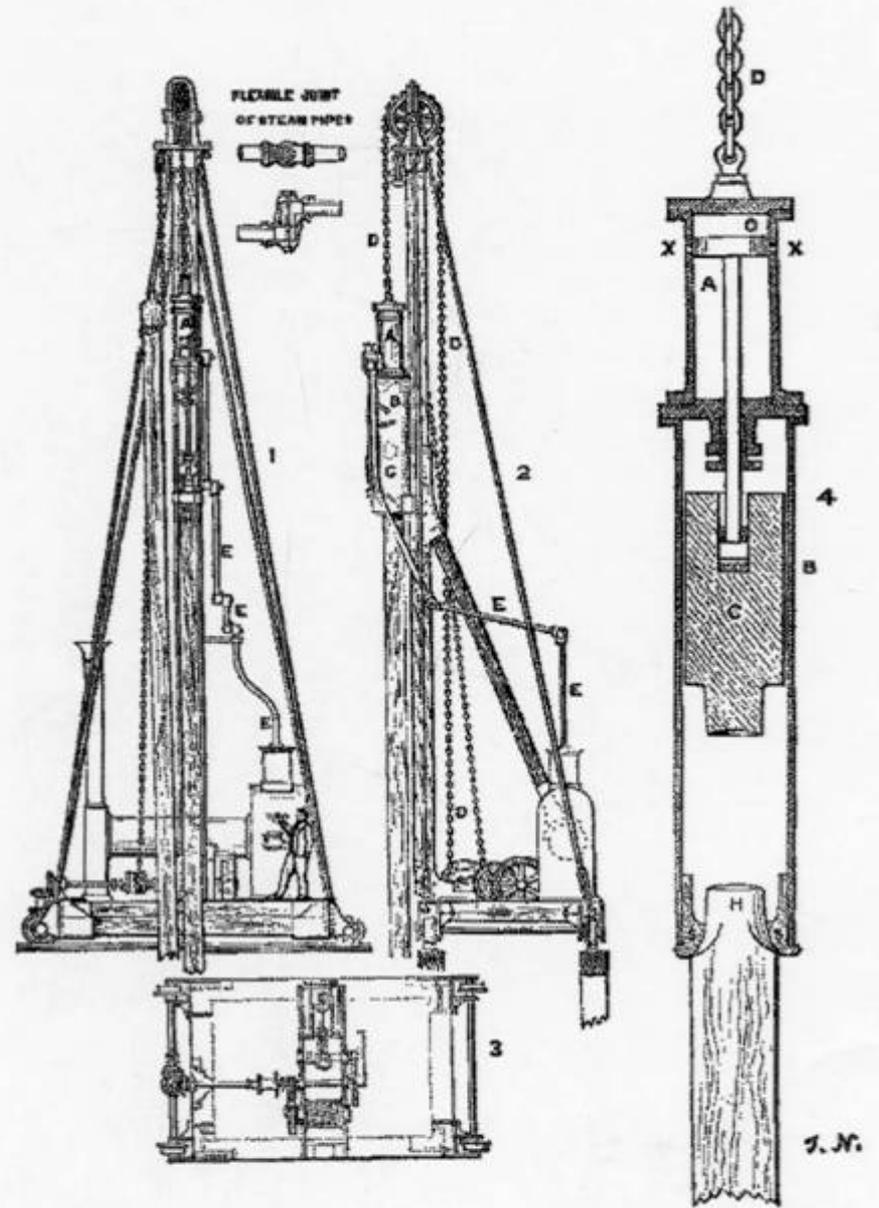


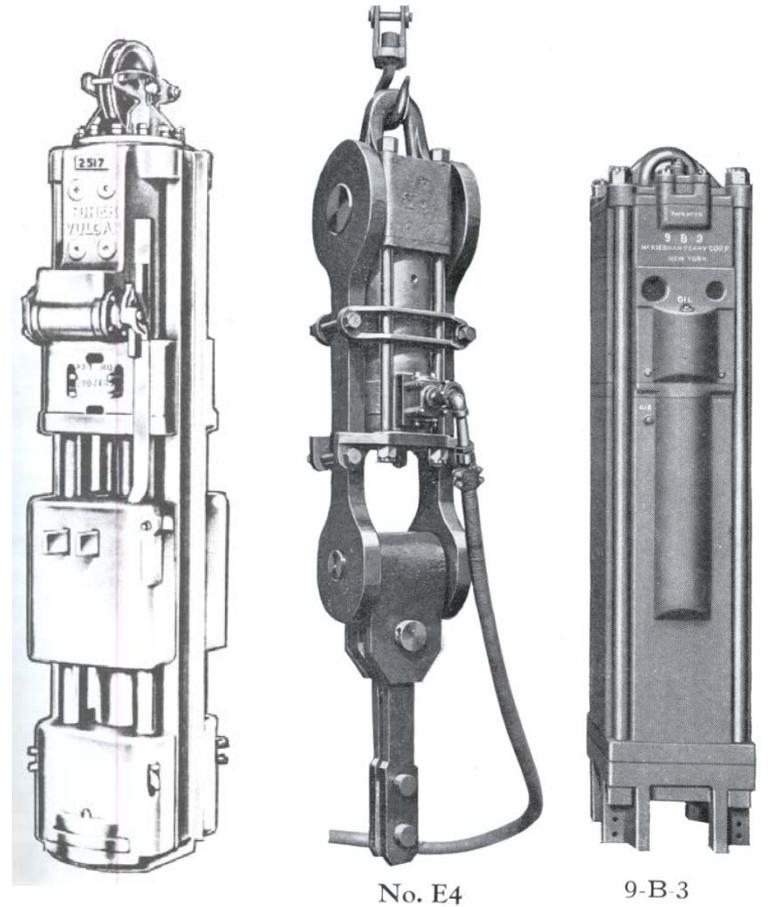
Air Hammers

First Steam hammer made in the US in 1845



Drawing of Nasmyth's original Steam Piledriver
Circa 1845

Types of Air/Steam hammers and extractors

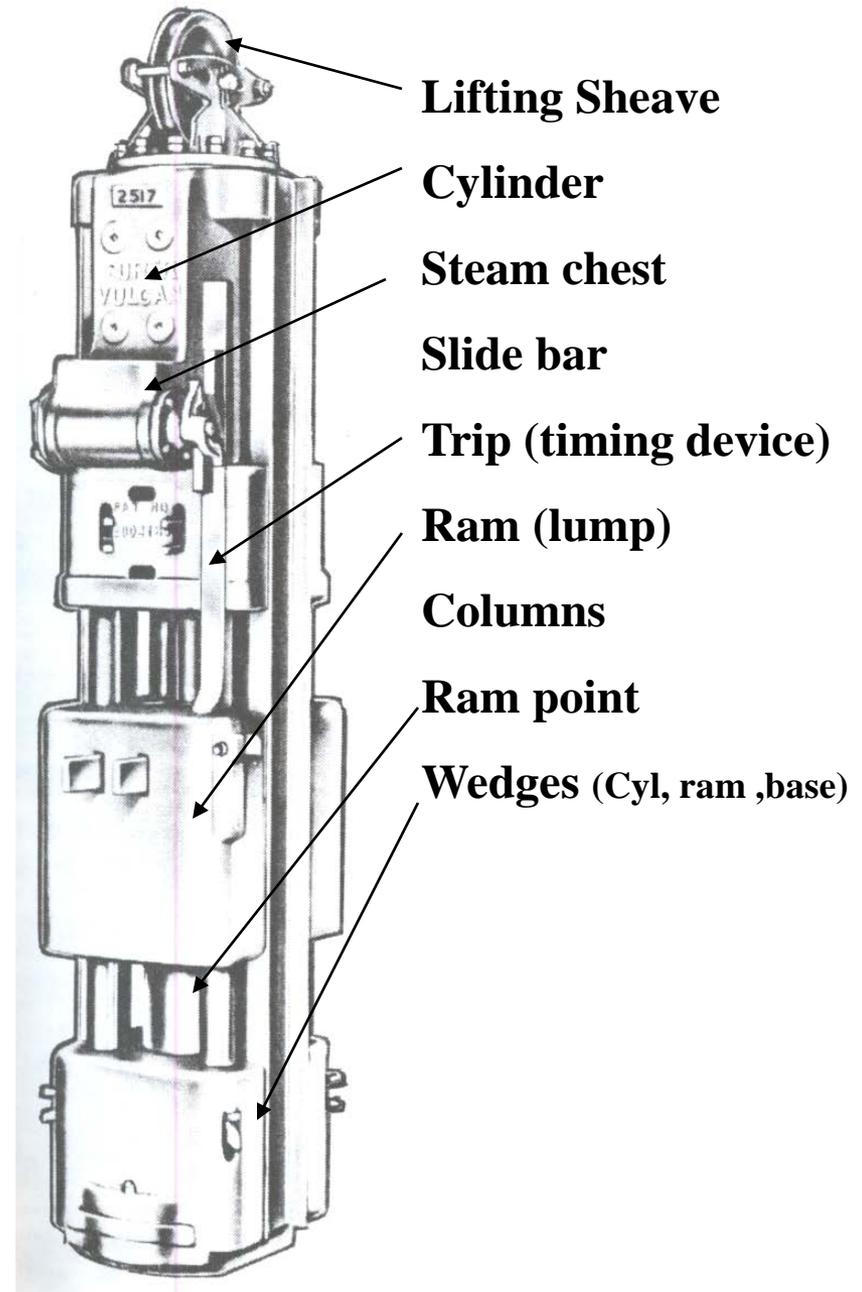


- 1) Single acting air/steam hammers and extractors
- 2) Differential acting air/steam hammers
- 3) Double acting air/steam hammers



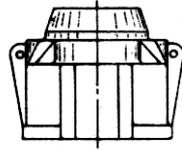
Air/Steam single acting hammers: Vulcan

The first #1 Vulcan was built
in 1887

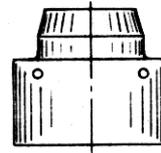
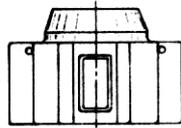


Vulcan drive caps

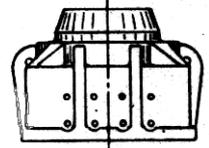
Box type



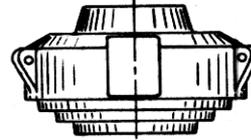
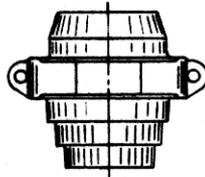
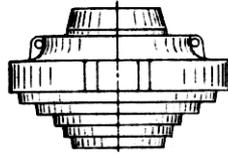
Concrete &
H-beam



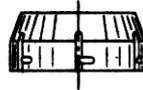
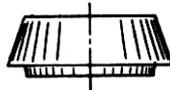
Concrete
with re-bar



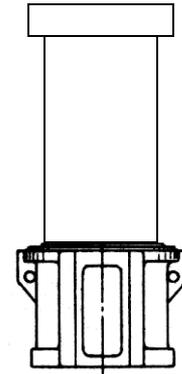
Pipe piles



Drive cap
repair
items



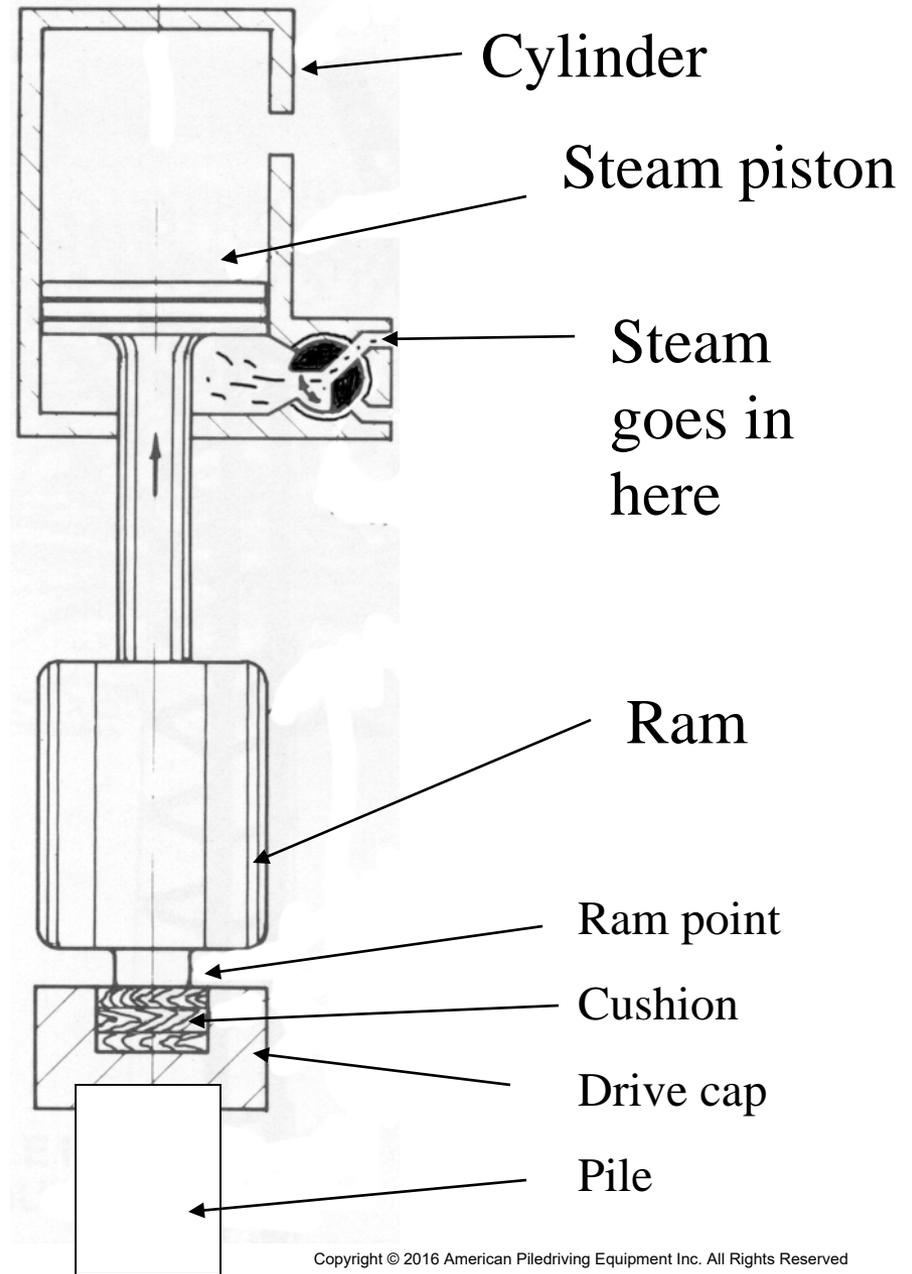
For repairing broken cones
on top of drive caps



Follower for
driving pile into
the ground

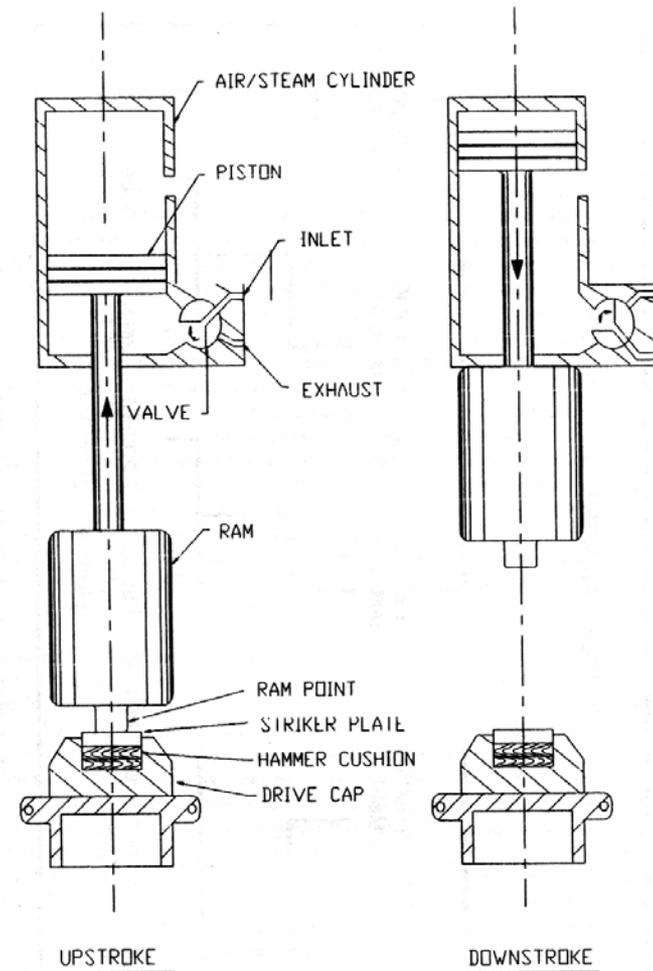
Single-Acting Steam/Air Hammers

Single-acting steam/air hammers are gravity, or drop hammers, for which the hoist line has been replaced by a pressurized fluid – steam or air.

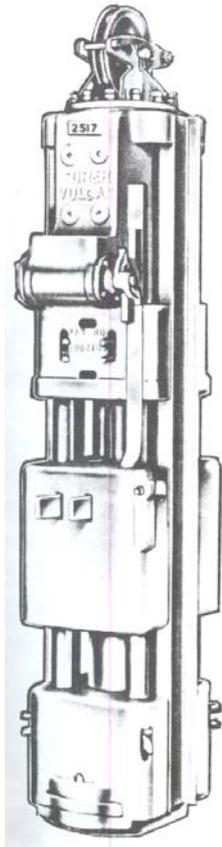


Single acting air/steam principle: Vulcan

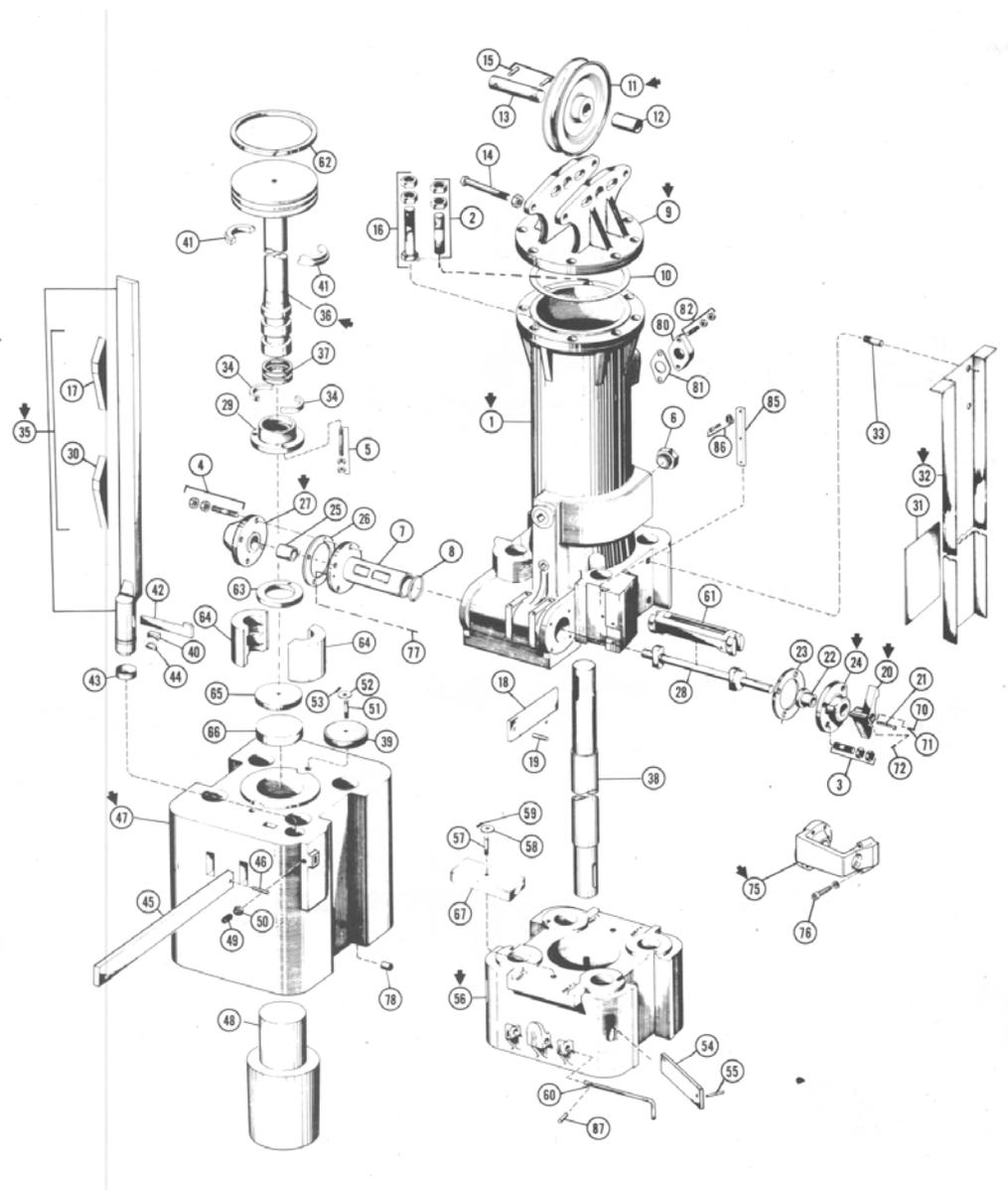
In single-acting hammers, the motive fluid (air or steam) is working on the upstroke only. The ram falls by gravity on the down stroke. On upstroke, the motive fluid flows under the piston through an open valve. The piston is forced up, lifting the ram to which it is rigidly attached. At the top of the stroke, a valve rotates, blocking the inlet motive fluid path and opening a fluid path to the exhaust port of the hammer. The motive fluid rushes through the exhaust port and the ram falls by gravity. This operation is repeated for each hammer stroke.



Exploded view of single acting air hammer: Vulcan



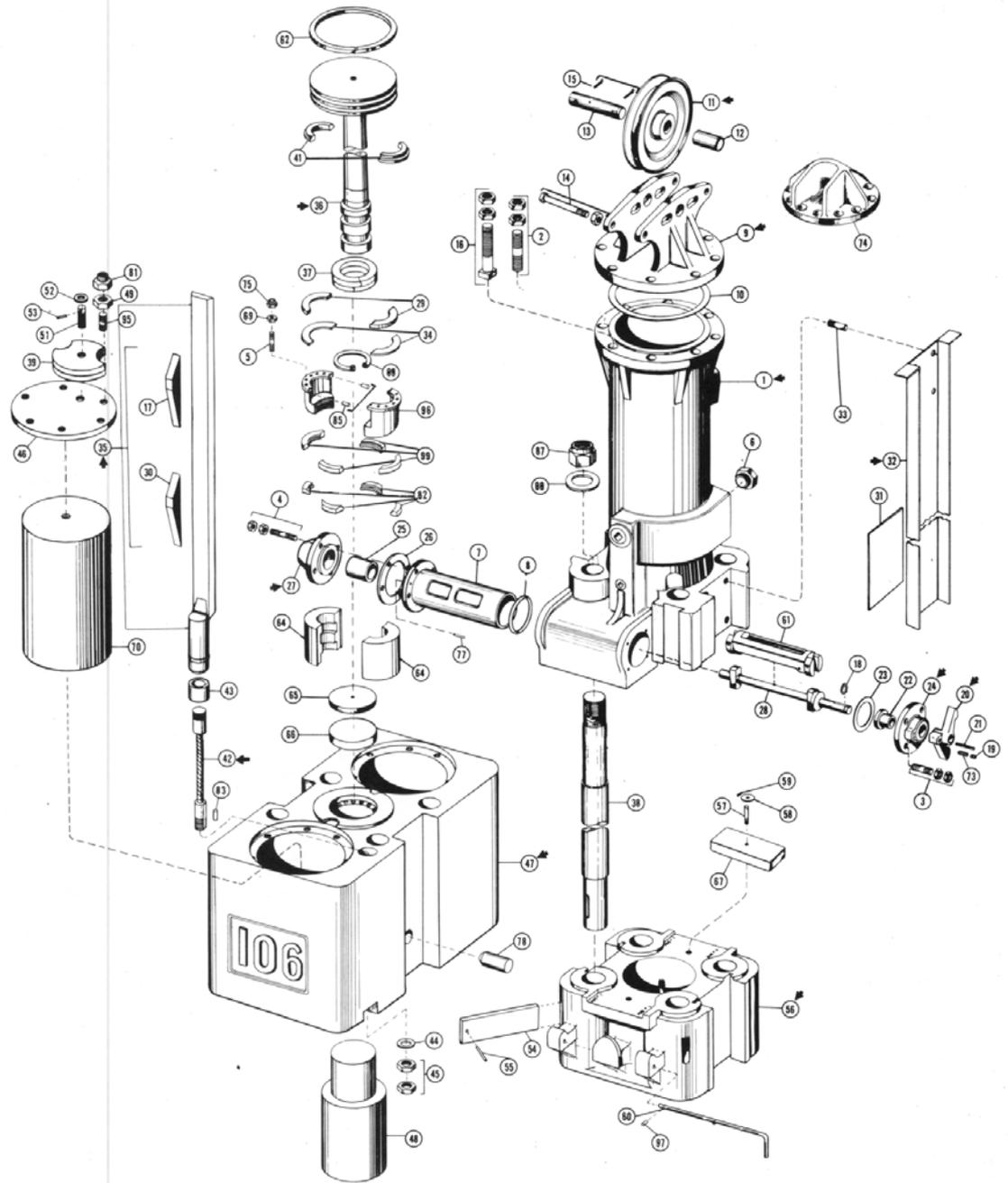
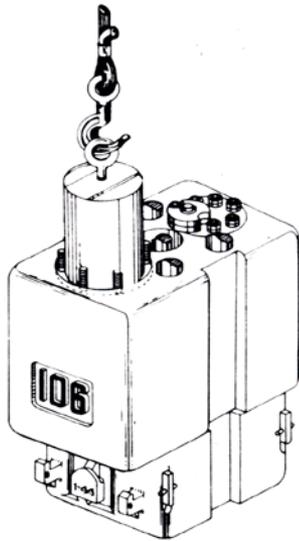
Assembled



Exploded view

Single acting air/steam: Vulcan

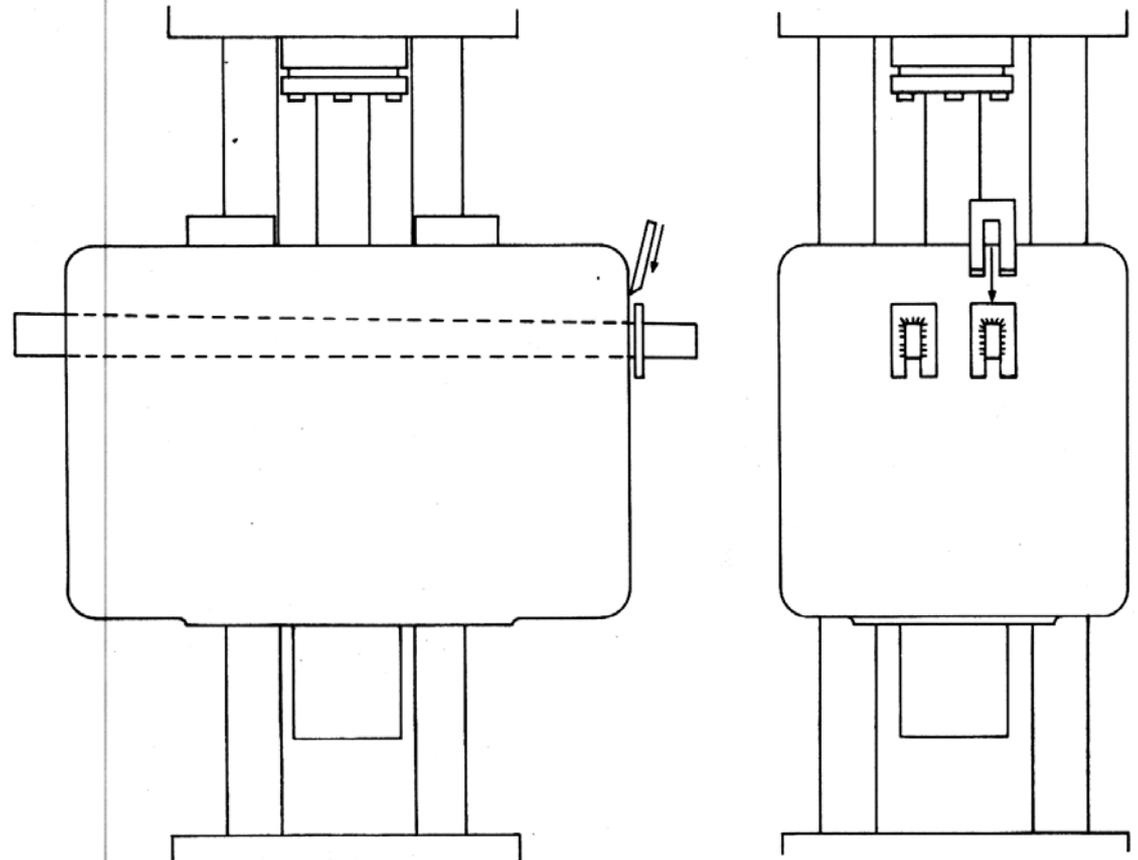
Adding mass to the ram to
increase foot pounds of energy



Single acting
air/steam:
Vulcan

Maintenance

Keeping Ram Keys Tight

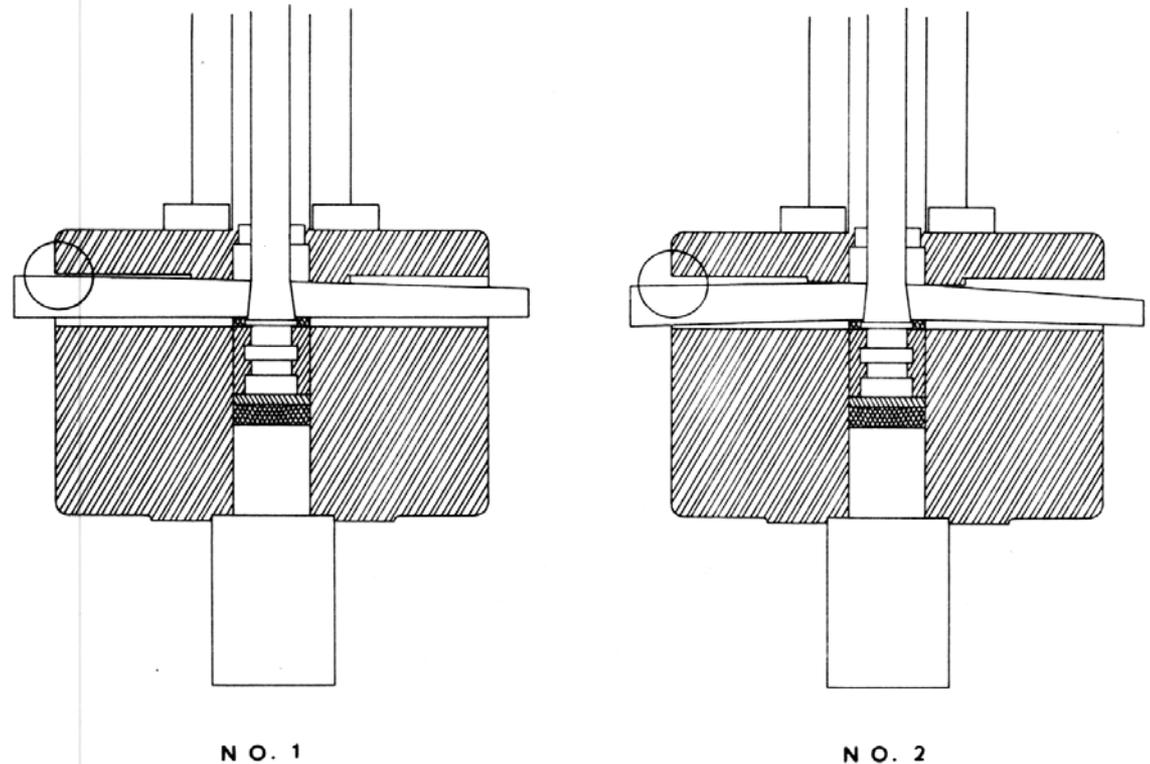


When some hammers get enough mileage on them to warrant retirement and under certain driving conditions, the contractor may have trouble keeping the ram keys tight. Usually under these circumstances, the contractor will weld the keys to the ram and worry about the consequences later. The drawing above shows a better way of keeping the keys tight and allows for quick and easy retightening during the job.

Single Acting Air/Steam: Vulcan

Maintenance

Ram Keys Too Tight

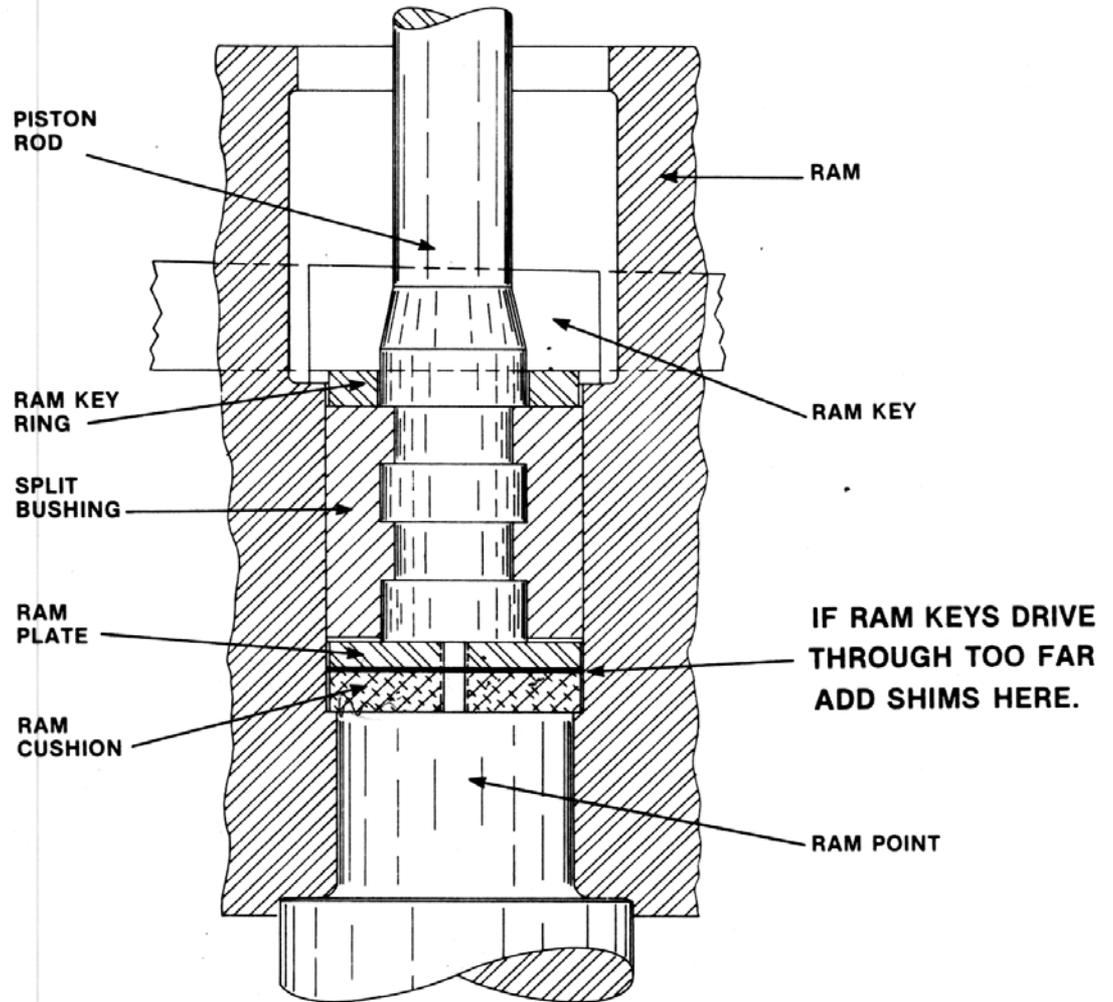


Sometimes it is difficult **not** to tighten the Ram Keys too much. Working with a large sledge hammer a Ram Key can easily be driven so far as to bend. Figure No. 1 shows a Ram Key properly seated. Figure No. 2 shows a Ram Key driven too far and bent. When the Ram Key is first installed there might be a slight gap as circled on drawing No. 1. When driving the Ram Key tight, if the gap starts to widen, as circled on drawing No. 2, then the Key has been driven too far and is bending.

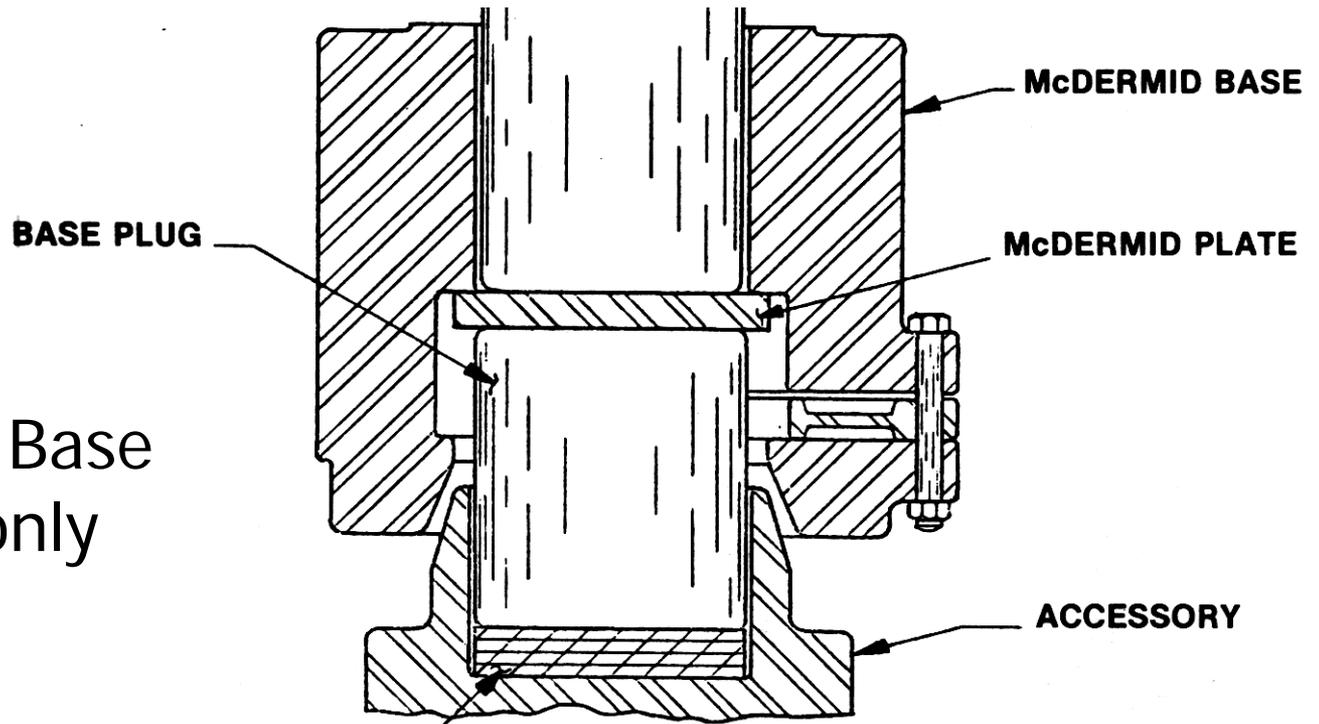
Single Acting Air/Steam: Vulcan

Maintenance

RAM KEY ADJUSTMENT



After a Hammer has a lot of "mileage" the parts that hold the Piston Rod to the Ram wear a little. This will necessitate some adjustment to insure proper tension of the Ram Keys. If this condition exists in your Hammer and the Ram Keys have a tendency to drive through too far, add Shims between the Ram Cushion and the Ram Plate.



BASE PLUG

McDERMID BASE

McDERMID PLATE

ACCESSORY

NOTE:

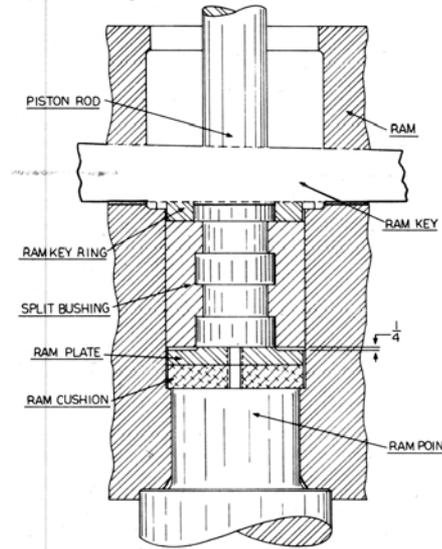
**CUSHION MATERIAL IS REQUIRED
BETWEEN BASE PLUG & ACCESSORY
TO PREVENT DAMAGE TO THE HAMMER**

Vulcan McDermid Base
for Wood piles only

We do not recommend the use of McDermid bases for any type of pile other than wood. But on occasion, contractors have found themselves in a position where they have had to adapt a McDermid base to standard Driving Heads or Pipe Caps. The above shows the arrangement necessary to accomplish this.

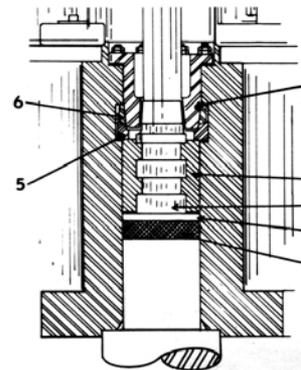
FOR NO. 0, OR, 08, 010:

Assemble so that the raised boss area of the Ram Plate is up. The end of the Piston Rod, not the Split Bushing should rest on the boss area.



FOR NO. 106:

To install the Piston Rod in the Ram, insert the Ram Cushion (1) followed by the Ram Plate (2). Then insert the Piston Rod (3) with the Split Bushing (4) in place around the rod. Place the Segmental Split Bushing Holding Ring (5) in the cast cavity above the rod bushing as shown, install the Segmental Pressure Ring (6). Using



four Dowel Pins, align the Ram Retainer Split Ring (7) around the Piston Rod and insert into Segmental Pressure Ring as shown. Securely fasten all hold-down nuts.

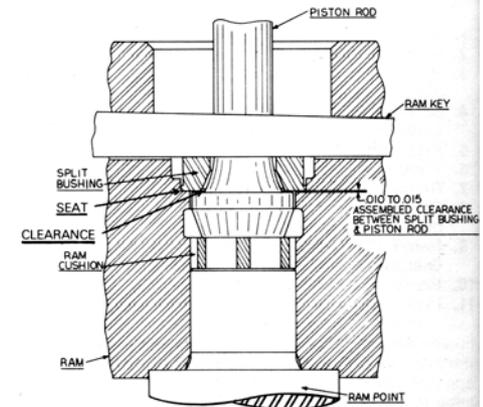
FOR NO. 014, 016, 020:

In the Single Acting Type Pile Hammers the simplest method of installing the Piston and Rod is with the Hammer in a vertical position. To install a new Piston and Rod, remove the following parts from the Hammer in the order specified:

1. Cylinder Head.
2. Gland and Bushing.
3. Piston Rod Packing.
4. Junk Ring.
5. Ram Keys.
6. Split Bushing.
7. Old Piston and Rod.

Eye bolts screwed into the end of the large diameter Piston facilitates handling of the Piston and Rod.

Prior to reassembling the Ram Keys to attach the lower end of the Piston Rod to the Ram, accurately determine the distance between the Split Bushing Seat and the top of the Ram Cushion. The distance between the Split Bushing Seat and the top of the Ram Cushion should be from .010" to .015" more than the thickness of the flange at the lower end of the Piston Rod. To diminish this distance, or measurement, place a steel shim of the correct thickness underneath the Ram Cushion. If it is necessary to increase this distance, or measurement, remove the Ram Cushion from the Ram and reduce its thickness by lathe turning to the required dimension. With the Ram Keys driven securely into place, the flanged end of the Piston Rod must be free to move laterally with the Split Bushing clamped tightly against its seat, or shoulder, inside the Ram.



Vulcan Single Acting:

Field Service Manual

For every additional inch the Key must be driven plane or mill 3/64" (.046) from the flat edge of the Key.

All Lower Column Keys must be inserted and driven from the inside of the base. Two keys of the set may be driven by inserting a drift through the opposite key slot in the base or all four keys may be installed with a small hydraulic jack applying a 30 ton pressure.

After key position has been established, mark the location of the column key pinhole and remove the key so this hole may be drilled.

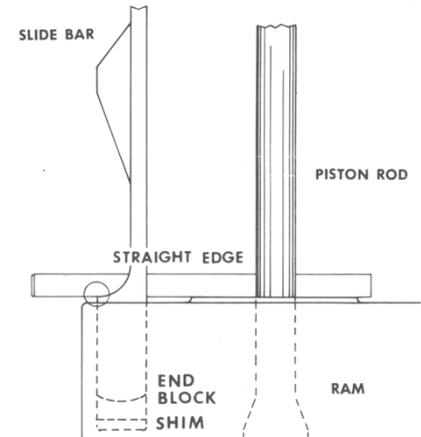
After the keys are driven tight, any excess length projecting INSIDE the base must be cut off so the end of the key is flush with the cylindrical hole in the base. An excessively worn shoulder on a column or corresponding seat may prevent the key from being driven tightly, in which event the shoulder and/or seat must be restored to the original dimensions. Unless the distance between the shoulders on all of the columns is the same and all are in line when the columns are in place, misalignment of the base with the cylinder will result. This will cause binding or scoring of the columns and will materially increase the friction on the reciprocating parts of the hammer. If this condition is not rectified, it may also cause fracturing of the column lug on the cylinder.

Slide Bar

If after installing a new slide bar, the slide bar key is found to be too loose, insert sufficient STEEL shims under the end block to take up the slack. Be sure that the key and key block are of correct width before determining thickness of the shims necessary.

A quick way to check the correct position of the slide bar is shown in the drawing below.

Place a straightedge across the machined boss area of the Ram as shown. The lower edge of the straightedge should be even with the "break" of the round stock of the slide bar as circled in the drawing.



RAM KEYS FOR NO. 2, 1, 06, 0, OR, 08, 010:

If unable to drive the original Ram Keys so that the small end of the Key projects sufficiently on the opposite side of the Ram to expose the pin hole, reduce the thickness of the Ram Cushion .021 for each additional inch that the Ram Key has to be driven. If the Ram Keys drive too far through the Ram, interpose a steel shim of the required thickness between the Ram Plate and the Ram Cushion. Check all alignment and clearances as set forth herein.

FITTING NEW RAM KEYS

Ram Keys are extra long to facilitate fitting. After assembling Piston & Rod as described in the previous paragraphs, drive the Ram Keys tight and cut off any excess Ram Key stock that will interfere with proper hammer operation.

Side Channels

To remove the Side Channels without destroying them for future use, drill away the countersunk head of the channel rivet stud. Then remove the side channel from the hammer by sliding the channel in the jaw toward the cylinder head end of the hammer. To remove the remaining portion of the channel rivet stud, drill a hole into the stud and remove by the use of a backing out tool (Easy-Out). To reinstall the old channels or install new channels, place channel in jaws on hammer and align the holes in the channel with those in the cylinder. Then screw the channel rivet studs into the tapped holes in the cylinder. Torch cut the channel rivet stud at approximately 3/4" above the surface of the channel. Heat the exposed portion of the channel rivet stud with a torch and hot rivet flush with the channel web surface. In case the channel has a tendency to spring away from the cylinder prior to riveting, it may be necessary to hold the channel in place temporarily with a cap screw in one of the holes while riveting the others. After the channel has been riveted to the cylinder there will be two ears extending above the lower portion of the cylinder. With a torch, heat these ears and bend over so that they are flat against that portion of the cylinder where the column keys are fitted.

Column Keys

Both Upper and Lower Column Keys are normally furnished 3/8" oversize in height.

After old keys have been removed, insert new keys and drive in with sledge hammer until tight. At this point measure the distance that the key lacks of being driven to normal position:

- Lower Keys — Flush with inside of cylindrical hole in the center of base.
- Upper Keys — Large end flush with side channel.

Vulcan Single Acting: Field Service Manual

Valve Setting

Particular care must be taken in setting the valve on all models of hammers in order to insure maximum efficiency. Detailed instructions for setting of the valve are contained on pages 19 thru 27. It will be noted that the procedure is the same for all models and the only variation found is in the dimensional aspects.

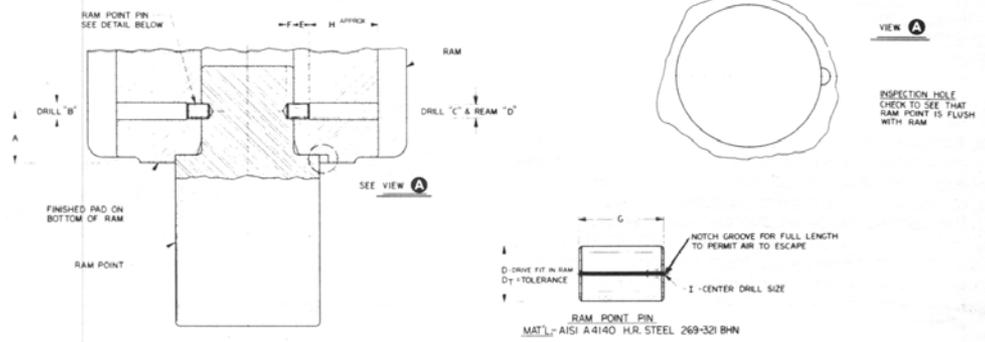
Removing Broken Ram Point

In order to remove a broken point, the side pins (if any) will have to be drilled out before any force is applied to the Ram Point. A force of 50 to 200 tons or even greater may be required against the flat end of the neck of the Ram Point inside the Ram. If sufficient force is not obtainable to press the old point out, drill a series of holes in a cross configuration through the Ram Point neck portion. Do not place these holes closer than 1/4" to the bore into which the Ram Point is fitted. With a torch, burn the metal from between the series of holes drilled. This will relieve the radial pressure on the Ram Point. After this is done, press out the remaining portion of the Ram Point.

Depending on bore condition, it may be necessary to hone or rebores the Ram. This should be done before inserting new Ram Point.

Inserting New Ram Point in Ram

A pressure varying between 50 and 150 tons is usually required to press the Ram Point into the body of the Ram. If the surface of the hole in the Ram has been damaged while removing the old Point, it should be rebores with a smooth finish, the corner should be chamfered slightly larger than the fillet radius on the Ram Point. When fitting the Point to the Ram, the finished diameter of the neck should exceed the finished diameter of the hole in the Ram by .001" for every inch of finished diameter in order to obtain a press fit in excess of 50 tons. Before inserting the new Ram Point, lubricate the surface of the hole in the Ram and likewise the surface of the neck of the new Ram Point with Molykote Type G Grease. After the Ram Point is installed, it should be pinned according to the adjacent diagram.



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HAMMER SIZE	DIMENSION									
	A	B	C	D	DT	E	F	G	H	I
2	3-1/8	1- 5/16	1- 7/32	1.250	+ .002	1-1/4	5/8	1-7/8	4-3/8	#6
1	4-5/8	1-13/16	1-23/32	1.750	+ .002	1-3/4	7/8	2-5/8	4	#6
106	4-5/8	1-13/16	1-23/32	1.750	+ .002	1-3/4	7/8	2-5/8	4	#6
06	4-5/8	1-13/16	1-23/32	1.750	+ .002	1-3/4	7/8	2-5/8	4	#6
08	4-7/8	1-13/16	1-23/32	1.750	+ .002	1-3/4	7/8	2-5/8	6	#6
010	4-7/8	1-13/16	1-23/32	1.750	+ .002	1-3/4	7/8	2-5/8	6	#6
014	5-1/2	2- 1/16	1-31/32	2.000	+ .002	2	1	3	7-3/4	#7
016	5-1/2	2- 1/16	1-31/32	2.000	+ .002	2	1	3	7-3/4	#7
020	7	2- 1/16	1-31/32	2.000	+ .002	2	1	3	7-3/4	#7

BASE/CYLINDER COLUMN HOLE REPAIR

In older Vulcan Single Acting Hammers, it is a commonplace occurrence that the Hammer Base and Cylinder become excessively worn in the area where the shoulder of the column bears on these parts (see Figs. 1 & 3). Column repairs are covered in Tip #32. In lieu of welding (not recommended) the following restoration procedure has been found to be very effective, as well as providing an easy method for repeated repairs.

Vulcan Single Acting:

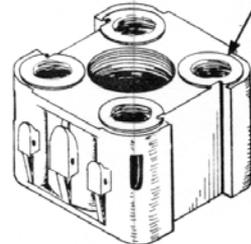


FIG. 1

When the top surface of the Base (Fig. 1) becomes worn and uneven, it is necessary to provide a new seat surface for the shoulder of the column. The following steps for repair are recommended:

1. Take a clean-up cut over the entire top surface of the base. If possible, limit metal removal to 1/16".
2. Using the original Column Hole for location, counterbore the top surface of the base to Dim. B, Fig. 2 and Dim. C, Fig. 2, so that Dim. A, Fig. 2 is as specified.
3. Repeat this procedure for all four column holes making sure that the four counterbores are exactly the same depth.
4. Press fit collars as set

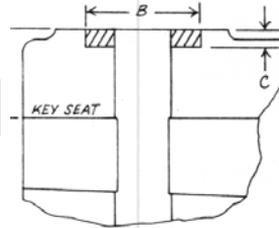


FIG. 2

out in the table below in each of the four counterbores. Be very sure that the center to center dimensions of the holes are as specified after installation of the collars.
NOTE: Never install collars in Base only. Always restore both Base and Cylinder.

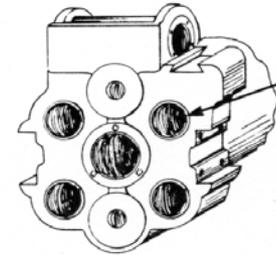


FIG. 3

When the spotfaced surface of the Cylinder around the column holes becomes worn and uneven, it is necessary to provide a new seat surface for the shoulder of the column. The following steps for repair are recommended:

1. Using the original column hole for location, counterbore the bottom surface of the cylinder to Dim. B, Fig. 4. This counterbore should be bored to a depth as measured from Dim. C, Fig. 4. The measurement is made from the face of the stuffing box to the bottom of the counterbore. Careful attention must be given to Dim. A, Fig. 4.
2. Repeat this procedure for all four column holes

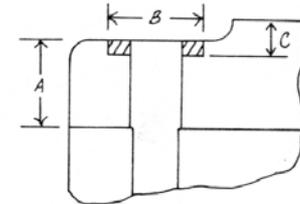


FIG. 4

making sure that the four counterbores are exactly the same depth.

3. Press fit Collars as set out in Table below in each of the four counterbores. Be very sure that the center to center dimensions of the holes are as specified after installation of the Collars.

NOTE: Never install Collars in Cylinder only. Always restore both Base and Cylinder.

IMPORTANT

These repair procedures should be done either at the factory or at a competent local machine shop, never in the field. Before proceeding, contact factory for detailed machining dimensions and most important hole center dimensions.

HAMMER SIZE	BASE COLLAR P/N	CYLINDER COLLAR P/N
#2	01V0315-4	01V0155-4
#1	02V0320-4	02V0159-4
06	03V0323-4	03V0159-4
08	04V0314-4	04V0162-4
010	05V0314-4	05V0162-4
106	13V0318-4	13V0149-4
#0	16V0313-4	16V0164-4
OR	17V0314-4	17V0163-4

Field Service Manual

Base/cylinder column hole repair

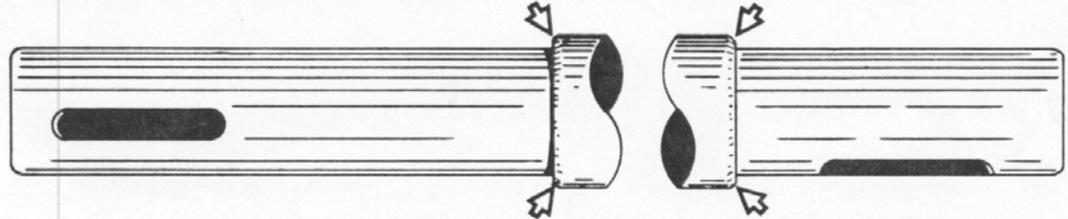
Vulcan Single Acting:

Field Service Manual

Column Repair

COLUMN SALVAGE

It is a frequent occurrence in the Size No. 2, No. 1, 06, No. 0, 08, OR, and 010 Hammers that the column shoulders will become worn and damaged as shown below:



Within limitations, salvage of such columns is possible by carefully followed procedures and practices.

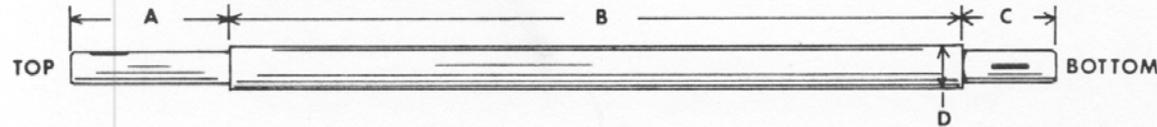
Step 1 — Between lathe centers, check the column for straightness (run-out) at the locations indicated.



If the run-out does not exceed .040" at any of the three points indicated, then the next step in the salvage procedure may be followed. If this run-out is exceeded, scrap the part.

Step 2 — Grind off damaged and worn area of column shoulder. Build up shoulder area by arc welding. Use rod conforming to AWS-E6010 or equal.

Step 3 — Re-machine column shoulders in accordance with linear and diameter dimensions shown in the table below:



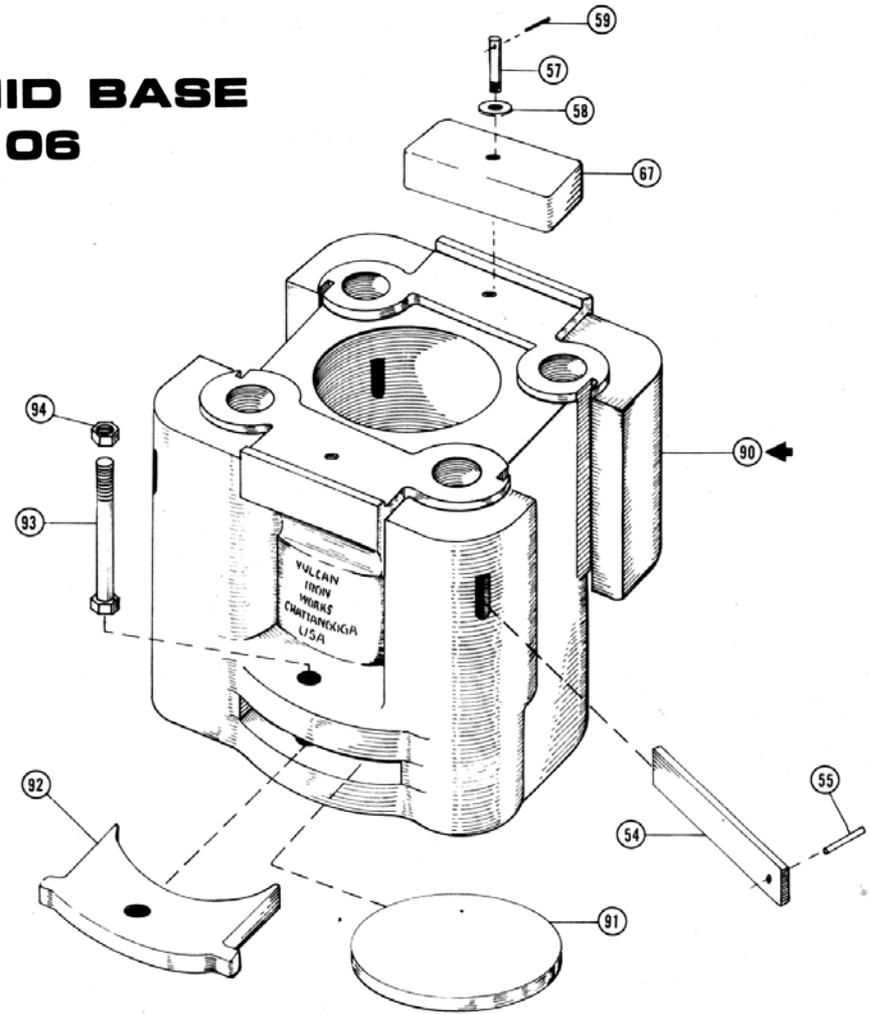
	#2	#1	06	#0	08	OR	010
A	15-1/4"	14-5/8"	14-5/8"	18"	18"	18"	18"
B	64-3/4"	72 7/16"	72 7/16"	85 15/32"	85 15/32"	85 15/32"	85 15/32"
C	8"	8 7/16"	8 7/16"	10-1/2"	10-1/2"	10-1/2"	10-1/2"
D	3.4375"	3.9375"	3.9375"	4.625"	4.625"	4.625"	4.625"



McDERMID BASE 2, 1, 106, 06

McDermid
Base
for
2, 1, 106, 06

including
parts detail



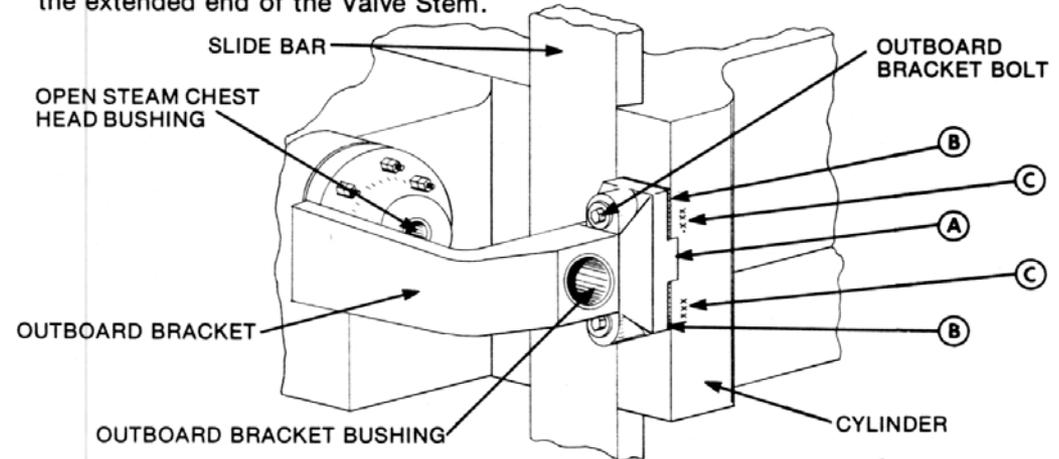
REPLACEMENT PARTS LIST

KEY NO.	DESCRIPTION	PART NO. SIZE 2	PART NO. SIZE 1	PART NO. SIZE 106	PART NO. SIZE 06
054	Lower Column Key	01V0304-4	02V0306-4	13V0304-4	03V0306-4
055	Lower Column Key Pin	01V0305-4	02V0307-4	13V0305-4	03V0307-4
057	Lower Bumper Stud	01V0306-2	02V0308-2	13V0306-2	03V0308-2
058	Washer/Bumper Stud	01V0307-2	02V0309-2	13V0307-2	03V0309-2
059	Pin/Bumper Stud	01V0308-2	02V0310-2	13V0308-2	03V0310-2
067	Lower Rubber Bumper	01V0309-2	02V0311-2	13V0309-2	03V0311-2
090	McDermid Base	01V0311-1	02V0313-1	13V0313-1	03V0313-1
091	McDermid Plate	01V0310-1	02V0312-1	13V0312-1	03V0312-1
092	McDermid Door	01V0312-1	02V0314-1	13V0314-1	03V0314-1
093	McDermid Door Bolt	01V0313-1	02V0315-1	13V0315-1	03V0315-1
093	McDermid Door Bolt Nut	01V0314-1	02V0317-1	13V0317-1	03V0317-1
094	Cotter Pin	01V0315-1	02V0316-1	13V0316-1	03V0316-1

Vulcan Single Acting: Field Service Manual Outboard bracket shims

OUTBOARD BRACKET SHIMS

On all Vulcan and Super Vulcan Offshore Pile Hammers, and all Vulcan Hammers equipped for Vari-Cycle, there is an extension of the Open Steam Chest Head (see illustration) called the "Outboard Bracket." This serves not only as a guard to protect the Slide Bar from damage and cables, but it also serves as an outboard bearing for the extended end of the Valve Stem.



It is absolutely essential in the final installation that the outboard bearing be right in line with the bore of the Bushing in the Open Steam Chest Head. Due to unavoidable differences in the manufacture of the Cylinder and the Outboard Bracket, a certain amount of Selective Assembly is necessary.

Inasmuch as the foot of the Outboard Bracket is bolted to the Cylinder, it is easy to create misalignment by excessive bolting pressure. It is therefore necessary to shim the foot of the Outboard Bracket to assure alignment of the two Bushings.

The foot of the Outboard Bracket is a "tongue and groove" joint with the Cylinder (see letter A). Shim Stock (see letter B) is required as shown in the illustration. Stamped into the Cylinder Casting on either side of the "tongue and groove" joint are the thickness requirements for the Shim Stock (see letter C). **DO NOT DEVIATE FROM SPECIFIED SHIM REQUIREMENTS.** The following information should be remembered:

- 1) Outboard Brackets are only included on Offshore Hammers and Onshore Hammers equipped with Vari-Cycle from Size 08 up.
- 2) When purchasing a new Cylinder, always include a new Outboard Bracket so that mating fit is assured.
- 3) When removing Outboard Bracket for maintenance reasons, be sure to keep the Shim Stock for each side intact for reinstallation.
- 4) When ordering a new Outboard Bracket, new Shim Stock will be furnished in adequate quantity for installation.

Vulcan Single Acting:

Field Service Manual

Stud Installation

STUD INSTALLATION

When you replace and install new studs in your Vulcan equipment, there are certain precautions to be observed.

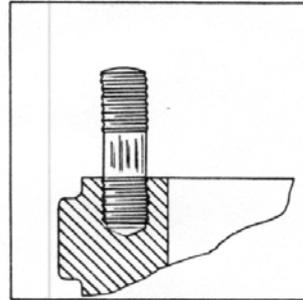


FIG. 1

All Vulcan studs have an unthreaded portion between the two threaded ends. DO NOT install studs using a pipe wrench on the unthreaded portion of the stud. Aside from possible damage to the threads, the marks or notches (Fig. 1) made by the pipe wrench create stress riser points in the stud.

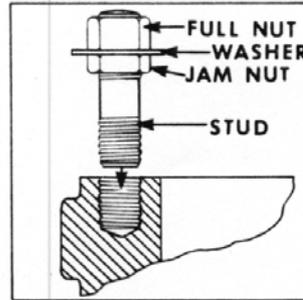


FIG. 2

The accepted method for stud installation is as follows: (1) First thread Jam Nut into stud. (2) Place flat washer on top of Jam Nut. (3) Thread Full Nut onto stud over washer. (Assembly shown in Fig. 2) After assembly, stud may be driven into tapped hole in the casting using either impact wrench or hand wrench. The washer prevents turning of the nuts and reduces thread stresses.

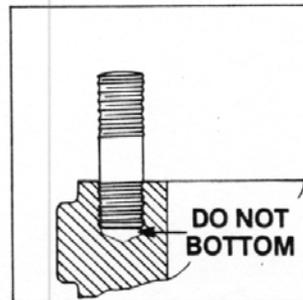


FIG. 3

When installing new studs, care must be taken to assure that the stud is not over-inserted. NEVER!! insert a stud into a tapped hole to the extent that it bottoms-out. If the stud is bottomed, the thread stresses are mislocated and the probability of stud failure is greatly increased.

Vulcan Single Acting:

Field Service Manual

Assembly procedures and torque specifications

ASSEMBLY PROCEDURES

In all Vulcan equipment mechanically bolted connections are kept to the minimum to avoid unnecessary maintenance. Where they are used...Cylinder Heads...Steam Chest Heads...Pipe Flanges...Stuffing Boxes...proper assembly and re-assembly practices should be followed. When assembling hammer components, it is essential that all nuts be installed on their respective studs using Torque Wrench equipment so as to insure equal and even clamping force on all joints. Given below in table form are the recommended torque levels for the various joints:

STUD SIZE	TORQUE			
	FULL NUT		JAM NUT	
	LB. FT.	M.-KG.	LB. FT.	M.-KG.
3/4"	144	20	108	15
7/8"	228	32	171	24
1"	338	47	254	35
1-1/8"	431	60	323	45
1-1/4"	541	75	408	56
1-1/2"	725	100	543	75
1-3/4"	933	128	699	97

NOTES:

- 1) The above Torque Values apply to both UNC & UNF studs and nuts.
- 2) Always be sure that your torque wrenches are in good condition and calibrated.
- 3) Torque Values shown are for threads lubricated with light engine oil or grease.

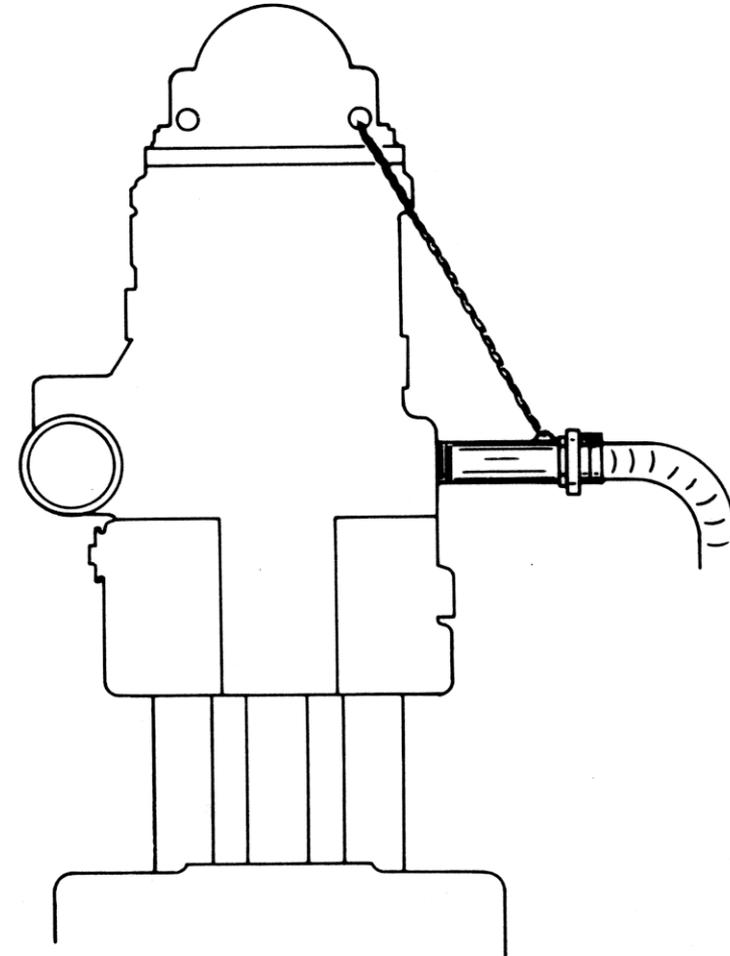
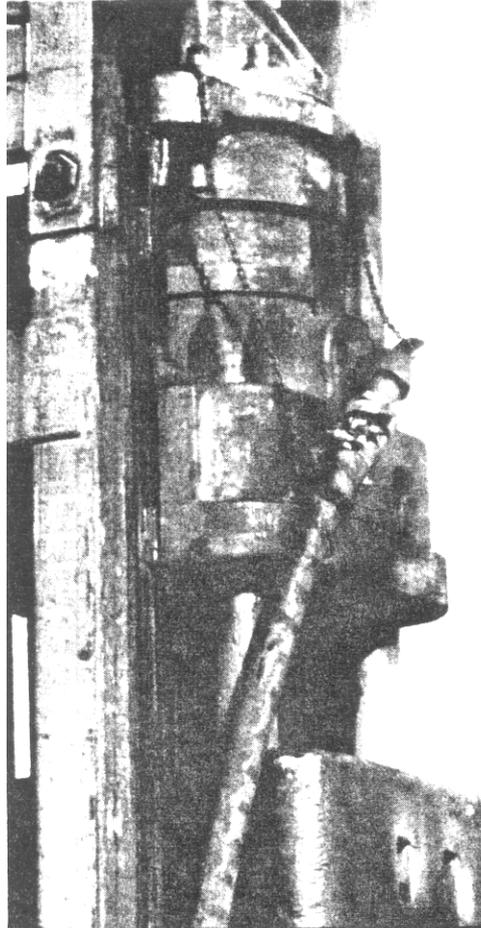
IMPORTANT

NEVER use a torque wrench on the Stuffing Box. This is an adjustable connection and at no time requires other than wrench adjustment.

PIPING DO'S & DON'TS

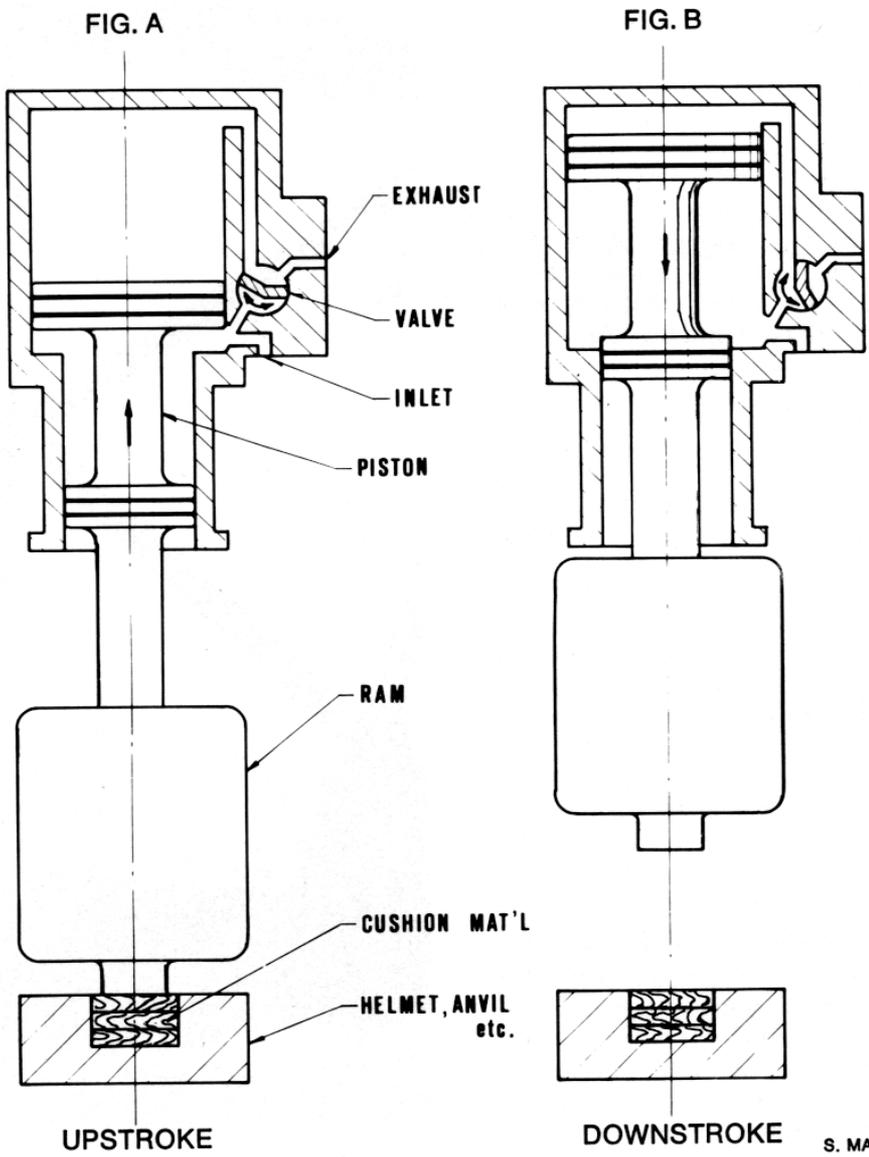
Air/Steam:
Vulcan

Safety issues



The length of the Nipple from the Inlet must be kept to a minimum. A long Nipple, as shown in the drawing, even though supported by chain or wire rope, will cause damaging leverage and vibration. Extensions to the side, like the arrangement in the picture, allow for good support of the Piping and Hose.

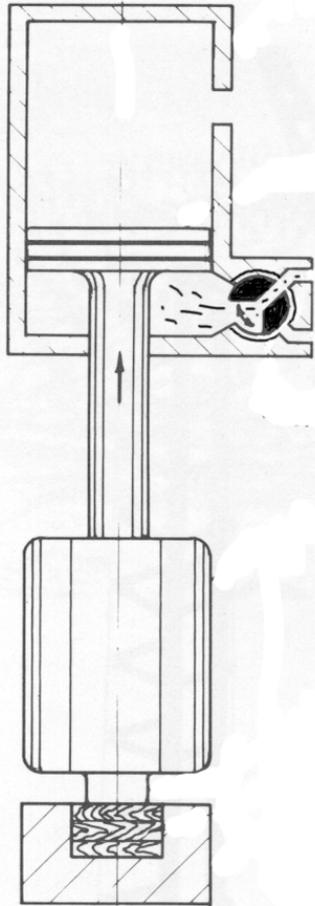
Differential acting steam/air hammer



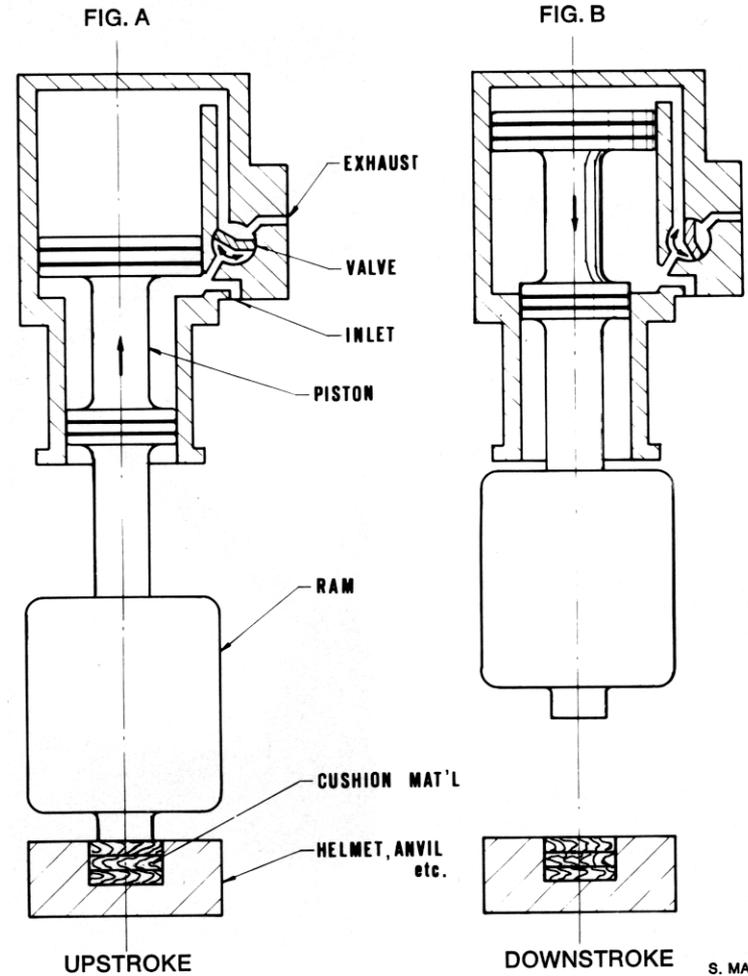
S. MAMICH

DIFFERENTIAL ACTING
STEAM/AIR HAMMER

Comparison Single vs Differential



SINGLE ACTING



UPSTROKE

DOWNSTROKE

S. MAMICH

DIFFERENTIAL ACTING
STEAM/AIR HAMMER



Differential Acting Air/Steam hammer

Superior Economy

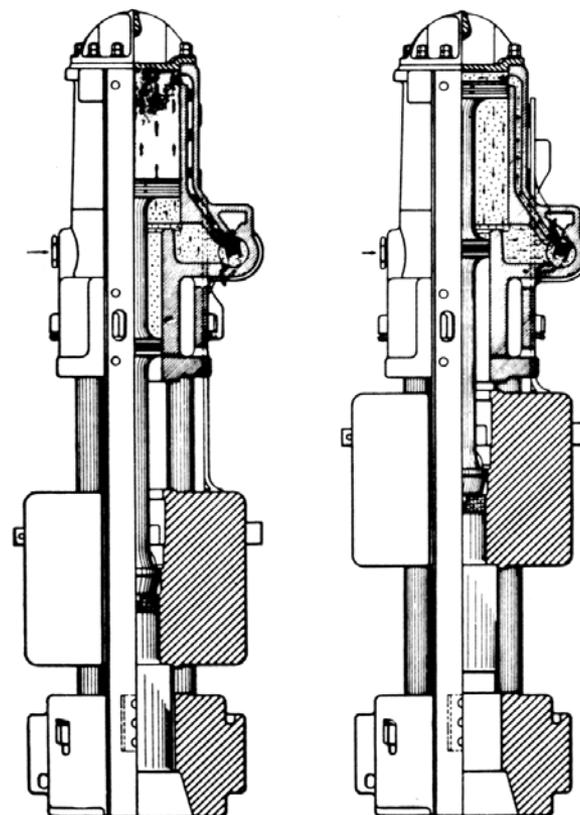
Faster Driving
See Vulcan Tip No. 11

Open Design
See Vulcan Tip No. 14

Heavy Ram
See Vulcan Tip No. 7

Short Stroke
See Vulcan Tip No. 7

Variable Energy
See Vulcan Tip No. 4



The Differential system requires 1/3 less air or steam as compared to a similar size Double Acting Hammer.

The Differential Hammer exhausts only once a cycle compared to twice per cycle on a Double Acting Hammer. The area between the two pistons (as shown by the dotted areas in the above drawings) is always under pressure. The differential in area between the large Upper Piston and the smaller Lower Piston drives the Piston and Ram up. On the Up Stroke the Valve allows the area above the Upper Piston to exhaust. At the top of the Up Stroke the Valve is shifted to close the exhaust and directs the air or steam above the top Piston. This Piston area is larger than the "differential area" and drives the piston on the Down Stroke.

Heavy ram short stroke concept Vulcan

11 RULES FOR PILE DRIVING

Concrete piles cracking while driving in either soft silt or very hard ground? The solution is the same for both problems: Use a thicker cushion block and a hammer with a heavier ram and shorter stroke.

The solution and others to related problems, comes from Prof. T. J. Hirsch of Texas A&M's Texas Transportation Institute, who led a research project in the problems of cracking and spalling concrete piles. TTI is the official research agency for the state highway department.

His reasoning is this: The compression wave sent down a pile by the hammer blow rebounds back up the pile when it reaches the end — as a tension wave if the pile tip is in a soft medium that offers little resistance, and as a compression wave if the pile tip is lodged against something very firm. If the pile is long and the stress waves short, the return wave will meet the compression wave of the next hammer blow, and the two can add up to a resultant force that is destructive.

A heavier ram has a longer impact time on the head of the pile, and thus produces a longer compression wave. Thicker cushioning also stretches out the impact time.

Professor Hirsch sums up the fundamentals of good pile design and pile driving as follows:

1. Use adequate cushioning materials between the pile driver's steel helmet or cap and the concrete pile head. For piles under 50 ft., only 3 or 4 in. of wood cushioning material (such as green oak, gum, pine, or fir wood plywood) may be adequate if there is reasonably good point soil resistance. More wood cushioning, 6 to 8 in. or more, may be required when driving longer piles in very soft soil. The wood cushioning material should be placed on top of the pile with the grain horizontal and inspected to see that it is in good condition. When it begins to become highly compressed, charred, or burned, it should be replaced. Some specifications require a new cushion on every pile. If driving is extremely hard, the cushion may have to be replaced several times during driving of a single pile. Adequate cushioning is usually a very economical way to control driving stresses.

2. Driving stresses can be reduced by using a heavy ram with a low impact velocity (short stroke) to obtain the desired driving energy rather than a light ram with a high impact velocity (large stroke). Driving stresses are proportional to the ram impact velocity.

3. Reduce the ram velocity or stroke during early driving when light soil resistance is encountered. Anticipate soft driving, or at the first sign of easy driving reduce the ram velocity or stroke to avoid critical tensile stresses. This is very effective when driving long piles through very soft soil.

4. If predrilling or jetting is permitted in placing the piles, be sure that the pile point is well seated with reasonable resistance at the point before full driving energy is used. Driving and jetting should not be done simultaneously.

5. Be sure that the pile driving helmet or cap fits loosely around pile top so that the pile may rotate slightly without binding within the driving head to prevent torsional stress. The helmet should be centered on pile head so eccentric load will not be applied.

6. The pile should be straight and not cambered because of uneven prestress or poor concrete placement during casting. High flexural stresses may result during driving of a crooked pile.

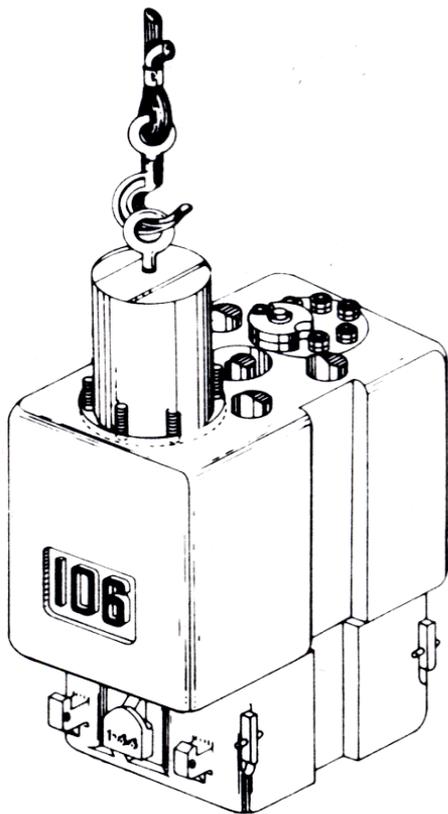
7. The top of the pile must be square or perpendicular to the longitudinal axis of the pile. Eccentricity concentrates stress.

8. Cut the ends of prestressing or reinforcing steel flush with the end of the pile head to prevent their direct loading by the ram stroke.

9. Use adequate spiral reinforcing at the pile head and tip to reduce the tendency of the pile to split or spall.

10. Use adequate amount of prestress in prestressed piles or reinforcement in ordinary precast piles to resist reflected tensile stresses.

11. Chamfer the top and bottom edges and corners of the pile to reduce the tendency of the concrete to spall.



Single Acting Air/Steam Hammer: Vulcan

Lubrication requirements

Proper lubrication in Pile Driving Hammers is most important. The specific recommendations shown should be followed. Adhering to good practices in lubrication will result in longer service life for your hammer and lower maintenance costs.

Lubricate Trip where it bears against the Open Steam Chest Head with Lubriplate No. 630 AA Grease or equal.

Swab Piston Rod with Steam Cylinder Oil prior to placing hammer in service and periodically during operation of hammer. When storing hammer, grease Piston Rod with Lubriplate No. 630AA Grease or equal.

Frequently lubricate all four columns above and below the ram with Lubriplate No. 630AA Grease or equal.

Lubricate Head Sheave with Lubriplate No. 630 AA Grease or equal.

Lubricate wear surfaces of Slide Bar with Lubriplate No. 630AA Grease or equal.

Lubricate flat outer surface of Upper Wedge with Lubriplate No. 630AA Grease or equal.

Lubricate Slide Bar dovetail at lower end of cylinder with Lubriplate No. 630AA Grease or equal.

Lubricate flat outer surface of Lower Wedge with Lubriplate No. 630AA Grease or equal.

Before placing hammer in leads, lubricate Side Channels with Lubriplate No. 630AA Grease or equal.

— NOTE —

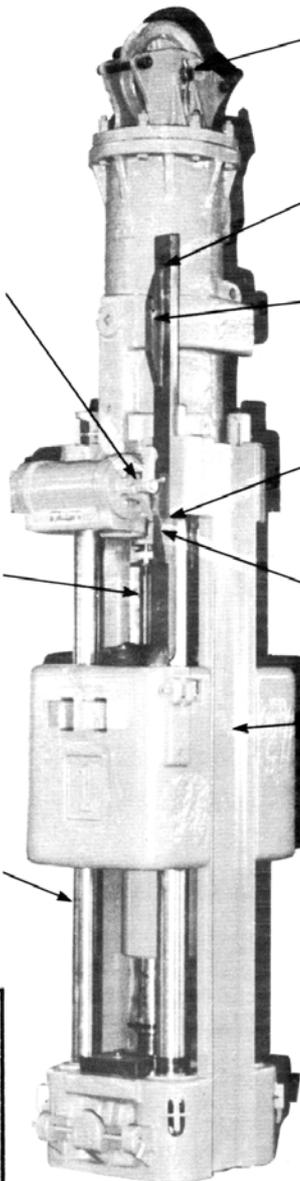
The use of hand-operated force feed lubricators is not recommended due to the intermittent feeding characteristics peculiar to this type of lubricator.

— STEAM OPERATION —

For steam operation, it is recommended that the lubricant to be introduced into the steam should be a high-grade Steam Cylinder Oil with at least a ten percent (10%) tallow or lard oil content. To obtain proper distribution of the Steam Cylinder Oil in the steam introduced into the hammer, it is recommended that a suitable line oiler be used in the steam line.

— AIR OPERATION —

For air operation, it is recommended that a high quality Air Compressor Oil, S.A.E. 10 weight, be used for internal lubrication of the hammer. To obtain proper distribution of the oil in the air introduced into the hammer, it is recommended that a suitable air line oiler be used with the hammer.



How do I know how much energy a differential acting hammer is delivering?

By counting Blows per Minute and referring to an energy chart!

Blow Count/Energy

One of the most frequent phone calls we receive is from contractors and engineers asking “Is a Hammer delivering full energy if the blow count per minute is less than listed in the Specifications?” Blow count does not indicate full or less than full energy.

A Single Acting Hammer will deliver full energy **if** the stroke is as listed in the Specifications. The length of the stroke is the only criteria of a Single Acting Hammer delivering full energy.

A Super Vulcan Differential Hammer derives some of its energy on the down stroke from the air or steam pressure. A Super Vulcan Hammer in proper condition will deliver full energy if the **P.S.I. at the Hammer** is as listed in the Specifications. The striking energy of a Differential Hammer will vary directly with the steam or air pressure (see Vulcan Tip Issue No. 4).

The blow count (not the energy) of any Hammer will be effected by the amount of Pile set on each blow, type of cushion material, the amount of cushion material. Too little cushion material will cause the Hammer to over stroke.

In Specifications published before 1972, blow count was listed as “blows per minute at normal stroke and no set”. This means, if the P.S.I. at the Hammer is as listed in the Specifications, the Hammer is functioning properly and the Pile is at refusal.

Energy
Delivery:
Vulcan

DIFFERENTIAL HAMMERS

SIZE	30C	50C	65C	80C	85C	100C	140C	200C	400C	600C
P.S.I.	120	120	150	120	128	140	140	142	150	150

SINGLE ACTING HAMMERS

SIZE	2	1	06	08	OR	010	014	016	020	030	040
P.S.I.	80	80	100	83	105	105	110	120	120	150	120
STROKE	2.42'	3'	3'	3.25'	3.25'	3.25'	3'	3'	3'	3'	3'

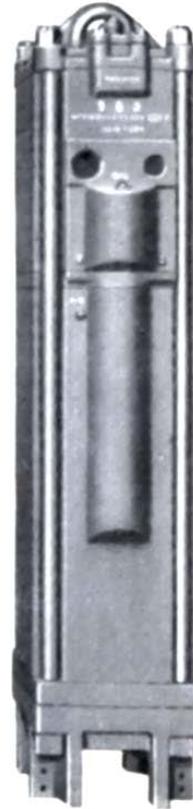
Double Acting Air Hammers

MKT

Double-acting Air Hammers

- McKiernan-Terry Corp.

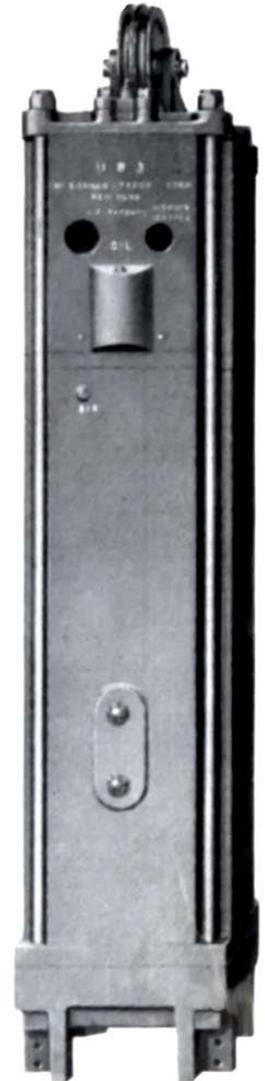
The predecessor to MKT was the McKiernan-Terry Company and in 1897 they introduced the double-acting hammers to the industry. Used to drive steel sheet piling, H-beams, timber piles, and pipe piles their rapid blows per minute gave the contractor increased production. The MKT double-acting hammers were also good for underwater driving. In addition they can be equipped with moil or chisel points for demolition work.



9B3



10B3



11B3

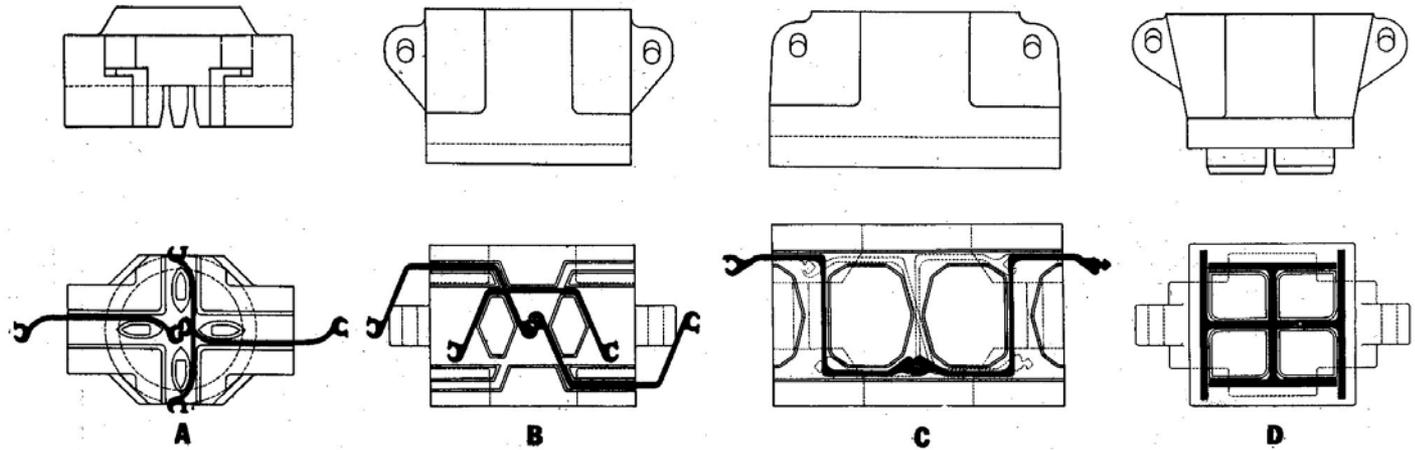
Anvils and Base Attachments

MKT

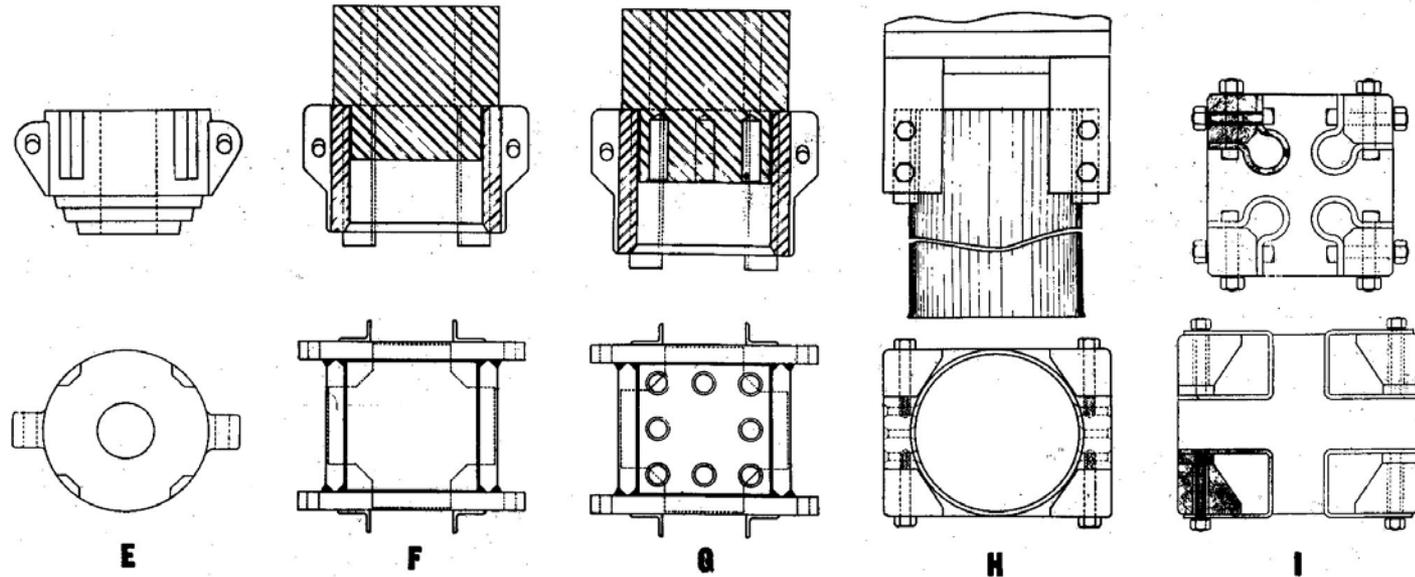
Double-acting Air Hammers

- Anvils

- Attachments



A—For driving one and/or two pieces of straight web steel sheet piling. **B**—For driving one and/or two pieces of deep arch steel sheet piling. **C**—For driving one and/or two pieces of Z-section steel piling. **D**—For driving steel H-beam piles.



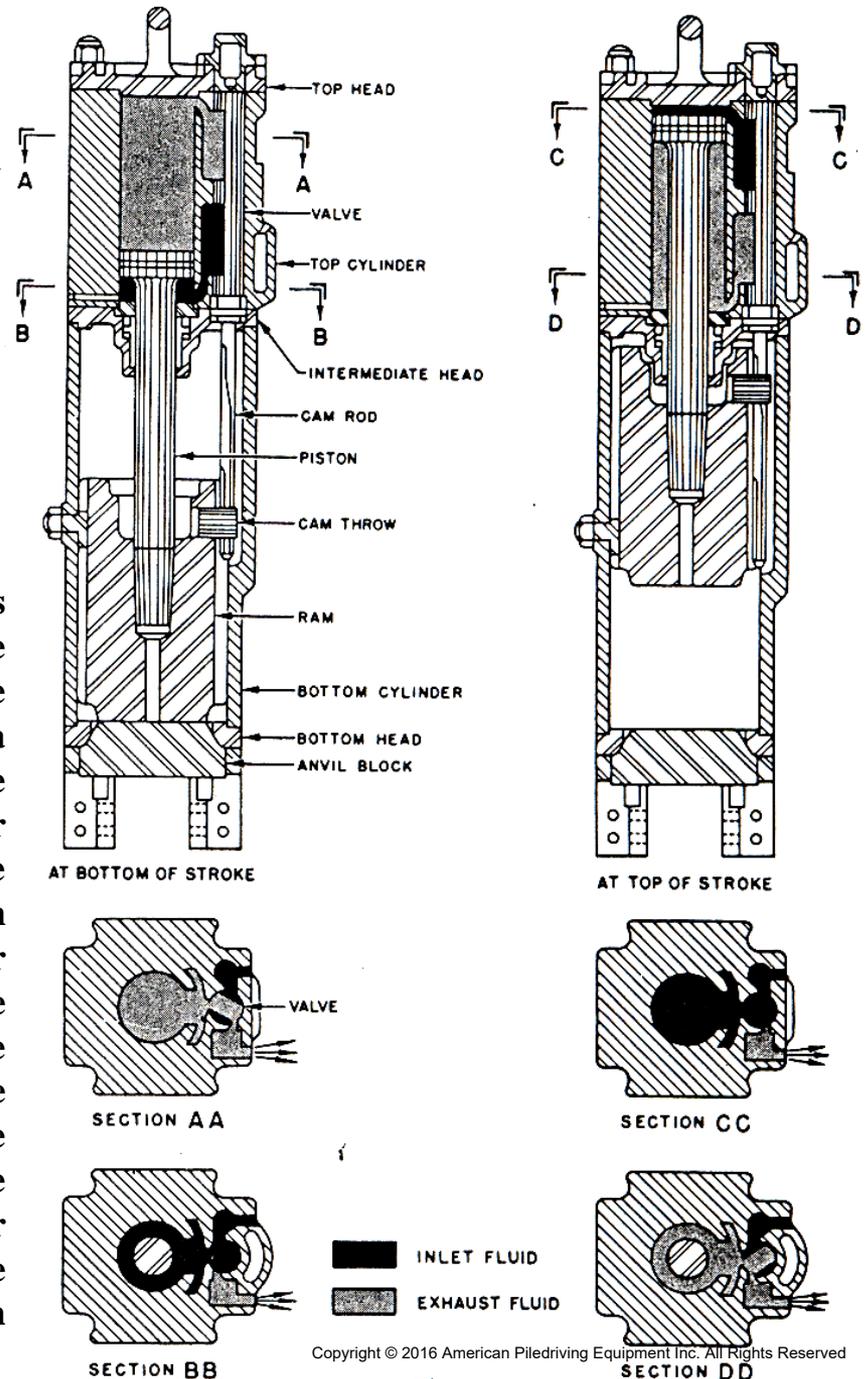
E—For driving pipe piles of all sizes. **F**—For driving smooth butt concrete piles. **G**—For driving concrete piles with extended reinforcing rods. **H**—Pipe sleeve, diameter determined by dimension M on page 4. **I**—Filler pieces for various sizes and sections of steel sheet piling or Wakefield wood sheet piling.

MKT

Double-acting Air Hammers

•Operation

In the MKT valve chest air can enter through two passages at the proper time into the power cylinder. One passage leads to the underside of the Piston and the other passage leads to the topside of the Piston. The valve chest also has a port for exhausting the spent fluid. The Operating Cycle starts like this – the spool valve opens a path for the air inlet to the underside of the ram and at the same time opens an exhaust path to the topside of the piston. The ram rises until the upper balancing port is sealed and the lower balancing port is open. The pressures on the ends of the spool valve become unequal and the valve is pushed to the down position. The inlet path is then opened to the topside of the Piston and the underside of the Piston is open to the exhaust port. The Piston moves down, first closing the lower balancing port, and then opening the upper balancing port. This action creates an unbalanced pressure at the lower end of the spool valve and the valve is thrown upwards and the operating cycle is repeated.



MKT

Double-acting Air Hammers

- 9B3
- 10B3
- 11B3

The Mechanics of Fluid-Valve Equipment

In the lighter types of McKiernan - Terry equipment (Hammers Nos. 0, I, 2, 3, 5, 6, 6.5 and 7 as shown in Fig. 3) and the Extractors (Nos. E.2 and E.4), the valve is thrown by a fluid system. All of these machines are Double Acting. The Spool Valve is located in the Valve Chest on the front of the machine.

The typical Valve Chest is made so that the motivating fluid can enter through two passages at the proper time into the power cylinder; one passage leading to the underside of the Piston and the other passage leading to the topside of the Piston. The Valve Chest also has a port to provide an exhaust passage for the spent fluid. Drilled holes in the Valve Chest allow high-pressure fluid to get behind the ends of the Spool Valve so it can be actuated. From these ends, passages lead to ports or ball valves in the cylinders, which are opened or closed by the movement of the Ram. The opening or closing of these passages determines the 'throwing' of the Spool Valve so that the fluid can be admitted or exhausted in proper sequence. A typical operating cycle follows: The Spool Valve opens a path for the inlet motive fluid to the underside of the Piston (Ram) and opens a path to the exhaust port from the topside of the Piston. The Ram rises until the upper balancing port is sealed and the lower balancing port is open. The pressures on the ends of the Spool Valve become unequal, and the Valve is pushed to the down position

The inlet path is then opened to the topside of the Piston, and the underside of the Piston is opened to the exhaust port. The Piston moves down, first closing the lower balancing port, and then opening the upper balancing port. This action creates an unbalanced pressure at the lower end of the Spool Valve and the Valve is "thrown" upwards, and the operating cycle is repeated. In all fluid.valve equipment, motive fluid is working on the up stroke and on the down stroke. On the down stroke the piston falls by gravity, and its velocity is increased by the fluid pressure on the top of the piston.

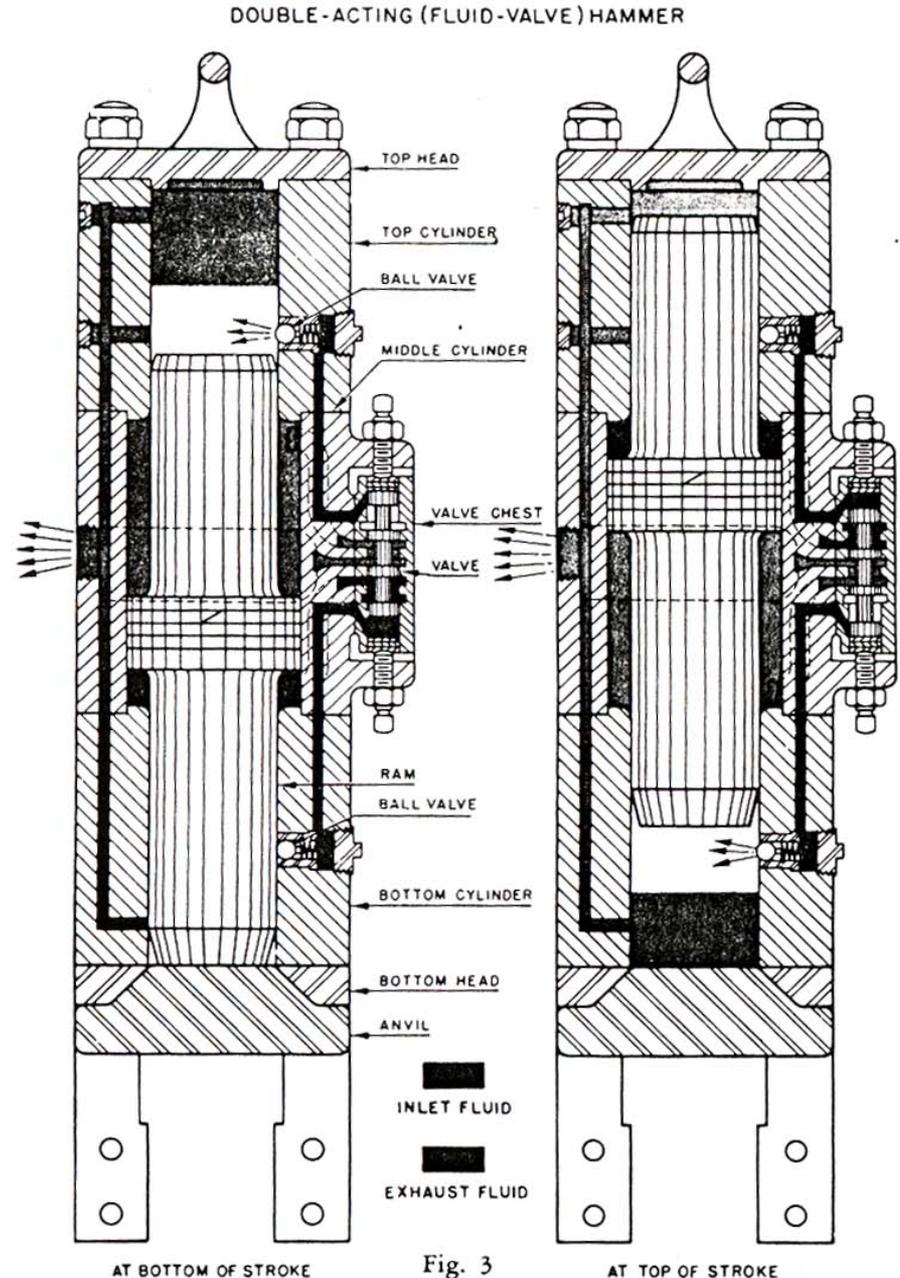


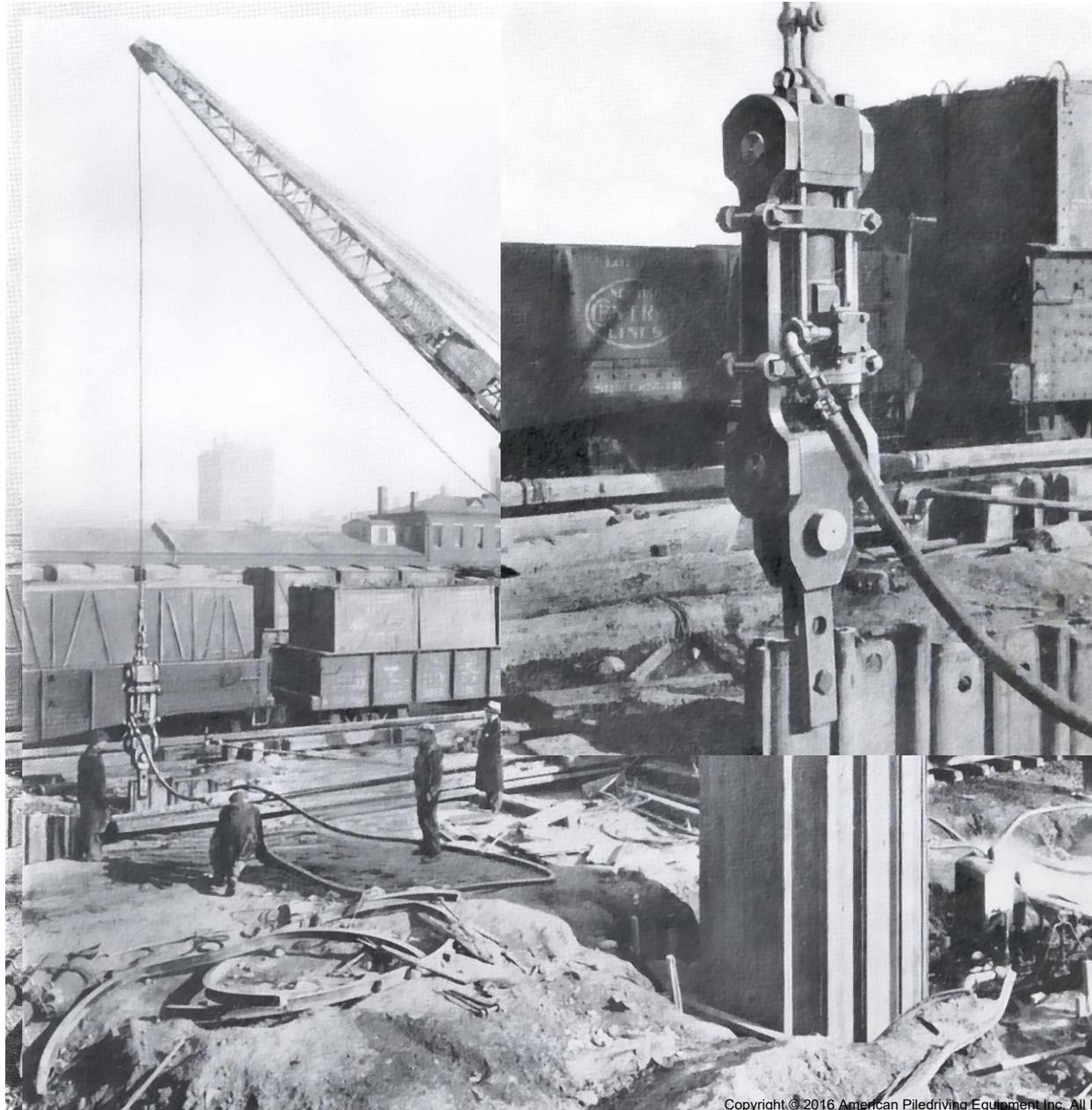
Fig. 3



MKT

Double-acting Extractors

- Photographs



MKT

Double-acting Extractors

•Service & Parts E-2

Part No.	Name	No. Req.	Code Word
E-201	Top Head.....	1	PULOX
E-202	Tie Rod.....	4	PULSA
E-203	Anvil Block.....	1	PULTE
E-204	Cylinder.....	1	PULUZ
E-205	Side Strap.....	2	PULVI
E-206	Side Strap Guide Bolt and Nut.....	4	PULWO
E-207	Ram.....	1	PULZY
E-208	Chest Cover Stud and Nut.....	4	PUPAX
E-209	Chest Cover.....	2	PUPBO
E-210	Chest Stud and Nut.....	4	PUPCU
E-211	Valve.....	1	PUPDY
E-212	Valve Chest.....	1	PUPEZ
E-213	Piston Ring.....	1	PUPIB
E-214	Bottom Head.....	1	PUPOC
E-215	Tie Rod Nut.....	4	PUPUD
E-216	Yoke.....	1	PUPWA
E-217	Yoke Pin.....	1	PUPXE
E-218	Pile Clamp Pin.....	1	PUPZI
E-219	Spacer.....	1	PURAZ
E-220	Pile Clamp.....	2	PURBI
E-221	Pile Clamp Bolt.....	2	PURCO
E-222	Taper Pin.....	1	PURDU

