regularly inspected and maintained. Clogged elements can be cleaned using cleaning gasoline or an appropriate solvent.

Cleaning is required under the following circumstances:

①The filter elements should be removed for inspection after 500 hours of operation. Extract the filter elements from the housing. The disassembled elements can be immersed in a suitable cleaning agent for inspection and cleaning. Alternatively, use a soft brush to remove contaminant particles from the surface of the candle filter elements. Subsequently, rinse with clean oil and blow dry with compressed air. If any element is found damaged or cannot be cleaned thoroughly due to prolonged use, it should be replaced. Simultaneously, check the sealing components for damage and replace them if necessary.

②The filter elements should be inspected and contaminants removed if the interval between flushing cycles shortens significantly. Conversely, if the interval between flushing cycles suddenly becomes longer, the filter elements should be inspected for possible damage or rupture.

③ All sealing components should be replaced during a major overhaul of the filter. A major overhaul is recommended every two years of service.

9.3 单向阀

单向阀主要由阀体、阀芯、弹簧和弹簧座组成，如图 8 所示。

阀的开启压力为 0.03MPa。

拆装时，只需将弹簧座旋转 45° 即可。

若有反流现象，需要将阀芯和阀体配对研磨。

9.3 Check Valve

The check valve primarily consists of a valve body, valve core, spring, and spring seat, as shown in Figure 8.

The valve cracking pressure is 0.03 MPa.

For disassembly and assembly, simply rotate the spring seat by 45 °.

If backflow is observed, the valve core and valve body require lapping as a matched pair.

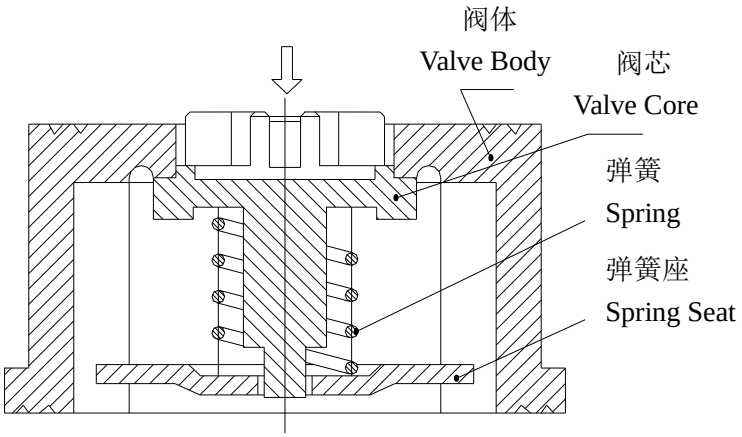


图 8 单向阀

Figure 8: Check Valve

9.4 机带油泵

齿轮箱采用齿轮油泵或螺杆泵。其中齿轮油泵为轴向间隙式的外啮合齿轮泵，其总体结构为三片组合式。齿轮端面与侧板之间有一定的轴向间隙，齿轮外径与泵体内孔有一定的间隙。

9.4 Gearbox-mounted Pump

The gearbox employs either a gear oil pump or a screw pump.

The gear oil pump is an external gear pump with axial clearance, featuring a three-piece modular structure. There is a defined axial clearance between the gear end faces and the side plates, as well as a radial clearance between the gear outside diameter and the pump body bore.

当主动齿轮旋转，使泵体吸油腔容积增大时，两齿轮间间隙形成真空。油液在大气压下进入泵吸油腔。两齿轮间的油液，被侧板和泵体所封闭，随齿轮旋转油液被带至出油腔。在出油腔一端，由于齿轮连续旋转互相啮合，使油腔容积逐渐缩小，将油液从出油口挤压排出，对外形成油压。

根据主机的转向和工作状态，齿轮箱配置单向齿轮泵或双向齿轮泵。

具有自吸性能的三螺杆泵的工作原理跟我们熟悉的齿轮泵的工作原理相类似，它是靠旋转的螺杆上的螺旋槽的分开与啮合来吸、排油。根据主机的转向和工作状态，齿轮箱配置相应的单向螺杆泵。

When the drive gear rotates, increasing the volume of the pump's suction chamber, a vacuum is formed in the spaces between the two gears' teeth. Oil is then drawn into the suction chamber under atmospheric pressure. The oil trapped between the gear teeth is enclosed by the side plates and the pump body, and is carried by the rotating gears towards the discharge chamber. On the discharge side, as the gears continue to rotate and mesh, the volume of the discharge chamber gradually decreases, squeezing the oil out through the discharge port and generating oil pressure.

Depending on the main engine's rotation direction and operating mode, the gearbox is equipped with either a unidirectional gear pump or a bidirectional gear pump.

The operating principle of the self-priming three-screw pump is similar to that of the familiar gear pump. It relies on the engagement and disengagement of the helical grooves on the rotating screws to draw in and discharge oil. Based on the main engine's rotation direction and operating mode, the gearbox is equipped with a corresponding unidirectional screw pump.

油泵在拆装时必须保证作业场所清洁，以防止灰尘落入泵中。

不允许用汽油清洗橡胶密封件。

拆装时不得敲打、撞击、以免损伤零件。

泵在维修装配后、重新装上齿轮箱前必须用手盘动输入轴，输入轴应转动轻快，不得有卡滞和异常杂音。

9.5 备用油泵

备用油泵的进油和出油管路中 90 度弯头不能超过四个，以免噪声过大和压降过大。

9.6 监控装置

齿轮箱监控装置由仪表板、监控仪表、接线盒组成，所有的远程监控信号都接线至接线盒，请见接线图。

During disassembly and assembly of the oil pump, the work area must be kept clean to prevent dust from entering the pump.

Do not clean rubber seals with gasoline.

Avoid knocking or impacting components during disassembly and assembly to prevent damage to parts.

After maintenance and reassembly, and before reinstalling the pump onto the gearbox, the input shaft must be rotated by hand. It should turn freely and smoothly, without any binding or unusual noise.

9.5 Standby Oil Pump

The suction and discharge pipelines for the standby oil pump should not contain more than four 90-degree elbows to avoid excessive noise and pressure drop.

9.6 Monitoring System

The gearbox monitoring system consists of an instrument panel, monitoring instruments, and a terminal box. All remote monitoring signals are wired to the terminal box. Please refer to the wiring diagram.

10. 自动控制系统

齿轮箱的自动控制系统符合 CCS 关于驾驶台及主控制站有一人值班的自动化要求。所有的仪表均安装在装有减震座的仪表板上，各个仪表均由电缆引到接线盒上。仪表型号规格及数量见监控系统接线图。

10.1 备用泵自动控制的要求

（1）在柴油机起动前，首先起动齿轮箱备用油泵，油泵起动的同时，油泵控制箱输出一个信号，控制台上备用泵指示灯亮；

（2）当滑油压力大于0.3MPa时，压力控制器 Pc2 触点接通，通过备用泵控制电路使备用泵停止工作；

（3）当滑油压力降到0.05MPa时，压力控制器 Pc1 触点接通，通过备用泵控制电路使备用泵重新工作。如压力回复，则重复（2）和（3），齿轮箱可正常工作；

10. Automatic Control System

The gearbox's automatic control system complies with the CCS requirements for one-man watch operation from the bridge and the main control station. All instruments are installed on a shock-absorbing instrument panel, with each instrument connected via cable to a terminal box. For the types, specifications, and quantities of instruments, please refer to the monitoring system wiring diagram.

10.1 Requirements for Automatic Standby Pump Control

(1) Before starting the diesel engine, the gearbox's standby oil pump must be started first. Simultaneously with the pump start, the pump control unit sends a signal, causing the standby pump indicator light on the control panel to illuminate.

(2) When the lubricating oil pressure exceeds 0.3 MPa, the contacts of pressure controller Pc2 close, causing the standby pump control circuit to stop the standby pump.

(3) If the lubricating oil pressure drops to 0.05 MPa, the contacts of pressure controller Pc1 close, causing the standby pump control circuit to restart the standby pump. If the pressure subsequently recovers, steps (2) and (3) are repeated, allowing the gearbox to operate normally.

（4）当滑油压力继续下降到0.04MPa 时，压力控制器 Pc3 触点接通，控制台上紧急状态报警指示灯亮。此时应采取特别措施；

（5）在采取特别措施无效或未采取特别措施时，压力继续下降，并降到0.02MPa 时，压力控制器 Pc4 触点接通,通过控制系统使主机停车，以免齿轮箱被损坏。

10.2 WTZK-50-C 压力式温度控制器

本控制器是一种随温度升降而使电路闭合或断开的电开关。其基本参数为：

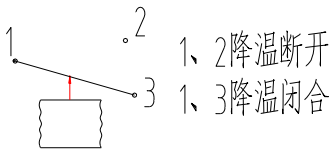
（1）温度调节范围 40~80℃；（指针指示值为下降动作点）

（2）差动可调范围 3~5℃；（差动即为在同一控制点上触头断开或闭合的两点间的温度差值）

（3）允许指示误差±2℃；

（4）允许动作误差 2℃；

（5）触头容量：交流电 380V，3A；直流电 220V，2.5A。



(4) If the lubricating oil pressure continues to drop to 0.04 MPa, the contacts of pressure controller Pc3 close, illuminating the emergency alarm indicator on the control panel. Special measures must be taken at this point.

(5) If these special measures prove ineffective or are not taken, and the pressure further drops to 0.02 MPa, the contacts of pressure controller Pc4 close, triggering a main engine shutdown via the control system to prevent damage to the gearbox.

10.2 WTZK-50-C Pressure-Actuated Temperature Controller

This controller is an electrical switch that opens or closes a circuit in response to temperature changes. Its basic parameters are:

(1) Temperature Setting Range: 40 ~ 80 ℃ (The pointer indicates the drop-out (break) set point).

(2) Differential (Adjustable Range): 3 ~ 5 ℃ (The differential is the temperature difference between the break and make points at the same control setting).

(3) Permissible Indication Error: ±2 ℃

(4) Permissible Operating Error: 2 ℃

(5) Contact Rating: AC 380V, 3A; DC 220V, 2.5A

齿轮箱出厂时，温度控制器已按要求调好，一般不需再调。当确需调节时，应按下述方法调节：（注意：拆装时严禁用手搬动或用工具碰撞拨臂）

a. 取下控制器的锁紧螺母，旋动调节杆，使指针指在所需要控制的温度值上，然后将取下的锁紧螺母按原位拧紧；

b. 旋动差动旋扭，以得到适当的差动值。

10.3 YWK-50-C 压力控制器

本压力控制器是一种随着压力变化而使电路闭合或断开的电开关，其基本参数：

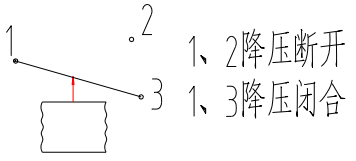
（1）压力调节范围 0~0.5MPa；(指针指示值为下降动作点)

（2）差动可调范围 0.03~0.1MPa；（差动即为在同一控制点上使触头断开或闭合的两点间的压力差值）

（3）允许指示差值±0.02MPa；

（4）允许动作误差 0.008MPa；

（5）触头容量：交流 380V，3A；直流 220V，2.5A。



The temperature controller is pre-set at the factory according to requirements and generally needs no adjustment. Should adjustment be necessary, proceed as follows: (Note: During disassembly or assembly, never move the lever by hand or bump it with tools)

a. Remove the lock nut from the controller. Rotate the adjustment stem to set the pointer to the desired control temperature. Then, re-tighten the lock nut to its original position.

b. Rotate the differential adjustment knob to obtain the appropriate differential value.

10.3YWK-50-C Pressure Controller

This pressure controller is an electrical switch that opens or closes a circuit in response to pressure changes. Its basic parameters are:

(1) Pressure Setting Range: 0 ~ 0.5 MPa (The pointer indicates the drop-out (break) set point).

(2) Differential (Adjustable Range): 0.03 ~ 0.1 MPa (The differential is the pressure difference between the break and make points at the same control setting).

(3) Permissible Indication Error: ± 0.02 MPa

(4) Permissible Operating Error: 0.008 MPa

(5) Contact Rating: AC 380V, 3A; DC 220V, 2.5A

齿轮箱出厂时，温度控制器已按要求调好，一般不需再调。当确需调节时，应按下述方法调节：（注意：拆装时严禁用手搬动或用工具碰撞拨臂）

a. 取下控制器的锁紧螺母，旋动调节杆，使指针指在所需要控制的温度值上，然后将取下的锁紧螺母按原位拧紧；

b. 旋动差动旋扭，以得到适当的差动值。

10.4 差压控制器

本控制器是控制压力差的自动保护装置，滤器前后压力分别接到控制器上下两端的气箱上，控制器获得的就是滤器的压差。当压差值大于规定值时，触点 1 和 2 断开，1 和 3 接通，经转换机构即发出报警信号。1，3 触点为接线触点。

压差控制器的基本参数：

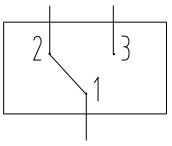
a. 压力调节范围 0.05~0.4MPa；

b. 差压开关的差值 0.02MPa；（不可调）

c. 开关触头容量：交流 220V，3A。

齿轮箱出厂时，压差控制器已按要求调好，一般不需再调。当确需调节时，应按下述方法调节：

调整时，打开盒盖，拨动调节盘，向右拨为加大刻度，向左拨为减小刻度。



压差上升1、3接通

The differential pressure controller is an automatic protection device that monitors pressure difference. The pressure before and after the filter is connected to the upper and lower pressure chambers of the controller respectively, allowing the controller to measure the filter's pressure drop. When this differential pressure exceeds the set value, contacts 1 and 2 open, while contacts 1 and 3 close, triggering an alarm signal via a connected control circuit. Terminals 1 and 3 are the wiring terminals for this alarm function.

The basic parameters of the differential pressure controller are:

a. Pressure Setting Range: 0.05 ~ 0.4 MPa

b. Differential Pressure Switch Value: 0.02 MPa (Non-adjustable)

c. Contact Rating: AC 220V, 3A

The differential pressure controller is pre-set at the factory and generally requires no adjustment. If adjustment becomes necessary, proceed as follows:

To adjust, open the controller's cover and turn the adjustment dial. Turning it to the right increases the set value, while turning it to the left decreases it.