

American Piledriving Equipment Inc.



D1-42 Diesel Hammer Operations Manual

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Chapter I Specifications

This pile hammer is designed for driving wooden piles of less than 40 tons load, small-size concrete piles and fences. It works on diesel fuel with the high-pressure fuel-injection system.

Specifications

1. Max. Length of the Pile Allowed	2200	mm
2. Max. Diameter of the Pile	240	mm
3. Ram Weight	140	kg
4. Max. Ram Stroke	2080	mm
5. Blow Count	46~80	per min
6. Energy per Blow	2548	Nm
7. Stroke of Lower Piston	18	mm
8. Capacity of Fuel Tank	1.2	L
9. Cooling Method	Water	
10. Water Tank	2	L
11. Compression Ratio	1:15	
12. Weight of Hammer	270	kg
13. Max. Fuel Consumption	0.75	L/h
14. Injector	P21-12	
15. Injection Pressure	14~16	Mpa
16. Pump Model	BFIB8×Z281, B71-3	
17. Winch Capacity	1360	kg
18. Dimension	2840×3050×4980	(mm)

Chapter II Working Principle

Starting, Fuel Injection and Compression

When the upper piston is lifted to a certain height by the trip gear through the winch mechanism, fresh air is sucked in through the exhaust ports. When the trip gear carrier hits the stops on the upper cylinder, the trip gear disengages and the upper piston falls by its own gravity.

The falling piston actuates the pump lever whereby a certain amount of diesel fuel is injected into the combustion chamber of the impact block via an injector. As soon as the falling piston passes the exhaust ports, compression of the air trapped in the cylinder commences. At the end of the compression, the upper piston hits on the impact block, pressing drive cap firmly onto the pile and driving the pile down.

Impact and Explosion

When the upper piston hits the impact block, the atomized diesel fuel ignites. The explosive force drives down the pile for the second time and pushes up the upper piston at the same time.

Exhaust

The ascending piston opens the exhaust ports up, releasing the exhaust gases and returning the pressure inside the cylinder to normal.

Scavenging

As the piston continues to ascend, fresh air is sucked in through the exhaust ports. The cylinder is thoroughly scavenged. And the pump lever returns to its original position, sucking again diesel fuel into the fuel pump. By then the upper piston have reached its peak and begun to fall. The same process is repeated again and again until the fuel flow is shut off.

The structure of the hammer and rig is shown in Diagrams 2 to 8.

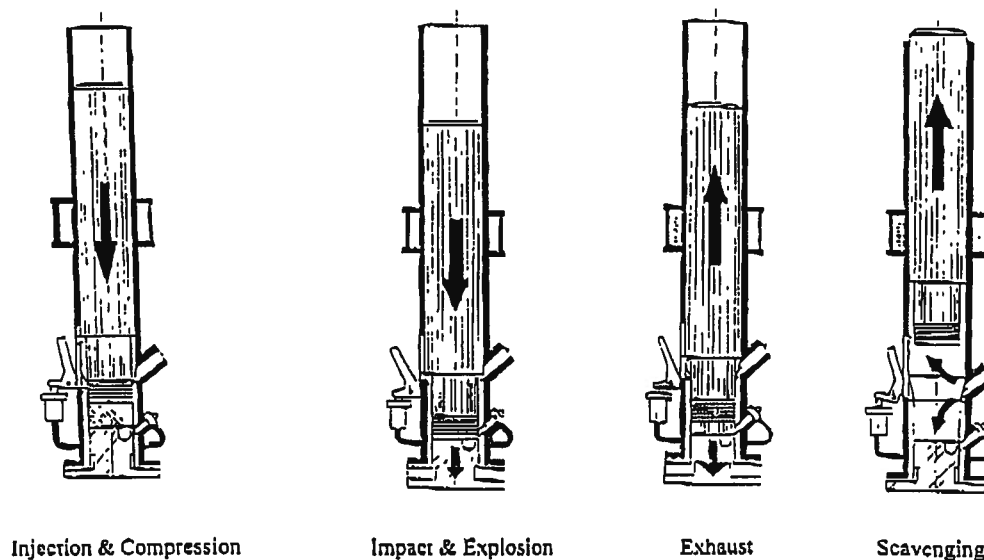


Diagram 1. Hammer Working Principle

Chapter III Operation

Installation of piling rig

- a) Install the winch on the sub-base frame;
- b) Connect the bottom of the lead with the front end of the sub-base frame;
- c) Connect gantry with universal joint;
- d) Erect the piling rig to connect gantry with the back of the piling rig and adjust the vertical grade of the mast;
- e) Put cable together, install the trip gear to position and rotate the safety sleeve;
- f) Lift the hammer in front of the piling rig; remove the safety sleeve, transportation pins and bolts on the clamps on one end.
- g) Install the hammer onto the guide tubes and fasten with screws (Diagram 10).
- h) Lower the trip gear and set the carrier horizontally to lift the hammer (Diagram.11)

Getting Hammer Ready

Fill the fuel tank, take out the air bleeding screw on the pump, bleed air in suction pipe and inside the pump. When the air is out, fasten the bolt and loosen in-line nut on the injector. Adjust the fuel setting to the maximum level. Raise upper piston to a certain height. Start pump by pulling pump lever until bubble-free fuel flows from the nut, and then fasten the nut. Pump by hand until atomized fuel flows from lower cylinder, which indicates that the fuel system is working normally. Clean the combustion chamber with clean soft cloth, lower upper piston slowly, and then fill the tank with clean water (hot water may be used in winter). This way, the hammer is ready.

Starting, running and stopping

1) Starting

Set fuel pump to a high setting. Lift upper piston by pulling up the trip gear. When trip gear hits the block on the upper cylinder, the upper piston will disengage and fall. The hammer starts. When the soil is soft and the temperature is low, the hammer may not start at the first attempt. In this case, one should lower the trip gear and re-start. When the pile meets enough resistance, the hammer will run normally.

2) Hammer in operation

Fuel level must be adjusted to keep the stroke between 1.4 meter to 1.6 meter.

Cautions:

- a) Four steel cables for fastening the helmet must be kept tight and downward movement of lower piston is not permitted. Otherwise the copper ring 2 pieces on lower piston would be badly damaged due to fast penetration in soft soil. When the cable is found to be loose, it

should be tightened immediately.

- b) Sufficient cooling water is required in transportation. If the pre-ignition happens, the cooling water should be replaced. However, the cooling water should not be replaced all at once.
- a) Inject lube oil to pump lever on upper piston (inside upper cylinder slot) every 10~15 minutes. It is not necessary to stop the hammer, but one must not stick the oiler inside the cylinder.)
- b) Check frequently whether fasteners are loose and whether winch brake functions properly.
- c) If one is required to do repair work on the leader, one must stay away from the leader guide rod and leave room for it to move, otherwise one may get injured by the moving clamps.
- d) When the pile is driven to tip elevation or an emergency stopping is necessary, one can stop the hammer by pulling the regulation rope on the right of fork to stop fuel flow or pull the pump lever. (Diagram 4)
- e) Hammer after use
Set the hammer on the pad, drain cooling water and lift trip gear to the top of the hammer. Install safety pin and sleeve and cover the hammer with rain cloth.

Chapter IV Maintenance

I. Assembly and Disassembly

- 1) Take off the drive cap, loosen the four cables and four crews between the drive cap and lower piston;
- 2) Take off two guide pins inside the springs and six fastening bolts, clean the lower piston, install piston rings, lubricate properly and make the nicks of piston rings staggered;
- 3) Install inner damping ring and the copper ring 2 pieces (Diagram 12);
- 4) Set the lower cylinder upside down, clean the sleeve, load lower piston into the cylinder. Notch on combustion chamber should be directed to the injector, return the upper cylinder back to its original position, lubricate the lower cylinder;
- 5) Raise upper piston, install piston ring with bevel side facing downward
- 6) Install catch ring and spring pin, make sure catch ring is not stuck, slowly put piston into lower cylinder with catch piston ring fitting band and lubricate it. Fill in fuel, make sure the slot is in between the guide rods and upper and lower blocks.
- 7) Install injector, fuel pump and pump lever. Adjust the clearance between the pump lever and piston, tighten the high-pressure hoses and watch for any leaks. Make sure the lever is not stuck.

A large clearance might cause the fuel injection to be insufficient.

- 8) To disassemble, reverse the above. When pulling the upper piston out, make sure that the spring pin is not lost. Make sure to hold the piston with safety clip and fasten the safety screw after disassembly. Drain the fuel and water tanks. Apply rust-preventive grease to the hammer after cleaning.

II. Maintenance

- 1) Each shift: check frequently.
- 2) 30 ~ 60 hours: normal check and repair
- 3) 100 ~ 200 hours: overhaul and perform major repair

III. Check List

- 1) Fasteners should not be loose.
- 2) Movable parts should be lubricated.
- 3) Check fuel pumps, injectors and fuel line system to see if there is any leakage or something stuck. Check if there is any damage on the ring of pump lever.
- 4) Clean the combustion chamber from exhaust ports.
- 5) Check piston ring groove, make sure that nothing is stuck in the ring groove, check the elasticity of the piston rings. When replacing piston rings, install them in alternate fashion. Chamfer the edge of the piston ring to R0.3-0.5mm as per Diagram 13. The chamfered side must face downward when installing piston rings on the upper piston. The chamfered side must face upward when installing the piston rings on the lower piston. After replacing the piston rings on the upper and lower pistons, wait for 4 to 6 hours before starting the hammer.
- 6) Clear carbon residues in piston ring grooves.
- 7) Check and change rubber ring 2 pc, inner damping ring, hoses and sealing pads.

- 8) Check and clean pump & injector.
- 9) Check the inside diameter of cylinder. When the wear is more than 120.25 mm, use larger-size piston ring or replace the sleeve.
- 10) Check the wear on copper weld area of pump lever and repair it when necessary.

The hammer is to be properly maintained after each job. We recommend the following measures:

- Clean dirt and rust from hammer, winch and sub-base frame. Apply grease especially to guide rods, pistons, cylinders and hammer.
- Check paint quality, re-paint when necessary.
- Side protector on upper cylinder should be installed, with no change in position.
- Bundle together the parts dismantled.

IV. Lubrication

Table 1

No.	Position	Lube Oil	Method	Period	Remarks
1	Guide slot of upper cylinder	Lube	Oiler	Every 15 min	
2	Pump Lever & Push Rod of pump	Lube	Oiler	Every 15 min	
3	When installing and removing piston rings	Lube	Oiler	During Assembly & Disassembly	
4	All the Pulley Axle	Grease	Smear by hand	During Assembly & Disassembly	
5	Eccentric Axle	Lube	Oiler	Every Hour	
6	Winch Gearbox	Lube	Oiler Funnel	----	Power must not be cut off
7	Cable	Grease	Smear	Every Week	
8	All Guide Screws	Grease	Smear	Every job	
9	Electric Motor		Follow the rules of lubrication on motors.		

Chapter V Trouble-shooting

Table 2

<i>Troubles</i>	<i>Cause</i>	<i>Solutions</i>
Hammer fails to start	<ol style="list-style-type: none"> 1. insufficient resistance due to soft soil 2. low temperature 3. breakdown in fuel system <ol style="list-style-type: none"> 1) air in fuel lines 2) injector breakdown 3) leakage in hoses 4) pump breakdown 4. cylinder breakdown 5. pump lever 	Shut fuel pump off and strike several times, then turn on the fuel pump Heat the fuel up Check atomizing condition after pumping Bleeding air Check and repair Check and repair Check if the injector leaks Check if injector is leaking or piston ring is out of flexibility Replace or do copper welding
Stop running suddenly	<ol style="list-style-type: none"> 1. out of fuel 2. fuel system breakdown 3. upper piston gets stuck 	Add fuel Open and clean Open and check
Hammer works unstable	<ol style="list-style-type: none"> 1. air in fuel line system 2. fuel pumped out unevenly 3. Wear on cylinder sleeve 	Bleeding air by hand pump Clean the pump Repair or change to bigger-diameter piston ring
Exhaust gas is black	<ol style="list-style-type: none"> 1. too much fuel 2. fuel is not pure 3. too much lube oil into the combustion chamber 	Adjust fuel pump settings Replace fuel Clean combustion chamber
Upper piston strokes too high	<ol style="list-style-type: none"> 1. too much fuel 2. soil too hard 	Adjusting fuel supply and clean combustion chamber. Reduce fuel supply
Pre-ignition	Temperature too high	Replace cooling water
Trip gear fails to engage on pawl	<ol style="list-style-type: none"> 1. wrong position of carrier 2. trip spring failure 	Readjust Replace the spring
Pump does not work	<ol style="list-style-type: none"> 1. air in pump 2. piston worn out 3. check-non-return valve broken 4. piston gets stuck 5. fuel system clogged 6. assembly mistakes 	Bleed air Replace the piston Repair it or replace Clean Readjust
Fuel not even pumped	<ol style="list-style-type: none"> 1. air inside pump 2. spring in injector fuel line broken 3. check valve worn out 4. piston stuck by debris 	Bleed air Replace Clean Clean
Injector fails	<ol style="list-style-type: none"> 1. air inside 2. needle valve gets stuck 	Bleed air Change it
Low injection pressure	<ol style="list-style-type: none"> 1. bolt is loose 2. spring failure 	Adjust pressure to 15MPa Replace
Injector leakage or poor atomization	<ol style="list-style-type: none"> 1. spring broken 2. needle valve is clogged 3. needle valve damaged 	Replace Clean or replace Replace

Chapter VI Safety Precautions

1. Operator is required to be familiar with mechanical structure, operation, and maintenance of the hammer.
2. Fasten bolts to prevent the leader from falling when erecting the leader. When adjusting the vertical grade, pay attention to the uneven surface. Inflate the tires properly. Handle the leader gently.
3. At job site, admittance to staff only.
4. Check all the connecting parts carefully before piling. It is strictly prohibited to use the hammer when it has something wrong.
5. Never repair the hammer when it is working.
6. Sufficient lighting must be provided for night shift.
7. Operator must not leave the job-site before the hammer stops and is kept in safe position.
8. Smoke or fires are strictly forbidden when filling the fuel tank.

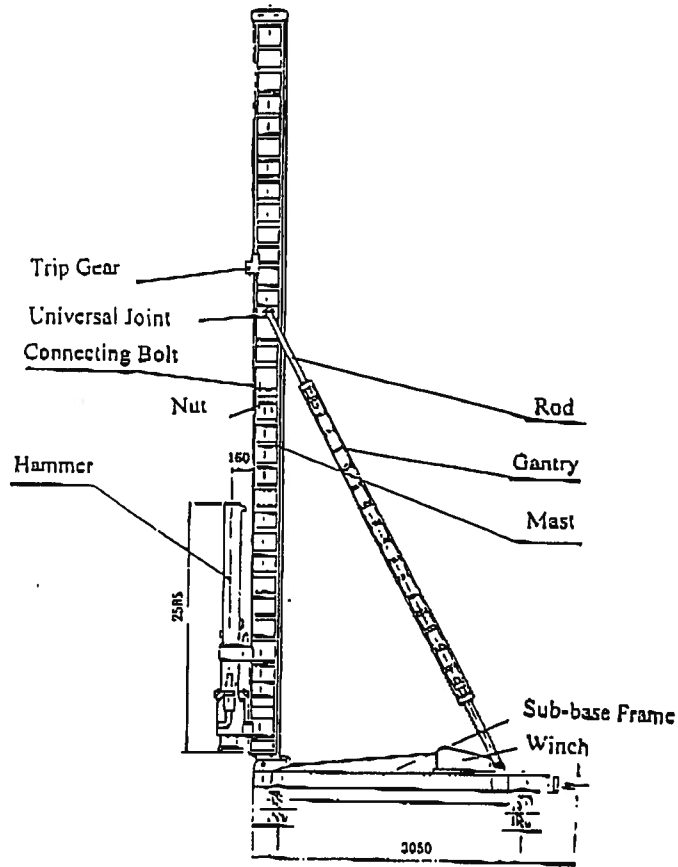


Diagram 2. D1 Hammer & Rig

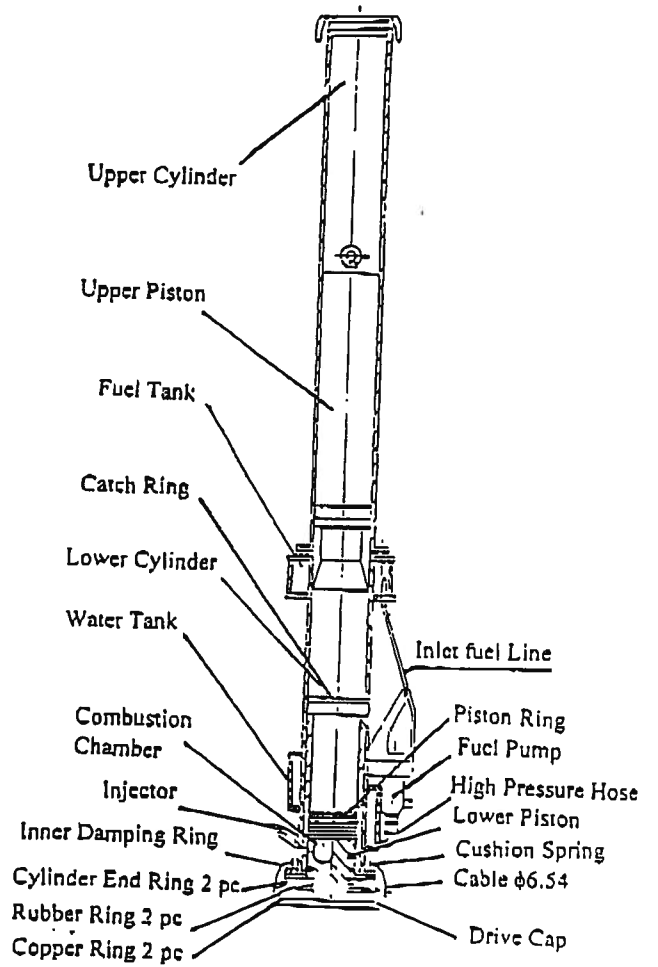


Diagram 3. Hammer Layout

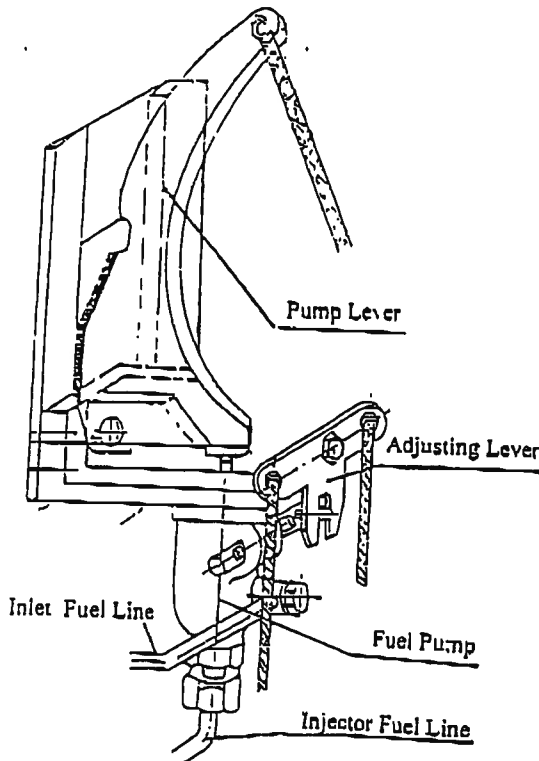


Diagram 4. Pump Lever Structure

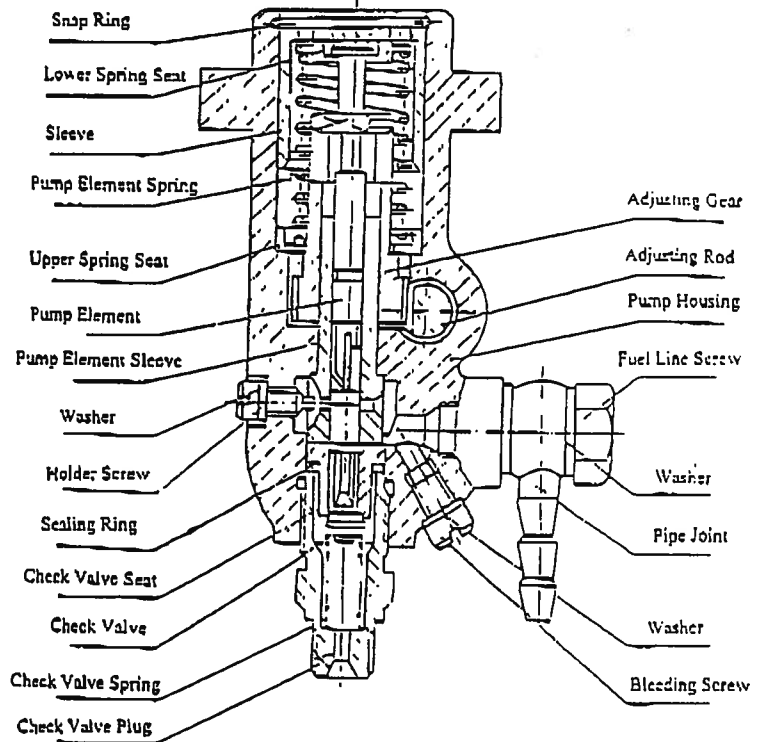


Diagram 5. High Pressure Fuel Pump

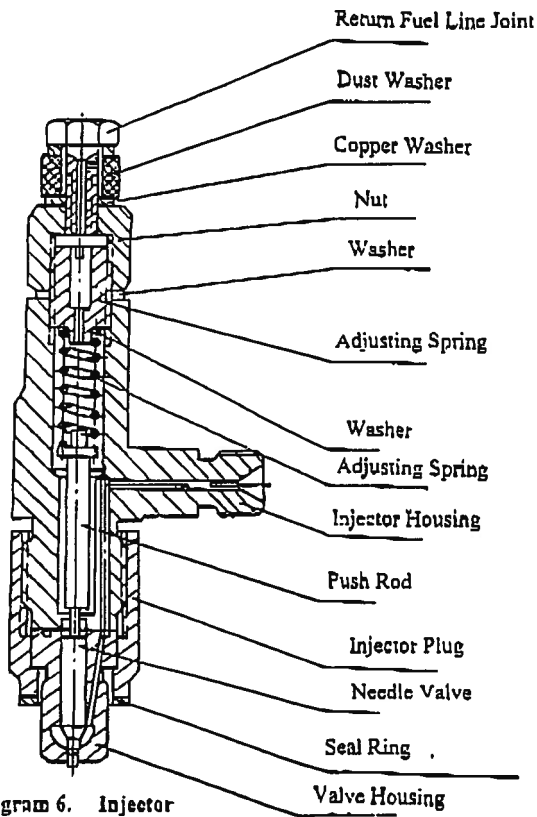


Diagram 6. Injector

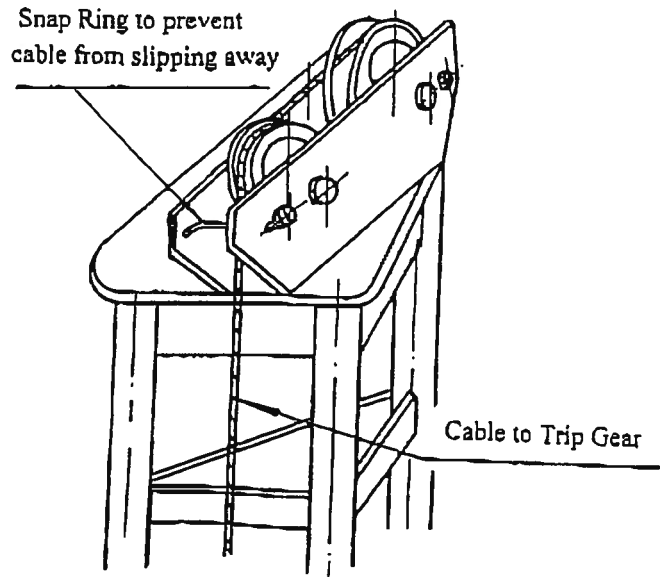


Diagram 7. Mast Upper Structure

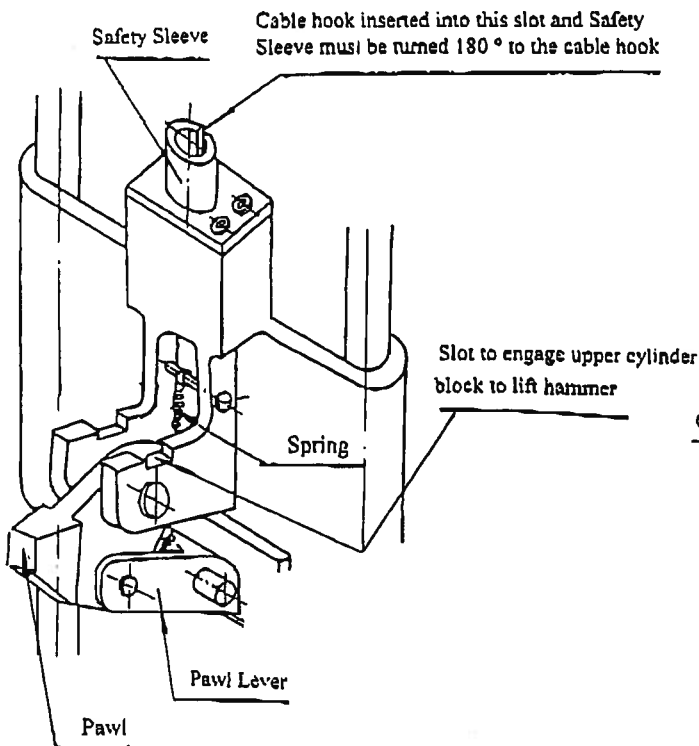


Diagram 8. Trip Gear

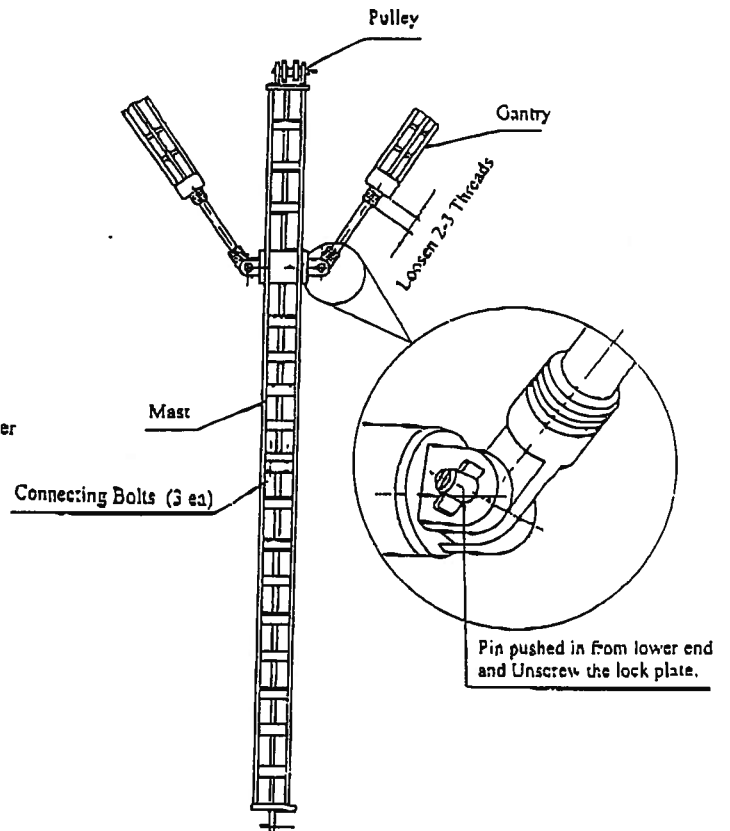


Diagram 9. Connection between Gantry & Mast

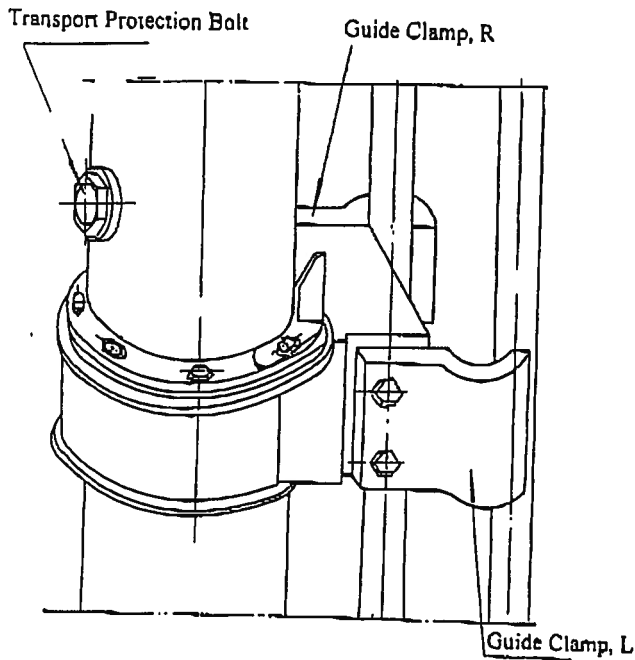


Diagram 10. Hammer Installation

When the Block is set horizontal, hammer can be lifted by trip gear

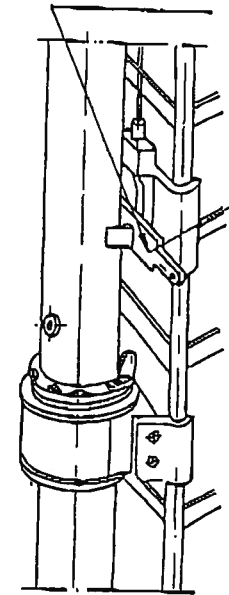


Diagram 11. Upper Cylinder Block

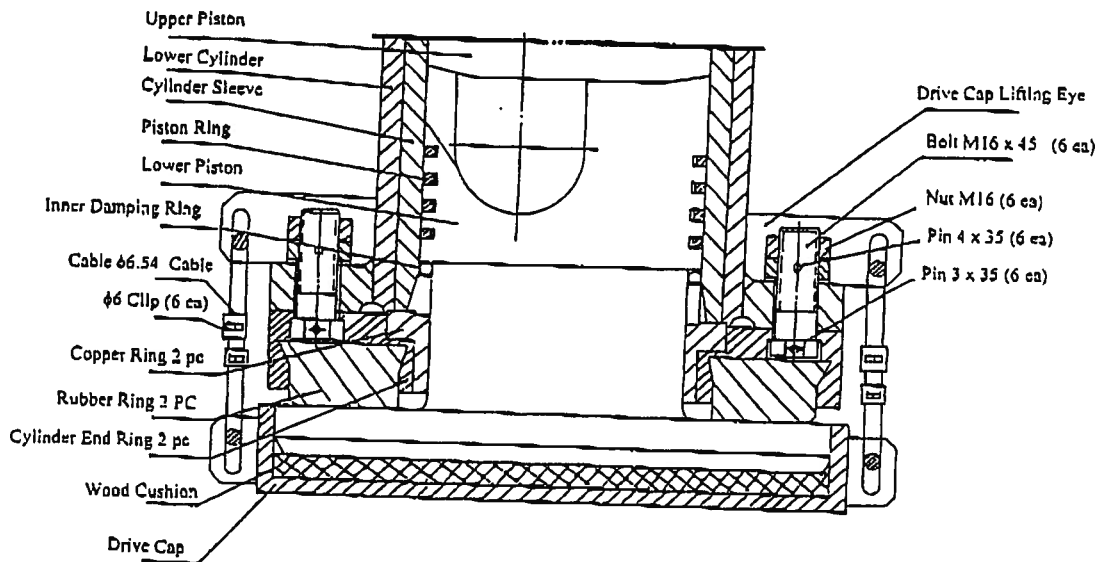


Diagram 12. Lower Piston & Drive Cap Installation

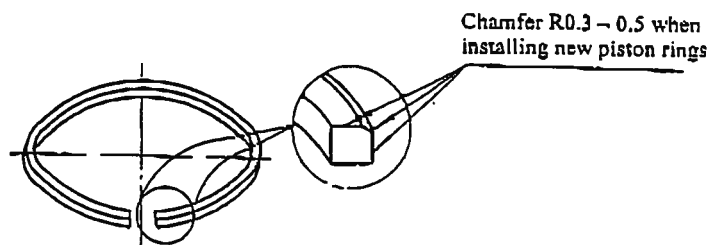


Diagram 13. Piston Ring Installation