

UNITED STATES
DEPARTMENT OF LABOR
MINE SAFETY AND HEALTH ADMINISTRATION
Metal and Nonmetal Mine Safety and Health

REPORT OF INVESTIGATION

Surface Nonmetal Mine
(Crushed & Broken Granite)

Fatal Machinery Accident
November 10, 2014

R&S Stone, Inc.
R&S Stone, Inc.
Floyd, Floyd County, Virginia
Mine I.D. No. 44-02991

Investigators

Billy J. Ratliff
Mine Safety and Health Inspector

Joseph H. Bosley
Supervisory Mine Safety and Health Inspector

Rodney L. Rice
Supervisory Mine Safety and Health Inspector

Jonathan A. Hall
Mechanical Engineer

Phillip L. McCabe
Mechanical Engineer

Originating Office
Mine Safety and Health Administration
Northeast District
178 Thorn Hill Road, Suite 100
Warrendale, Pennsylvania 15086
Donald J. Foster Jr., District Manager



OVERVIEW

On November 10, 2014, Carl A. Hixon, Crusher Operator, age 45, was using a torch to cut a drill bit wedged in a jaw crusher, when the bit released and struck him. Hixon was hospitalized and died on January 17, 2015, as a result of his injuries.

The accident occurred due to management's failure to establish and implement policies and procedures to safely clear a jaw crusher. The jaw crusher was not blocked against hazardous motion to protect miners from flying/falling materials resulting from its movement.

Hixon did not receive task training on safe work procedures for clearing or dislodging material in a jaw crusher. Specifically, he was not trained on the potential hazards resulting from a sudden release of stored energy from a jammed crusher.

GENERAL INFORMATION

R&S Stone, Inc., a surface crushed granite operation owned and operated by R&S Stone, Inc., is located in Floyd, Floyd County, Virginia. The principal operating official is Terry G. Reed, President. The mine typically operates one 8-hour shift, five days per week and employs seven persons.

At this operation, granite is drilled and blasted from a multiple-bench quarry. An excavator is used to load a haul truck which transports and dumps the broken granite into a pan feeder. The material is then fed into a jaw crusher for initial sizing. When smaller sizes are needed, the material is conveyed to a cone crusher for further reduction. After crushing and sizing, the material is stockpiled. The finished products are sold as construction aggregates.

The Mine Safety and Health Administration (MSHA) completed the last regular inspection at this operation on September 11, 2014.

DESCRIPTION OF ACCIDENT

On Friday November 7, 2014, at approximately 2:45 p.m., Carl A. Hixon, Crusher Operator, went to check the partially filled primary jaw crusher because it was jammed. Before checking on the problem, he de-energized the crusher and locked it out. Hixon and Cherokee Gibson, Laborer, entered the crusher and began to manually lift rocks out of the machine. They found that a 7-inch long by 5-inch diameter drill bit was wedged lengthwise between the jaw plates in the crusher.

The crew discussed options for removal of the bit. An attempt was made to remotely remove the drill bit from the crusher using a small backhoe to pull a chain wrapped around the bit, the drill bit would not move. At the end of the shift, Hixon reported to the mine office and discussed the problem of removing the bit with Tammy Evans, Mine Foreman. At about 4:00 p.m., everyone left the mine.

During the weekend, Hixon and Reed worked together to install a septic system at a non-mining-related job site. At that time, Hixon and Reed discussed the drill bit wedged in the jaw crusher at the mine. Reed instructed Hixon to use the mine's larger pit excavator and chains to remove the drill bit from the crusher. Reed informed Evans of his discussions with Hixon and reiterated his instruction to use the pit excavator on the next attempt.

On the day of the accident, Hixon picked up Kevin Faulkner and Cesar Martinez, Equipment Operators, at an off-site shop and took them to the mine. They arrived at the mine at approximately 7:30 a.m. Faulkner and Martinez went to fuel the mobile equipment while Hixon assisted Evans with the beginning of shift workplace examinations. Hixon and Evans completed the examinations about 8:00 a.m., and Evans went to the mine office while Hixon returned to the plant.

When Hixon arrived at the jaw crusher, he was joined by Faulkner, Martinez, and Thomas A. Fox, Equipment Operator. Together, they attempted to use the backhoe one more time to remove the drill bit but were unsuccessful. Martinez then left to grease the processing equipment while Hixon moved a service truck onto the crusher feed ramp and unrolled the truck's onboard oxy-acetylene torch hoses. At approximately 8:15 a.m., Hixon climbed down into the jaw crusher with the welding torch to cut the bit free. Faulkner and Fox watched Hixon from a work platform approximately 12 feet above the jaw crusher. Martinez returned to the crusher and waited in the service truck nearby. At approximately 8:27 a.m., the stored energy (pressure) from the crusher ejected the bit and it struck Hixon.

When Faulkner saw Hixon slumped over and apparently unconscious, he immediately radioed the office and requested emergency medical assistance (EMS). Fox entered the crusher to check Hixon. Martinez heard a loud noise, while in the truck and ran to the crusher to investigate. When Martinez arrived at the crusher, Faulkner told him to close the regulators on the torch and then climbed into the crusher. Reed heard Faulkner's call for help and also ran to the crusher. Martinez and Reed helped Fox and Faulkner pull Hixon from the crusher and administer first aid until EMS arrived.

A life-flight helicopter transported Hixon to a local hospital where he was admitted in critical condition. On November 27, 2014, Hixon was transported to an extended care facility in Greensboro, North Carolina, where he died on January 17, 2015. The cause of death was attributed to multiple blunt force trauma.

INVESTIGATION OF THE ACCIDENT

MSHA was notified of the accident at 9:30 a.m. on November 10, 2014, by a telephone call from Terri R. Smith, Vice-President, to the National Call Center. The National Call Center notified Kevin T. Hardester, Staff Assistant, and an investigation was started the same day. An order was issued under Section 103(j) of the Mine Act. After an Authorized Representative arrived at the mine site the order was later modified to Section 103(k) of the Mine Act. A Part 50 citation was issued for untimely reporting.

MSHA's accident investigator traveled to the mine, conducted a physical inspection of the accident scene, interviewed employees, and reviewed documents and work procedures relevant to the accident. MSHA conducted the investigation with the assistance of mine management, mine employees, and the Virginia Department of Mines, Minerals, and Energy.

DISCUSSION

Location of the Accident

On November 10, 2014, Hixon slid approximately 12 feet downward on a piece of rubber belting, and climbed into the jaw crusher (see Figure 1). A noncontributory citation was issued for a violation of 30 CFR 56.11001. Hixon was not protected from hazardous movement of either the crusher components or the drill bit while he was in the crusher. While standing on a rock, Hixon used a torch to attempt to cut the drill bit free from between the jaw plates. Soon after Hixon started to cut the bit, the bit was forcibly ejected from the crusher and struck him (see Figure 2).

Drilling and Blasting

Between October 18 and October 29, 2014, Fox operated a company-owned Atlas Copco Model ROC F9-11 highwall drill for eight shifts to complete a 52-hole pattern for subsequent blasting. The blast holes were drilled in 9 rows to depths of 15 feet and 30 feet. According to Fox, two drill bits were lost at the bottom of separate 30-foot deep blast holes. After the drilling was completed, the excavator operator, the haul truck driver, and the crusher operator were instructed by Fox to watch out for the two missing bits.

Austin Powder Company was contracted to conduct the blasting operation. On October 30, 2014, at 1:16 p.m., the shot was initiated. The contractor's blasting report shows that the volume of material produced by the shot was 4,880 cubic yards or 11,224 tons.

After the shot, one of the missing drill bits was found while the excavator was loading trucks. The second bit lodged lengthwise in the primary jaw crusher. This is the drill bit involved in the accident. The drill bit was a 5-inch diameter by 7-inch long Model T51 DC Retractable bit, manufactured by Atlas Copco (see Figure 3). The drill bit weighed approximately 27 pounds.

Lost drill bits are often found after they pass through the jaw crusher at this operation. When interviewed, Reed stated that this was the first drill bit to get caught lengthwise between the jaw plates and jam the crusher.

Jaw Crusher

The Model MS-3042 jaw crusher involved in the accident was manufactured in November 1995 by Minyu Machinery Corp., LTD, located in Taiwan, Republic of China. The jaw crusher was the primary component of a portable rock crushing unit that included a vibrating rock feed table. The complete unit was assembled in 1996 by Construction Equipment Corporation (CEC) of Lake Grove, Oregon. The unit was purchased by the current mine operator in 1998. Figure 4 shows a cross-section of the jaw crusher.

Jaw Crusher Design

The jaw crusher is driven by an electric motor with a smaller multi-v-belt pulley driving a larger multi-v-belt pulley attached to the pitman arm shaft. A large flywheel is mounted on the opposite end of the pitman arm shaft. The pitman arm shaft is mounted to the crusher main frame using two large roller bearings, one on each end of the shaft. The pitman arm (the moving part or “jaw” of the crusher) is mounted to the pitman arm shaft using two large roller bearings and the shaft can rotate freely within the pitman arm.

The pitman arm shaft is designed as an eccentric, a circular disk that is solidly fixed to a rotating axle with its centre offset from that of the axle, and provides the action to crush and feed the material (rock) into the crusher. By design, the diameter of the eccentric of the pitman arm shaft is larger than the diameter of the shaft mounted to the crusher frame. As the shaft rotates, the eccentric portion of shaft rotates within the pitman arm. Figure 5 is a representative illustration of the end view of the pitman arm shaft or the eccentric.

The toggle plate acts as a fulcrum for the lower (lever) portion of the pitman arm. The edges of the plate are not connected to the pitman arm or toggle block but are inside the groove of the toggle seats, one in the back of the pitman arm and one in the front of the toggle block. The tension rods connected to the lower portion of the pitman arm are spring loaded to keep the toggle plate in position while the crusher is operating.

The shim plates are steel plates of different thicknesses that are used to adjust the gap between the main frame and the bottom of the pitman arm. The size of the gap changes the size of the crushed material leaving the bottom of the crusher. The hydraulic cylinder attached to the main frame and toggle block is used only when changing the shim plates. Once the toggle block bolts are loosened, the hydraulic cylinder is used to push the pitman arm away from the shims, allowing the shims to be installed or removed accordingly. The cylinder can also be used to help retract the toggle block when retightening the bolts. The investigators determined that a hydraulic cylinder was not installed in the crusher; however, a hydraulic cylinder is not needed to operate the crusher and its use is not recommended for clearing jams.

Jaw Crusher Operation

The jaw crusher is used to crush large material into smaller material. The large rotating mass of the large v-belt pulley and flywheel drives the pitman arm and creates the crushing action. The motion of the pitman arm forces the material lower into the jaws with each shaft rotation as the material is reduced in size. Once the material reaches the size dictated by the gap between the main frame and pitman arm, the material drops from the bottom of the crusher.

The Parts and Service Manual provided with the jaw crusher recommends placing material into a grizzly or other type of feeding unit to avoid overloading the crusher. The manual also recommends using an electric overhead hoist to clear the crusher when it is jammed. The design of this crusher does not allow for the jaws to be disengaged or otherwise opened to remove a clog or clear a jam.

When the investigators asked if anyone attempted to open the jaw plates to allow the drill bit to fall through, Reed stated that, “this is an old-style jaw crusher and the jaw cannot be opened until it completes its full cycle of closure.”

Weather

On the day of the accident, weather conditions were clear with an average temperature of 47 degrees Fahrenheit. Sunrise was at 6:54 a.m. Weather and lighting were not considered to be contributing factors to the accident.

Summary

1. No blocking was used to protect the victim from hazardous movement of either the jaw crusher components or the drill bit.
2. The haul truck dumped rock directly into the pan feeder which fed the jaw crusher. The mine operator did not use a grizzly or other recommended type of feeding unit to prevent unwanted items such as a drill bit from entering the crusher.
3. The rotating mass of the crusher applies a large amount of compressive force to any object stuck in the jaw. When an object, such as a drill bit, is jammed in the crusher, this compressive force supplies enough energy to propel an object from the crusher when that object is loosened.

TRAINING AND EXPERIENCE

Carl A. Hixon had 3 years 20 weeks of mining experience as a crusher operator, all at this mine. The investigators reviewed the mine operator’s Part 46 training records for Hixon and found that he had received all required training with the exception of task training on removing objects jammed in the crusher. There is no evidence that Hixon or any other miners received adequate task training on safe operating procedures related to dislodging objects stuck in the jaw crusher.

ROOT CAUSE ANALYSIS

The investigators conducted a root cause analysis and identified the following root causes:

Root Cause: Management failed to establish policies or procedures to protect miners from hazardous motion of the jaw crusher components or objects stuck in the jaw crusher.

Corrective Action: Management established policies and procedures to ensure that miners would not enter the jaw crusher to free any jammed material or objects and trained miners on these procedures. The onsite Kobelco SK400 excavator, equipped with a 10,000 pound hammer, will be used to dislodge any items that become wedged through the crusher plates.

Root Cause: Management failed to task train miners on safe procedures for dislodging objects stuck in the jaw crusher, and hazards resulting from a sudden release of stored energy from a jammed crusher.

Corrective Action: Management has revised their Part 46 training plan to include task training for all miners on safe procedures for dislodging objects stuck in the jaw crusher, including the hazards resulting from a sudden release of stored energy from a jammed crusher. All miners were trained according to the revised plan.

CONCLUSION

The accident occurred due to management's failure to establish and implement policies and procedures to safely clear a jaw crusher. The jaw crusher was not blocked against hazardous motion to protect miners from flying/falling materials resulting from its movement.

Hixon did not receive task training on safe work procedures for clearing or dislodging material in a jaw crusher. Specifically, he was not trained on the potential hazards resulting in a sudden release of stored energy from the jammed crusher.

ENFORCEMENT ACTIONS

Issued to R&S Stone, Inc.

Order No. 8731261 - Issued on November 10, 2014, under Section 103(j) of the Mine Act. An Authorized Representative modified this order to Section 103(k) of the Mine Act upon arrival at the mine:

An accident occurred at this operation on November 10, 2014, at 8:27 hours. This order is being issued, under Section 103(j) of the Federal Mine Safety Act of 1977, to prevent the destruction of any evidence which would assist in investigating the cause or causes of the accident. It prohibits all activity at the area of the plant where the accident occurred until MSHA deems that it is safe to resume normal operations in this area. This order was initially issued orally to the mine operator at 10:10 hours and has now been reduced to writing.

The initial order is modified to reflect that MSHA is now proceeding under the authority of Section 103(k) of the Federal Mine and Health Act of 1977. This Section 103(k) Order is intended to protect the safety of all persons, including those involved in the rescue and recovery operations or investigation of the accident. The mine operator shall obtain prior approval from an Authorized Representative of the Secretary for all actions to recover and / or restore operations in the affected area. Additionally, the mine operator is reminded of its existing obligations to prevent the destruction of evidence that would aid in the investigating the cause or causes of the accident.

The order was terminated on November 12, 2014, after conditions that contributed to the accident no longer existed.

Citation No. 8731264 - Issued under Section 104(a) of the Mine Act for a violation of 30 CFR § 56.14105:

A serious accident occurred at this operation on November 10, 2014 at 0827 hours, when an employee entered the jaw crusher to cut a lodged drill bit that seized the jaw crusher. The power was locked out but the bit contained stored energy from the pressure of the jaw. The employee bent over the bit with a torch when the bit sprang from the jaw and struck him in the chest and head. The position of the employee did not protect him from the hazardous motion. Failure to protect the employee from hazardous motion could lead to a fatal accident. The employee died on January 17, 2015, as a result of his injuries.

Citation No. 8915004 - Issued under of Section 104(a) of the Mine Act for a violation of 30 CFR § 46.7(b):

Management failed to task train miners on safe procedures for dislodging objects stuck in the jaw crusher, including the projectile hazard associated with a sudden release of stored energy. This failure placed miners at risk and contributed to the serious accident that occurred at this operation on November 10, 2014, when a miner was seriously injured while using a torch to cut a drill bit that was wedged in a jaw crusher. When the bit was freed, stored energy was released and the bit became a flying projectile that struck the miner. The victim was hospitalized and subsequently died on January 17, 2015, as a result of his injuries.

Approved: Kevin H. Abel
Kevin H. Abel
Acting District Manager

Date: 05-11-2015

LIST OF APPENDICES

Appendix A: Persons Participating in the Investigation

Appendix B: Victim Information

Appendix C: Accident Scene Photos and Illustrations (Figure 1 – Figure 5)

APPENDIX A

PERSONS PARTICIPATING IN THE INVESTIGATION

R&S Stone, Inc.

Terry G. Reed	President
Terri R. Smith	Vice-President
Tammy Evans	Foreman
Thomas A. Fox	Equipment Operator
Cesar Martinez	Equipment Operator
Kevin Faulkner	Equipment Operator

Virginia Department of Mines, Minerals, and Energy


Bentley Smith	Mine Inspector, Division of Mineral Mining
---------------	--

Mine Safety and Health Administration

Billy J. Ratliff	Mine Safety & Health Inspector
Joseph H. Bosley	Supervisory Mine Safety & Health Inspector
Rodney L. Rice	Supervisory Mine Safety & Health Inspector
Jonathan A. Hall	Mechanical Engineer
Phillip L. McCabe	Mechanical Engineer

APPENDIX B

VICTIM INFORMATION

Accident Investigation Data - Victim Information										U.S. Department of Labor												
Event Number: 6 6 3 0 0 1 6										Mine Safety and Health Administration												
Victim Information: 1																						
1. Name of Injured/Ill Employee: <i>Carl A. Hixon</i>			2. Sex: <i>M</i>		3. Victim's Age: <i>45</i>		4. Degree of Injury: <i>01 Fatal</i>															
5. Date(MM/DD/YY) and Time(24 Hr.) Of Death: <i>a. Date: 01/17/2015 b. Time: 2:17</i>						6. Date and Time Started: <i>a. Date: 11/10/2014 b. Time: 8:27</i>																
7. Regular Job Title: <i>181 crusher operator</i>				8. Work Activity when Injured: <i>039 cutting drillbit from jaw crusher</i>				9. Was this work activity part of regular job? <table style="margin-left: auto; margin-right: auto;"><tr><td>Yes</td><td><input checked="" type="checkbox"/></td><td>No</td></tr></table>				Yes	<input checked="" type="checkbox"/>	No								
Yes	<input checked="" type="checkbox"/>	No																				
10. Experience a. This			b. Regular			c. This			d. Total													
Years	Weeks	Days	Years	Weeks	Days	Years	Weeks	Days	Years	Weeks	Days											
<i>3</i>	<i>20</i>	<i>0</i>	<i>3</i>	<i>20</i>	<i>0</i>	<i>3</i>	<i>20</i>	<i>0</i>	<i>3</i>	<i>20</i>	<i>0</i>											
11. What Directly Inflicted Injury or Illness? <i>082 drill bit</i>						12. Nature of Injury or Illness: <i>370 contusion, fractures, lungs, neck, jaw</i>																
13. Training Deficiencies: <table style="width: 100%;"><tr><td>Hazard:</td><td></td><td>New/Newly-Employed</td><td>Experienced Miner:</td><td></td><td>Annual:</td><td></td><td>Task:</td><td></td></tr></table>											Hazard:		New/Newly-Employed	Experienced Miner:		Annual:		Task:				
Hazard:		New/Newly-Employed	Experienced Miner:		Annual:		Task:															
14. Company of Employment: (If different from production operator) <i>Operator</i> Independent Contractor ID: (if applicable)																						
15. On-site Emergency Medical Treatment: <table style="width: 100%;"><tr><td>Not Applicable:</td><td></td><td>First-Aid:</td><td><input checked="" type="checkbox"/></td><td>CPR:</td><td></td><td>EMT:</td><td><input checked="" type="checkbox"/></td><td>Medical Professional:</td><td></td><td>None:</td><td></td></tr></table>											Not Applicable:		First-Aid:	<input checked="" type="checkbox"/>	CPR:		EMT:	<input checked="" type="checkbox"/>	Medical Professional:		None:	
Not Applicable:		First-Aid:	<input checked="" type="checkbox"/>	CPR:		EMT:	<input checked="" type="checkbox"/>	Medical Professional:		None:												
16. Part 50 Document Control Number: (form 7000-1) <i>220143510002</i>						17. Union Affiliation of Victim: <i>9999</i> <i>None (No Union Affiliation)</i>																

APPENDIX C

ACCIDENT SCENE PHOTOS AND ILLUSTRATIONS



Figure 1 – Path that Hixon traveled from the adjacent walkway.

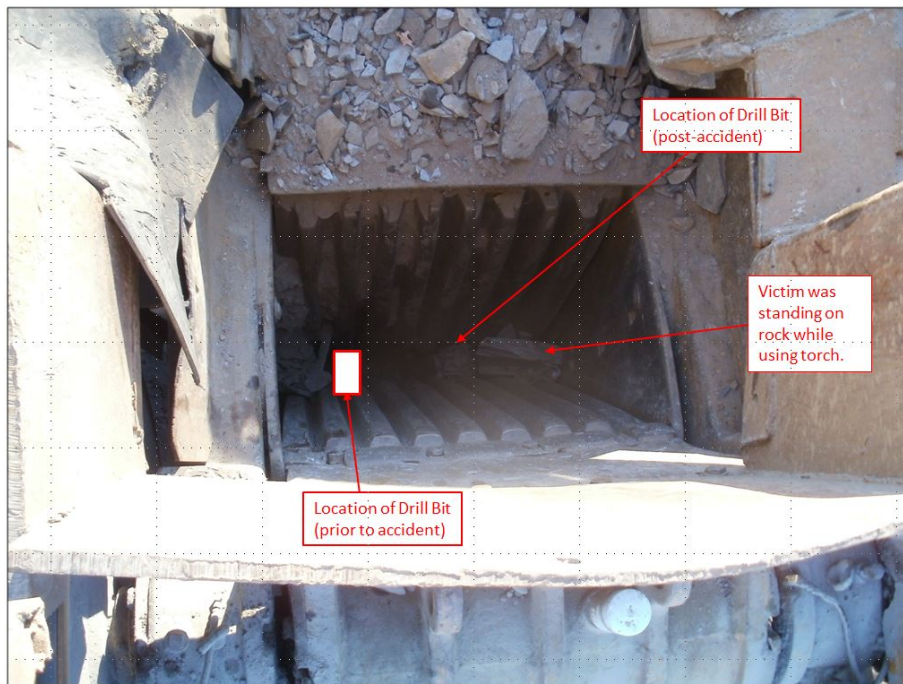


Figure 2 – View of the jaw crusher showing position of the victim and the pre-accident and post-accident positions of the drill bit.



Figure 3 – Close-up photo of the drill bit.

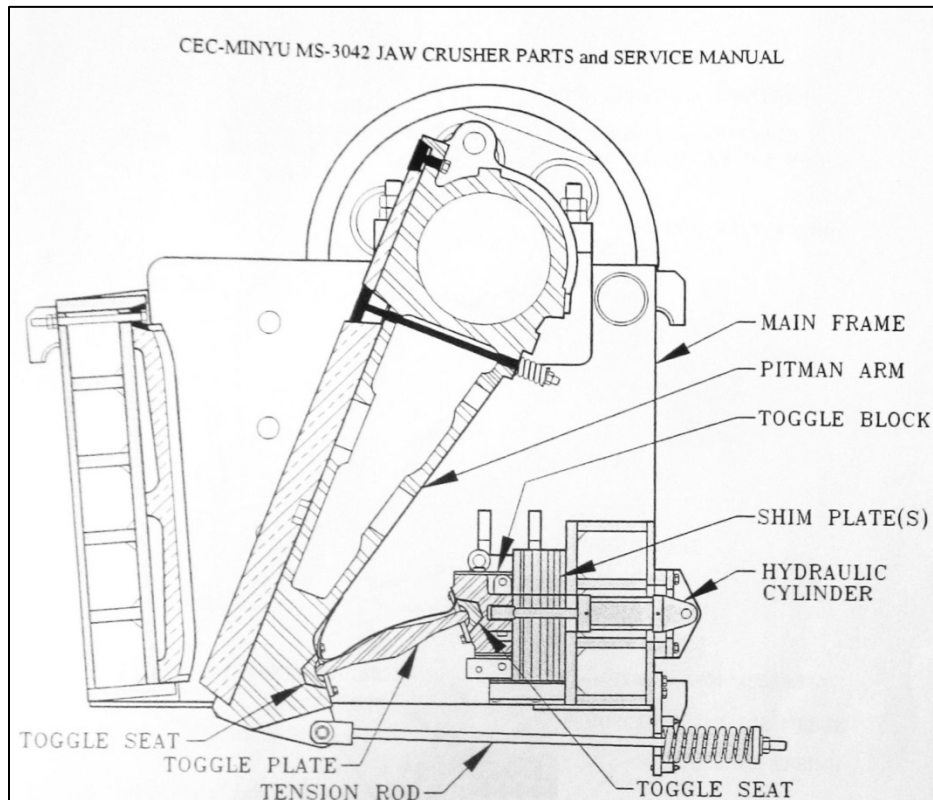


Figure 4 - Pictorial cross-section of the Minyu MS-3042 jaw crusher.

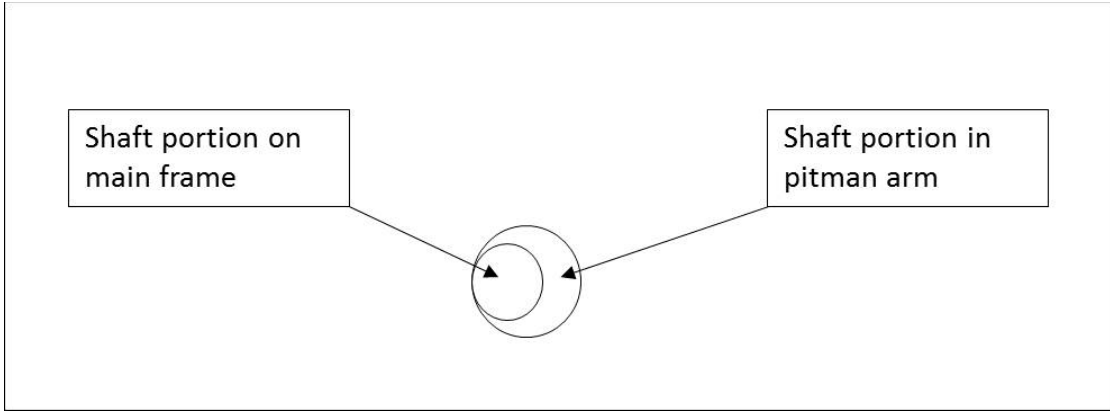


Figure 5 - Representative illustration of the end view of the pitman arm shaft or the "eccentric."