

OPERATING, MAINTENANCE AND
PARTS MANUAL FOR

MS350 AND MS500

SINGLE-ACTING PILE HAMMERS

WARRANTY

MKT CORPORATION STANDARD WARRANTY

WARRANTY — MKT Corporation warrants new Products sold by it to be free from defects in material or workmanship for a period of 90 days after date of delivery to the first user and subject to the following conditions:

MKT Corporation's obligation and liability under this Warranty is expressly limited to repairing or replacing at MKT Corporation's option, any parts which appear to MKT Corporation upon inspection to have been defective in material or workmanship. Such parts shall be provided at no cost to the user, at the business establishment of the authorized MKT Corporation distributor of the Product during regular working hours. This Warranty shall not apply to component parts or accessories of Products not manufactured by MKT Corporation and which carry the warranty of the manufacturer thereof, or to normal maintenance (such as oil filters). MKT CORPORATION MAKES NO OTHER WARRANTY, EXPRESS OR IMPLIED, AND MAKES NO WARRANTY FOR MERCHANTABILITY OF FITNESS FOR ANY PARTICULAR PURPOSE.

MKT Corporation's obligation under this Warranty shall not include any transportation charges, costs of installation, duty, taxes or any other charges whatsoever, or any liability for direct, indirect, incidental, or consequential damage or delay. If requested by MKT Corporation, Products or parts for which a warranty claim is made are to be returned transportation prepaid to MKT Corporation, Dover, N.J. Any improper use, including operation after discovery of defective or worn parts, operation beyond rated capacity, substitution of parts not approved by MKT Corporation, or any alteration or repair by others in such manner as in MKT Corporation's judgment affects the Product materially and adversely, shall void this Warranty.

NO EMPLOYEE OR REPRESENTATIVE IS AUTHORIZED TO CHANGE THIS WARRANTY IN ANY WAY OR GRANT ANY OTHER WARRANTY UNLESS SUCH CHANGE IS MADE IN WRITING AND SIGNED BY AN OFFICER OF MKT CORPORATION AT DOVER, N.J.

**CAUTION
DO NOT WELD**

ANY WELDING ON THE HAMMER MUST BE APPROVED BY THE FACTORY. NOTE WARNING PLATE ON HAMMERS. WELDING ON HAMMER MAY VOID WARRANTY. CONSULT FACTORY.



LOCATION OF SERIAL NUMBERS

The location of the Serial Number on our equipment is as follows:

Steam/Air Pile Hammers - Located on the left front on each part (top head, cylinder, etc.)

Steam/Air Extractors - Located on the left side front and each sidestrap.

Diesel Pile Hammers - Located on the instruction plate above the travel plug on the front of the hammer.

Vibratory - Located on the center post of the control side of the power pack.
Located on the left side or motor side of the exciter housing.

Earth Boring Units - Located on the front of the roller base and the top of the motor housing.

WHEN ORDERING PARTS, MENTION THE MODEL AND SERIAL NUMBER OF YOUR HAMMER.

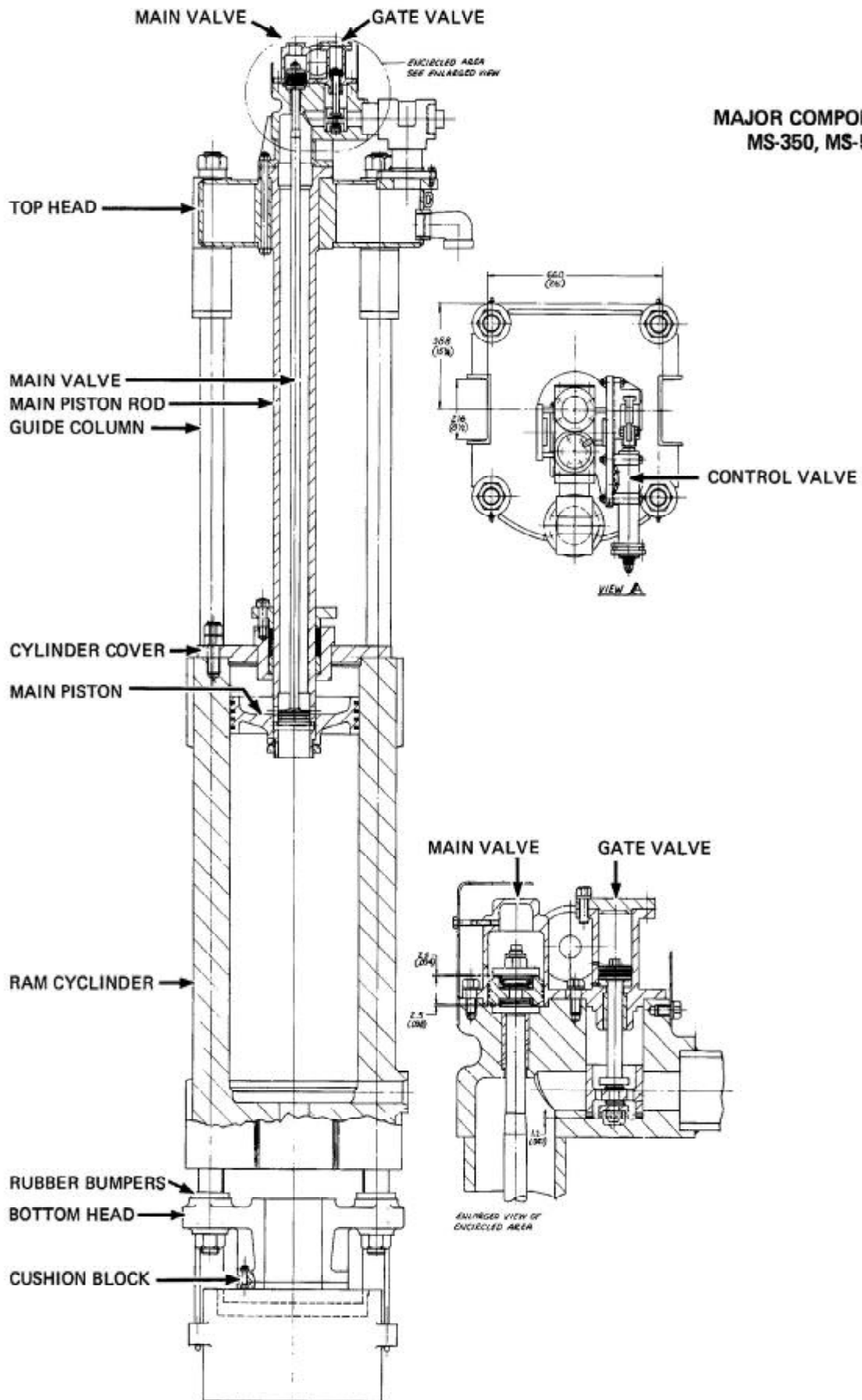
OCCUPATIONAL HEALTH WARNING!

CONSTRUCTION EQUIPMENT FREQUENTLY OPERATES AT SOUND LEVELS ALMOST AS LOUD AS AN ELECTRONIC ROCK MUSIC GROUP. SUCH SOUND LEVELS ARE HARMFUL TO THE HUMAN HEARING SYSTEM. SUSTAINED EXPOSURE TO SUCH HIGH SOUND LEVELS CAN PERMANENTLY IMPAIR ONE'S HEARING.

HEARING PROTECTION SHOULD BE WORN BY ANYONE AND EVERYONE WITHIN CLOSE PROXIMITY TO AN OPERATING PILE INSTALLATION MACHINE!

This manual contains parts, description maintenance, operational principles and troubleshooting instructions for the MKT MS-350 and MS-500 Single Acting Steam-Air Pile Hammers. Sufficient descriptive material together with photographs and line drawings are included to enable the operator and service personnel to understand the operation and service of the MS Hammers.

WHEN ORDERING PARTS, MENTION THE MODEL AND SERIAL NUMBER OF YOUR HAMMER.



**MAJOR COMPONENTS
MS-350, MS-500**

DESCRIPTION OF THE MS-350 AND MS-500 HAMMERS

The MKT MS-350 and MS-500 are Single Acting Pile Hammers which can be operated using either air or steam.

In all Single Acting Hammers, the motive fluid acts only to raise the driving weight. Gravity produces the downward stroke, and thus the blow of the hammer.

The energy per blow delivered by a Single Acting Hammer is thus related to the distance the driving weight falls. In the MS-350 and MS-500, this distance or (stroke) can be infinitely varied from 24" to 48". This variability makes the MS Hammer an extremely versatile tool, applicable to a wide variety of driving conditions.

The MS-350 and MS-500 consist of the following major components:

Ram Cylinder which acts as the falling weight of the hammer, as well as its main cylinder.

Cylinder Cover - Fastened to the top of the ram cylinder through which the main piston rod passes.

Main Piston Rod- Extending from the center of the Ram Cylinder Cover into the hammer's Top Head.

Main Piston - Fitting inside the ram cylinder at the lower end of the main piston rod.

Main Valve - Fitting inside the main piston rod and extending to the top head, the vertical movement of which causes the ram cylinder to rise and fall.

Gate Valve - Serving to open and close the inlet of the hammer thus regulating fluid flow into the hammer.

Control Valve - Consists of two plungers activated by the control bar and control line, thereby regulating the stroke of the hammer.

Guide Column - 4 rods extend between the bottom and top head on which the ram cylinder is guided.

Bottom Head - Holds the Guide Column as well as the drive cap upon which the Ram Cylinder strikes.

Top Head - Holds the Guide Column, houses the Gate Valve, Control Valve, the top of the main valve and the hammer's lifting shackles.

Cushion Block - Fitting in the upper portion of the drive cap and serving to cushion the blow and eliminate metal to metal contact between the ram cylinder and drive cap.

Rubber Bumpers - Bumpers are on the upper and lower head. Four (4) on the Bottom Head and four (4) on the Top Head Spacers. These rubber bumpers are to keep the ram cylinder from making metal to metal contact with either the top or bottom head.

THE MS350 AND MS500 CONTROL SYSTEM CONSISTS OF THE FOLLOWING COMPONENTS:

1. CONTROL VALVE ASSEMBLY

The control valve assembly regulates the length of stroke of the ram/cylinder. It also distributes the high pressure steam/air required for the operation of the gate valve and main valve assemblies. The components include the control bar, two plungers and a control bar roller mounted on a common shaft. One plunger is in a fixed position - the other plunger is free to travel along the shaft on mating threads. The axial distance between the two plungers is set by the control cable and determines the stroke of the hammer.

2. GATE VALVE ASSEMBLY

The gate valve admits or shuts off the high pressure steam/air supply to the main valve assembly. It is located on the top head and consists of a large and small piston mounted on a common shaft. The large piston fits into the air inlet and acts as a gate. The gate is activated into open or closed position by high pressure steam/air from the control valve acting on the underside of the smaller gate control piston.

3. MAIN VALVE ASSEMBLY

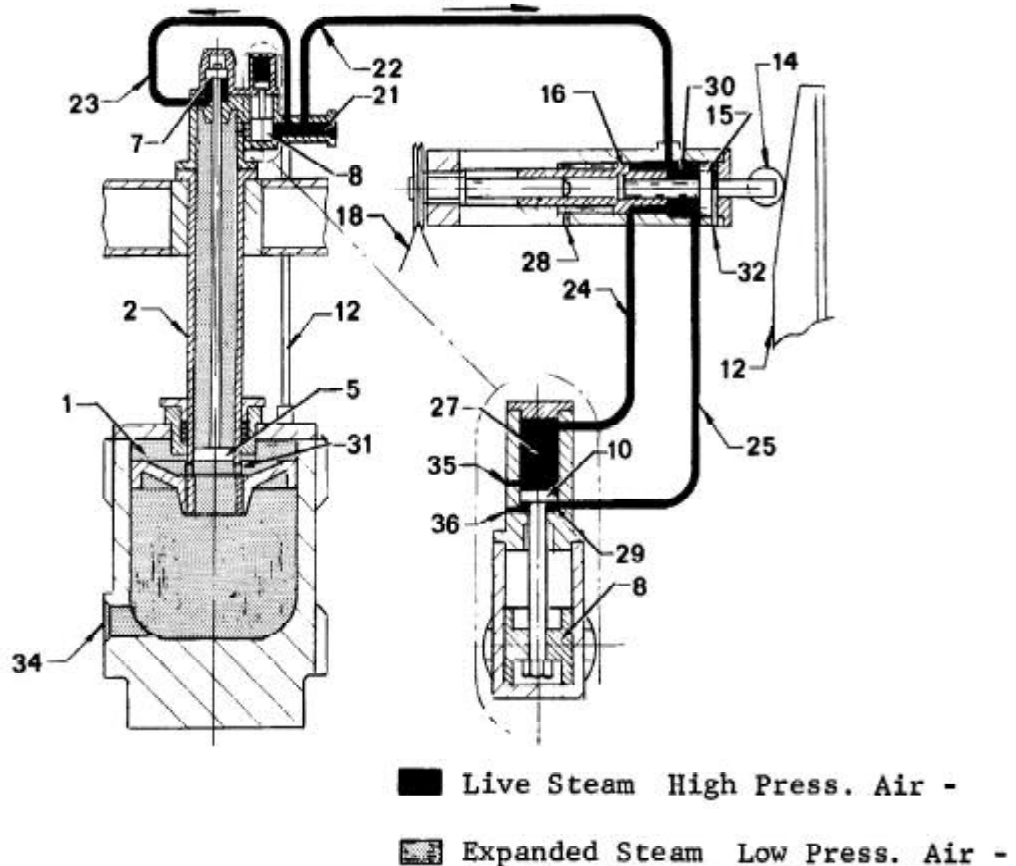
The main valve assembly is located within the main piston rod of the ram/piston assembly and supplies high pressure steam/air to raise the ram/cylinder. Its components include one large piston and one small piston mounted at opposite ends of a common piston rod. The smaller diameter piston operates within a cylinder located on the top head and the larger diameter piston operates at the bottom of and within the base of the main ram/cylinder piston rod. Operation of the main valve assembly is dependent upon differential pressures acting on the large and small pistons - thus the main valve is a differential valve.

SETTING CONTROL VALVE ASSEMBLY FOR PROPER OPERATION

This adjustment should be made with the Control Valve mounted on the hammer. Remove Control Device (19) from the Shaft (20), rotate Shaft (20) counterclockwise until it stops, then rotate back about 1/8 of a turn. On Control Device, pull left hand Control Line (18) all the way to the stop. Reassemble Control Device to the Shaft (20). It may be necessary to position the gear inside the Control Device for keyway alignment.

OPERATION OF THE MS HAMMER USING STEAM OR AIR

With the ram/cylinder in the rest position on the pile, high pressure air/steam pressurizes the inlet (21) up to the gate valve (8); and pressurizes lines (22), (23), (24) and (25), which, in turn, pressurizes cylinder chambers (27), (29) and (30). The differential valving in the main valve is in its raised position closing off inlet port (31). The hammer is ready to operate as soon as air/steam discharges through ports (35) and (36) located in the Gate Valve Assembly, which is the indication all chambers are pressurized.

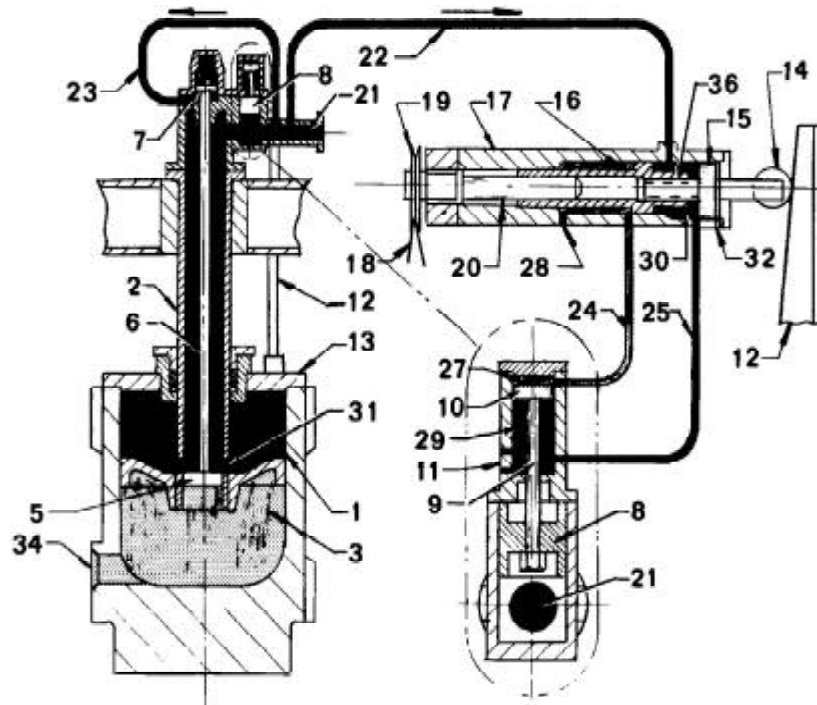


ILLUSTRATION

Important!

Two 1.5 mm bores (35 and 36) are present on Cylinder with Piston (10). The condensation which forms during the warming-up process is blown out through these bores. Since air or live steam enters into the Gate Valve even when the hammer is stopped, this is constantly heated and kept free from condensation. Condensation impairs the control function of the hammer.

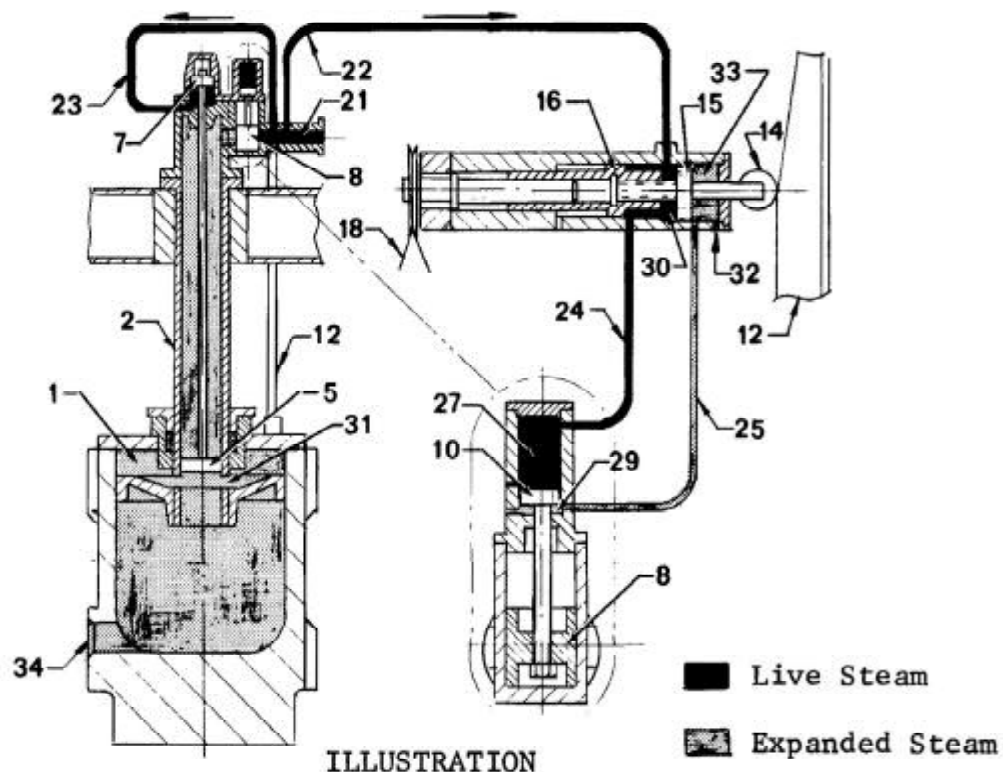
To start operation, a pull on the control line (18) rotates control valve shaft (20) which starts travel of plunger (16) towards plunger (15). The ram will begin to raise as soon as plunger (16) has traveled far enough to uncover the port of line (24) connecting the control valve with the gate valve. Cylinder Chamber (27) is now vented to atmosphere through line (24) and exhaust port (28). Gate Valve Control Piston (10) having high pressure steam/air within cylinder chamber (29) moves upward pulling gate valve piston (8) upward and opening inlet line (21) to the ram/cylinder. High pressure steam/air surges into the hollow stem of the main piston rod and acts against the larger area of the lower piston (5) of the differential valve forcing the valve assembly, pistons (5) and (7) down. With the valve assembly in its lower position, high pressure flows into chamber (31) and the ram/cylinder begins its upward stroke.



Live Steam High Pressure Air
 Expanded Steam Low Pressure Air

ILLUSTRATION

As the ram continues its upward stroke, the control roller (14) follows the taper of the control bar resulting in a shifting of the control valve assembly inboard. Immediately before the desired stroke is reached, plunger (15) uncovers the port for line (25) venting cylinder chamber (29) to atmosphere through line (25) and exhaust port (32). The high pressure steam/air in cylinder chamber (30) flows through the opened porting for line (24), pressurizes cylinder chamber (27) forces gate valve control piston (10) and gate valve (8) assembly down and into the closed position. Further flow of high pressure steam/air to the ram/cylinder is now shut off.



As a result of the expansion of the steam/air motive fluid, the upward stroke of the ram/cylinder continues until the high pressure steam/air acting on the smaller diameter main valve piston (7) overcomes the force of the reduced pressure acting on the larger diameter main valve piston (5). When this occurs, the main valve shifts upward closing off the inlet to cylinder chamber (31). The ram/cylinder having completed its power stroke begins its gravity fall. The spent motive fluid is exhausted from the ram/cylinder through port (34). As the ram/cylinder descends, high pressure air/steam acting on plunger (15) shifts the complete control valve assembly including plungers (16), (15) and control roller (14) in the outboard direction with the control roller always maintaining contact with the control bar. The limits of travel of the control valve assembly is then the degree of taper on the control bar. Immediately prior to the ram/cylinder completing its downward stroke, the action of the control bar on the control roller has shifted all valving to the positions as shown in Illustration No. 2 and the ram/cylinder is now ready for its next power stroke.

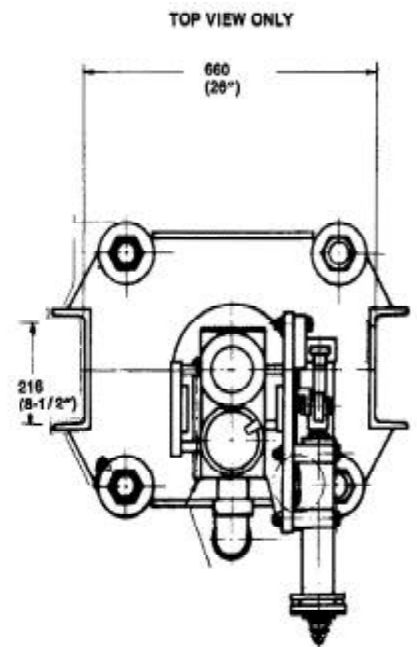
MS-350 PILE HAMMER

SPECIFICATIONS

Ram Cylinder	7,716 Lbs.	3,500 Kg.
Max. Stroke, Variable	12" to 48"	.3m to 1.2m
Max. Energy Per Blow	30,800 Ft.Lb.	4,200 Mkg.
Blows Per Min.	40 - 50	40 - 50
Steam Consumption, Lbs. Per Hour	1,550	700 Kg.
Compressed Air Req'd. (Actual)* 1	900 C.F.M.	25.5m ³
Steam-Air Pressure at Hammer* 2	100/105 P.S.I.	7-8 Kg./cm ²
Net Wt. of Hammer	10,000 Lbs.	4,535 Kg.
Net Wt. of Hammer with Universal Drive Cap	10,950 Lbs.	4,967 Kg.
Min. Size Hose	2 1/2"	65mm
Length	180 5/8"	4,580mm
Width (Leads)	26"	656mm
Max. Depth From Center Line To Back of the Hammer	16 5/8"	423

***NOTES:**

1. Since the volume and pressure of compressed air delivered to a hammer will vary with compressor condition, weather, length and condition of the air line, and other varying factors, air consumption is given in this manner. Generally, to assure satisfactory hammer operation, your compressor should be able to deliver 150% of this actual compressed air volume.
2. Steam or air pressure is given at the hammer in pounds per square inch. Pressures required at the boiler or air compressor will vary with weather, installation of the boiler, length and type of steam or air line used. Steam pressure must be regulated at the prime mover to run the hammer to speed.



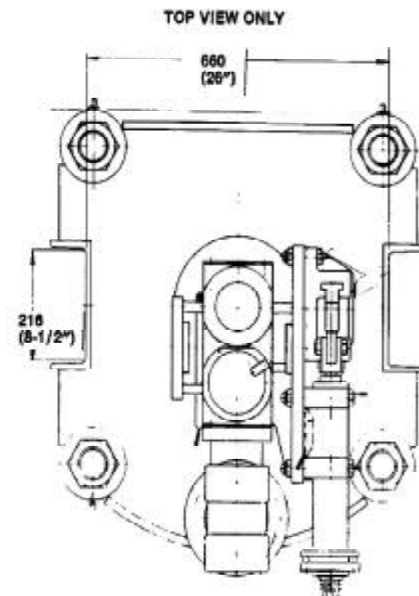
MS-500 PILE HAMMER

SPECIFICATIONS

Ram Cylinder	11,000 Lbs.	5,000 Kg.
Max. Stroke, Variable	24" to 48"	.6m to 1.2m
Max. Energy Per Blow	44,000 Lbs.	6,000 Mkg.
Blows Per Min.	40 - 50	40 - 50
Steam Consumption, Lbs. Per Hour	2,200	1,000 Kg.
Compressed Air Req'd. (Actual)* 1	1,200 C.F.M.	34m ³
Steam-Air Pressure at Hammer* 2	110/115 P.S.I.	7-8. Kg./cm ²
Net Wt. of Hammer	15,250 Lbs.	6,900 Kg.
Net Wt. of Hammer with Universal Drive Cap	17,000 Lbs.	7,710 Kg.
Min. Size Hose	3"	75mm
Length	181	4,600mm
Width (Leads)	26"	656mm
Max. Depth From Center Line To Back of the Hammer	16 1/2"	420

***NOTES:**

1. Since the volume and pressure of compressed air delivered to a hammer will vary with compressor condition, weather, length and condition of the air line, and other varying factors, air consumption is given in this manner. Generally, to assure satisfactory hammer operation, your compressor should be able to deliver 150% of this actual compressed air volume.
2. Steam or air pressure is given at the hammer in pounds per square inch. Pressures required at the boiler or air compressor will vary with weather, installation of the boiler, length and type of steam or air line used. Steam pressure must be regulated at the prime mover to run the hammer to speed.



PILE STATIC LOAD BEARING DETERMINATION:

FOR:

MKT MS-350 and MS-500 are Single Acting Steam-Air Pile Hammers.

The "Engineering News" formula is most commonly used in the U.S.A. to convert the dynamic energy delivered by a pile hammer to the static load which will be supported by a driven pile. Even when the "Engineering News" formula is not specifically specified, its use can be helpful in selecting the size of hammer which will most likely be applicable to a particular pile driving job.

NOTE: MKT does not guarantee its products against breakage due to abuse. Generally, driving at 10 blows per inch penetration is considered practical refusal for any size hammer.

"Engineering News" Formula

$$R = \frac{2E}{(S + 0.1) 2000}$$

WHERE:

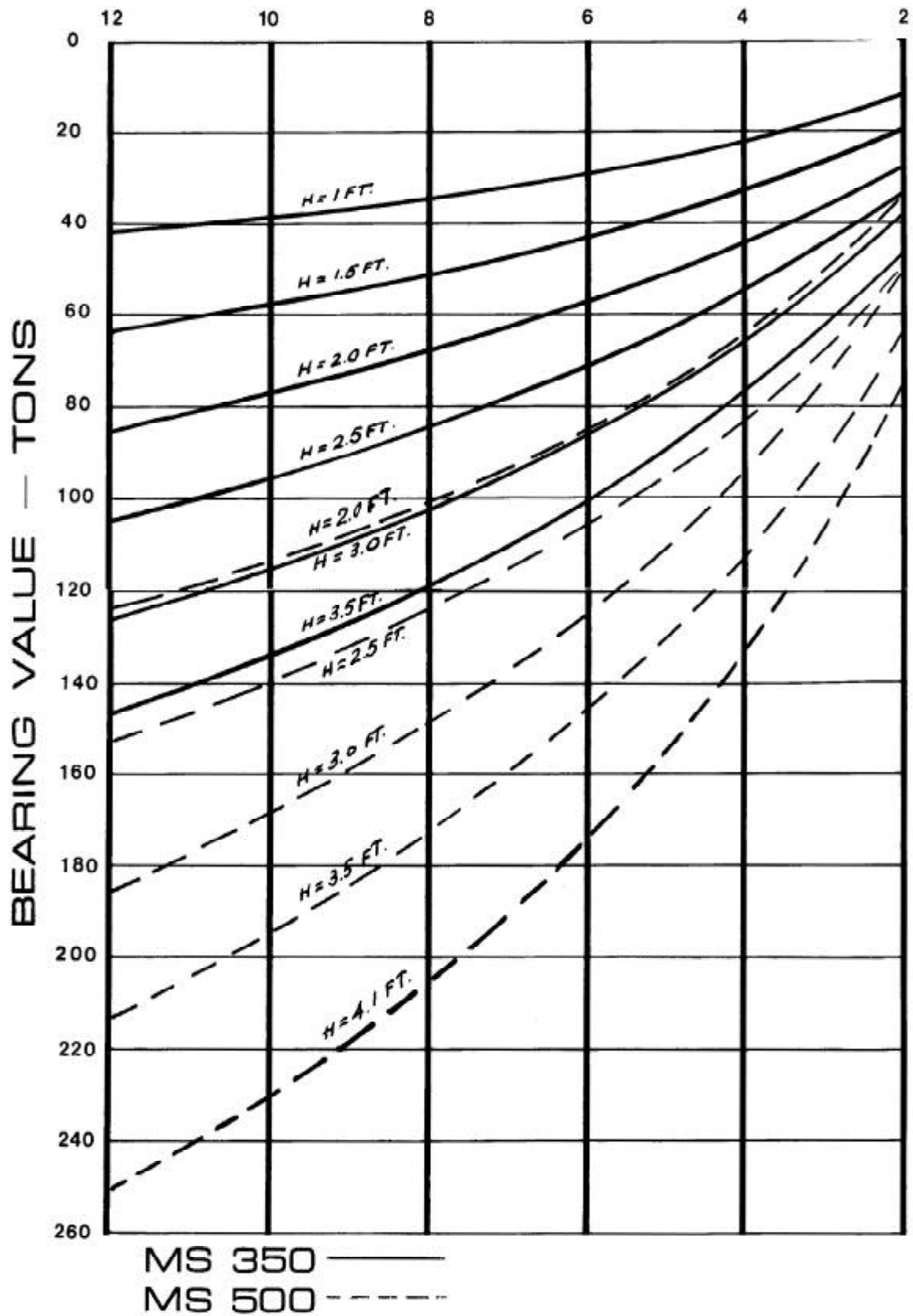
R = Pile Bearing (Tons)
E = Energy (Ft.Lb.)
S = Pile set per blow in inches/blow

Example Assume a stroke of 3 ft. and a
MS-350: penetration of 1/8 inch/blow

E = WH; Weight of Ram Cylinder x stroke in feet =
7716 Lb. x 3' = 23148 Ft. Lb.

$$R = \frac{2 \times 23148}{(.125 + 0.1) 2000} = 102.88 \text{ Tons}$$

BLOWS PER INCH



OTHER USEFUL FORMS OF THE "ENGINEERING NEWS" FORMULA

$$R = \frac{2E}{(S + 0.1) 2000}$$

Since "R", the load (tons) to be supported by a specified pile is usually known; and "E", the energy (ft.lb.) for the hammer which will be used, is also known; generally a pile hammer user is interested in solving the Engineering News Formula for "S", the set of the pile, or its movement per blow in inches per blow. The Engineering News Formula, as stated in the following forms can then be more useful:

$$P_1 = \frac{12,000B}{E-100B}$$

where P_1 = The observed blows of the hammer per driven foot of pile.

B = The specified load bearing of the pile in tons.

E = The energy of the hammer used in foot-pounds.*

$$\text{or } P_2 = \frac{6,000B}{E-100B}$$

where P_2 = The observed blows of the hammer per driven 6 inches of pile.

$$\text{or } P_3 = \frac{3,000B}{E-100B}$$

where P_3 = The observed blows of the hammer per driven 3 inches of pile.

$$\text{or } P_4 = \frac{1,000B}{E-100B}$$

where P_4 = The observed blows of the hammer per driven 1 inch of pile.

The MKT "Pile Load Bearing Data Chart" can be useful in rapidly finding the solution of the last form of the equation.

*NOTE: For all Single-Acting hammers, $E = Wh$, where W = weight of the Ram of the hammer in pounds and h = the stroke of the Ram in feet.

STEAM OR COMPRESSED AIR LINES

SIZE OF FLUID LINE:

The MS Pile Hammers require a minimum hose size. Check Hammer Specifications. Operating the hammer with a smaller diameter hose than required will result in the hammer not running up to the rated number of blows per minute.

FITTINGS FOR FLUID LINE:

Universal joints for connecting the inlet hose to the hammer are recommended. These permit more supple movement of the hose in respect to the hammer.

SECURING OF FLUID LINE:

To avoid a whipping air or steam hose in the event of inlet mounting joint failure, it is recommended that the line be secured to the hammer by a chain. MKT provides a chain horn on all of its Steam/Air Hammers to facilitate this important safety measure.

CLEANING FLUID LINES:

Before connecting the hose to the fluid inlet of the MS Hammers, the hose should be blown out with steam or air. The hammer and its control system can be damaged by foreign matter.

DRAIN COCK IN FLUID LINE:

The operation of the hammer will be improved if a drain cock or valve is installed in the fluid line as near to the hammer as possible. This will permit condensed fluid to be blown out of the line before starting to drive each pile.

LENGTH OF FLUID LINE:

The length of the hose should always be held to a minimum. Unusually long lengths of hose between the fluid supply and the hammer will result in a decrease of fluid pressure at the hammer with a corresponding decrease of hammer speed.

BENDS IN FLUID LINE:

Pipe elbows, bends and kinks in the fluid line should be avoided, as they cause a decrease in fluid pressure, thus impairing the hammer's performance.

FLUID LINES IN COLD WEATHER:

Long lengths of hose in cold weather afford more opportunity for the formation of condensate in the hose resulting in erratic operation of the hammer. The use of metal pipe as a fluid line in cold weather is to be avoided as it permits excessive condensation unless properly insulated.

LUBRICATION

Operation of a pile hammer without oil for even a brief period of time will cause serious damage to the hammer!!! Lubrication at all necessary points, in the recommended manner, is an absolute necessity to the proper operation and maintenance of the MS Hammers. More troubles with mechanical equipment of all kinds occur due to improper consideration of lubrication than for any other reason. Remember! oil is cheaper than repairs.

Oil for Air Operation. The oils recommended for steam operation should not be used when the Hammer is operated on compressed air, because they are too heavy and sticky unless heated by steam. Oil of approximately the following specifications is recommended for air-driven Hammers:

Gravity, degrees API	17 to 28
Pour Point, degrees Fahrenheit	0 to 40
Viscosity, Saybolt Seconds at 210F	48 to 60
Percentage of compounded oil	0 to 3

OIL FOR NORMAL STEAM OPERATION. A high grade compounded steam cylinder oil containing 5% to 7% animal oil is recommended for steam operation. Oil of this type produces an emulsifying effect when in contact with moisture, and the resulting lather resists the tendency of steam to work oil off the internal moving surfaces of the Hammer. Oil meeting the following specifications has proven successful under average conditions:

Gravity, degrees API	22 to 25
Pour Point, degrees Fahrenheit	10 to 40
Flash Point, degrees Fahrenheit	529 to 590
Viscosity, Saybolt Seconds at 210F	120 to 140
Percentage of compounded oil, usually acidless tallow or lard	5 to 7

OIL FOR ABNORMALLY WET STEAM OPERATION. Hammers are often run on very wet steam due to the inability of the boiler to produce a quality steam, the length of steam line and hose between boiler and Hammer, the weather, or any factor causing condensation in the steam. When there is excess water in the steam, a cylinder oil containing 10% to 12% compounded animal oil is necessary to insure that the oil will not be washed from the moving parts.

FLUID LINE LUBRICATORS:

Any standard sight feed lubricator, if properly installed and operated will be acceptable for use with the MS Hammers. MKT can supply either an air or steam lubricator if specified.

The purpose of a lubricator in the fluid line is to introduce oil into the intake fluid. This oil will be carried into the hammer to lubricate the various moving parts, and interior surfaces.

It is essential that the lubricator be installed in accordance with the manufacturer's instructions. The lubricator must be kept filled, and a steady supply of oil must be fed into the line whenever the hammer is in operation.

FLUID LINE LUBRICATORS - Continued:

In general, the lubricator should be placed in the fluid line between the throttle valve and the hammer.

The lubricator should be installed so that the outlet pipe extends into the center of the fluid line, at right angles to the flow. This will allow the oil to become wholly diffused in the fluid. If the oil enters near the wall of the line, it will wash along the surface and never act as an effective lubricant for the hammer.

Never mount a lubricator at a bend in the fluid line. Fluid striking the oil outlet pipe head-on will cause the lubricator to operate intermittently. Fluid turning past the oil outlet pipe will fail to diffuse the lubricant properly.

Air operation requires more oil for proper lubrication than does steam operation. For this reason, it is essential that a steady supply of oil be fed into the air line. The water present in steam operation acts as a partial lubricant which is not available when using air.

PISTON ROD LUBRICATION:

The extensive surface of the piston rod should be lubricated before starting the hammer at the beginning of the day. This should be done using a clean cloth and the same type of oil which is being used in the lubricator. During operation, this rod will be lubricated by oil present in the intake fluid.

GUIDE COLUMN AND TOP HEAD LUBRICATION:

The (4) Guide Columns and Top Head must be greased at the beginning of each day and after each two hours of operation using Texaco Aircraft Grease #4685 or equivalent.

CONTROL VALVE AND GATE VALVE LUBRICATION:

The Control Valve and Gate Valve must be greased at the beginning of each day and after every two hours of operation using Texaco Aircraft Grease #4685 or equivalent.

GUIDE BAR AND CONTROL ROLLER LUBRICATION:

The Guide Bar and Control Roller should be lubricated using a clean cloth or brush.
Grease at the same interval as other greasing operations.

MS SINGLE ACTING PILE HAMMERS

LUBRICATION RECOMMENDATIONS

	TYPE OF LUBRICATION	INTERVAL
Top Head Guide Column Control Valve Gate Valve	Texaco Aircraft Grease #4685 via Alemite Fitting	Before beginning operations and with every two hours of operation
Main Piston Rod	Same oil is used in lubricator. Apply with clean cloth.	Before starting the Hammer
Lubricator Air	Texaco Ursa Oil C or Kilfrost Oil	
Steam	Texaco Honor Cyl. Oil or Equivalent	Keep Fluid Line Lubrication full at all times during operation
Saturation Steam	Texaco Leader Valve Oil or equivalent	
Forked Head Control Roller Control Bar	Texaco Aircraft Grease #4685 or Equivalent.	Before beginning Operation and after every two hours of operation

STARTING AND OPERATING THE MS-350 AND MS-500

Before putting the hammer into operation, be sure all lubrication recommendations have been followed, and that all nuts and bolts are sufficiently tight. See Illustration for torque Spec. MS-350 or MS-500.

It is also recommended that the condition of the cushion block in the drive cap be occasionally checked. New cushioning material should be added whenever the thickness of the old material reaches 1" thick or less.

All exhaust ports must be opened before the hammer is put into operation. The hammer will not operate if these ports are left closed. Remove the 6 pan head screws from the control valve, the adhesive tape from the holes in the Gate Valve, Top Cylinder, the plug from the Top Main Valve Cylinder, and the Wooden Plug from the Ram Cylinder Exhaust Port. These ports should always be closed when the hammer is not in operation to prevent foreign matter from entering the hammer.

STEAM OPERATION:

When using steam, it is always necessary to warm the hammer before beginning any driving operation. This is accomplished by seating the hammer firmly on the pile to be driven and setting the Control Valve to Stop by means of the Control line. The Throttle Valve in the fluid line is opened slightly to allow steam to flow to the hammer. When pure steam emerges from the Gate Valve cylinder ports, the control line can gradually be pulled into the stroke position.

AIR OPERATION:

As with steam operation, the hammer must be firmly seated on the pile with all exhaust ports open, and the Control Valve in the Stop position. Open the throttle valve on the air line, and gradually pull the control line into the stroke position. Increase the stroke slowly until the desired height is reached.

STROKE ADJUSTABILITY:

The stroke of the MS-350 and MS-500 is infinitely variable by means of the Control Valve actuated by the control line. See Illustration on next page. The degree of stroke can also be varied by reducing the volume of fluid to the hammer with the throttle valve.

STARTING AND RUNNING THE MS-350 AND MS-500 DURING EASY DRIVING:

When starting a pile during easy driving, the Hammer should be run slowly, preferably with manually controlled strokes, so the pile does not run ahead of the Hammer and permit the Hammer to drive upon its own retaining members.

HANDLING HAMMER HOIST LINE:

The Hammer hoisting line must be kept slack at all times while the pile is being driven, so the full weight of the Hammer rests squarely on the pile. A pile which is allowed to run ahead of the Hammer will permit the Hammer to drive on its own retaining members, damaging the Hammer.

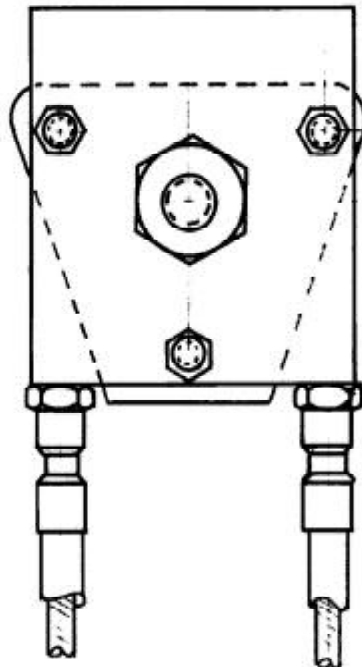
STOP HAMMER AT PILE REFUSAL:

Do not continue driving a pile when it has stopped moving. For practical purposes, a pile is at refusal at 10 blows per inch of penetration. There are two direct results of driving a pile at refusal: damage to the pile and/or damage to the Hammer.

Engineers are cautioned against selecting infinitesimal values of set for their formulae to improve the pile-bearing capacities which can be reached by a Hammer. The use of a larger Hammer is the only safe and sure way to assure that a pile has been driven to a greater bearing capacity.

STROKE ADJUSTABILITY:

The stroke of the MS Hammers is infinitely variable, by means of the Control Valve actuated by the control line. See Illustration below. The degree of stroke can also be varied by reducing the volume of fluid to the hammer with the throttle valve.



LEFT

Pull out to
Increase Stroke

RIGHT

Pull out to
Reduce Stroke
or Shut off Hammer

OPERATION:

1. Know the specification of your Hammer: Never use excessive steam or air pressure. This can cause the Hammer to jump.
2. Do not use the full power of the Hammer when starting piles or during easy driving. At full power, the pile may easily run ahead of the hammer permitting the hammer to deliver its total input blow to its own retaining members.
3. Keep the Hammer hoist line slack. The full weight of the MS Hammer should rest on the pile throughout the driving operation. A taut Hammer hoist line will allow the hammer to deliver its blow to its own retaining members.
4. Keep the hammer on and in vertical alignment with the pile. This will reduce wear and possible damage to the bottom of the hammer. The use of leads is recommended to reduce the possibility of misalignment.
5. Do not continue to drive piles at refusal. Continued driving of piles which have stopped moving will damage the pile and possibly the hammer. Any driving after a pile reaches a set of 1/10 of an inch per blow is, for practical purposes, driving at refusal.

MAINTENANCE ON THE JOB:

1. Follow lubrication instructions carefully. Use only the proper oils and grease, and lubricate at the recommended intervals.
2. Do not use worn hose: Pieces of rubber lining from worn hoses can be blown into the hammer and clog ports or valves. Be sure before attaching the inlet hose, that all dirt has been blown out, and that couplings are free of dirt and grit.
3. Keep nuts and bolts tight: Always check the torque on fasteners to assure that they have not loosened. (See Page 30). It is especially important to be sure that the Guide Column Bottom Nuts are tight.

MAINTENANCE ON THE JOB - Continued:

4. Renew worn Packing to assure efficient operation: Be sure that the gland is seated in the Ram Cylinder Cover against the packing. The gland nuts should be tightened so that the gland will exert an even pressure on the packing. A gland which is made up unevenly can score the piston rod.
5. Always use drive caps and the proper thickness of cushioning material. The striking end of the Ram Cylinder MUST NEVER strike a pile or an uncushioned drive cap. Add new cushioning material whenever the thickness of the old approaches 1" or less.
6. Rubber Bumpers that are located on the upper head spacers and on the lower head should be replaced whenever they are worn badly or broken. The Ram Cylinder should never make metal to metal contact with either head.

MAINTENANCE IN UNUSUALLY COLD WEATHER:

1. In unusually cold weather, warm up the Hammer slowly using the methods previously described. Never start the Hammer at full speed in cold weather. Give the steam time to warm the working parts or allow time, in air operation, for friction to warm working parts before permitting the Hammer to operate at full stroke. Drain off as much condensate as possible while warming the hammer.
2. Keep steam lines as short as possible, when using steam as the motive fluid. When piping is used to any extent, it should be well insulated to prevent excessive radiation and consequent excessive condensation in the line.
3. A gooseneck should be placed in the air line, when using compressed air as the motive fluid and when any appreciable amount of piping is used from the compressor to the Hammer. In turn, the gooseneck should be placed in a salamander with a low fire to heat the air supplied to the Hammer, in an endeavor to prevent the moisture in the air from freezing inside the Hammer, causing the Valves and Pistons to freeze and stop the Hammer.

MAINTENANCE IN UNUSUALLY COLD WEATHER - Continued:

4. Alcohol has been used by some contractors as an alternative to the foregoing method. To introduce the alcohol into the air line, a tank is mounted above the compressor manifold and anti-freeze alcohol is allowed to drip into the air manifold through a partially opened valve.
5. Drive Caps should be heated in cold weather before they are subjected to the blow of the Ram. The Hammer should be run very slowly, with manually controlled strokes, until the heat of impact warms the Drive Cap. As an alternative, parts which are not heated by the process of warming up the Hammer can be warmed under a steam spray in very cold weather before they are put to use, to prevent breakage.
6. The exhaust ports in the control valve, gate valve piston rod, and the main valve top cylinder should be checked periodically to assure that they are free of ice.

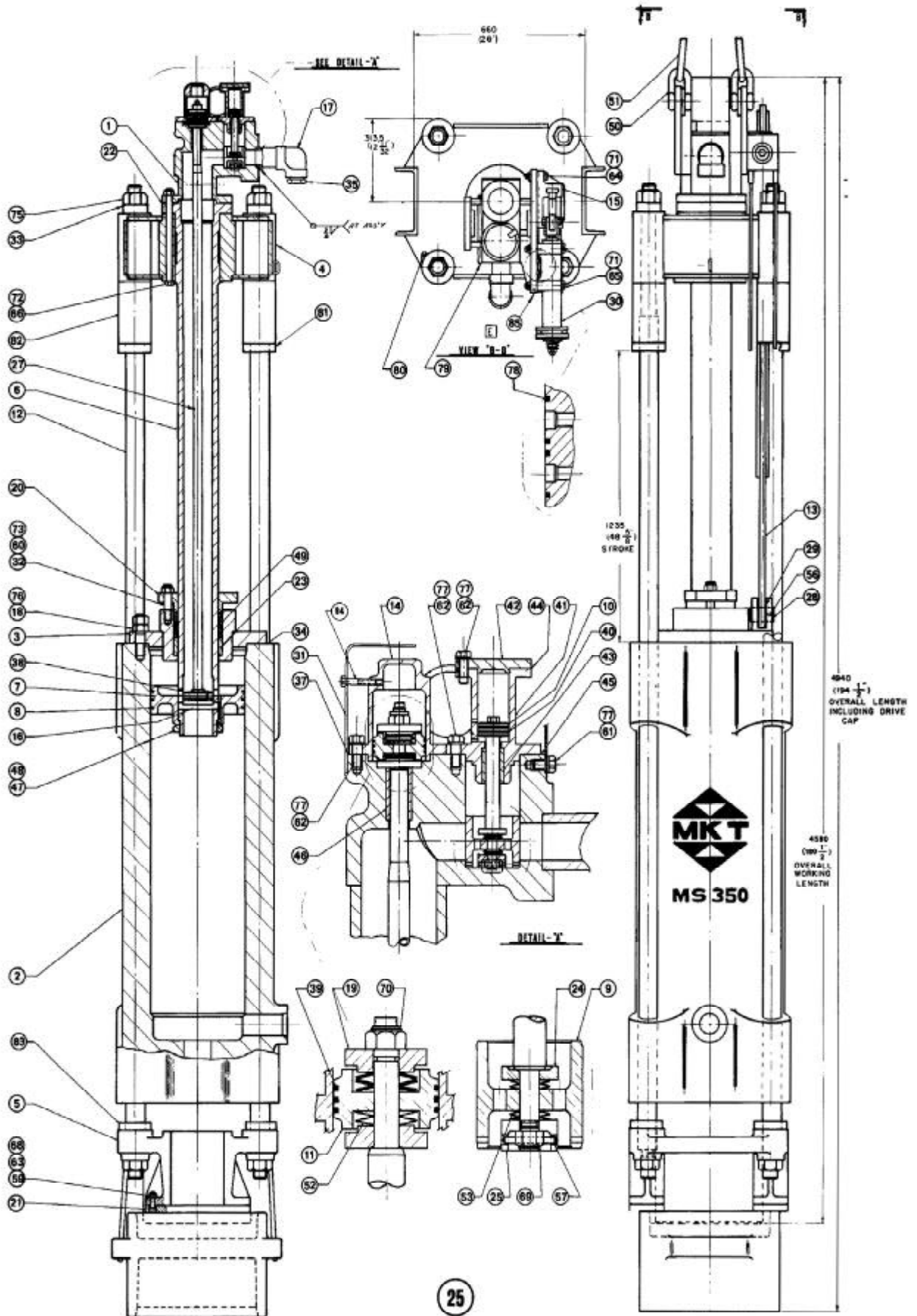
MAINTENANCE FOR A HAMMER NOT IN SERVICE:

1. All inlet and exhaust ports should be plugged or taped at all times when the hammer is not in operation to prevent dirt and grit from entering the hammer.
2. All grease fittings should be properly lubricated, and the guide columns and main piston rod coated with oil.
3. If an MS-350 or MS-500 is to be taken out of operation for a period of less than 3 months, detach the inlet line and pour one quart of oil down the hose. Re-attach the hose and run the hammer several strokes to assure that the oil has been flushed over all internal surfaces. All grease fittings should be properly lubricated, and the main piston rod and guide columns wiped, using a clean cloth and a heavy grease.

MAINTENANCE FOR A HAMMER NOT IN SERVICE - Continued:

4. Should the hammer be placed in storage for an extended period of time, the Guide Columns and main piston rod should be well conserved in grease and further protected by wrapping oil pipes or plastic strips around them. The Control Valve assembly and control line should be removed from the hammer, lubricated and stored in a clean dry place. All exhaust and inlet ports should be tightly sealed, and the packing removed.
5. Upon putting an MS-350 or MS-500 back into operation after a long period of storage, all parts should be lubricated and checked to assure that they are of easy action. Replace the packing and check the tightness of all fasteners.

GENERAL ASSEMBLY
MS-350



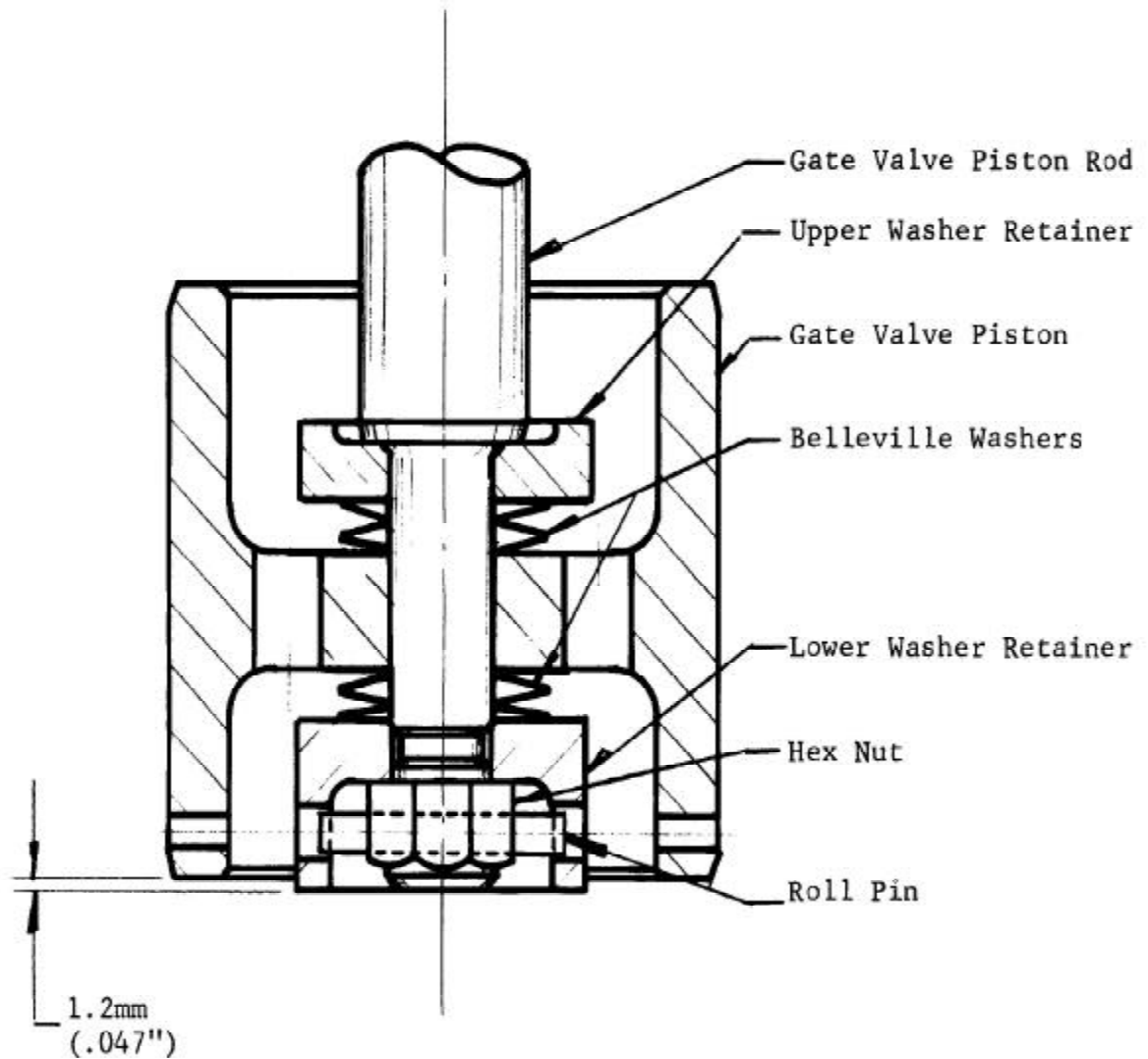
ITEM NO.	PART NO.	DESCRIPTION	QTY. REQ'D.
42	1 236 00 93	Cover, Gate Valve Top Cylinder	1
43	1 236 01 01	Bushing, Gate Valve Cylinder	1
44	1 236 01 02	Gasket, Gate Valve Cylinder Cover	1
45	1 236 01 03	Gasket, Gate Valve Cylinder	1
46	1 236 01 07	Bushing, Main Valve	1
47	0 921 00 32	Bearing Locknut #AN-30	1
48	1 226 00 60	Half Nipple 4" x 4" Long Steel Extra Strong	1
49	0 935 00 26	Packing, Main Piston	1
50	0 938 00 46	Shackles, Crosby #S-2150	2
51	0 938 00 47	Wire Rope Sling	1
52	0 950 00 01	Belleville Washers, Main Valve	9
53	0 950 00 02	Belleville Washers, Gate Valve	6
56	0 950 00 05	Roll Pin, 12 mm x 120 DIN 1481	1
57	0 950 00 06	Roll Pin, 5 mm x 40 DIN 1481	1
59	0 950 00 09	Flat Washer, M17 DIN 125	8
60	0 950 00 10	Cotter Pin, 6 mm x 55 DIN 94	2
61	0 950 01 01	Hex Hd. Cap Scr.-M16 x 25 DIN 933 (8.8)	4
62	0 950 01 02	Hex Hd. Cap Scr.-M16 x 40 DIN 933 (8.8)	12
63	0 950 01 15	Hex Hd. Cap Scr.-M16 x 70 DIN 931 (8.8)	8
64	0 950 01 04	Hex Hd. Cap Scr.-M20 x 75 DIN 931 (8.8)	2
65	0 950 01 05	Hex Hd. Cap Scr.-M20 x 150 DIN 931 (8.8)	4
66	0 943 02 67	Hex Hd. Bolt 1-8 NC x 14 1/4 GR. 8	8
68	0 950 02 01	Hex Locknut M16 x 2 DIN 985	8
69	0 950 02 02	Hex Locknut M16 x 1.5 DIN 985	1
70	0 950 02 03	Hex Locknut M20 x 1.5 DIN 985	1
71	0 950 02 04	Hex Locknut M20 x 2.5 DIN 985	6
72	0 920 00 38	Flexloc Nut 1"-8 NC-SPS #30 FA-1608	8
73	0 950 02 06	Cast. Hex Nut M30 x 2 DIN 935	2
75	0 950 02 08	Hex Nut M56 x 4 DIN 934	8
76	0 950 02 09	Hex Nut M36 x 3 DIN 934	12
77	0 950 03 01	Lockwasher M16 DIN 127	22
78	0 913 01 23	Metric "O" Ring 26.5mm I.D. x 3mm C.S.Viton	3
79	0 950 00 15	Soc.Pipe Plug-M12 x 1.5 Taper DIN 906	2
80	0 950 00 16	Grease Fitting H1-M10X1 DIN 71412	8
81	1 215 00 50	Bumper	4
82	1 216 00 15	Spacer	4
83	1 226 01 10	Bumper - Lower	4
84	0 950 01 09	Hex Hd. Bolt M8 x 1.25-50 DIN 931	1

ITEM NO.	PART NO.		DESCRIPTION	QTY. REQ'D.
1	6	216 00 13	Main Valve Housing - Machining	1
2	4	226 00 04	Ram Cylinder, Machining	1
3	4	226 00 06	Ram Cylinder Cover	1
4	6	226 00 07	Top Head, Weldment & Machining	1
5	6	226 00 08	Bottom Head, Machining, Casting	1
6	4	236 00 11	Piston Rod	1
7	3	226 00 12	Piston, Main Machining	1
8	1	226 00 14	Piston Ring, Main Piston	3
9	2	215 00 15	Piston, Gate Valve	1
10	2	215 00 16	Piston Rod, Gate Valve	1
11	2	215 00 17	Piston, Top Main	1
12	3	226 00 18	Guide Column	4
13	4	236 00 03	Control Bar Assembly	1
14	3	216 00 05	Top Cylinder, Main Valve	1
15	3	216 00 22	Control Bar Guide - Investment Casting	1
16	1	215 00 23	Rest Pin, Piston	1
17	0	930 04 97	4" Elbow, Malleable Iron 300 P.S.I.	1
18	1	215 00 26	Stud, Ram Cylinder Cover	6
19	1	215 00 27	Retainer, Belleville Washer, Top Main	2
20	2	216 00 11	Gland - Machining	1
21	2	215 00 29	Cushion, Bottom Head	2
22	2	215 00 30	Gasket, Main Valve Housing	1
23	2	215 00 31	Bushing, Packing	1
24	1	215 00 32	Retainer, Upper Washers, Gate Valve	1
25	1	215 00 33	Retainer, Lower Washers, Gate Valve	1
27	3	236 00 37	Piston, Main Valve	1
28	1	215 00 38	Pin, Control Bar	1
30	3	216 00 42	Control Valve Assembly - (See P/L)	1
31	2	215 00 43	Guard	1
32	1	215 00 44	Stud, Gland	2
33	1	216 00 16	Spacer, Guide Column	4
34	2	226 00 46	Gasket, Ram Cylinder Cover	1
35	0	930 04 98	Hex, Bushing - 4" to 2 1/2 - Steel	2
37	2	215 00 49	Gasket, Top Cylinder, Main Valve	1
38	1	235 00 23	Piston Ring, Main Valve	3
39	1	235 00 24	Piston Ring, Top Main Valve	3
40	1	235 00 25	Piston Ring, Gate Valve Piston	2
41	4	216 00 06	Gate Valve, Top Cylinder - Machining	1

ITEM NO.	PART NO.		DESCRIPTION	QTY. REQ'D.
1	6	216 00 13	Main Valve Housing - Machining	1
2	5	236 00 04	Ram Cylinder, Machining	1
3	5	236 00 06	Ram Cylinder Cover	1
4	6	236 00 07	Top Head, Weldment & Machining (Sh. 1 & 2)	1
5	6	236 00 08	Bottom Head, Machining, Casting	1
6	4	236 00 11	Piston Rod	1
7	3	236 00 12	Piston, Main Machining	1
8	1	235 00 22	Piston Ring, Main Piston	3
9	2	215 00 15	Piston, Gate Valve	1
10	2	215 00 16	Piston Rod, Gate Valve	1
11	2	215 00 17	Piston, Top Main	1
12	3	236 00 18	Guide Column	4
13	4	236 00 03	Control Bar Assembly	1
14	3	216 00 05	Top Cylinder, Main Valve	1
15	3	216 00 22	Control Bar Guide	1
16	1	215 00 23	Rest Pin, Piston	1
17	2	236 00 25	Inlet Assembly	1
18	2	236 00 26	Stud, Ram Cylinder Cover	6
19	1	215 00 27	Retainer, Belleville Washers, Top Main	2
20	2	216 00 11	Gland - Machining	1
21	2	215 00 29	Cushion, Bottom Head	2
22	2	215 00 30	Gasket, Main Valve Housing	1
23	2	215 00 31	Bushing, Packing	1
24	1	215 00 32	Retainer, Upper Washers, Gate Valve	1
25	1	215 00 33	Retainer, Lower Washers, Gate Valve	1
27	3	236 00 37	Piston, Main Valve	1
28	1	215 00 38	Pin, Control Bar	1
30	3	216 00 42	Control Valve Assembly - (SEE P/L)	1
31	2	215 00 43	Guard	1
32	1	215 00 44	Stud, Gland	2
33	1	236 00 16	Spacer, Guide Column	4
34	2	236 00 46	Gasket, Ram Cylinder Cover	1
35	2	236 00 47	Gasket, Inlet - Weldment	1
36	0	930 02 22	Street Elbow - 3" - Steel	1
37	2	215 00 49	Gasket, Top Cylinder, Main Valve	1
38	1	235 00 23	Piston Ring, Main Valve	3
39	1	235 00 24	Piston Ring, Top Main Valve	3
40	1	235 00 25	Piston Ring, Gate Valve Piston	2

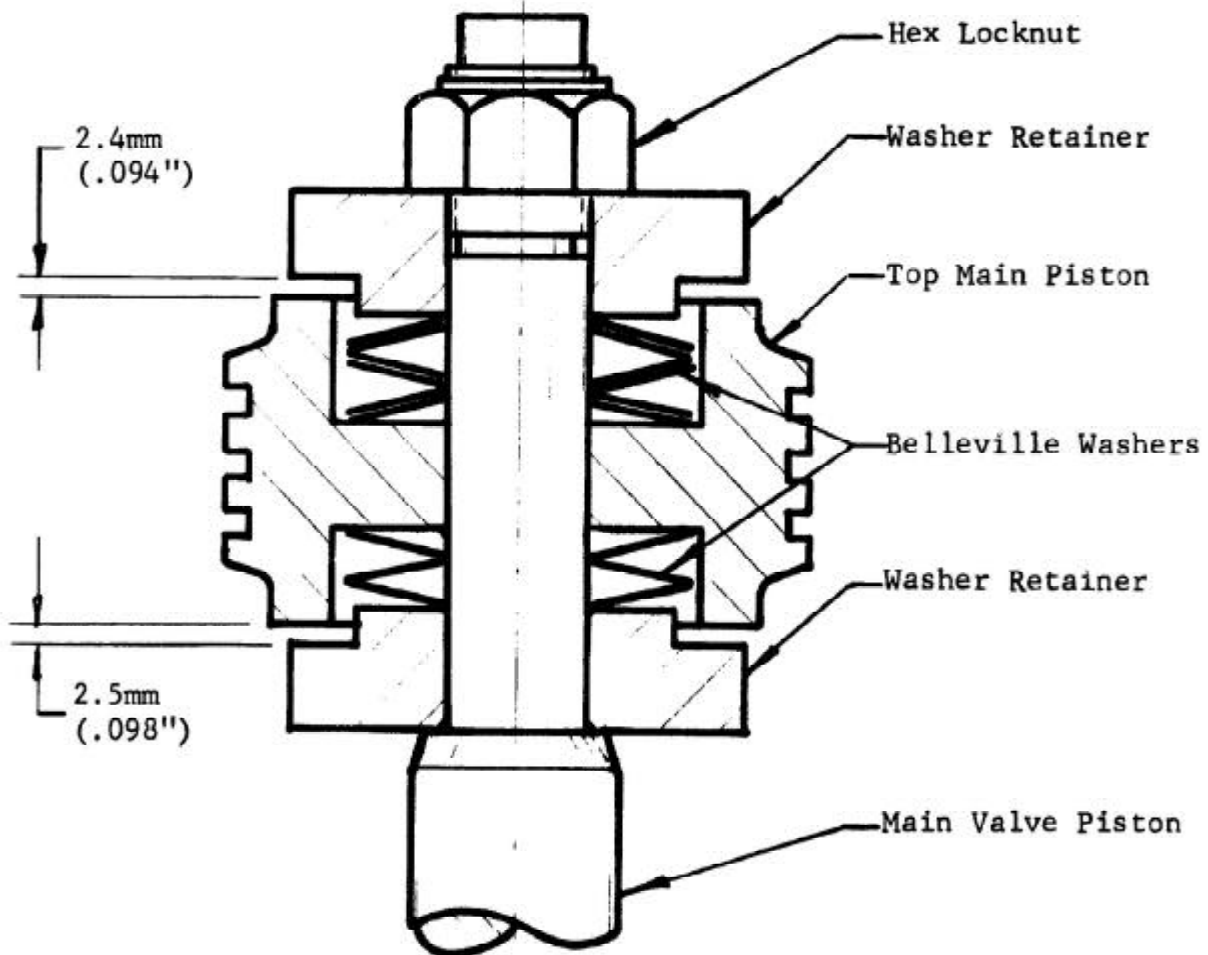
ITEM NO.	PART NO.		DESCRIPTION	QTY. REQ'D.
41	4	216 00 06	Gate Valve, Top Cylinder - Machining	1
42	1	236 00 93	Cover, Gate Valve Top Cylinder	1
43	1	236 01 01	Bushing, Gate Valve Cylinder	1
44	1	236 01 02	Gasket, Gate Valve Cylinder Cover	1
45	1	236 01 03	Gasket, Gate Valve Cylinder	1
46	1	236 01 07	Bushing, Main Valve	1
47	0	921 00 32	Bearing Locknut #AN-30	1
49	0	935 00 26	Packing, Main Piston (15 Ft.Reqd.per Hammer)	15 Ft.
50	0	938 00 46	Shackles, Crosby #S-2150	2
51	0	938 00 47	Wire Rope Sling	1
52	0	950 00 01	Belleville Washers, Main Valve	9
53	0	950 00 02	Belleville Washers, Gate Valve	6
56	0	950 00 05	Roll Pin, 12 mm x 120 DIN 1481	1
57	0	950 00 06	Roll Pin, 5mm x 40 DIN 1481	1
59	0	950 00 09	Flat Washer, M17 DIN 125	8
60	0	950 00 10	Cotter Pin, 6 mm x 55 DIN 94	2
61	0	950 01 01	Hex Hd. Cap Scr.-M16 x 25 DIN 933 (8.8)	4
62	0	950 01 02	Hex Hd. Cap Scr.-M16 x 40 DIN 933 (8.8)	18
63	0	950 01 15	Hex Hd. Cap Scr.-M16 x 70 DIN 931 (8.8)	8
64	0	950 01 04	Hex Hd. Cap Scr.-M20 x 75 DIN 931 (8.8)	4
65	0	950 01 05	Hex Hd. Cap Scr.-M20 x 150 DIN 931 (8.8)	4
66	0	943 02 67	Hex Hd. Bolt 1-8 NC x 14 1/4 GR. 8	8
67	0	950 01 07	Hex Hd. Cap Scr.-M16 x 50 DIN 933 (8.8)	8
68	0	950 02 01	Hex Locknut M16 x 2 DIN 985	8
69	0	950 02 02	Hex Locknut M16 x 1.5 DIN 985	1
70	0	950 02 03	Hex Locknut M20 x 1.5 DIN 985	1
71	0	950 02 04	Hex Locknut M20 x 2.5 DIN 985	8
72	0	920 00 38	Flexloc Nut 1"-8 NC-SPS #30 FA-1608	8
73	0	950 02 06	Cast. Hex Nut M30 x 2 DIN 935	2
75	0	950 02 14	Hex Nut M64 x 4 DIN 934	8
76	0	950 02 12	Hex Nut M48 x 3 DIN 934	12
77	0	950 03 01	Lockwasher M16 DIN 127	30
78	0	913 01 23	Metric"O" Ring 26.5mm I.D.x3mm C.S. Viton	3
79	0	950 00 15	Soc. Pipe Plug-M12 x 1.5 Taper DIN 906	2
80	0	950 00 16	Grease Fitting H1-M10X1 DIN 71412	8
81	1	236 00 50	Bumper	8
82	2	236 00 15	Spacer	4
83	0	950 01 09	Hex Hd. Bolt M8 x 1.25-50 DIN 931	1

The Gate Valve Piston is supported between Belleville Washers. Their task is to absorb the energy which is developed when this valve opens or closes. The spring washer should be compressed to establish the dimension given below.



Belleville Washer Data:
Size: B31.5 x 16.3 x 1.25 DIN 2093
MKT Part No. 950 00 02

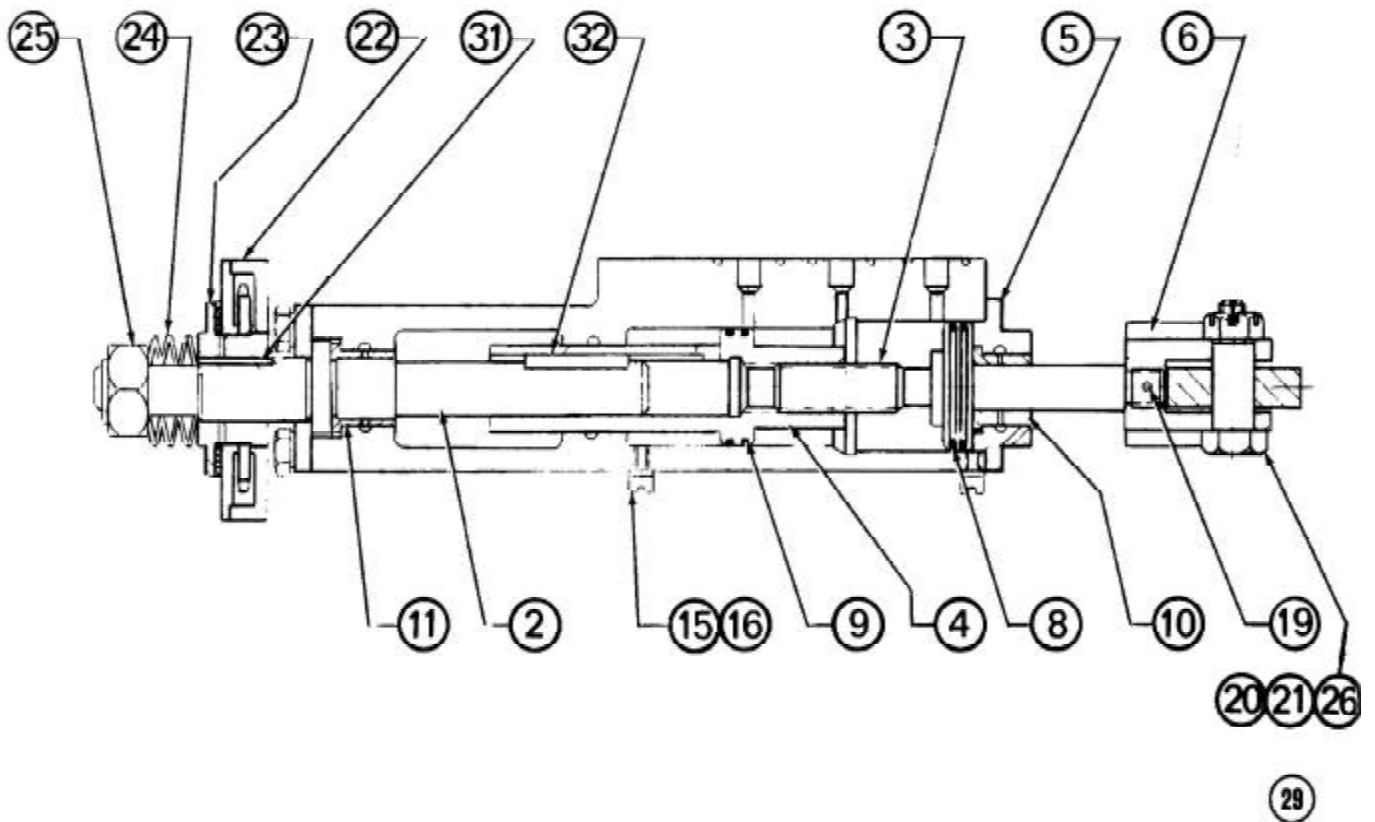
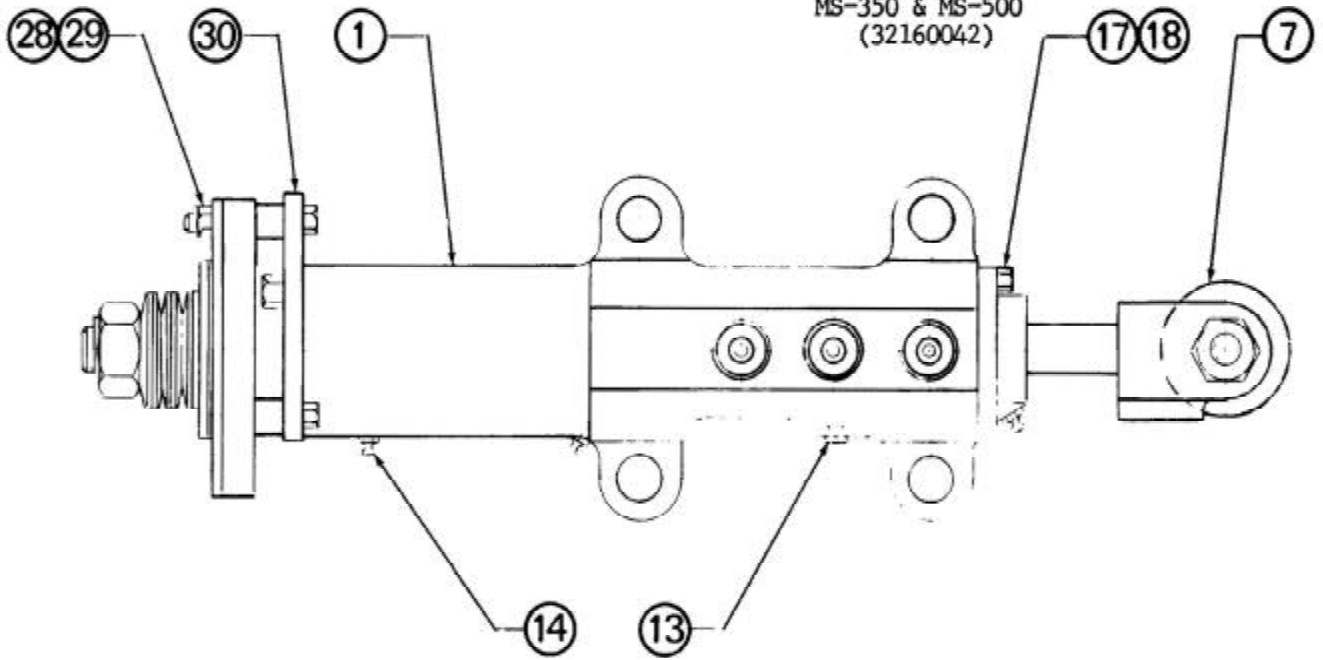
The top main piston is supported between Belleville Washers. Their task is to absorb the energy which develops when inflowing pressure forces the main valve piston downward. The washers should be compressed to the dimensions specified below.



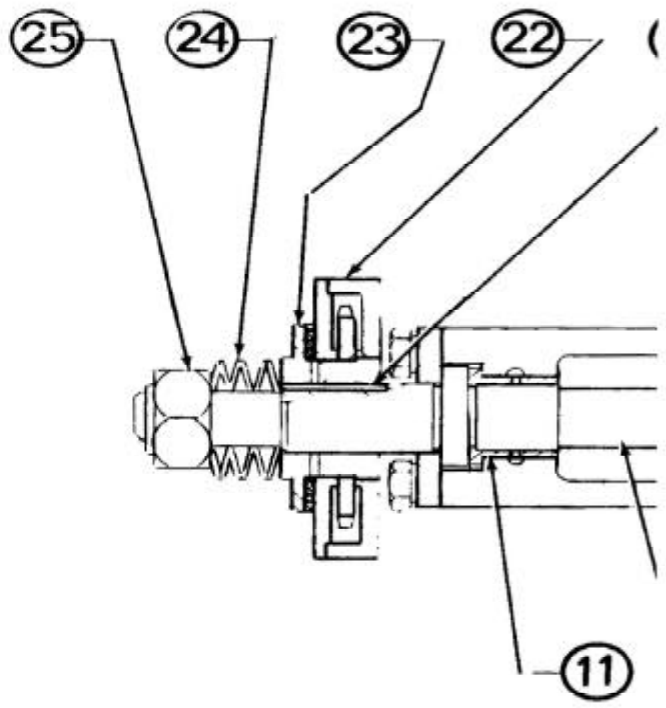
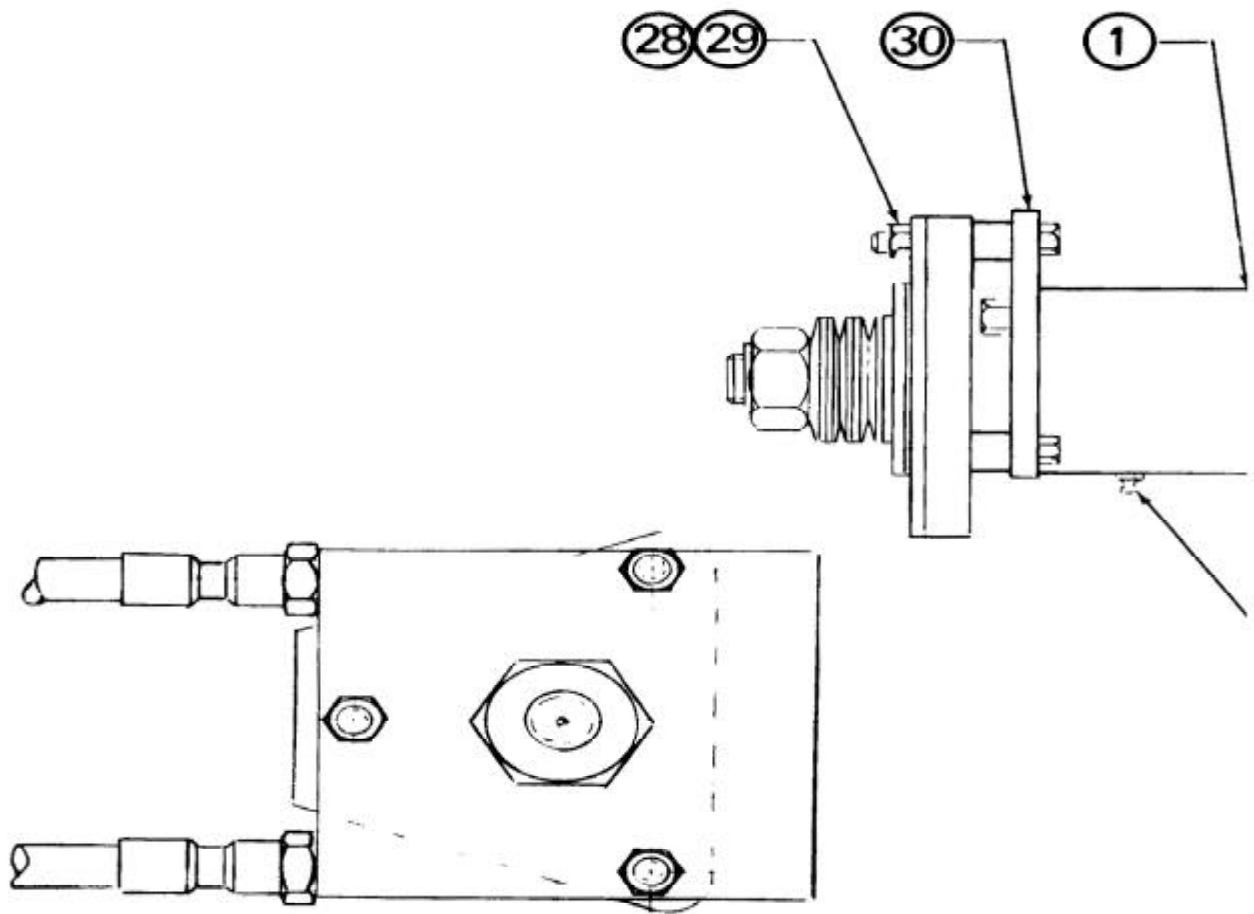
Belleville Washer Data:

Size: B50-25.4-2 DIN 2093;
MKT Part No. 950 00 01

CONTROL VALVE ASSEMBLY
MS-350 & MS-500
(32160042)



(Continued)



ITEM NO.	PART NO.	DESCRIPTION	QTY. REQ'D.
1	4 216 00 09	Body	1
2	2 215 00 98	Shaft	1
3	2 215 00 96	Control Plunger	1
4	2 215 00 97	Control Plunger	1
5	2 215 00 95	Flange	1
6	2 216 00 39	Clevis	1
7	1 236 01 00	Roller	1
8	1 235 00 26	Piston Ring	2
9	1 235 00 27	Piston Ring	2
10	0 914 00 81	Bearing - Oilite #FF1202-03	1
11	0 914 00 82	Bearing - Oilite #FF1314-03	1
13	0 950 00 11	Plug 10mm x 1 Taper DIN 906	1
14	0 950 00 12	Grease Fitting H1-M6 x 1 DIN 71412	3
15	0 950 01 10	Pan Head Scr. M6 x 1-10mm Lg. DIN 85	6
16	0 950 03 02	Lockwasher M6 DIN 127	6
17	0 950 01 08	Hex Hd. Cap Scr. M12 x 1.75-25 Lg. DIN 933(8.8)	8
18	0 950 03 03	Lockwasher M12 DIN 127	8
19	0 950 00 06	Roll Pin - 5 ϕ mm x 40 DIN 1481	1
20	0 950 01 14	Hex Hd. Shoulder Scr. M18 x 2.5-60 DIN 610	1
21	0 950 03 04	Cotter Pin - 4 x 35 DIN 94	1
22	2 215 00 89	Control Device Modification	1
23	1 215 00 86	Brake-Control Valve	1
24	0 950 00 18	Belleville Washer B50 x 20.4 x 2 DIN 2093	3
25	0 950 02 03	Lock Nut M20 x 1.5 DIN 985	1
26	0 950 02 13	Hex Nut, Slotted M18 x 2.5 DIN 937	1
28	0 950 01 09	Hex Hd. Bolt M8 x 1.25-50 DIN 931	3
29	0 950 02 11	Hex Nut M8 x 1.25 DIN 934	3
30	2 236 00 85	Flange - Control Valve	1
31	0 950 00 13	Key 8 x 7 x 35 Metric & Brit. #6885	1
32	0 950 00 14	Key 8 x 7 x 50 Metric & Brit. #6885	1

MS-350 TORQUE ON BOLTS AND NUTS

	<u>MKG</u>	<u>FT. LBS.</u>
COLUMN NUTS	170	1200
COVER STUD NUT	54	390
TOP CROSS HEAD NUTS	15	110

MS-500 TORQUE ON BOLTS AND NUTS

	<u>MKG</u>	<u>FT. LBS.</u>
COLUMN NUTS	220	1600
COVER STUD NUT	100	725
TOP CROSS HEAD NUTS	15	110