

# HYDRAULIC HAMMER BREAKER



## Operator's Manual

***MechMaxx***

[www.mechmaxx.com](http://www.mechmaxx.com)



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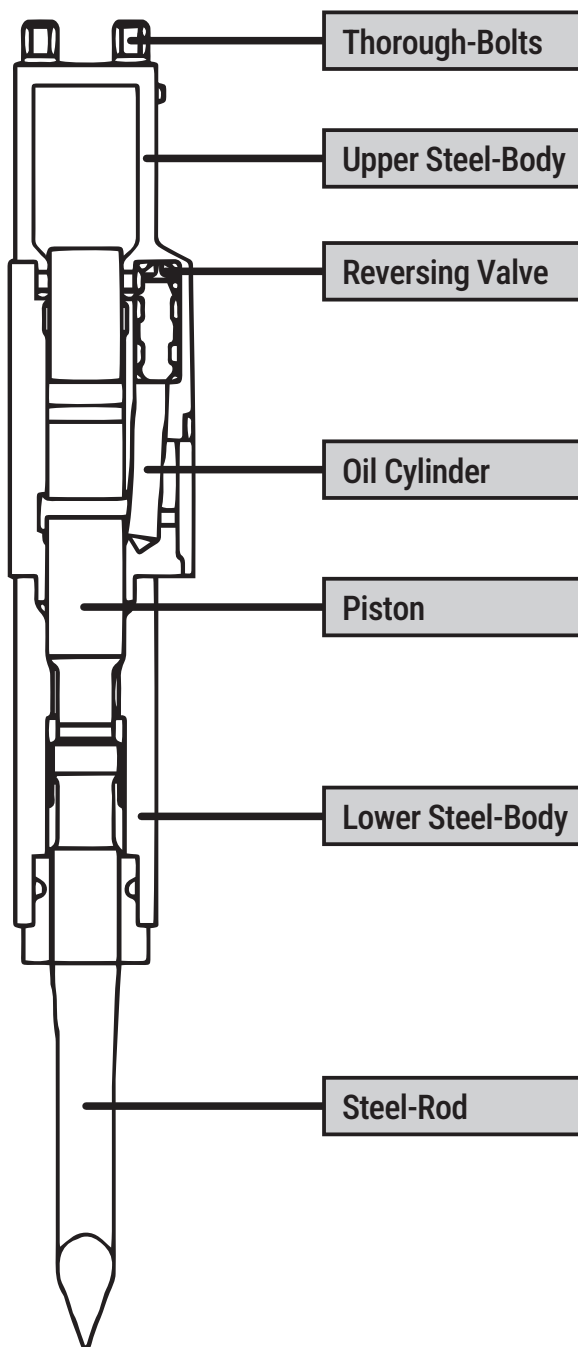
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## SPECIFICATIONS

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Specifications	
Working Pressure	8-10 MPa
Working Flow Rate	2.6-7.9 GPM
Rate	500-1200bpm
Hose Diameter	1/2 in
Chisel Diameter	1.38 in
Gross Weight	206 lbs
Packing Size	29 x 16 x 21 in

## KNOW YOUR MACHINE



### **Thorough-Bolts**

The four bolts connecting the upper steel-body, breaker cylinder and lower steel-body together.

### **Upper Steel-Body**

It is mainly used for storing nitrogen.

### **Reversing Valve**

It controls piston to move up and down at certain frequency.

### **Oil Cylinder**

As the heart of the breaker, it includes hydraulic circulating system to control reciprocation of the piston.

### **Piston**

It converts hydraulic kinetic energy into that of striking, to strike the rod for breaking purpose.

### **Lower Steel-Body**

It supports the oil cylinder and fixes the rod to prevent oil cylinder from being damaged due to the counter vibration force during striking.

### **Steel-Rod**

The rod has received special strengthening treatment to bear the friction from direct striking.

## SAFETY

- Any equipment may have danger due to any careless or improper operation of breaking hammer.
- Read and understand the warning message of this manual to avoid any injury. Should you have any enquiry, please consult your executive, Mechmaxx dealers, or A/S center.
- Safety is never anything to deal with warnings.
- You have to take into consideration the potential risks and how to avoid them when operating Mechmaxx breaking hammer.
- Never operate a breaking hammer if you are not very sure about operation.
- Never start or operate a breaking hammer unless you are sure of a safe and reliable environment.
- Never make a reckless operation before you are pretty sure of how to operate a Mechmaxx breaking hammer. Make a thorough check over the breaking hammer first.

### Warning



- Read carefully the following warning messages. These will make you aware of risk and how to stay away from it.
- Injury could happen if proper prevention is not rendered.

### Manual

- a) Read this manual carefully prior to installation, operation and maintenance; should you have anything not clear, please consult your executive, Mechmaxx dealers, or A/S center for detailed information.
- b) Please keep this manual clean.

### Overalls

- a) You must put on protective overalls to avoid any possible injury. Too loose clothes may be stuck into machine. E.g, you have to wear helmet, safety goggles, earplugs, safety shoes, fitted overalls, gloves and mask.
  - b) Never use a necktie or a scarf. Wind up your long hair.
- Hoisting equipment.
  - Injury may occur due to improper operation of a hoisting equipment.
  - Make sure the hoisting equipment is in good condition.
  - Make sure the hoisting equipment conforms to the local legal regulations and your operation requirements.
  - Ensure that there is enough performance strength with the hoisting equipment and understand how to use the hoisting equipment.

### Warning



- Read carefully the following safety messages. Neglect of the following safety practice will cause injury of operator or related personnel, and lead to errors with equipment.

### Laws and Regulations

- Use of the equipment should follow local laws and regulations.

### Practice

- You may cause serious injury to yourself or others if you start operation you are not familiar with without due practice.
- Practice on a piece of clean and flat ground, away from operating field.
- Make sure you are able to make safe operation for any new operation.

### Status of Equipment

- A breaking hammer with defect may result in injury to you and others. Never operate or use a breaking hammer with defect or any part missing.
- Follow the operation procedure of this manual strictly before use of this breaking hammer.

### Application Scope of Breaking Hammer

- Operation beyond the designed scope of breaking hammer is considered risky.
- Never operate a breaking hammer beyond the application scope.
- No refitting is allowed for the breaking hammer for purpose of improving performance, without permission.

### Message delivering

- a) Failure to deliver correct message may lead to an accident.
- b) Personnel should keep watch around where you are operating.
- c) Make sure your hand gesture can be understood while working with others.
- d) Remember that loud noise often stays on the operating field. Never give an order by talking to each other.

### Operating field

- a) Operating field is risky.
- b) Make an inspection to the operating field prior to any operation.
- c) Check if there is any pothole, anything not firmly fixed, or hidden stone, etc.
- d) Check and take care of the public facilities nearby the operation (like cables, air or water tubes, etc)

### Crushed rocks and fragments

- a) Fragments flying off during operation may hurt you.
- b) You must wear safety goggles.

### Hillocks and ditches

- a) Collapse may happen due to operation at a hillock or ditch.
- b) Never operate close to a hillock or ditch, which is risky and may cause a collapse.

### Safety fence

- a) It is very dangerous to operate in a public area without safety fence.
- b) Set safety fence around breaking hammer to keep people from getting close when operating in a public area or where operator cannot have a clear sight.



#### Caution

- Operate as required by safety regulations to avoid any potential risks.

### Caution



- Apply grease evenly to the breaking hammer when operating.
- Never operate the breaking hammer in water, which will cause malfunction.
- Take special care when lifting and delivering.

### Maintenance

- Never attempt any repairing or maintenance that you are clear of.
- Never make any repairing or maintenance over breaking hammer without permission. Otherwise, injury or damage may occur. Contact your MechMaxx center for consultation before any repairing or maintenance over a breaking hammer.

### Accumulator

- Some redundant high-pressure enters the accumulator when breaking hammer is working.
- The accumulator can compensate the pressure required for breaking hammer even if hydraulic loop is in lack of pressure.
- Never attempt to dismantle accumulator before pressure is discharged. Otherwise, serious injury/damage may occur.
- Never attempt to dismantle accumulator with pressure.

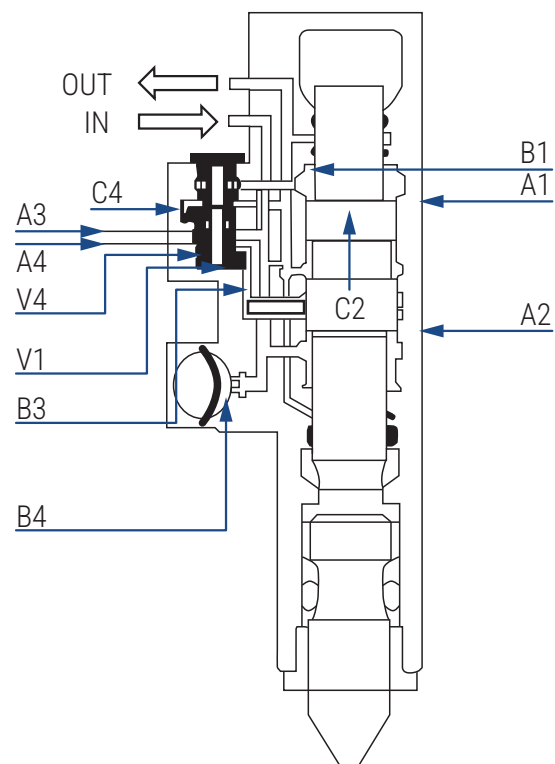
### Hydraulic system

- The pressure flowing in the hydraulic oil way is very risky.
- Turn off engine and discharge the remaining pressure inside the tube controlling operation before dismantling and connecting hydraulic oil tubes.
- People concerned should keep away from hydraulic oil tubes while breaking hammer is working

### Operating Principle

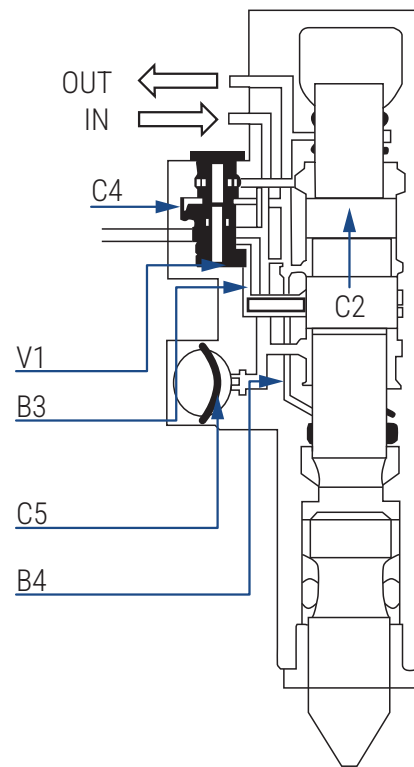
<Relation between pressure actions>

Pressure A1 in the back cavity of piston is greater than that of A2 in the front cavity; high-pressure oil always acts on cavity A2. When oil pressure is working, the pressure of A1 goes drops from a higher level, and vice versa. Piston C2 is therefore reciprocating. Similarly, high-pressure cavity A3 of valve <A4, then high-pressure oil continuously acts on cavity A3 and A4. Valve then moves to A4 and vice versa. The shift of valve C4 also changes pressure of piston's back cavity B1 from high-pressure side to the low one and vice versa. Valve C4 and piston C2 are having the same reciprocation. Besides, the upper body is filled with nitrogen. When piston moves backward, the nitrogen is compressed and air-energy is stored. When piston is working, the air energy is then converted into kinetic energy of piston.



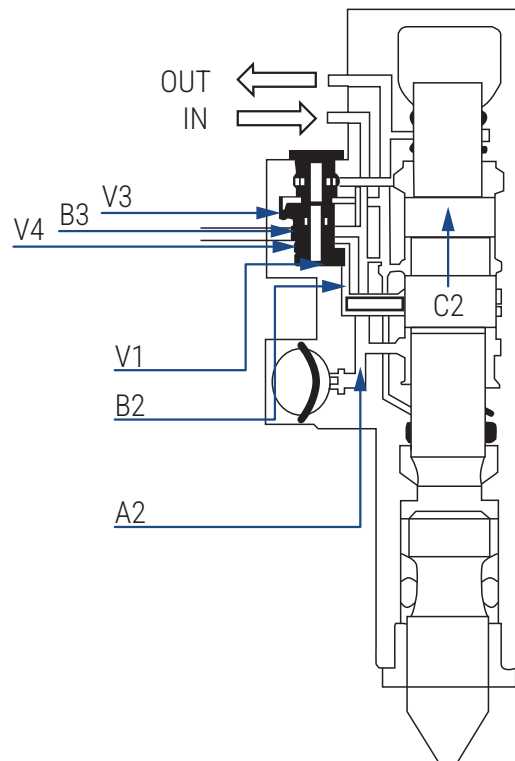
<Piston startup>

When high-pressure oil flows into the intake "IN" of hydraulic braking hammer, high-pressure oil will act on the front cavity A2 of piston. High-pressure cavity V1 will then control the valve. And when back-cavity B1 is connected through "OUT" oil outlet and changed to low-pressure, high-pressure oil will act on the front cavity A2 of piston, and piston C2 will move backward. Meanwhile, the nitrogen in the upper body will then be compressed into air pressure and stored into accumulator C5.



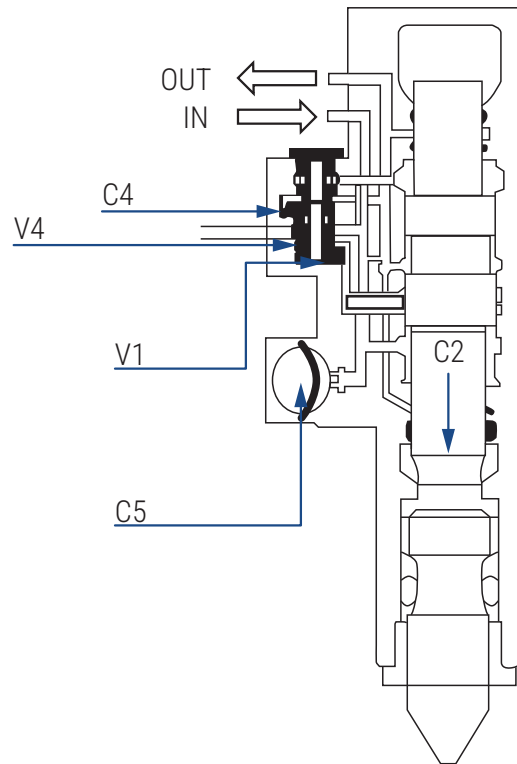
<Valve pressure filling>

When piston moves backward, back-cavity B1 is connected with valve shift-port B3, high-pressure oil will act on the change-cavity V4 of the valve to effect changes over the valve. In the mean time, back-cavity B1 is disconnected from low-pressure cavity V3 and is connected with high-pressure cavity of valve V1. The pressure inside back-cavity B1 will then be increased.



<Continuous striking of piston>

When piston C2 reaches the dead point at the top, the high-pressure oil from high-pressure cavity of valve V1 will continuously act on the back-cavity B1, which will make a continuous striking of piston; meanwhile, the energy stored inside accumulator C5 will then be converted into the energy of compressed air and enter the upper body. The effect of high-pressure oil of high-pressure cavity V1 and change-cavity V4 of the valve leads to the efficient turn-on of the valve.



**Precautions**

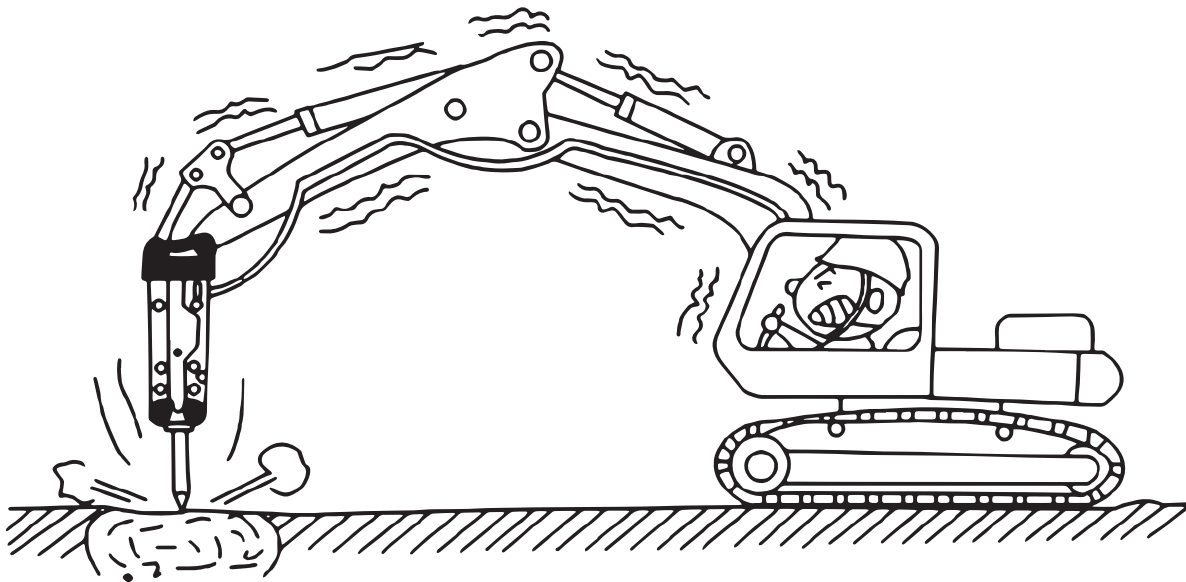
- Protective shield against fragments should be installed in front of the driver's cab to prevent from any injury/damage due to shivers during operation.
- All personnel on site, including excavator driver, must wear earplugs and face-mask during the course of operation.
- The driver should operate the breaking hammer by sitting on the seat. Breaking hammer can only be used when both excavator and breaking hammer are in normal state.
- In case anyone enters the dangerous area of operation, stop the breaking hammer immediately; compared with excavator, the breaking hammer in operation may cause more possible injury to people with the fragments flying off.
- Operate excavator as required by manufacturer's safe operation regulations when operating with a breaking hammer. Ensure to use a well-installed and properly adjusted breaking hammer.
- Never operate a breaking hammer when reaction is shown due to drinking alcohol or taking drugs.
- Ensure stable working conditions and lower operating device when conducting maintenance and inspection/repairing.

## OPERATION

### Proper Operation Mode

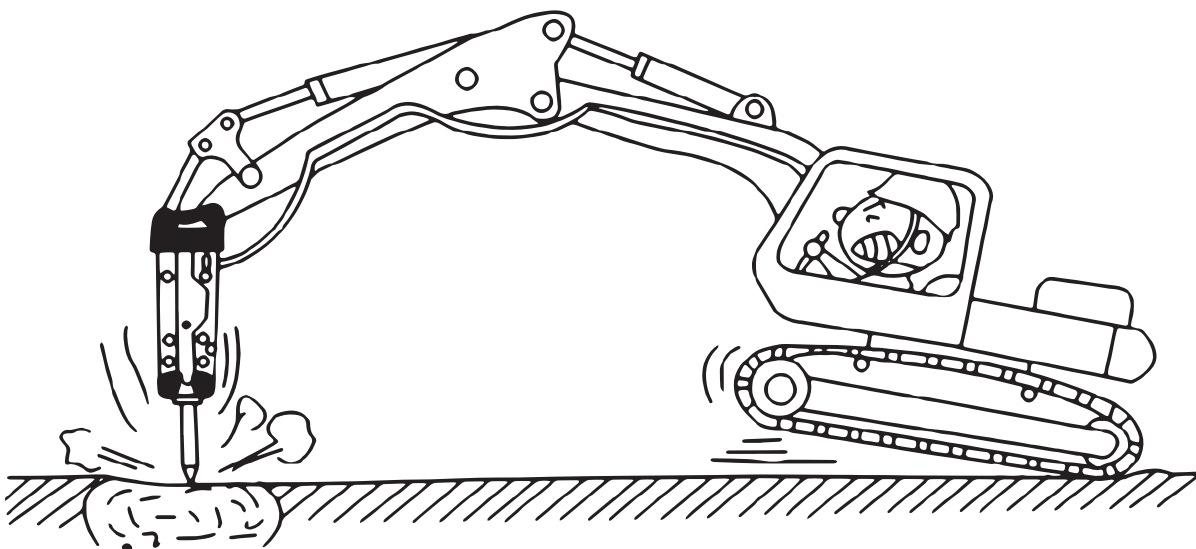
#### 1) Appropriate Breakdown Power

To effectively break down, breaking hammer should be used with appropriate breakdown strength. If the breakdown strength is not strong enough, the hammering energy of piston will not effectively crush stones; the counter force of this kind of hammering will be transferred to the hammer itself, the large and small arms of excavator, and will therefore damage these components.



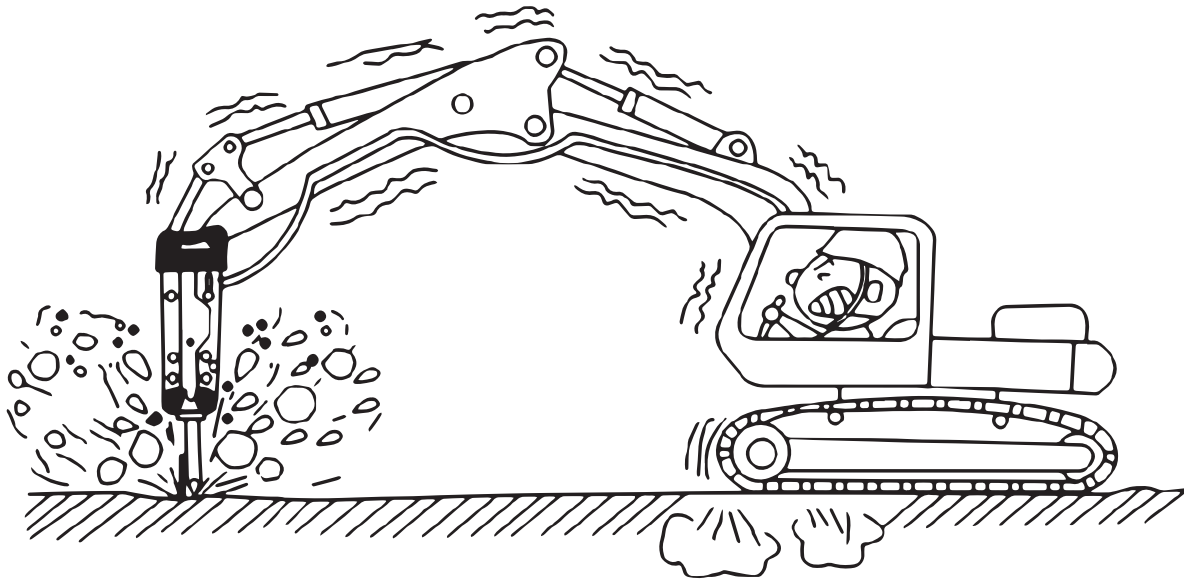
**FIG 3-1**

On the other hand, while lifting the large excavator arm, if using excessive breakdown strength during crushing operation, the machines may suddenly tilt during crushing stones, the fierce crash of hammer to the stones will cause severe damage to the hammer; if crushing under these circumstances, the vibration will spread to the caterpillar track of excavator, so in such a situation operation should be avoided in order to protect the track.



**FIG 3-2**

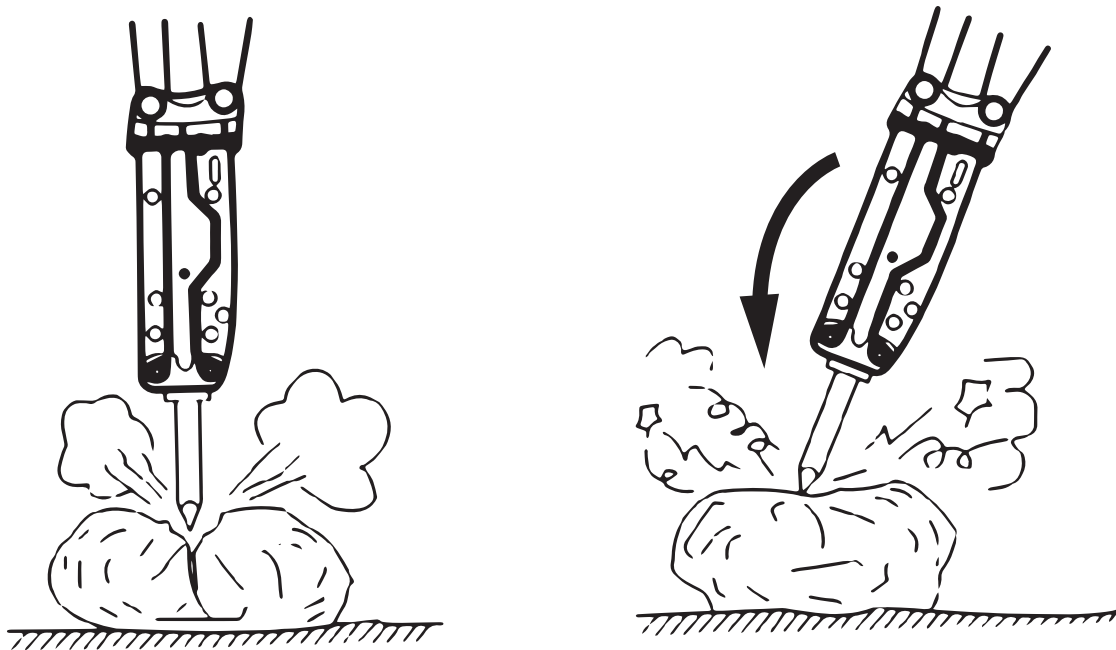
Therefore during striking period, attention must be paid to the breakdown strength of breaking hammer at all times. Do not operate if breakdown strength is not appropriate.



**FIG 3-3**

2) Breakdown Direction

Breakdown direction should be in a straight line with the steel-rod. When the steel-rod crushes rocks, it should maintain the vertical direction to carry on the work as much as possible. If hammering direction inclines, then during hammering operation, the steel-rod may slide, causing the steel-rod and piston broken or to get stuck. Therefore while carrying on crushing operation, breakdown points should be carefully chosen, in order to ensure the stable hammering.



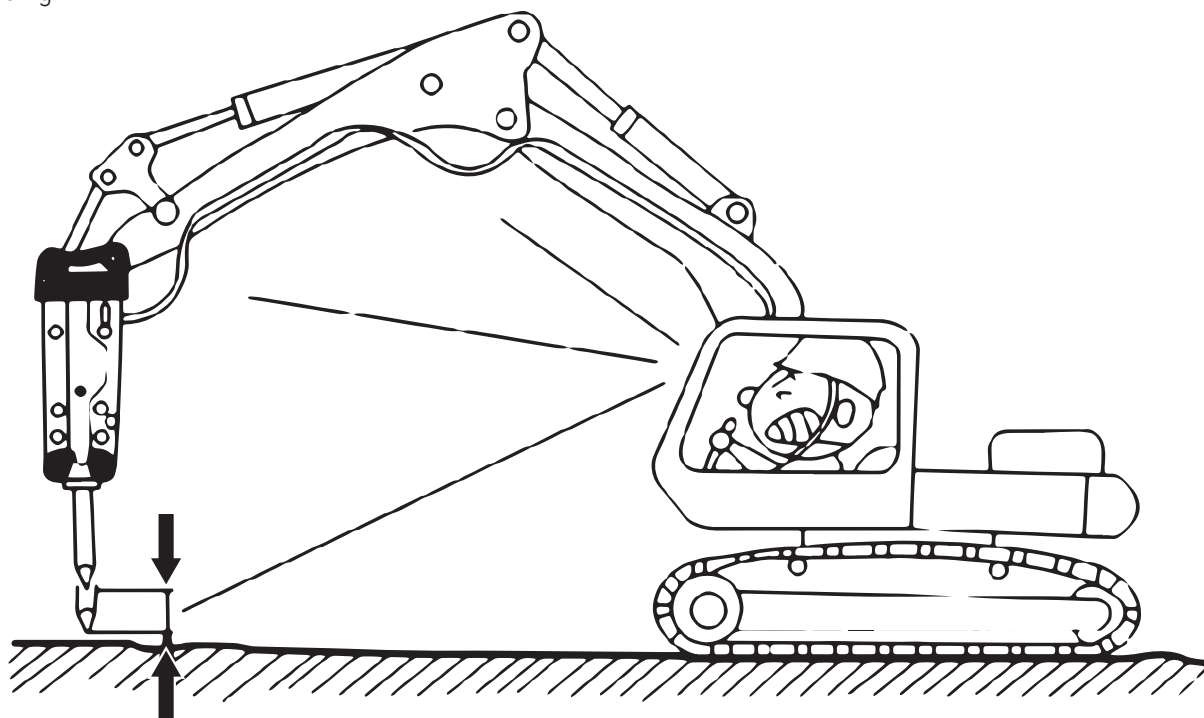
**FIG 3-4**

### 3) Precautionary Measures During Operation

During breaking hammer operation period, operators should pay attention to the followings:

a) Operation should be stopped if hoses are in severe vibration

Check if the vibration of high and low pressure hoses of breaking hammer is too drastic. If yes, it might be because the accumulator fails, you should immediately contact your local service office authorized by us to obtain repair service. You should further inspect if there is oil leaking at the hose joints, if so, re-tighten the joints. As illustrated by Figure 3-5, visual check if there is some allowance of the steel-rod during operation; if there is no allowance, it must be stuck in the lower body. Dismantle the lower body, check if the part needs repairing or the failed part needs replacing.



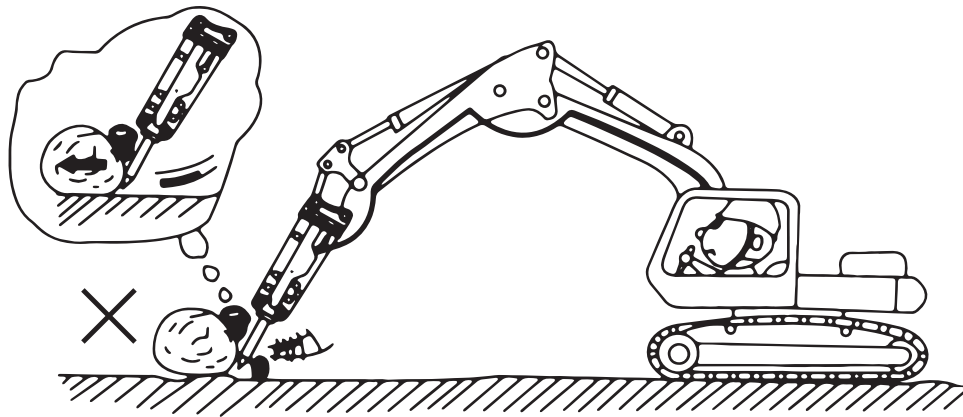
**FIG 3-5**

b) Stop operations (to avoid excessive empty strikes)

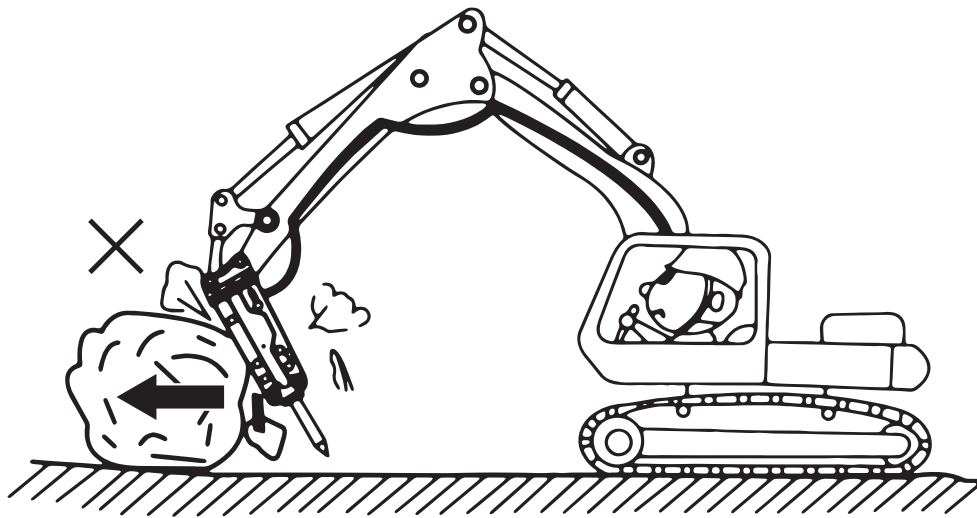
Stop hammering immediately once stones are crushed. If continuing the empty strikes, the accumulator might be damaged, bolts will be loosened or broken, even the excavator will be adversely affected. When using hammer with improper breakdown strength or using steel-rod as a pry bar, it will cause empty strikes. (The crushing sound will change when striking empty)

C) Breaking hammer can not be used to remove stones

As shown in Figure 3-6 and 3-7, do not use the end of steel-rod or the side of the support to roll or push stones. Because at that moment, oil pressure comes from large and small arms, bucket, swinging or sliding operations of excavator, therefore the large and small arms will be damaged. In the meantime, the bolts of breaking hammer may be broken, support may be damaged, and steel-rod may be broken or scratched; one should avoid using breaking hammer to move stones. In particular, excavator should never move when the steel-rod is inserted into the stones.



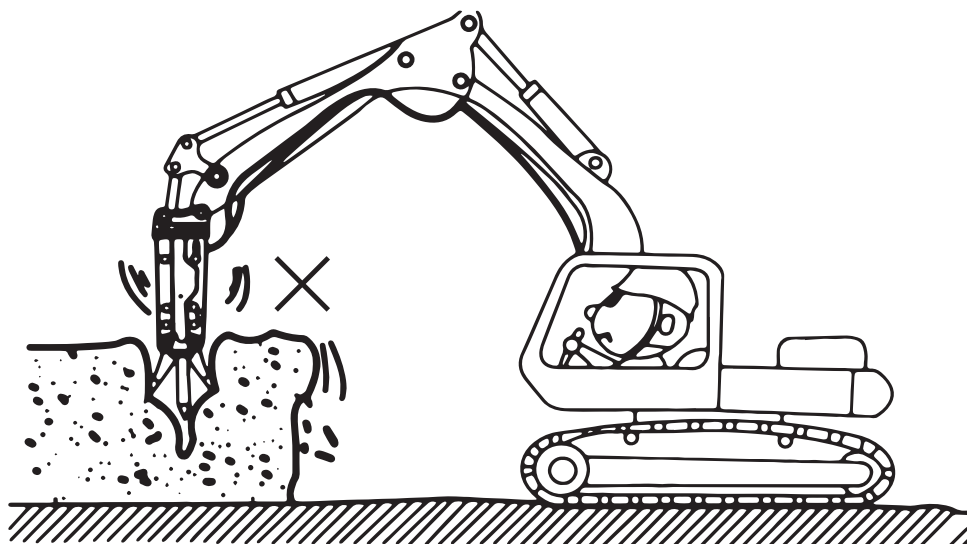
**FIG 3-6**



**FIG 3-7**

d) Never use steel-rod as a pry bar

As illustrated by the figure, if using steel-rod as a pry bar during crushing the stones, the bolts and steel-rod may break.



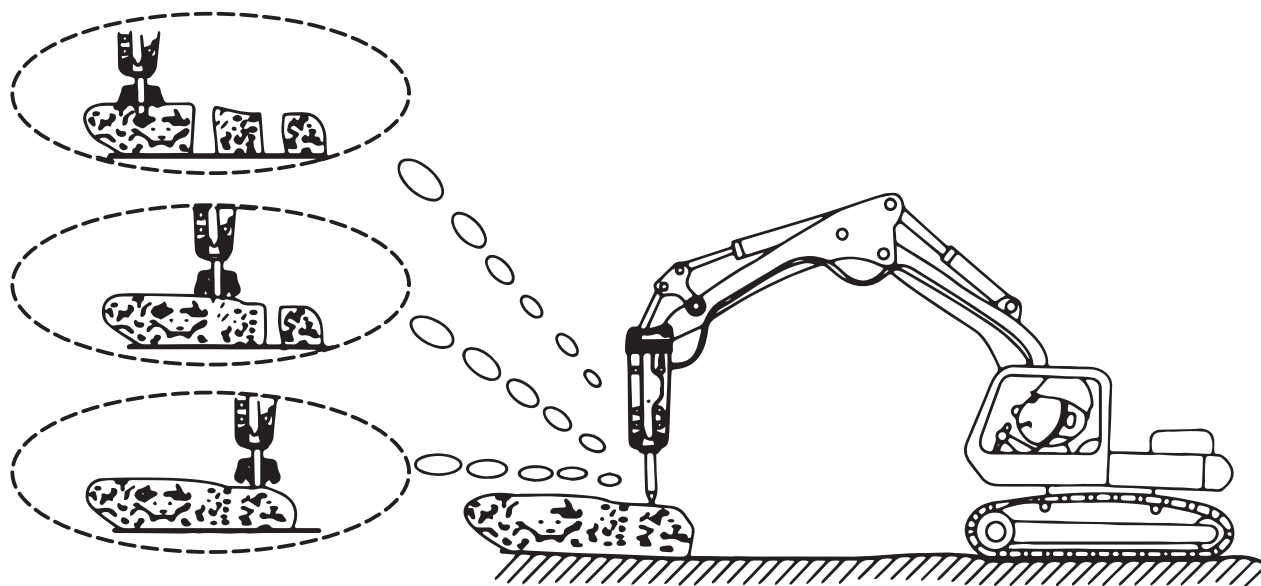
**FIG 3-8**

e) Do not strike continuously for more than one minute

When striking hard rocks, do not continue crushing the same place for over one minute, then change to another place. Prolonged operation will increase the oil temperature, which would lead to accumulator damage and excessive wearing of steel-rod.

f) For long and hard large stones, start crushing it from the end.

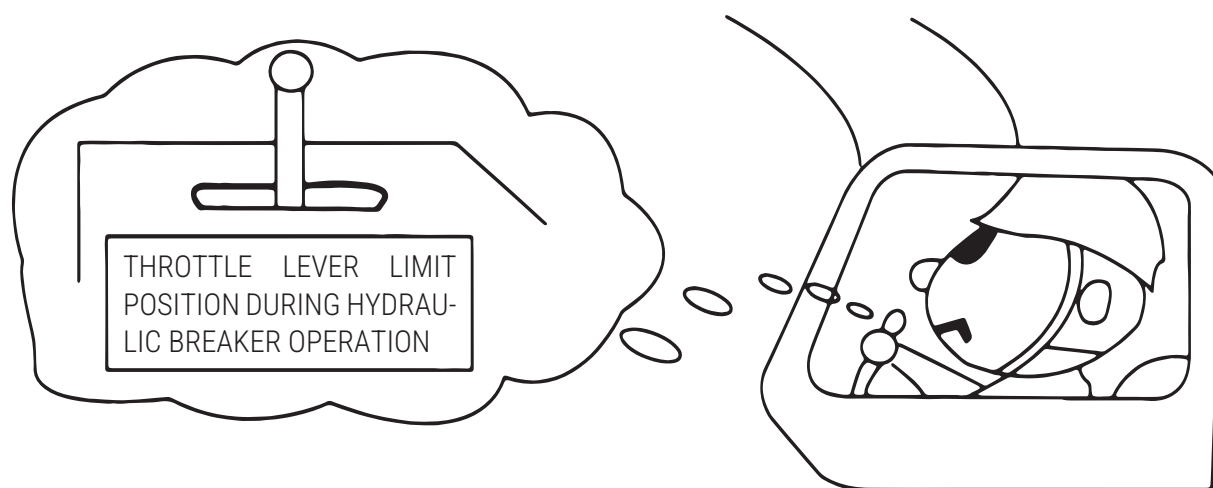
For those longer stones, one may start the crushing from cracks or their ends, which is relatively easy to break stones.



**FIG 3-9**

g) Breaking hammer should be operated at appropriate engine speed

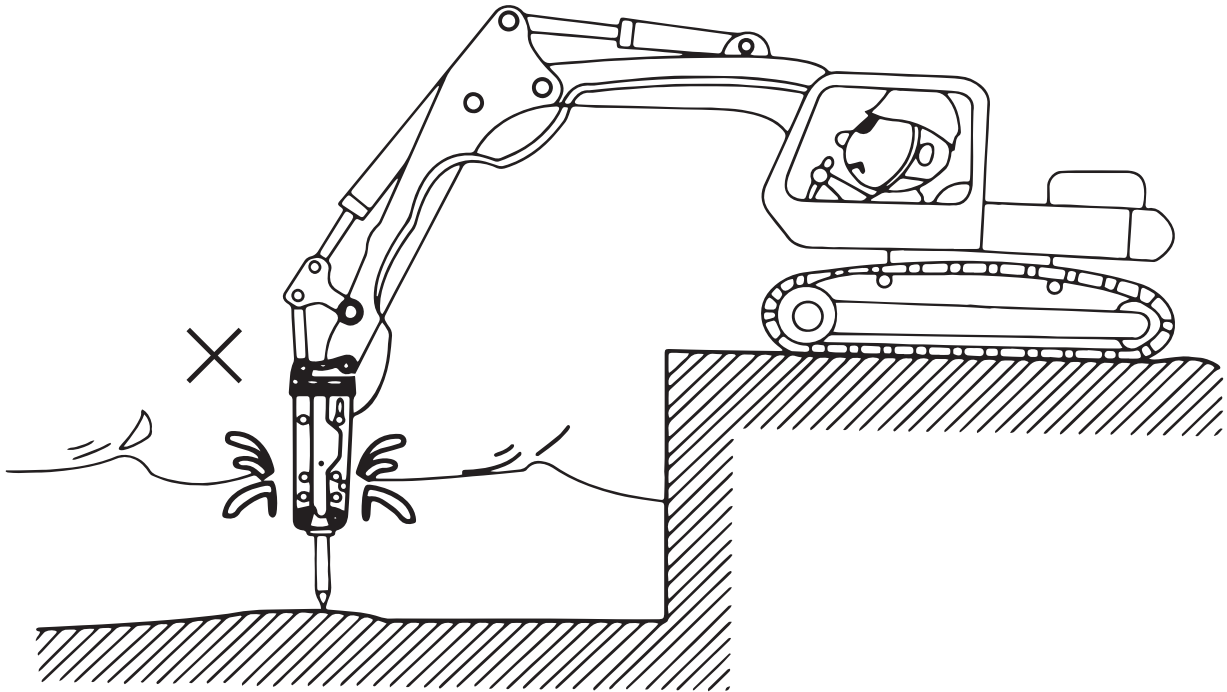
During crushing operation, the engine speed should meet the required value; the engine speed over the operation requirement will not increase breakdown strength, but the raised oil temperature will lead to damaging equipment.



**FIG 3-10**

h) Breaking hammer could not work in water or mud

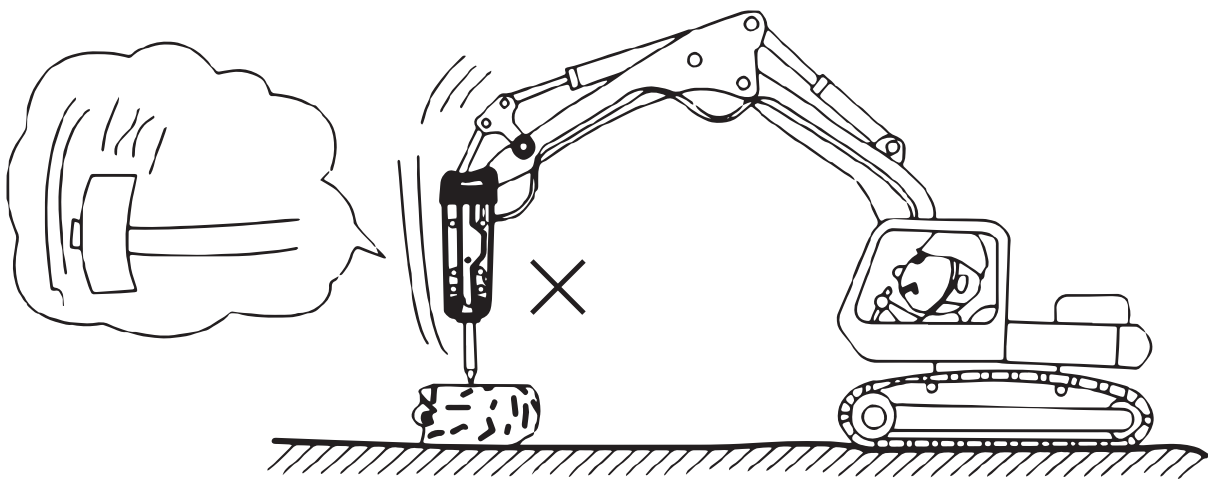
Do not use breaking hammer in water or mud; Otherwise, the piston or similar components may rust and lead to permanent damage. If in or under water operation is required, order special underwater breaking hammer.



**FIG 3-11**

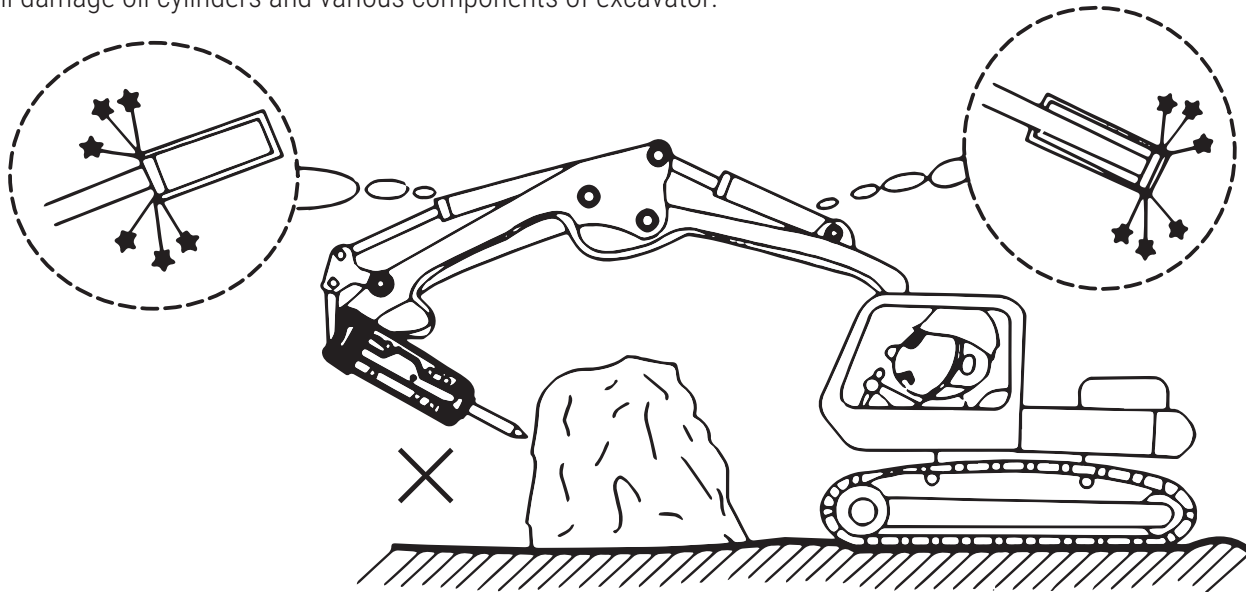
l) Do not allow breaking hammer to fall directly to crush stones.

If the breaking hammer falls directly to crush stones, hammer or excavator will bear too much power, which will easily damage excavator parts.



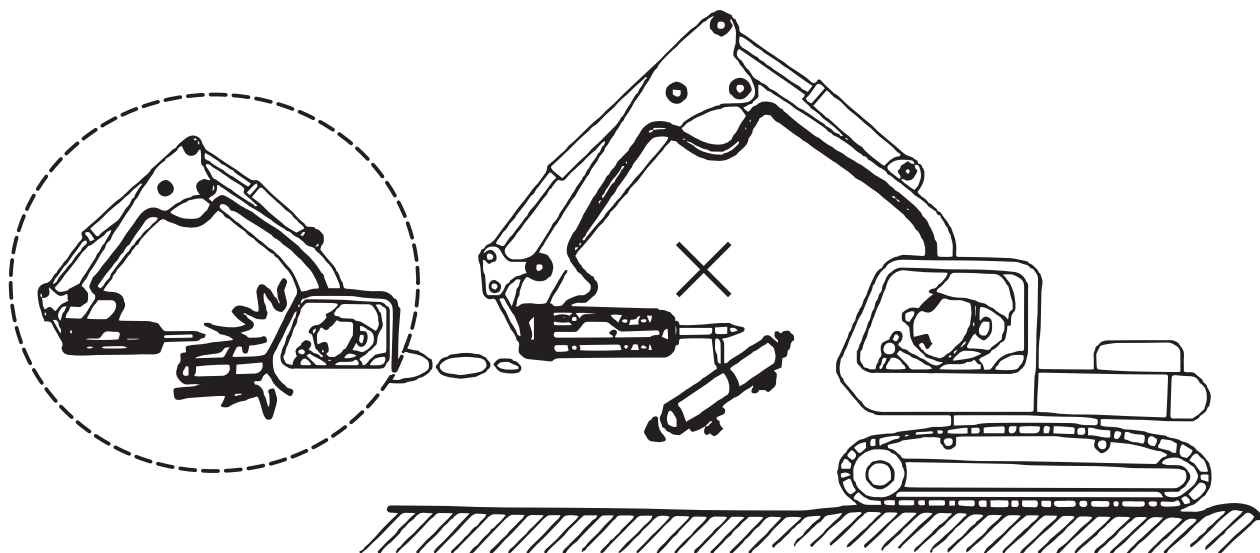
**FIG 3-12**

j) When oil cylinder rod on the excavator's large arm has its maximum stroke, do not start striking operation. When oil cylinder rod has its maximum stroke (rod is fully extended or retracted), if conducting crushing operation, it will damage oil cylinders and various components of excavator.

**FIG 3-13**

k) Do not use breaking hammer to hang objects

Do not tie ropes to the breaking hammer, supports and steel-rod to hang objects; this will easily damage the breaking hammer, supports and steel-rod, and this is also a very dangerous operation.

**FIG 3-14**

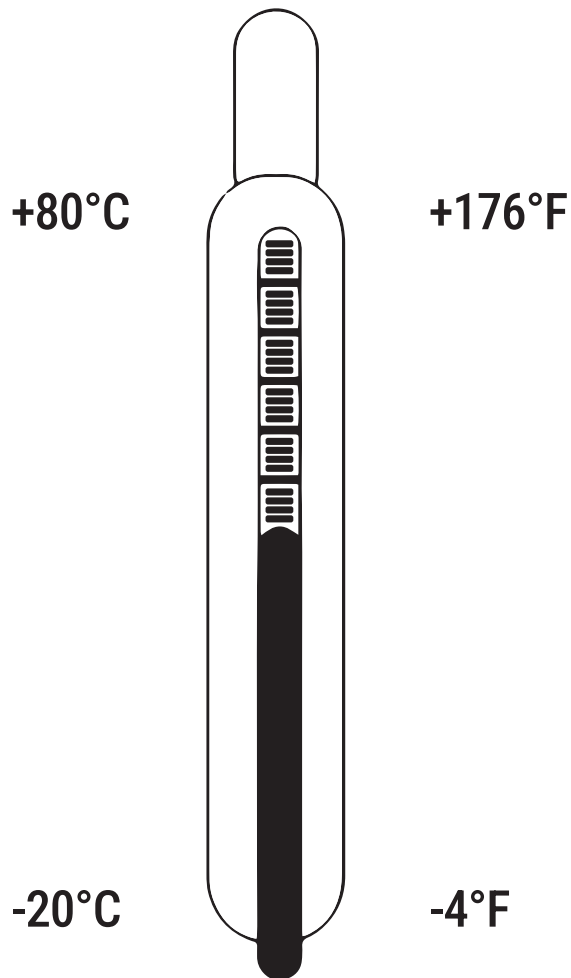
i) It is worth mentioning that in winter, the engine should be started for 5-20 minutes to warm up before operating the breaking hammer.

The engine should be preheated according to the maintenance instructions of excavator; if without engine preheating and operating crushing at low temperature, it could easily damage various parts of breaking hammer, such as piston and seals, etc.

### Operating Temperature

Operating temperature should be between  $-20^{\circ}\text{C}$ ~ $80^{\circ}\text{C}$  ( $-40^{\circ}\text{F}$ ~ $176^{\circ}\text{F}$ )

When temperature drops below  $-20^{\circ}\text{C}$  ( $-40^{\circ}\text{F}$ ), preheat the breaking hammer and steel-rod before hammer starts operations, in order to avoid damage to accumulator, rubber cup and steel-rod; breaking hammer must maintain a normal operating temperature during operation.



#### Important Notice

When the temperature is below  $-20^{\circ}\text{C}$ , and hydraulic oil is in the state of low temperature, hydraulic breaking hammer should not be put into use; otherwise, it will lead to hammer's oil seal broken and the high pressure of accumulator will tear up the rubber cup. Pay attention to relevant provisions of excavator manufacturers.

### How to Charge Nitrogen (N<sub>2</sub>)

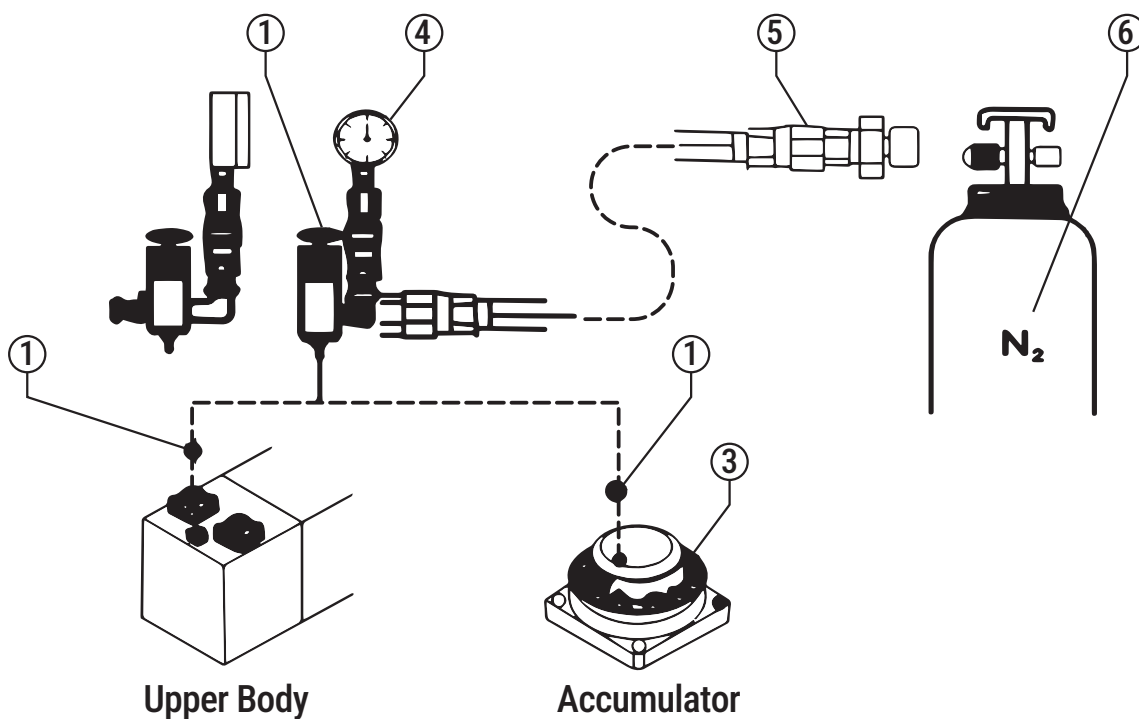
1. Connect the hose (5) on the nitrogen (N<sub>2</sub>) steel cylinder (6)



**Warning**

The accumulator can only be charged with nitrogen (N<sub>2</sub>). Charging other gas(es) is extremely dangerous, and the accumulator, the upper body can possibly explode.

2. Loosen the charging valve cap (1)
3. Accumulator, connect the upper body to the charging equipment
4. Tighten the triple valve switch (2) on the charging equipment
5. Rotate the regulator switch (3), and observe the charging pressure value displayed on the pressure gauge (4)
6. When the nitrogen (N<sub>2</sub>) pressure is less than or close to the stipulated value, please slowly rotate the regulator switch. (Warning: if there is no overflow valve in the charging equipment, the overflow air pressure is very dangerous.)
7. Tighten the triple valve on the charging equipment, the accumulator pressure value is 60 bar, and the upper body pressure value is 6 bar.
8. Tighten the nitrogen (N<sub>2</sub>) charging switch.
9. Adjust accumulator and upper body to appropriate pressure value.
10. Release the pressure inside hoses and charging equipment.
11. Please check if there is any gas leak, check if there is oil leak from charging valve.
12. Tighten the charging valve cap (1).
13. Give appropriate pressure value (bar).



## DISMANTLING & REASSEMBLING

### Dismantling and Reassembling of Steel-Rod

1) Dismantling

- a) Place breaking hammer at a flat working field
- b) Please confirm the gearbox of excavator is in neutral and has fully stopped.
- c) Turn off the engine.
- d) Use screwdriver to dismantle the rubber plug screw a
- e) Dismantle lock pin b of steel-rod
- f) Dismantle flat pin c of steel-rod
- g) Dismantle steel-rod d

2) Reassembling

- a) Clean and lubricate steel-rod and flat pin
- b) Install steel-rod d, flat pin c and lock pin b of steel-rod
- c) Check if flat pin c is locked tightly by lock pin b. Screw on rubber plug screw a

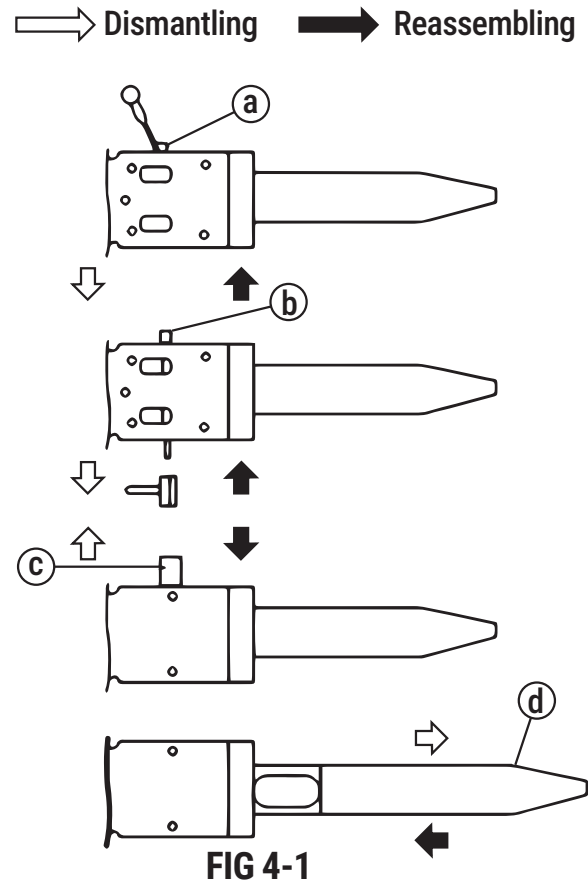


FIG 4-1



**Warning**

Do not attempt to disassemble or assemble the equipment until you have finished reading this chapter.

### Charging and Discharging of Nitrogen (N<sub>2</sub>) for Upper Body



**Warning**

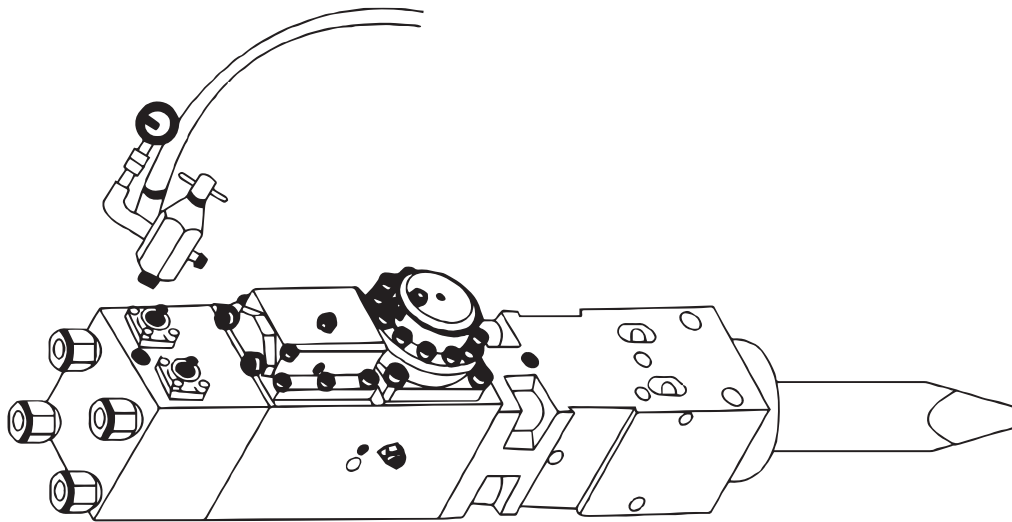
Never attempt to dismantle or assembly upper body.

1) Upper body nitrogen (N<sub>2</sub>) discharging

- Completely discharge the nitrogen (N<sub>2</sub>) in upper body. Otherwise it might explode if bolts are loosened.
- Observe the following charging steps.

2) Upper body nitrogen (N<sub>2</sub>) charging

- Install the charging joints of charging valve, connect N<sub>2</sub> steel cylinder and charge the upper body.
- Connect charging valve cap to the upper body



**FIG 4-2**

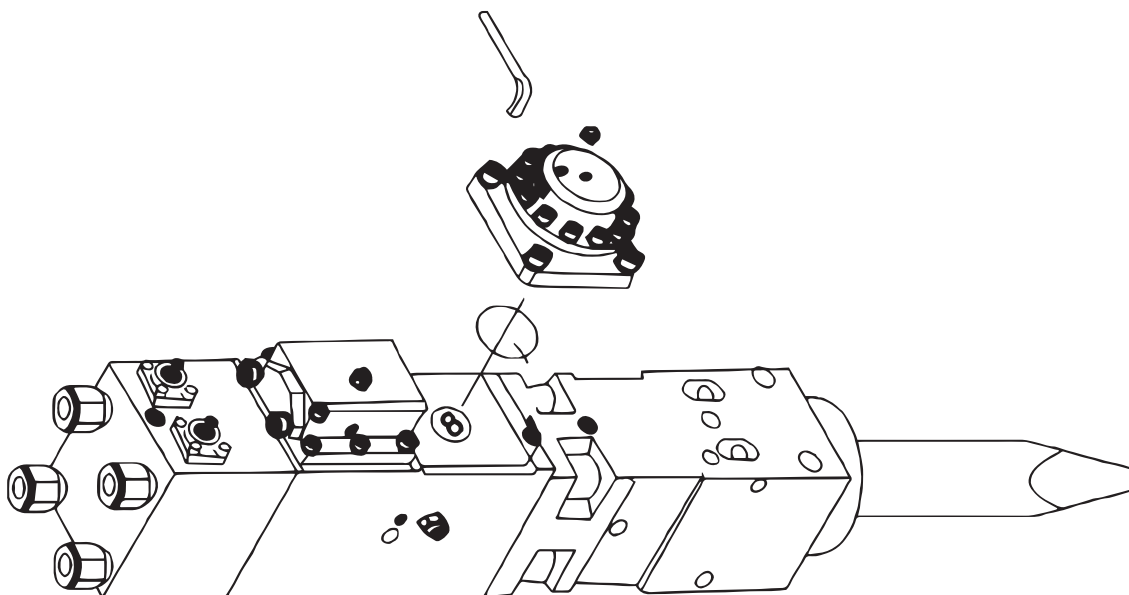
**Dismantling and Reassembling of Accumulator Ass'y**

1) Dismantling

- First, dismantle accumulator cap.
- Discharge nitrogen (N<sub>2</sub>).
- Place the accumulator ass'y flat as Figure 4-3, then use an inner hexagon spanner to dismantle them.
- Dismantle the O-ring.

2) Reassembling

- Fasten the O-ring.
- Use torque spanner with the torque strength of 600N.M to screw up all the inner hexagon bolts in diagonal direction.



**FIG 4-3**

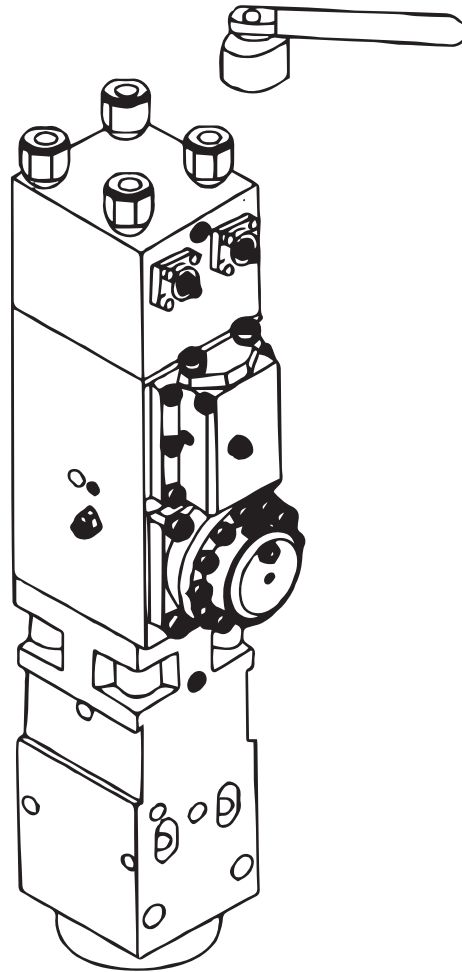
## Loosening and Tightening of Thorough-Bolts

### 1) Loosening

- To loosen the nuts of thorough bolts requires a strong spanner or percussion wrench. But once they get loosened, we can use hands to screw them off.

### 2) Screwing up

- First, clean thorough bolts and their contact surface.
- Grease the thorough bolts.
- When the thorough bolts are screwed halfway, use the same degree of torque strength to screw them up in diagonal direction. Screwing up the thorough bolts requires torque wrench.



**FIG 4-4**

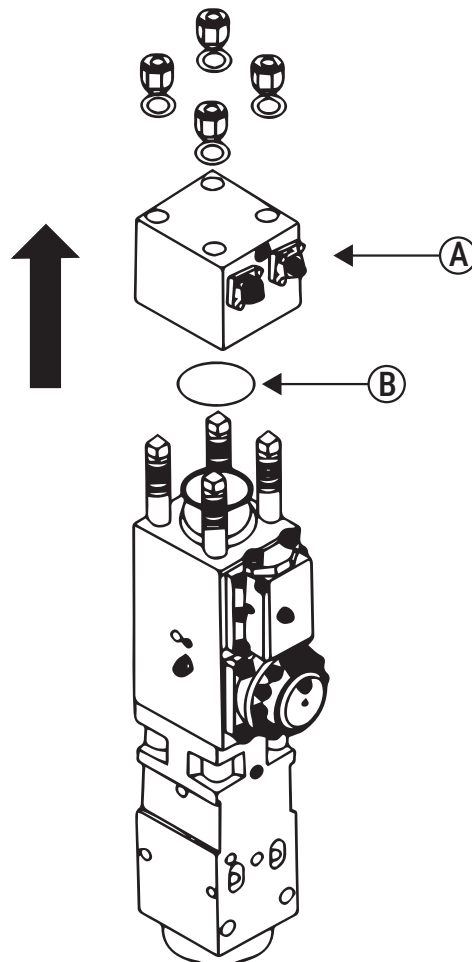
## Dismantling and Reassembling of Upper-Body

### 1) Dismantling

- Require crane/overhead trolley conveyor to dismantle the upper body-a
- Dig out O-ring-b

### 2) Assembling

- After greasing the O-ring of upper body, place it on the top of the oil cylinder, it should perfectly fit into b.
- Connecting the top of upper body and oil cylinder requires crane/overhead trolley conveyor a.



**FIG 4-5**

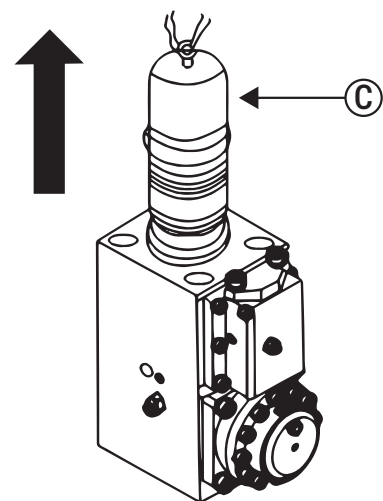
**Dismantling and Reassembling of Piston/Seal-Seat**

1) Piston and seal seat dismantling

- Use crane to vertically lift piston C. Choose position according to the conditions of working room.
- Vertically place the dismantled piston, use rubber hammer to slowly pound the seal seat from the bottom of the piston to the top, then dismantle it.

2) Piston and Seal Seat Reassembling

- Use crane/ overhead trolley conveyor to put piston C slowly into the oil cylinder
- Plastic or rubber hammer should be used to pound the seal seat to enter it into the rubber groove and completely inserted inside.



**FIG 4-6**

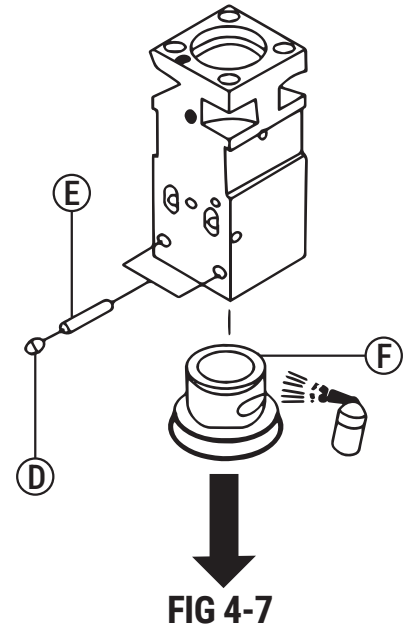
**Dismantling and Reassembling of Steel-Rod Under-Bushing**

1) Dismantling

- Dismantle rubber plug screw D
- Dismantle lock pin E of under-bushing
- Dismantle under-bushing F of steel-rod
- If the under-bushing is hard to dismantle, please heat the bottom of the lower body
- Check the degree of wearing of steel-rod and under-bushing.

2) Reassembling

- Clean all parts
- Spray supramoly over the contact surface between steel-rod under-bushing and the lower body
- Install steel-rod under-bushing F
- Install lock pin E of lower-body
- Install rubber plug screw D



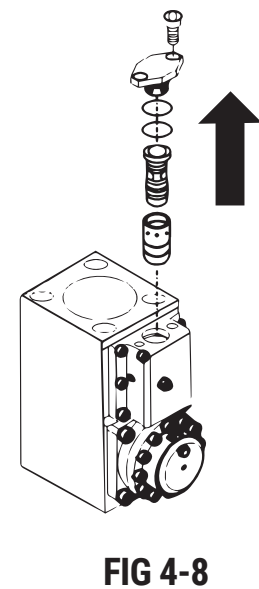
**Dismantling and Reassembling of Control Valve Ass'y**

1) Dismantling

- Dismantle bolt (M24)
- Dismantle the seal cap of control valve
- Dismantle the O-ring of seal cap
- Dismantle valve plug and valve

2) Reassembling

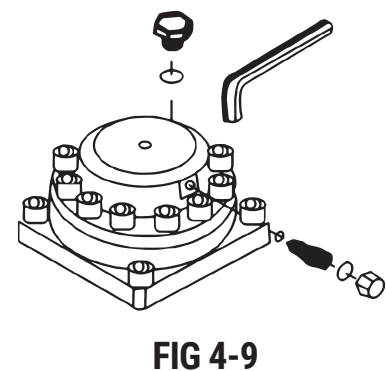
- Brush off the hydraulic oil on seal cap of control valve and insert it into the control valve.
- Grease the O-ring and place it in the seal cap.
- Use inner hexagon wrench to screw up the bolt of control valve cap.



**Dismantling and Reassembling of Accumulator Rubber-Cup**

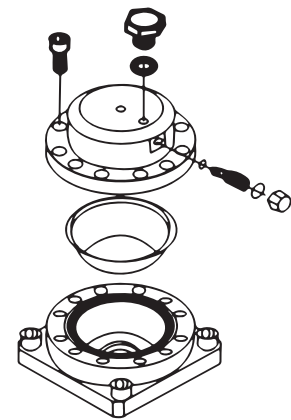
1) Dismantling the accumulator

- When dismantling the accumulator, nitrogen (N<sub>2</sub>) should be completely released before taking the next step.
- Fix the accumulator to the working table, then dismantle the charging valve, dismantle the charging valve with a sleeve ratchet-handle wrench of counter back-turning.



## 2) Rubber cup reassembling

- Place accumulator body on the working table, put it into the rubber cup, fix it closely to the edge of accumulator with fingers.
- Assembly accumulator seal cap, put the cap on the top of rubber cup, insert it and fix the bolts, use inner hexagon wrench to screw these bolts. Use torque wrench with the exact same torque strength to screw up the bolts in diagonal direction.

**FIG 4-10**

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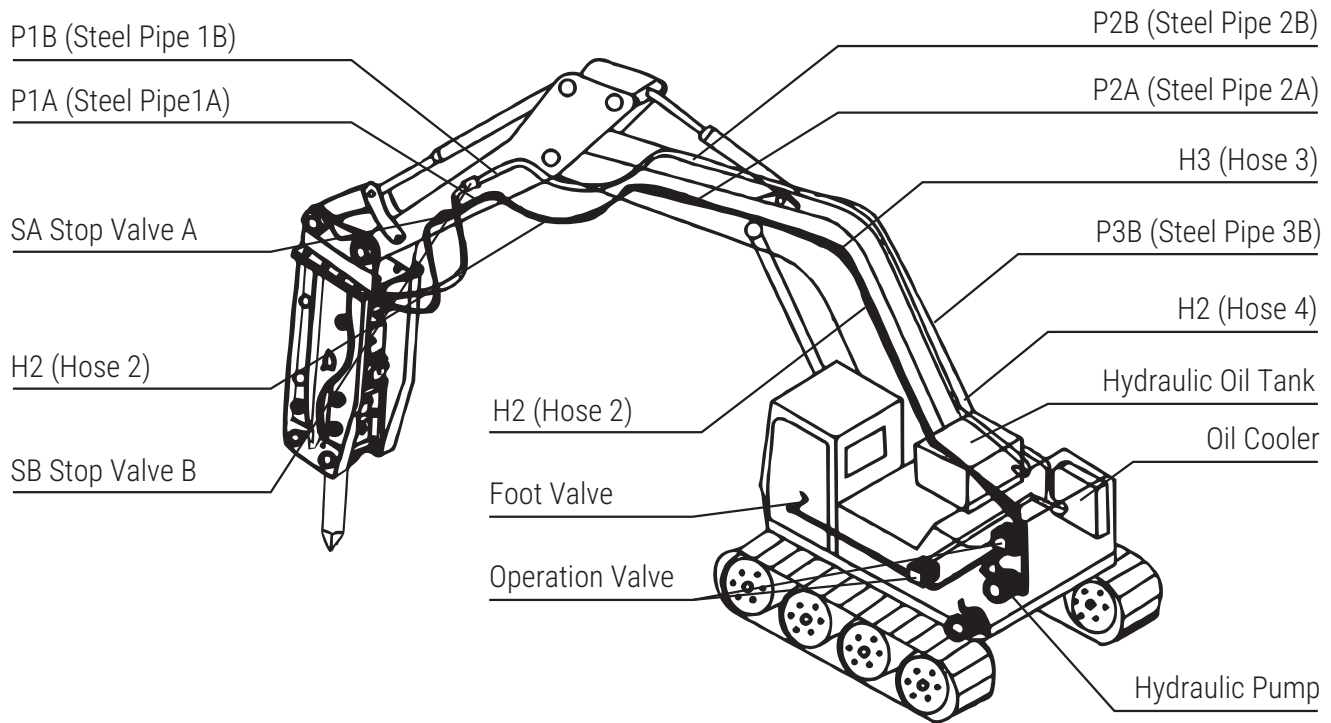
## INSTALLATION

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### Normal Installation

- Put the square shape wooden frame on the smooth ground, put breaking hammer on the wooden frame.
- Set up nitrogen pressure valve in the upper body according to the stipulated pressure value of the breaking hammer; if it requires to regulate all pressure values of breaking hammer, please contact our technical personnel or authorized personnel.
- If the breaking hammer has an accumulator, set up gas pressure in the accumulator to 60KG/CM.
- In the close state of stop valve of excavator, overflow valve should be regulated to control the set pressure of breaking hammer.
- If the excavator does not have an overflow valve for breaking hammer, please install one overflow valve to control the set pressure.
- Use two support shaft pins, tightening bolts and nuts and stop ring to install breaking hammer onto the excavator; during installation, use excavator carefully.
- Open stop valve, operate the breaking hammer after fully preheated.
- Check working pressure and striking frequency; if the striking frequency is relatively low, check the flow of working oil.
- Check if there is oil leak at the joints of hard hose and soft hose, if so, please screw them up or replace the sealing parts.
- Make sure to grease the steel-rod evenly, if necessary, grease it again.
- If excavator has quick connection system, the breaking hammer can be quickly installed to excavator as required by the manufacturer of quick connection joint.
- After completing all the above steps, please fill in delivery report and installation report and mail them to our company.
- The steps of dismantling the breaking hammer from the excavator are the exact opposite of the steps of installing.

**Installed onto an Excavator**

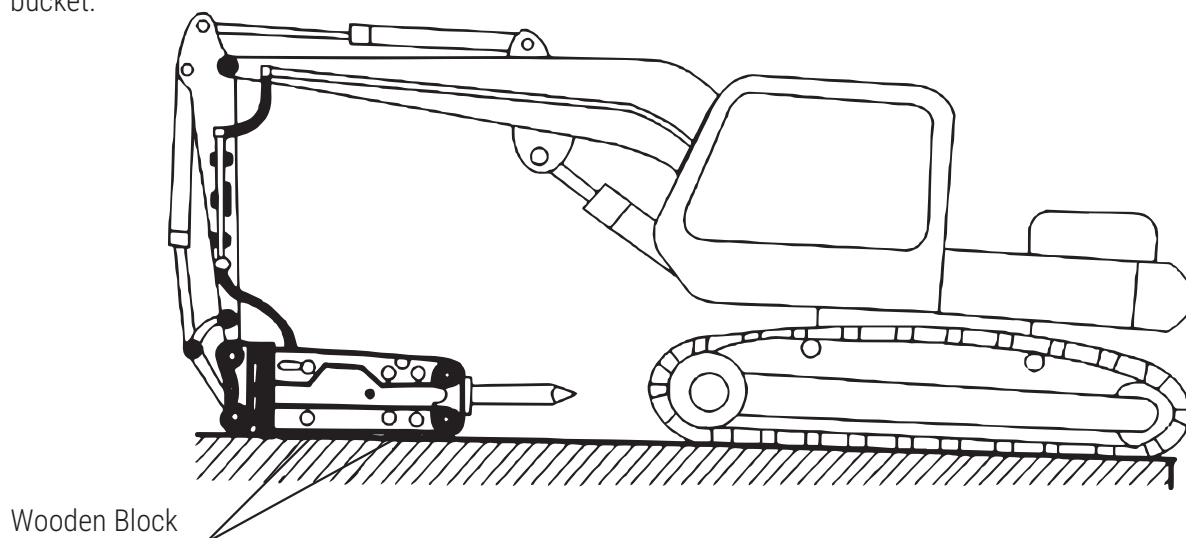


**FIG 5-0**

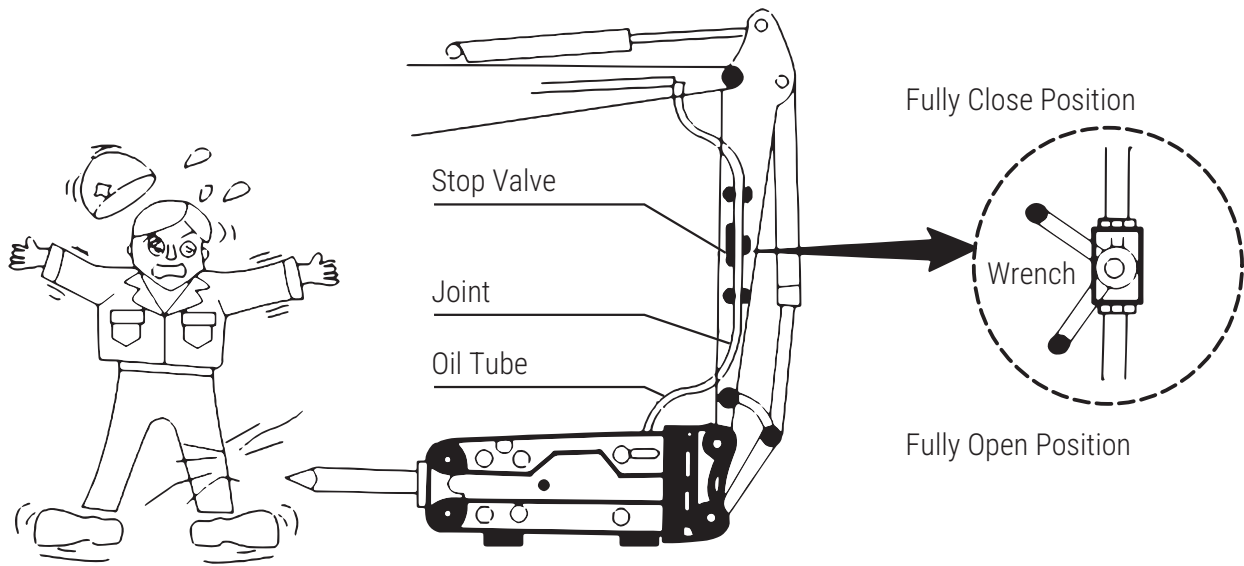
**Precautions for Installation**

When bucket and breaking hammer work in turns, the breaking hammer is connected to excavator with two hydraulic oil tubes and two shaft pins; therefore the bucket and the breaking hammer are very easy to replace each other. But impurities are very easy to be mixed into the hydraulic oil duct, so follow the steps below when disassembling and installing:

1) Choose a smooth and clean place, better in the repairing shop; after the excavator is driven in, turn off the engine and master switch. After that, if the pressure of excavator hydraulic oil tank is high, then release the pressed air in the tank. Then place the excavator according to Figure 5-1. This makes it very easy to replace breaking hammer and bucket.

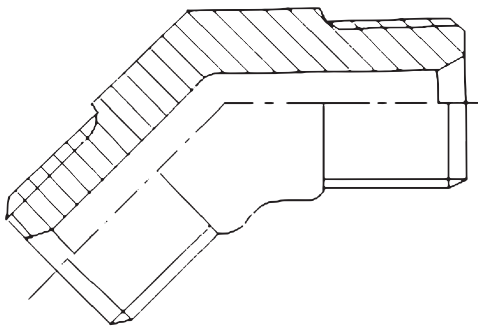


**FIG 5-1**

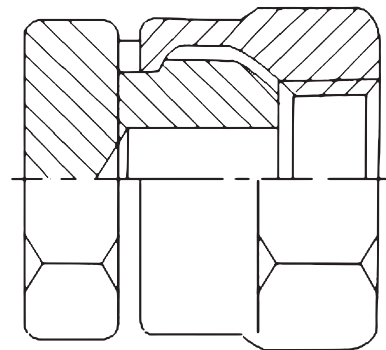


**FIG 5-2**

- 2) Rotate the stop valve at 90° which is installed at the end of the small arm to prevent hydraulic oil outflow.
- 3) Turn loose the hydraulic hose joints at the side of the small arm, at this time, there will be a small amount of hydraulic oil overflow, use an empty container.
- 4) To prevent mud, soil, dust and other impurities from getting into the tubing and joints, caps should be put on straight joints and 60° elbow joints and screwed up.

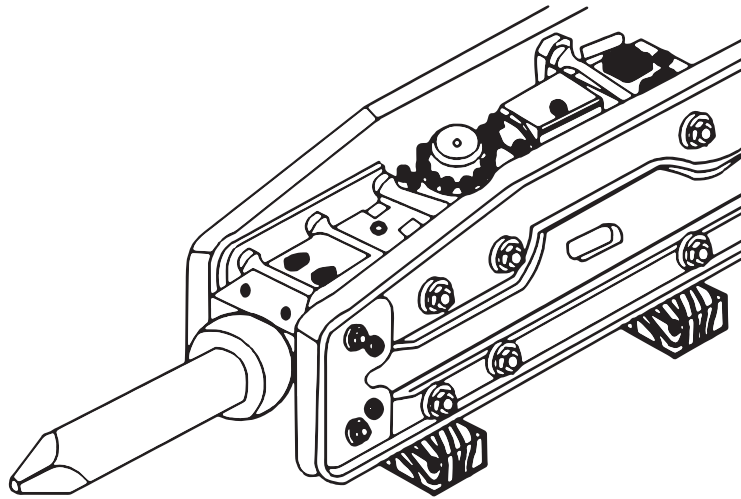


**FIG 5-3**



**FIG 5-4**

These joints are used to connect low pressure and high pressure hoses. While the bucket is working, use joint caps to cover the joints at the side of the small arm and prevent the dust.

**FIG 5-5**

5) Draw out the shaft pin that connects the bucket and the small arm, then dismantle the breaking hammer, replace the bucket and go back to work; when the hammer is placed outdoors, it should be cushioned with wooden blocks, and covered with canvas or similar waterproof fabrics. Furthermore, if the hammer is not going to be used for a while, all parts should be cleaned and lubricated and then stored indoors.

6) The steps of installing the breaking hammer are the exact opposite of the dismantling; clean the bucket or other operational hoses and joints if they are dirty; please use authorized or recommended light oil or detergent for the cleaning.

## MAINTENANCE

### Routine Inspection

Before operation, please confirm the following points have been checked.

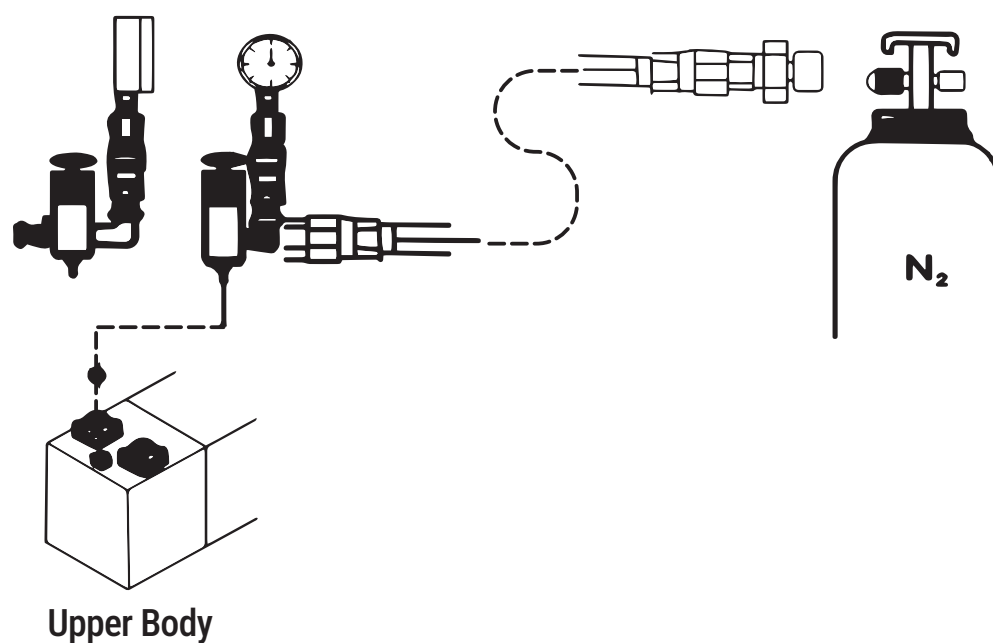
Check Items	Check Points	How to Maintain
Loosening or Loss of Bolts and Screw Caps	<ul style="list-style-type: none"> <li>• Main Body Screw</li> <li>• Guard Plate Screw</li> </ul>	<p>Check if it is loose Screw up the bolts again</p>
Hose parts are loose, hose damaged and oil leaking	<ul style="list-style-type: none"> <li>• Oil pressure duct of breaking device</li> <li>• Oil pressure hose</li> </ul>	<p>Re-screw up the loose parts Replace the severely damaged parts</p>
Abnormal oil leakage	<ul style="list-style-type: none"> <li>• Connection part of back body and oil cylinder</li> <li>• Front body and steel-rod</li> </ul>	<p>Please contact your local sales or service offices</p>
Abnormal steel-rod wearing and damage.	<ul style="list-style-type: none"> <li>• Steel-rod</li> </ul>	<p>Damaged, broken or worn-out steel-rod should be immediately replaced or repaired. The excessively damaged steel-rod should be replaced and should not be used again.</p>
Lubrication	<ul style="list-style-type: none"> <li>• Lubricate with lubricant both before work and after working continuously for two and three hours each time.</li> <li>• Pour lubricant five to ten times</li> </ul>	<p>Pour lubricant from lubricant input hole of front body</p>
Volume and contamination of hydraulic oil	<ul style="list-style-type: none"> <li>• Conditions of hydraulic oil</li> </ul>	<p>The quality change of hydraulic oil varies with different working environments. The simplest way to judge the quality change is to observe the oil color. If the quality deterioration is severe, please get rid of the oil from the tank immediately and after cleaning the tank, fill new hydraulic oil.</p>
Loss of rubber pin and fixing ring	<ul style="list-style-type: none"> <li>• Rubber Pin</li> <li>• Buckle</li> </ul>	<p>Immediate repairing should be made to avoid risk.</p>

### Precautions for Delivery

As hydraulic pressure breaking hammer is delivered out of the plant, its upper body has no N<sub>2</sub> filled. Once its upper body is filled with N<sub>2</sub>, the piston's front part will stretch out of cylinder. In such a case, the piston will get rusty as breaking hammer is idling for a long time.

**Warning**

When delivering breaking hammers, the following steps should be taken for filling its upper body with N<sub>2</sub> and operating it.

**FIG 6-1**

### Check Nitrogen (N<sub>2</sub>)'s Refilled into Upper Body

**Warning**

Prior to filling N<sub>2</sub>, check equipment surroundings to ensure its safety, and upper body does not allow filling of other gas, except N<sub>2</sub>. As upper body is filled with N<sub>2</sub>, do not get close to the front part of steel-rod. When finished, the steel-rod of breaking hammer will stretch out automatically.

- 1) Connect a pressure gauge with triple valve, then turn the handle of triple valve anti-clockwise.
- 2) Connect charge hoses with nitrogen cylinder.
- 3) Dismantle plug screw from breaking hammer, then install triple valve on the charge valve of upper body. (Ensure triple valve is installed with O-ring.)
- 4) Connect the other end of charge hose to triple valve.
- 5) Turn upper valve handle of anti-clockwise to discharge N<sub>2</sub>, then slowly turn the handle of triple valve clockwise to the set charge pressure.
- 6) Turn the handle of triple valve counter-clockwise to close, then turn the valve handle of nitrogen cylinder clockwise to turn off N<sub>2</sub>.
- 7) Charge hose dismantled from triple valve should be covered with its cap.
- 8) Turn the handle of triple valve clockwise, and check the charge pressure in upper body again.

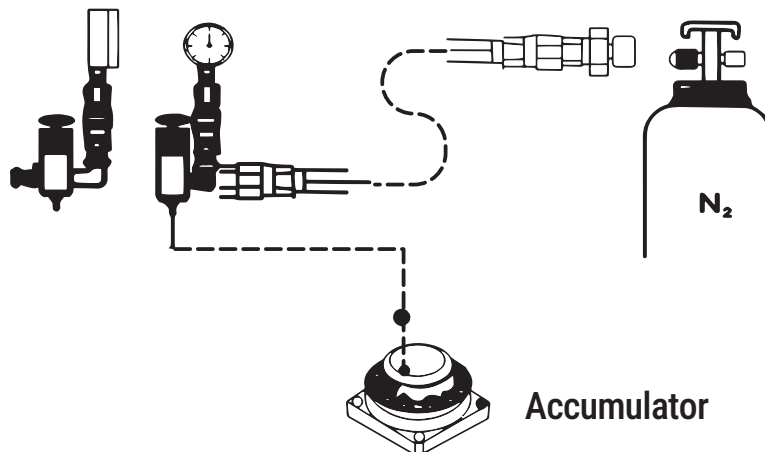
**Notice**

When finishing gas filling for upper body based on Step 1-8, turn the handle of triple valve anti-clockwise first, and remove the triple valve of charge valve of upper body later. However, if pressure in upper body needs to be regulated, the next Step 9-13 should be taken.

- 9) Remove charge hoses from triple valve.
- 10) Install triple valve tightly on charge valve.
- 11) When turn the handle of triple valve clockwise, pressure value in upper body will appear on pressure gauge.
- 12) If N<sub>2</sub> pressure is a bit lower, Step 1-8 should be taken again till pressure rises to the set value.
- 13) If N<sub>2</sub> pressure is too high, turn the regulator of triple valve anti-clockwise slowly, with atmospheric pressure discharged out of upper body; when pressure gauge shows appropriate correct pressure value, close the regulator clockwise. Once pressure too high, breaking hammer can not work normally. Ensure atmospheric pressure conforms to the set pressure value, and ensure triple valve is installed with O-ring.

**Check N<sub>2</sub> filled into accumulator****Warning**

Accumulator can only be used for N<sub>2</sub>, and other gases are not permitted

**FIG 6-2**

- 1) Check charge pressure
  - (1) Install adaptor and pressure gauge to triple valve.
  - (2) Turn the handle of triple valve anti-clockwise.
  - (3) Remove the plug screw of accumulator and turn triple valve tightly.
  - (4) Turn the regulator (2) anti-clockwise slowly, and observe the charge pressure value indicated on pressure gauge.
  - (5) Ensure the charge pressure value, and tighten the regulator (2) completely.
  - (6) Loosen the regulator (2) to discharge N<sub>2</sub> in triple valve.
  - (7) Remove triple valve, and tighten plug screw and cap. (Ensure plug screw and cap is installed with O-ring.)
- 2) Fill accumulator with N<sub>2</sub>
  - (1) Check charge pressure based upon the above-mentioned same steps, then remove the cap of triple valve.
  - (2) Connect both ends of charge hose with triple valve and N<sub>2</sub> steel cylinder separately.
  - (3) Turn the handle of triple valve clockwise.
  - (4) Turn the valve handle of N<sub>2</sub> tank anti-clockwise to fill accumulator with N<sub>2</sub>.
  - (5) Tighten the regulator (2) entirely.
  - (6) Turn the valve handle of N<sub>2</sub> tank clockwise till tap is turned off.
  - (7) Loose the regulator of triple valve to discharge the rest N<sub>2</sub> in charge hose.
  - (8) Remove charge hoses out of triple valve and N<sub>2</sub> cylinder.
  - (9) Remove charge hose, then regulate pressure according to the method stated on Step 1 <Check charge pressure>.
  - (10) Fill accumulator with N<sub>2</sub>, check each screw hole, regulation valve, etc. on its main body to see if there is gas leaking.

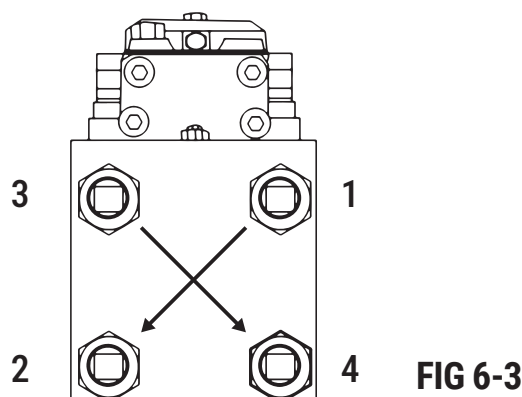
**Check and Replace Fastening Bolts**



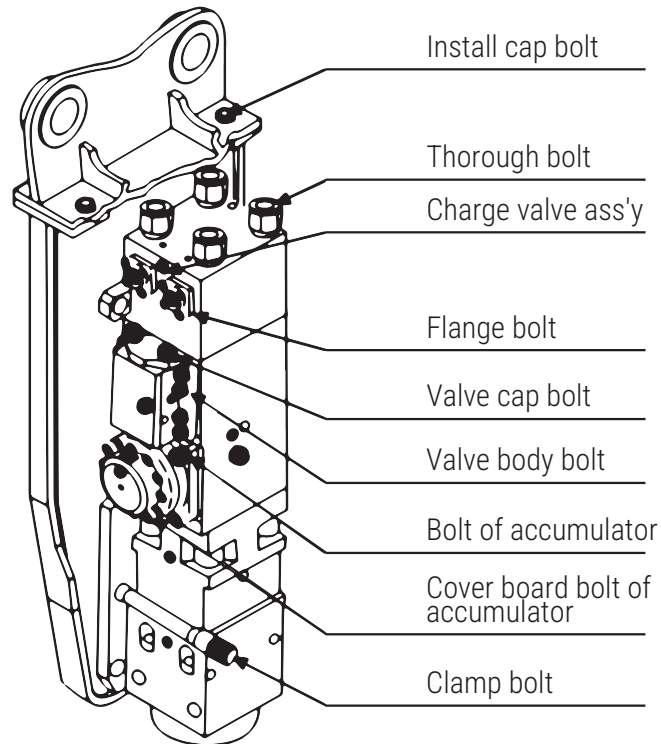
**Notice**

Prior to loosening fastening bolts, discharge all gas pressure in upper body Entirely. Otherwise, when fastening bolts are removed, upper body will spring out and lead to severe consequences.

- 1) Before loosening the fastening bolts, discharge N<sub>2</sub> in upper body entirely.
- 2) Remove all fastening bolts and meanwhile check them whether cracked and damaged.
- 3) When fastening bolts are installed, tighten them at diagonal direction one after another, rather than tighten a bolt at one go.
- 4) Use the set spanning torque wrench, see the moment form at Section 6-4(2)



**Moment**

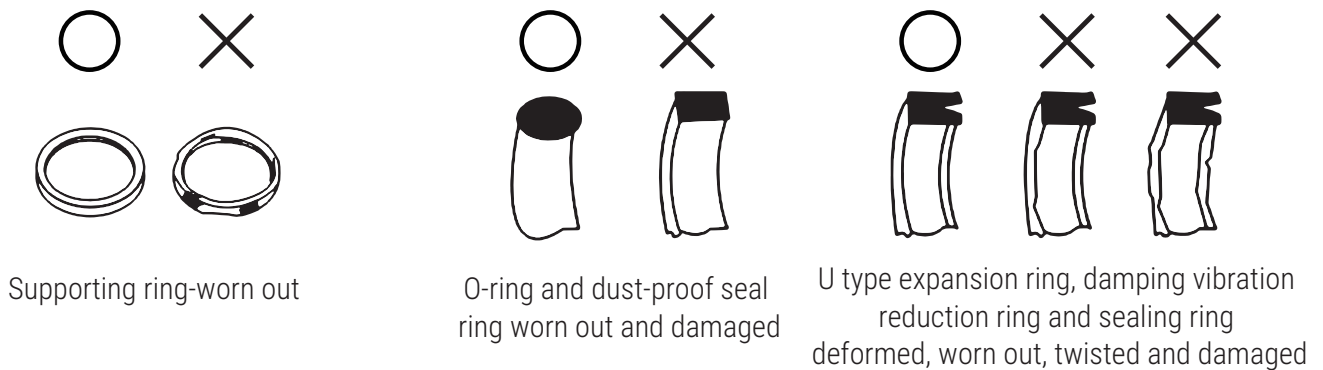


**FIG 6-4**

CLASSIFICATION	
Install cap bolt K.g.m (N.m)	225(2250)
Thorough bolt K.g.m (N.m)	150(1500)
Charge valve ass'y K.g.m (N.m)	35(350)
Flange bolt K.g.m (N.m)	20(200)
Valve cap bolt K.g.m (N.m)	60(600)
Valve body bolt K.g.m (N.m)	45(450)
Bolt of accumulator K.g.m (N.m)	60(600)
Coyer board bolt of accumulator K.g.m (N.m)	45(450)
Clamp bolt K.g.m (N.m)	250(2500)

**Check and Replace Sealing Elements**

1) Once hydraulic oil leaking is found with breaking hammer, change damaged sealing elements immediately. To clearly identify the damaged place of sealing elements, please see the picture blow:



**FIG 6-5**

- 2) When sealing elements is found damaged, causes must be trased and handled in time.
- 3) When exchanging sealing elements, apply grease on sealing elements and sockets, and tow by middle finger based on marks, grasp with thumb and insert the sealing socket tightly. Never use too much strength to deform sealing elements.



**Notice**

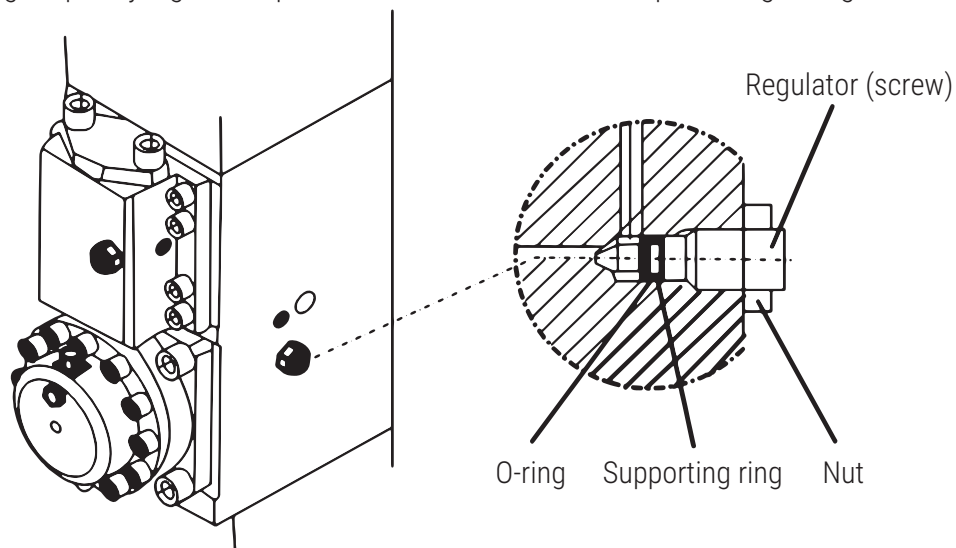
In actual work, sealing elements should be changed every 1000h.

**How to Reset the Striking Frequency**

Regulator that is used for regulating striking frequency is the authorized equipment for our breaking hammer. Striking frequency should be changed at any time as per work condition for a more efficient striking operation. And its basic theory is to regulate striking frequency through changing piston stroke, and at the same time, keeping work pressure and hydraulic oil flow unchanged. Regulator should be installed on the right side of oil cylinder of breaking hammer.

For regulating striking frequency, use wrench to remove the nut at the front part of regulating screw of regulator, and then revolve regulating screw to the inside bottom so as to get the lowest striking frequency, and at the time, turn the regulating screw externally 2 circles to get the max striking frequency.

After necessary striking frequency regulation, please install the nut at the front part of regulating screw to its original place and tighten it



**FIG 6-6**

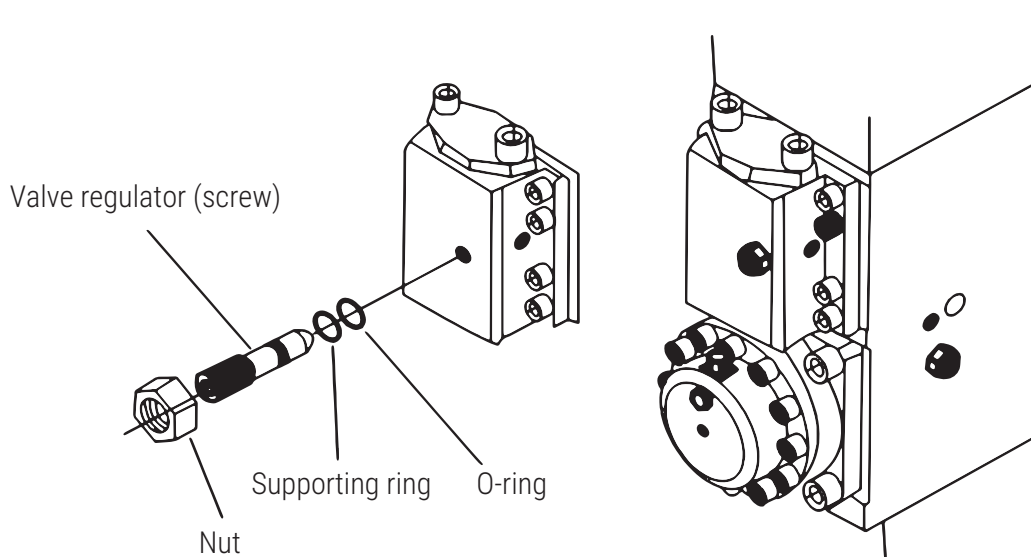
## Adjust Oil Supply with Control Valve

How to operate:

When excavator provides breaking hammer with insufficient oil, control valve receives rated operating pressure by lowering striking frequency. On the contrary, when there is too much oil supply is, control valve keeps rated operating pressure by improving striking frequency.

How to regulate control valve:

When control valve closes entirely to stop operating oil flow, regulate the notch on control valve aiming at the place marked with "1" as shown in the following picture. For the present place, we generally recognize it as "0" operating oil flow condition. If the regulator on control valve is loosened, then operating oil capacity can be started to increase.



**FIG 6-7**

## Wearing Parts

1) When they are damaged or worn out, we greatly recommend you to change the following items:

- Steel-rod
- Lower body (it has to be replaced in maintenance shop)
- Flat-pin of steel-rod Lock pin (lock pin of steel-rod)
- Rubber plug screw (lock pin) Hydraulic sealing elements
- Bolt at support side
- Hydraulic hoses

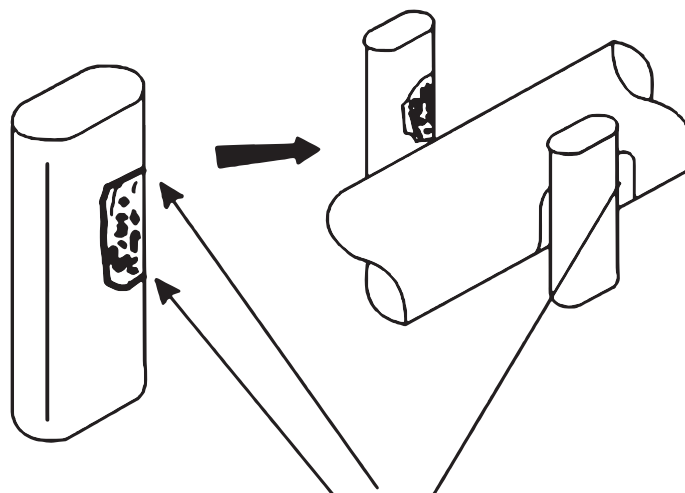
2) We recommend users should prepare wearing spare parts, such as flat-pin and lock pin of steel-rod, rubber plug screw, bolt and hydraulic hoses.

3) When actual work reaches every 600h, hydraulic sealing elements change is required.

4) Flat-pin of steel-rod

-When flat-pin of steel-rod is seriously deformed, the change becomes quite difficult.

Therefore, the interface between its flat-pin and steel-rod should be changed after every 100-150h operation, thus both surfaces of flat-pin of steel-rod can be totally used. If the used steel-rod is not a genuine one, we can not guarantee the good operation condition of relevant parts for breaking hammer.



Abrade burr and high spot on the surface by grinder or dresser

**FIG 6-8**

As regulating the direction of flat-pin of steel-rod, its surface should be placed on the side of steel-rod.

-As changing wearing parts, check the worn condition of wearing elements such as crack and scratch, particularly after abrading burr of flat-pin and high spot on the surface, more check should be done carefully.

-First of all, abrade worn parts of lower body and flat-pin of steel-rod, and then change steel-rod; abrade bruised and damaged parts of lower body, then change new flat-pin of steel-rod.

**Notice for Long-Term Storage**

-Breaking hammer should be stored at the place with little temperature change.

-Remove steel-rod and discharge N<sub>2</sub> inside.

-Apply grease on piston end, and steel-rod and lining should be applied with anti-rust oil.

-As no lubricating can be done, steel-rod must be constricted so that piston can enter oil cylinder.

-The adapter connecting excavator and main parts should be covered with cap so as to prevent dust from oil ducts.

-Leave the breaking hammer upright. If impossible, breaking hammer should lie on the flat floor with square timber sticks underneath.

-If breaking hammer lies above square timer sticks more than 6 months, please check the corrosion condition of all sealing parts and bolts in oil cylinder before operation.

1) Storage method

CYCLE	MEASURES
Every 3 months	To ensure good operation condition with sealing elements, leave the breaking hammer top side down
Every 6 months	Check corrosion condition of all sealing parts and bolts inside oil cylinder

2) Prior to work

CYCLE	MEASURES
Every 3 months	Check sealing elements
Every 6 months	Check sealing elements and corrosion condition

**Notice**

If breaking hammer lies above square timer sticks more than 6 months, please check the corrosion condition of all sealing parts and bolts in oil cylinder before operation.

**Operating Oil and Filter**

## 1) Operation oil

-Breaking hammer uses the same operation oil as excavator does.

-When breaking hammer operates continuously, oil temperature will rise, so please check oil viscosity at this moment.

-The too high viscosity of operation oil will result in un-smooth operation, irregular strike while air pocket in operation pump and viscose with big valve may occur.

-If the viscosity of operation oil is too thin, low operation efficiency may occur due to inner leaking, and oil seal and liner may be damaged due to high temperature.

-In the operating period of breaking hammer, supply operation oil before dipper works, because impurity oil can cause operation disorder with hydraulic parts, breaking hammer and excavator, which will lower their operation efficiency.

-Operation hydraulic oil should be added after breaking hammer's initial operation work for 250 hand every 500 h later on.

## 2) Oil duct filter

-Because impurity in hydraulic oil will shorten the service life of hydraulic parts and even cause oil duct stop, oil filter should be used for removing impurity from oil.

-Oil duct filter should be changed Initial operation work for 50h and the next every 125h.

-Because of spare parts worn out, repair and maintenance as well as oil change and recoiling, impurity, dusts and others can enter hydraulic tubes.

-Installing oil duct filter, the rated capacity of filter should suit to the maximum oil-return capacity of operation pressure.

## 3) Oil duct cooler

-The purpose of using oil duct cooler is to lower operation temperature of hydraulic oil.

-During hammering operation, it is recommended to change the original oil duct cooler or install auxiliary cooler if oil temperature rises too high.

## TROUBLE SHOOTING

### Leakage of Hydraulic Oil

Even if oil leakage occurs, it's unnecessary to change parts in every case; check the leaking condition as per the following form. Users can handle it by themselves before calling their distributors.

	Oil leaking area	Condition	Causes and measures
<b>A</b>	Between steel-rod and front cover	For severe oil leak, check whether it is hydraulic oil or grease	Change damaged sealing elements
<b>B</b>	Breaking hammer surface	Oil leaking at the connection between big valve and hose	Tighten again the loosened hose and bolt of breaking hammer
<b>C</b>	Valve body and bolt cap	Oil leaking with re installed valve body after overhaul	Normal condition: outflow of lubricant and anti-rust oil applied during installation
<b>D</b>	Between main valve and the surface of oil cylinder	Oil leaking with reinstalled valve body after overhaul	Normal condition: Clean the oil used, and if checking finds damaged oil seal, change another seal.
<b>E</b>	Between oil cylinder and upper body	Oil leaking due to loose thorough-bolt and nut	Re-tighten
		Oil leakage	Change damaged O-ring
<b>F</b>	Between oil cylinder and upper and lower bodies	Oil leaking now	Installed bolts on oil cylinder surface are loosened and should be tightened again while oil seal should be changed.

**Breaking Hammer Not Performing Well**

Condition	Main causes	Measures
Breaking hammer can't strike	Too low oil temperature	Oil temperature must reach at least 30°C
	Inappropriate operation of main valve	Check the operating buttons of breaking hammer in driver's cab
	Pressure in upper body and over flow Lower pressure set for valve	Check pressure of N <sub>2</sub> and overflow valve
	Hydraulic oil pump is not working with good performance	Contact excavator manufacturer immediately
Striking frequency gets normal first, but strikes irregularly later on.	Oil shortage resulting in rising oil temperature	Add hydraulic oil
	Too higher pressure in upper body	Check atmospheric pressure
	Too lower pressure set for overflow valve	Check overflow valve pressure
	Insufficient lowering pressure of steel-rod	Check small and big arms of excavator to supply enough lowering pressure
	Too big clearance between steel-rod and front cover	Check the clearance between steel-rod and front cover
	Excessive wearing on the top of steel-rod	Remove steel-rod to check
	Hydraulic oil pump is not working with good performance with much higher back pressure	Ask excavator manufacturers to check oil way
	Main valve with impurity inside	Remove main valve for cleaning
	Piston and oil cylinder getting stuck	Check and overhaul
weak striking power	Lower atmospheric pressure in upper body	Check atmospheric pressure

Condition	Main causes	Measures
Low striking frequency	Atmospheric pressure too high	Check atmospheric pressure
	Insufficient lowering pressure of steel-rod	Check small and big arms of excavator to supply enough lowering pressure
	Pressure set by overflow valve is too low	Check overflow valve pressure
	Hydraulic oil pump does not operate with proper performance	Ask excavator manufacturer to check oil way
	Too higher operation pressure	Check set pressure

**Frequent Problems**

Preconditions for normal operation and prolonged service life for Mechmaxx series breaking hammers:

- use such grades of hydraulic oils (Grade P with frequency Q)
- use clean hydraulic oils
- conduct proper maintenance as per operation and maintenance manual.

When an agent receives a user's malfunction report, user would normally request agent for the quickest possible actions for trouble shooting. The experienced engineer(s) dispatched by the agent shall check for possible causes, confirm the trouble state so that sufficient measures can be taken to eliminate the malfunction. It is recommended to entrust user to remove small trouble(s). should they fail to find out the causes, separate proper counter-actions can be taken to solve it.

You may follow the corresponding measures for checking and solving problems in case there is any:

Items	State	Causes	Actions
Main Body	Breaking hammer not working	<ul style="list-style-type: none"> <li>-Insufficient power (PXQ)</li> <li>-Insufficient falling pressure with rod</li> <li>-Blocked tube</li> <li>-Breaking hammer stuck</li> <li>-Hydraulic oil sinking into upper cover cavity</li> <li>- Insufficient hydraulic oil</li> </ul>	<ul style="list-style-type: none"> <li>-Check power</li> <li>-Follow correct instructions</li> <li>-Inspect and repair</li> <li>-Check and replace worn parts</li> <li>-Replace sealing components</li> <li>-Add hydraulic oil</li> </ul>
	Striking gets abnormal or stops & grease enters cylinder during 30-90 min operation	<ul style="list-style-type: none"> <li>-Insufficient power (PXQ)</li> <li>-Blocked tube</li> <li>-Too high pressure in upper body cavity</li> <li>-Oil seal damaged</li> <li>- Immense grease flows into cylinder</li> </ul>	<ul style="list-style-type: none"> <li>-Check power</li> <li>-Inspect and repair</li> <li>-Make adjustment</li> <li>-Replace oil seal</li> <li>-Discharge grease as required</li> </ul>

Items	State	Causes	Actions
Main Body	Rod broken	Conduct striking slantwise, removing stones with the rod as crowbar	Exert force downward along the direction of rod to check the clearance of small-arm, connecting-rod and flat-pin.
	Rod-head softened	Continuous striking at a certain spot for long time	Find another breaking spot
	Rod-head broken	Max force used for striking from beginning	Striking with lower speed for the first 30min
	Difficult to dismantle or install rod flat-pin	Flat-pin deformed	Check whether normal
	Excessive clearance between the support and the breaking hammer.	Bolts of clip plate loosened	Re-tighten the bolts
	Prematurely worn front cover	Lacking grease lubrication	Replace lower bushing or bushing
	Low striking frequency	-Insufficient power (PXQ) -Insufficient falling pressure with rod -Too high pressure in upper body cavity -Pressure drop in upper body cavity	-Check power -Follow correct instructions -Set to required air pressure value -Add again Nitrogen (N <sub>2</sub> )
	Weak striking force	-Insufficient falling pressure with rod -Insufficient power (PXQ) -Rod broken in front cover	-Follow correct instructions -Check power -Replace rod and piston
-Oil leak at the I/O tube -Oil leak between the control valve and the cylinder -Oil leak between the rod and the front cover -Oil leak between the upper cover and the cylinder	-Adopter loose and O-ring & support ring damaged -Adopter loose and O-ring & support ring damaged -Oil seal worn and damaged -Hexagon-socket bolt damaged or thorough bolt nut loosened	-Tighten adopter and replace O-ring & support ring -Tighten adopter and replace O-ring & support ring -Replace oil seal -Replace hexagon-socket bolt and tighten thorough bolt nut	

Items	State	Causes	Actions
Main Body	See if breaking hammer operates with fluctuation	Error in setting pressure of overflow valve	Check and slowly increase pressure
	Too fast with oil temperature rise	Not well ventilated with excavator. Hydraulic pump worn prematurely and tube blocked	Reset breaking hammer Check and replace hydraulic pump
	Hose vibrating from oil input	Too low oil input	Check oil quantity
	Hose vibrating from oil return	Air-pressure too low or too high	Reset air-pressure
	Not well positioned while breaking stone with rod	Too big clearance betwn smallarm, connecting-rod or flat-pin and shaft lining, causing premature wearing.	Check rod and fix it tightly to breaking hammer
	Emulsification with hydraulic oil	Water in oil	Replace hydraulic oil immediately
	Too much drop with engine rotation	-Insufficient output power -Drop with engine performance -Too low oil temperature	-Reduce pressure inside upper-body cavity -Lower position of accelerator -Ask for check by excavator manufacturer -Pre-heat operation

## MAINTENANCE INSTRUCTIONS

### Warranty Instructions for Steel-Rod

#### 1) Selection of steel-rod

**Attention**

A proper selection of steel-rod suitable for operation is extremely important not only for improving the working efficiency of breaking hammer but for prolonging the service life of the steel-rod as well.

**A****B****C**

A: "-" head type of steel-rod

- applicable for excavation and ditch-digging with various soft and neutral lamination rocks

B: "+" head type of steel-rod

-applicable for crushing granule and neutral concrete or soft non lamination rocks.

- also applicable for secondary blasting and crushing for soft and neutral hard rocks

C: Tack steel-rod

-Applicable for crushing medium-hardness racks or small cracking rocks, making them even smaller.

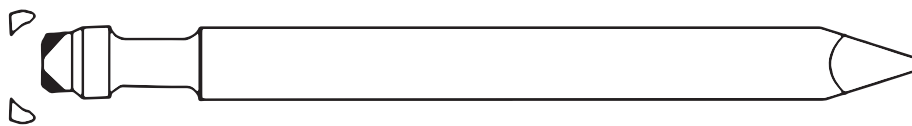
## 2) Claim standards for steel-rods

Mechmaxx steel-rods are manufactured through strict process and quality control, not only in terms of acceptance of materials processed but grinding and even final finishing as well. Documents of steel-rods are well preserved, covering the whole quality tracing records from shipment of steel-rods up to their normal service life. However, the service life of rods vary greatly with the working conditions, operation mode or the types of rocks to be crushed, apart from the factors related to rod quality itself. It is therefore difficult to determine the standard service life of steel-rods.

The following claim standards apply to each of the malfunctions listed below during use of breaking hammers, so that users may have a proper use of our products and their service life can be maintained.

### (1) Damage with the striking face of plunger or with contact point of rod flat-pin (Fig 8-2, 3)

It rarely happens that the striking face of plunger or with contact point of rod flat-pin is damaged. This damage occurs because there is not a proper parallelism with the striking point of plunger and rod, which has resulted in an excessively concentrated striking force to the angle of rod. Claim can be made in this case.



**FIG 8-2**



**FIG 8-3**

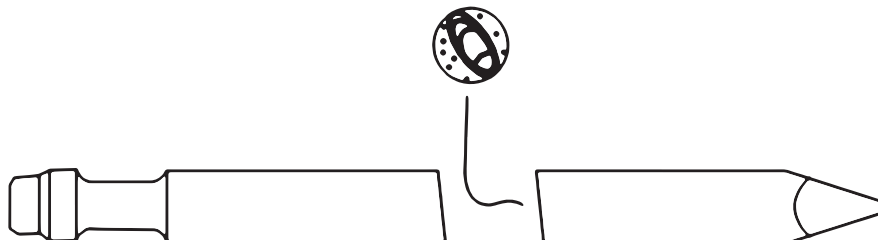
### (2) Damage with the striking face of plunger or with contact point of rod flat-pin (Fig 8-4)

Adopting first-class material, Mechmaxx steel-rods receives proper heat treatment and therefore possesses great strength against stress. In case of a too thin and long plunger, the rod tip may have plastic deformation. Brittleness occurs due to insufficient strength or improper heat treatment. All these contribute to malfunction, which can be claimed for.



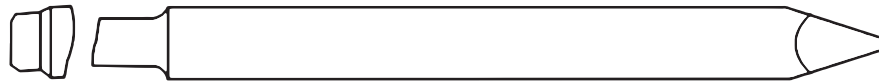
**FIG 8-4**

If fatigue crack start appears inside the rod as shown in Fig 8-5, this indicates defects with material. It is therefore claimable in this case.



**FIG 8-5**

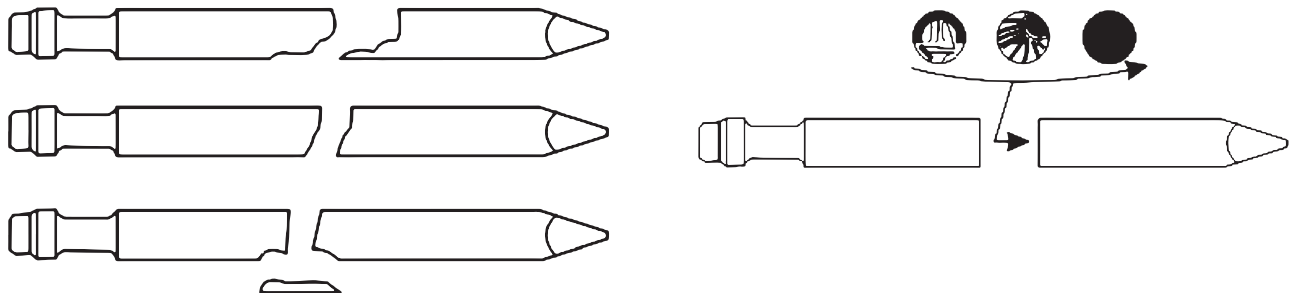
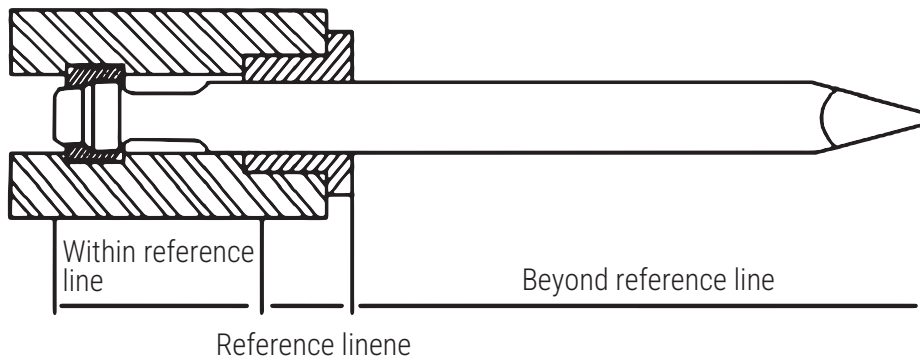
If there is any crack in any direction somewhere with the sleeve of the steel-rod, as indicated in Fig 8-6, this shows defects with material or improper heat treatment. Use can claim for this breakage problem.



**FIG 8-6**

(3) Crack/Damage beyond reference line (Figs 8-8, 9)

If there is any crack/damage somewhere beyond the front bush of the rod (as shown in Fig 8-8, refer to the reference line Fig 8-7). This may be due to the excessive bending overload the rod has taken. When the rod is inserted into something crashed and pulled or pushed, or when the rod cannot strike in from the surface of the crashed articles and get stuck to receive pushing, the rod then will take bending load. Generally, cracks would appear as shown in Fig 8-9, together with crack/damage of clam-shape due to concentrated stress because of bending load. They will spread around quickly from the crack. This may also happen if cracks occur to the rod during operation. Claim for crack/damage beyond the reference line will not be accepted.



**FIG 8-7/8/9**

(1) Steel-rod head is squeezed flat (Fig 8-10)

With good heat-treatment, the steel-rod of Mechmaxx breaking hammer has a sound performance against wearing and cracking, and therefore it cannot be squeezed flat (Fig 8-10) in normal working condition. However, if the rod strikes continuously for a long time but still cannot crush or penetrate the object, plastic deformation (squeezed flat) may occur, rather than worn-out. Therefore, improper operation is the main reason for the above phenomenon. And consequently this does not fall into the scope of claim.



**FIG 8-10**

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