AN IMPROVED VANDERWILT ROCK SAW

G. D. EMIGH, *University of Arizona, Tucson, Arizona.*

A simple and inexpensive device for sawing rock specimens up to 7 inches square in cross section was designed and described by Vanderwilt.[1] Some changes in Vanderwilt's original design were made by the present writer, and a machine was constructed at the University of Arizona which incorporated these changes. It has been in operation for more than a year and has given very satisfactory results.

Vanderwilt's article describes the original saw clearly and concisely, but for the sake of completeness the main features of the machine will be briefly described. The saw consists of a straight blade of sheet iron which is drawn back and forth across the rock specimen by means of an arm connected to an eccentric on a pulley. Power is provided by an electric motor connected with belts to a series of pulleys. Abrasive is automatically fed with water under the saw edge, and the dragging of this abrasive under the moving blade provides the cutting action.

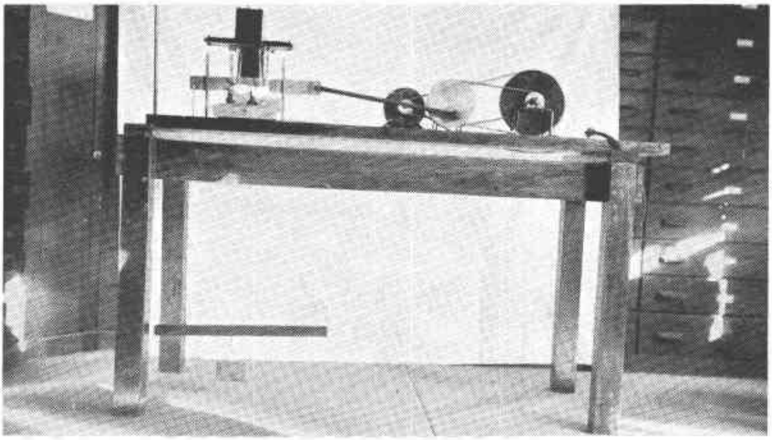

FIG. 1. Vanderwilt Rock Saw and Table.

The photographs accompanying this article show the mechanical construction of the saw. It is a compact unit contained on a plank 12″ wide and 6 feet long. A one-fourth h.p. electric motor running at a speed of 1500 r.p.m. is connected by $\frac{1}{4}''$ round leather belting to three pulleys. These reduce the speed so that the last pulley—to which the connecting rod moving the saw blade is fastened—runs at the desired speed. There

---

[1] Vanderwilt, John W., A rock saw: *Am. Mineral.*, vol. **19**, pp. 224–229, 1934.

are four pulleys in the speed-reducing unit. The one on the motor is made of aluminum and can be purchased at any hardware store. The largest pulley is made of wood, and the other two were machined out of steel. Bearings are made of brass, and the bearing supports are strap iron bent in the shape shown in the diagrams, and bolted to the plank base.

The connecting rod joining the eccentric and the saw blade is made of ½ inch lead pipe. Where it connects to the eccentric, a T-joint 1½ inches wide was put on to act as the bearing. This gives a long enough bearing surface so that the connecting rod moves in a vertical plane without sidewise motion. The length of a stroke is 4 inches. The saw is made of 16-gauge sheet iron 18 inches long and 2 inches wide. It fits into a slot in the end of the connecting rod and is fastened there with a small bolt. The blade works between four iron guide posts which keep it in a fixed vertical plane.

The rock specimen to be cut is clamped in position under the blade with a wooden clamp. Details of this clamp can be seen in the diagrams. It consists of a short piece of board with a hole bored in it, in which fits a long screw coming from the plank base. The front end of the board fits on top of the specimen and the back end is blocked up with wooden blocks. Tightening on the screw then clamps the board down firmly on top of the specimen. The specimen rests on a wood block 2 inches thick which in turn is placed in a pan. The block should project above the pan. The reason for this is that the saw blade seldom works perfectly flat—especially after it becomes worn—and to avoid cutting the sides of the pan, the pan must be lower than the block. The pan catches the cuttings and worn abrasive washed from under the saw blade. It is provided with a spout to allow overflow of the water.

The feed box which holds the abrasive is a separate unit, and is clamped on top of the wooden clamp holding the specimen. The feed box is a wooden box with celluloid sides in which two small holes are bored opposite each other. A string passes through these holes, and is fastened on one end to a rubber band which in turn is fastened to an iron post. The other end of the string is fastened directly to the connecting rod. Each time the connecting rod moves back it pulls the string forward, and on the forward stroke the rubber band pulls the string back again. As the string moves back and forth through the holes it pulls out the abrasive which falls on a tin chute, then into a rubber tube which directs it onto the specimen. A second set of tubes near the abrasive tubes are for water which is allowed to drip slowly. The water supply is in a large glass jar set far enough above the saw so as to feed by gravity. The water serves three purposes; it washes the abrasive under the saw, it lubricates the blade, and it washes the cuttings from under the blade. The abrasive and water fall onto a sloping shelf of plaster of Paris which is made on the specimen itself. The slope is made about 1½ inches wide and extends across the entire length of the specimen (see Fig. 2). The slope, of course, is toward the saw blade, and the abrasive falling on the slope is washed down and into the saw-cut by the water.

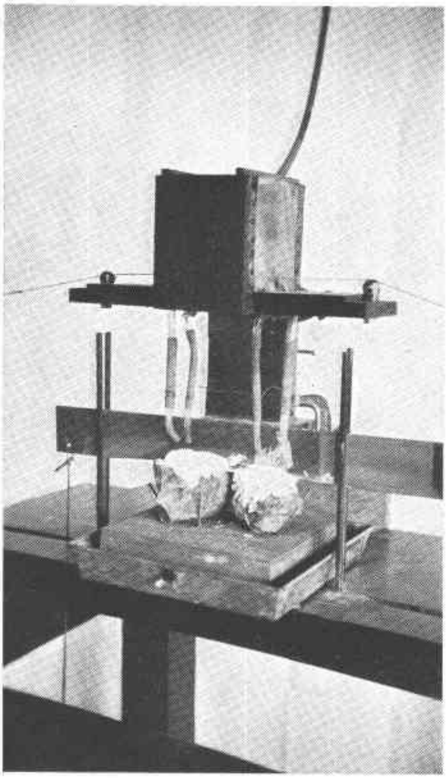

FIG. 2. Abrasive Feed Device.

In order to increase the speed of the cutting action, and to help steady the blade, weights are suspended under the saw by means of a wire suspended from each end of the blade. These wires pass through slots cut in the plank base, and under the table are fastened to a stick of wood. Weights are then suspended from this crosspiece, and by moving the weights along the bar, a position can be found in which the blade rides evenly on the specimen.

This completes a generalized summary of the saw. It might be well now to go more into detail concerning its successful operation.

The feed box which is shown in detail in the figures differs from that described by Vanderwilt only in the way the abrasive and water are fed to the specimen. A fairly stiff piece of wire is fastened to each rubber tube and to the frame of the feed box. By bending this wire the tubes can be directed so as to feed to any position on the plaster of Paris slope. With small specimens the tubes may be too short to reach within an inch or two of the specimen, and glass extension tubes are placed in the ends of the rubber tubes. These glass tubes and the wires holding them in position can be seen in Fig. 2. The flow of water coming from the water tubes is controlled by clamps. It is important not to let the water touch the abrasive tubes, for as soon as the latter get wet, the carborundum packs and clogs the tube. The amount of abrasive pulled out of the holes by the moving string varies with the distance the string is pulled back and forth. With a hole slightly larger than a common string, a $\frac{1}{4}$ to $\frac{1}{2}$ inch stroke is sufficient. One end of the string is fastened to the connecting rod, which, having a 4″ stroke would pull the string four inches. This difficulty is overcome by fastening rubber bands to each end of the string, and by varying the number of rubber bands a differential pull can be made which will produce any length stroke desired. Experiments were run using different sizes of abrasive from 60-mesh to 200-mesh and finer. Sixty-mesh abrasive is not only too coarse to cut fast but also gouges the sides of the cut badly. Eighty-mesh cuts faster than any other size, and is the size used, although 100-mesh is nearly as satisfactory. With an abrasive finer than 100-mesh, the cutting action is slower but a much smoother cut is made. In cutting a very choice or friable specimen one should use 150-mesh material as this causes practically no gouging on the walls. The abrasive can be used repeatedly, but after each cut it is reduced in size. Eighty-mesh carborundum after two cuts through quartz is reduced largely to 100-mesh.

It is extremely important to clamp the specimen firmly in position, otherwise, under the vibration and saw movement it will work loose, bind the blade and stop the saw. Many specimens are so shaped that they can be clamped easily in a firm position, but we have found it advisable to brace the bottom of specimens with nails driven into the wooden supporting block and by means of wooden wedges. By taking a little time one can clamp any shaped specimen into a cutting position. The machine here described can cut a specimen up to 8″×10″ in cross-section. The saw blade works much more evenly on a long cutting surface. No difficulty is encountered in cutting a small rock, but the blade will run more evenly if two or more small specimens are cut at a single operation.

The saw blade hangs loose from the end of the connecting rod. With a speed of 120 strokes a minute one can adjust the weights so that the saw rides evenly, but when the number of strokes is increased to 190, the saw often "flops" badly in spite of adjustments of the weights. This trouble can be largely overcome by putting a metal wedge in the open slot space in the connecting rod just behind the blade. In this way the connecting rod and the blade become one stiff unit.[2] The 20-inch connecting rod is long enough so that the vertical motion at its end is less than an inch and the extra length of the saw cuts this down still further. The blade wears down slowly, and when it has worn down about $\frac{1}{2}$-inch it can be turned over and the reverse edge used. At first, the saw was run at a speed of 120 strokes a minute. Later this was increased to 190 by replacing the 2 inch motor pulley with one $2\frac{1}{2}$ inches in diameter. The higher speed increases the cutting action considerably, but at the same time causes trouble at the start before the saw has had time to "seat" itself. Our practice is to start the operation at 120 strokes a minute using the smaller pulley, then, after the blade is running smoothly in its cut, change to 190 strokes a minute by replacing the small pulley with the larger one. The leather belt is kept loose enough to fit both pulleys. Aside from this, it is better to have the belt loose so that when the saw sticks, as it will do occasionally, the motor pulley will slip, preventing the motor from burning out.

The heavier the weights that are suspended under the blade, the faster is the cutting action, providing the speed is not greatly reduced. We use weights of from 5 to 15 pounds.

Following are the cutting rates of the saw using 100-mesh carborundum, 7 pound weights and 190 strokes a minute:

quartz —$\frac{3}{4}$ to 1 inch an hour
calcite —4 inches an hour
quartz-sulfide ore—2 inches an hour

The width of a specimen does not seem to affect the cutting speed very appreciably. A specimen 7 inches wide will cut apparently as fast as one 3 inches wide.

To anyone contemplating the construction of one of these saws it would seem advisable to use at least a $\frac{1}{3}$ h.p. motor in order to use heavier weights under the blade. The ideal motor would be one with adjustable speeds, but such a motor is more expensive than the constant speed

---

[2] Vanderwilt recently has developed a device which tends to eliminate completely "flopping" of the saw blade. He uses a longer weight bar than the one shown in Fig. 1, and fastens one end of the bar with a pivot to the table leg. With this system the saw blade is kept in approximately a horizontal position by shortening at intervals the wires coming from the saw blade. A small link chain has been found convenient here, for by dropping a link every hour or two the saw blade can be kept nearly horizontal. Vanderwilt reports that since using this device he has had no trouble with the blade sticking.

motor. Our arrangement—interchanging motor pulleys—is quite satisfactory. If a constant speed machine is used it should not be run over 120 strokes a minute. The feed box could be improved by making it V-shaped rather than square, thus doing away with dead space. One might improve the blades by cutting a few V-shaped notches along their edges which would help to work the abrasive under the moving edge.

Following is the approximate cost of the machine described here:

Motor	$7.00
Table	8.00
Labor	10.00
Miscellaneous parts	3.50
10 saw blades	1.50
	$30.00

The writer wishes to acknowledge his indebtedness to Dr. M. N. Short for encouragement and criticism and to Mr. E. M. Patterson for assistance in working out the details of the mechanism.