Technical information
Damage to the windlass due to excessive external force

If the chain is forced to pull out by a large external force when the clutch is engaged, the hydraulic motor will be turned in the slack down direction, which may damage the hydraulic equipment such as the hydraulic motor and counterbalance valve, as well as the windlass itself. Please understand the following precautions before use.

1. Operation of the Windlass

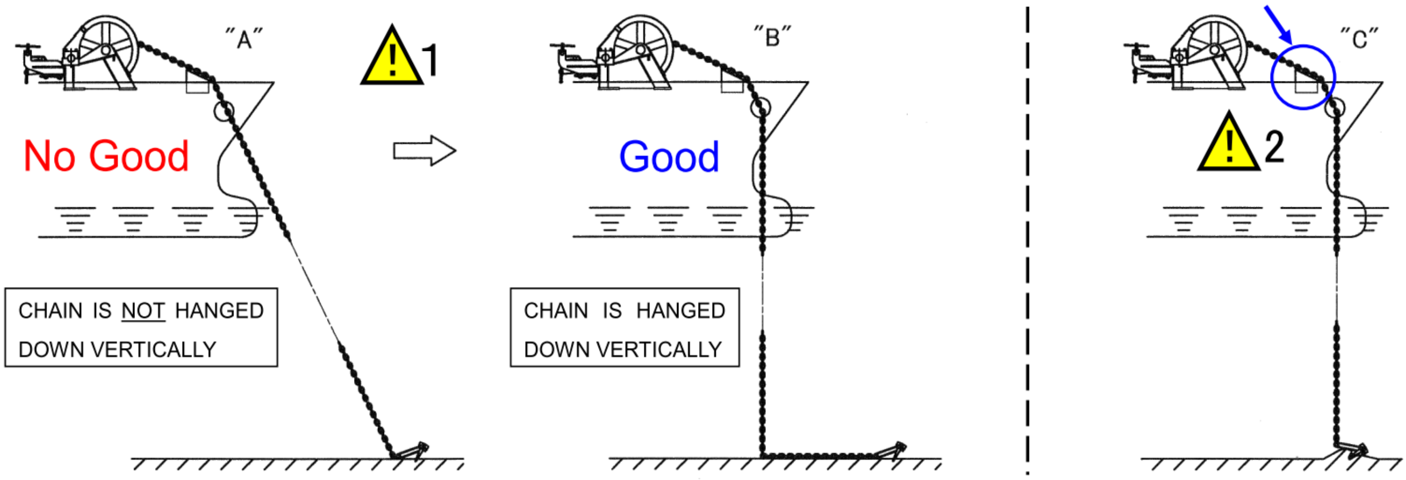
1) Operate the windlass carefully not to apply excessive external force.

2) Move the vessel so that the anchor chain is hanged down vertically into water during the heaving operation.

3) If the anchor chain becomes being inclined (condition of "A") , take the following operations.

- Immediately stop the heaving operation and tighten the brake of gypsy wheel and disengaged the clutch.
- Move the vessel so that the anchor chain is hanged down vertically (condition of "B") by assist of main engine.
- After making sure the anchor chain is hanged down vertically, restart the heaving operation.

Note) In case that the windlass slows down or stops during heaving operation, it shows that excessive load applies on the windlass.



4) In case that the anchor bites into sea bottom as shown fig."C", put a chain stopper and move the vessel in order to pull-out the anchor from sea bottom. Never attempt to pull out by heaving force of windlass. Also, do not use the windlass hoisting force to move the vessel.

2. Damage to the windlass body

If an excessive external force is applied to the chain drum of the windlass, the main body parts of the windlass may be damaged, such as a broken chain drum, bent main shaft, or deformed frame and gear case.

3. Mechanism of hydraulic motor damage

When an excessive external force is applied to the windlass, the hydraulic motor will be damaged by the following mechanism.

Technical information

Damage to the windlass due to excessive external force

1) When the hydraulic motor is turned by excessive external force, a large amount of hydraulic oil is pushed out to side "a" of the motor.

2) The hydraulic oil pushed out to side "a" is blocked by the check valve to hold the load.

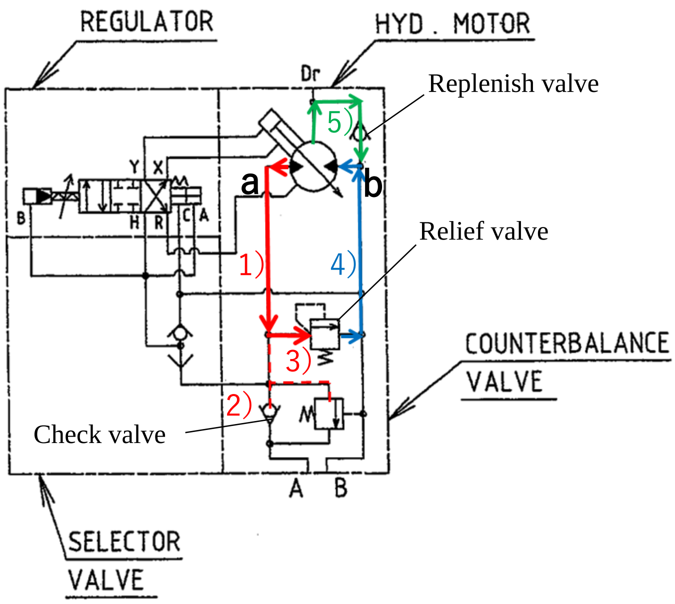
3) When the pressure on side "a" (red line) exceeds the relief valve set pressure, the relief valve is activated. A large amount of hydraulic oil flows through the relief valve instantaneously, however if the flow rate is too high, the pressure on side "a" becomes abnormally high.

4) The motor tries to suck in the amount of oil pushed out from side "a" to side "b". However, due to the passage resistance of the relief valve, the amount of oil passing from side "a" to side "b" is insufficient.

5) The shortage of hydraulic oil on side "b" due to 4) is replenished from the drain line through the replenish valve (green line), but if the replenishment cannot keep up, the pressure on side "b" (blue line) becomes negative pressure. In addition, the spring of the replenish valve may be deformed by a large amount of hydraulic oil passing through the replenishment valve instantaneously.

6) When the pressure on side "b" (blue line) becomes negative, the inside of the cylinder becomes negative and the piston and the con-rod inside the hydraulic motor are pulled outward. Then, the retaining ring that regulates the movement of the con-rod is deformed or damaged. As a result, the con-rod drops out of the drum, damaging the piston and the internal parts including the con-rod.

7) Alternatively, the valve spool and valve casing will seize due to poor lubrication caused by the valve spool being turned at a speed exceeding the maximum speed of the hydraulic motor and the pressure of side "b" (blue line) becoming negative pressure. As a result, the oldham coupling is damaged.



Hydraulic circuit diagram of hydraulic motor unit

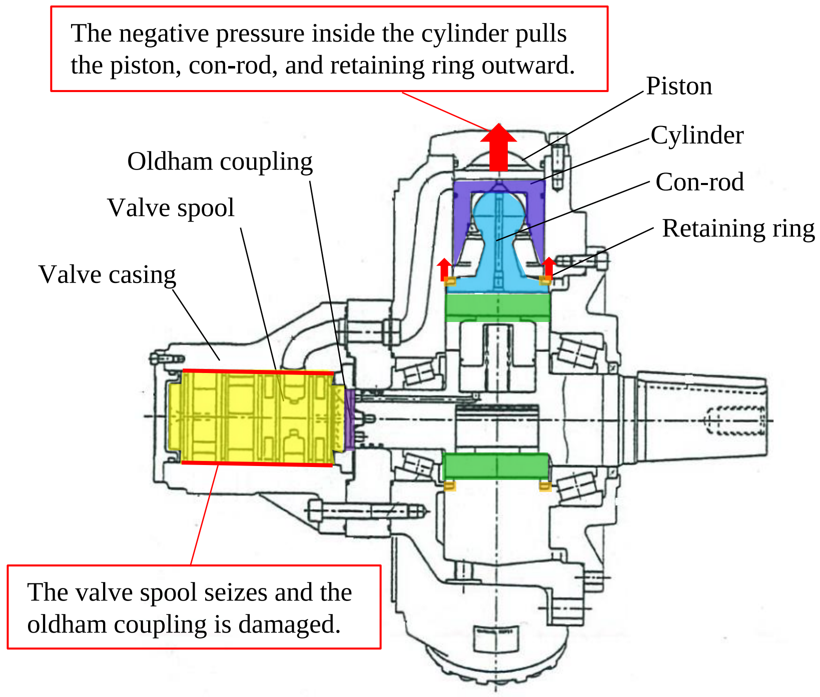
(Reference)

KAWASAKI HEAVY INDUSTRIES, LTD.
PRECISION MACHINERY BUSINESS DEVISION
CUSTOMER SERVICE DEPARTMENT

2021.11

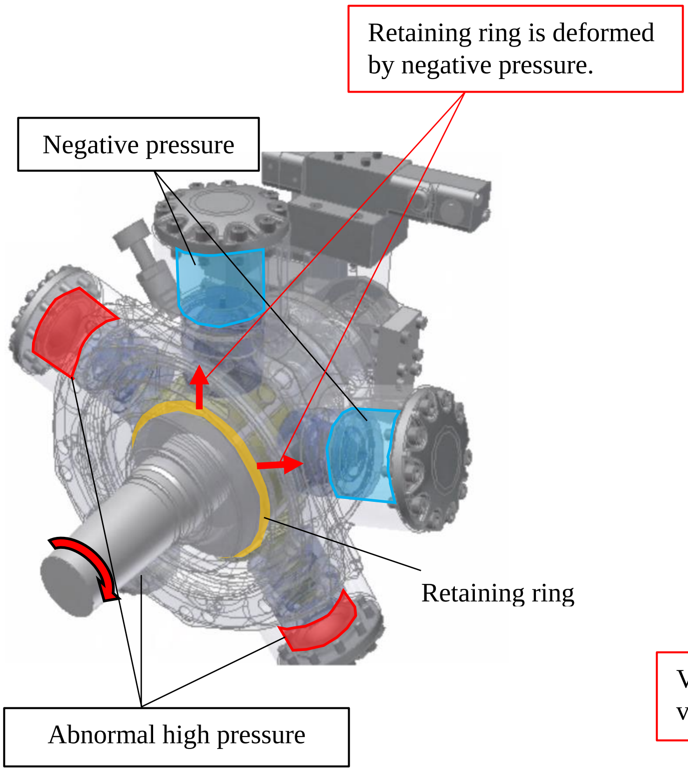
Technical information

Damage to the windlass due to excessive external force



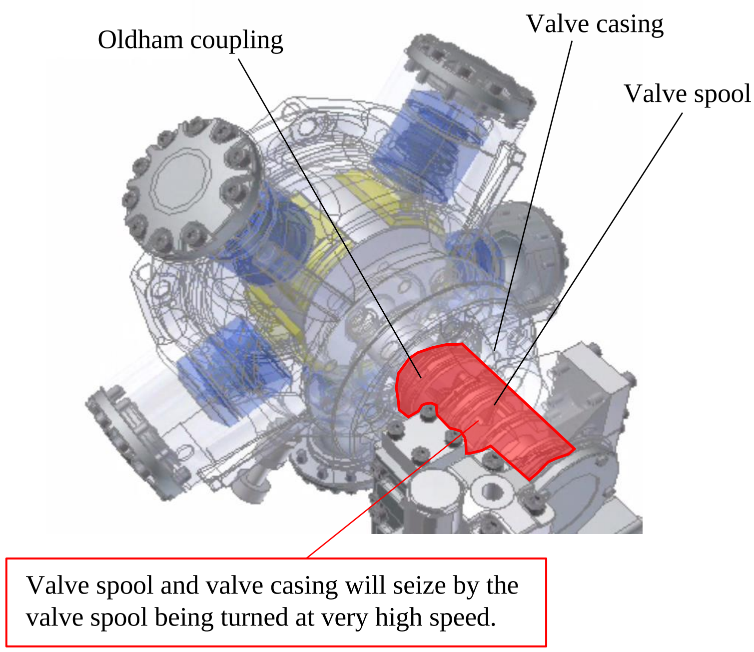
Cross-sectional view of hydraulic motor

(Reference)



Internal view of hydraulic motor

“Deformation and damage of retaining ring”



Internal view of hydraulic motor

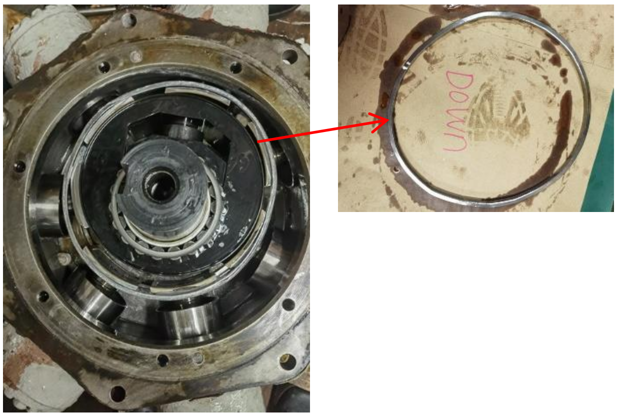
“Seizure of valve spool”

KAWASAKI HEAVY INDUSTRIES, LTD.
PRECISION MACHINERY BUSINESS DEVISION
CUSTOMER SERVICE DEPARTMENT

2021.11

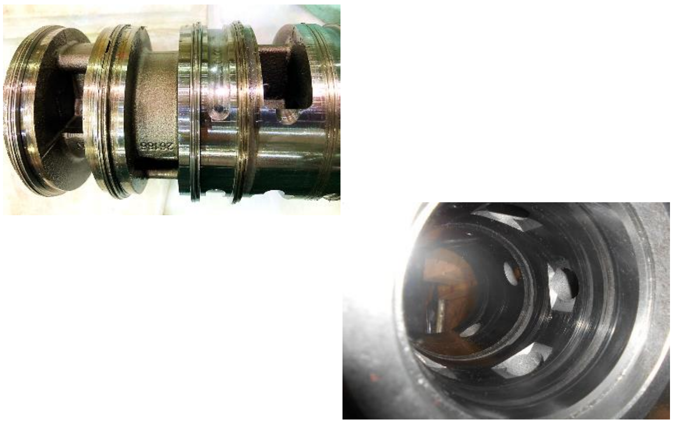
Technical information
Damage to the windlass due to excessive external force

Damaged internal parts



Deformation of the retaining ring

Damaged oldham coupling



Seizure of valve spool and valve casing

Damaged piston

Deformation of the spring of the replenish valve

KAWASAKI HEAVY INDUSTRIES, LTD.
PRECISION MACHINERY BUSINESS DEVISION
CUSTOMER SERVICE DEPARTMENT

2021.11