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INFORMATION CIRCULAR 3

Revised March 5, 1968

HAND PLACER MINING METHODS

Panning

The gold pan is the placer prospector's basic tool. It is used in prospecting new districts, offering a rapid determination of the presence of gold while being light and easy to carry. Panning is used as a guide in determining future working places as an area is being mined, and cleaning up rocker and other concentrates.

The panning operation consists of uniform agitation and washing. The material is dumped into the pan and held under water while the hands are used to wash and remove the large stones and break up clay stumps. The muddy water is then carefully poured off; this desliming usually requires 1 or 2 repetitions. With the sample covered with water, the pan is next shaken and rotated in a slightly circular motion, keeping the surface horizontal. The movement is fairly rapid, but not excessively so and the extent of movement in any one direction should be on the order of 1-1/2 to 2 inches. The action is vigorous, but not violent. This agitation causes the gold to settle and the light material to rise to the surface. Care must be taken to insure that every particle of the sample is moving; a "dead spot" will not allow the gold to settle. Once the surface material is composed of light minerals only (as indicated by the unchanging appearance of the top portion), it way be washed away. This is accomplished by dipping the pan into the water, then tilting it backward and to one side and then forward and down again, allowing the water to wash the material forward out of the pan. The same procedure is then done to the other side. This operation is done smoothly and quickly, and, with proper manipulation, will skim off the top 1/4" of material. This entire process of agitating and washing is then repeated again and again, the gold does not settle at once, but during the many steps of agitation. Occasionally the pan is lifted and shaken vigorously from side to side. As the sample volume decreases, the pan is tilted away from the operator during agitation, allowing the gold to settle at the junction of the bottom and wall of the pan; in addition, the panning must be done more carefully to allow for the increasing ratio of heavy to light minerals. Finally, nothing remains in the pan except the gold and heavy black sands. The gold may be separated by adding mercury to amalgamate the gold, or by drying and treating with a magnet and then blowing away the remainder of the undesired heavy minerals which were not picked up by the magnet.

Needless to say, panning is very slow and laborious and requires experience before one is capable of proper manipulation. A good panner can carefully wash around 100 pans (0.6 cubic yards) in 10 hours.

The Rocker

The rocker (fig. 1) is used for the same service as the pan as it is mainly a prospecting tool; although occasionally a large rocker is used for mining small deposits where water is scarce. A man is able to wash 3 to 5 times more yardage than with the gold pan, and the use of the rocker eliminates much of the backbreaking strain of continuous panning. On the other hand, the easy mobility of the pan as a prospecting device is lost.

The operation consists of shoveling gravel onto a screen or grizzly, pouring water over it from a dipper, and at the same time giving the device a rocking motion. The grizzly retains all the stones, which are removed when washed clean. The water and the undersize pass onto a canvas apron which saves most of the gold and places the remainder at the head end of the trough. Riffles, canvas, blankets, corduroy, burlap, or cocoa matting with expanded metal have been used to cover the bottom of the trough and all have met with varying degrees of success in saving the gold. The combination of cocoa matting covered with expanded metal lath has proven to be quite effective for most gravels. The frequency of cleaning up depends on the richness and character of the gravel.

The rocking motion should be sufficient to keep the gravel disturbed, allowing the gold to settle out, but a too vigorous movement will cause a gold loss. The gravel bed should be lifted slightly with each motion and should be evenly distributed across the trough. Generally speaking, the rocker is not noted for its ability to save fine gold, but with careful and expert manipulation, high recoveries can be achieved. Tailings from rockers and sluice boxes should be occasionally panned to check for gold losses. When gold is found near the lower end of the rocker or sluice box, losses should be suspected.

Sluices and Riffles

If sufficient water is available, the riffled sluice box is the best gold saving device for most operations. A continuous operation, it will treat many times over the amount of material which a rocker could wash in a given time. In addition, it is more efficient in that it is able, with proper operation, to save much of the fine gold which may be present. Sluices are made in varying widths, from as little as 6" to as great as 6', depending on the size of the mining operation. The length will also vary, depending on the nature and character of the gravel. The sluice need not be any longer than is necessary to free the gold from the gravel; for a medium-sized mining operation, the most prevalent length today is in the neighborhood of 60-80 feet, though a 12-foot box might serve under certain circumstances.

Figure 2 shows a small sluice, one suitable for prospecting or a small scale hand operation. A sluice of this type is easily built and fairly inexpensive. On the other hand, it will have a relatively short life compared to boxes of sturdier construction. Although not shown in the drawing, sluices of this type may be made to telescope; for instance, one end may be 14" wide and the other 12". This allows a longer sluice to be erected and transported with a minimum of time and labor; canvas is usually placed at the joint to prevent leakage. Long sluices may also be made by merely butting two or more boxes together and fastening them by means of an overlapping sleeve, canvas again being used to seal the joint.

The actual gold saving devices are riffles which are placed in the bottom of the sluices. Their function is to break up the material passing over them -- slowing it down to allow the denser particles to settle out, to form pockets to retain the gold as it settles, and to form eddies or "boils" which roughly classify the material in the riffle spaces. The riffle shape, spacing, and position with respect to the flow determine the boil, which should be strong enough to prevent the riffles from packing, but still allow deposition of gold.

The choice of riffles for an operation depends largely on the size of the gold in the deposit. Figure 3a shows a type of pole riffle which has proven successful as a saver of coarse gold. As it does not retard the current as much as other types, more yardage with less water may be treated in a given period of time, but for the same reason, it is a poor recoverer of fine gold. In some operations, the pole riffle (general term: longitudinal riffle) is replaced with iron rails, which offer longer service. Longitudinal riffles are often placed in the head end of boxes and are followed by Hungarian riffles.

Figure 3b shows a Hungarian or transverse riffle, probably the most widely used type in all sluicing operations. This riffle gives more resistance to flow and is a better collector of fine gold. The riffle spacing tends to pack, however, especially when heavy black sands are present in large quantity. When this happens, frequent clean-ups become necessary. As shown, riffles are usually made in sections to provide ease in handling during clean-up. In addition, they are often capped with strips of iron or rubber to prolong their life.

A variation of the Hungarian riffle is the block riffle (fig. 3c). Used often in the upper portion of the sluice, they are economical when timber is cheap. They are easily replaced and give a smooth floor over which boulders may slide; they wear quickly, however, when placed under heavy service. Also shown in this drawing are sluice liners or sideplates. They are almost always used in all kinds of sluices and serve the double function of preventing wear on the sides of the sluice and holding the riffles in place. However, for the small wooden prospecting sluice, the life of the box itself would probably not justify their use, and the riffle hold-downs are nailed in place through the sides of the sluice.

Another variation of the Hungarian riffle, and probably the most widely used in Alaska, is the angle-iron riffle shown in Figure 3d. These are usually placed in sluices made of steel plate. Steel sluice boxes have a life measured in seasons and, if much mining is to be done in one general area, are well worth their high capital investment. As shown in the figure, the angle-irons are made up in sections by welding the ends to a narrow plate, placing the riffles at a slight angle to encourage a more vigorous riffle boil. The dimensions and spacing are not rigid, as is the case in all the drawings, but may be varied to suit the individual operator and the conditions imposed by the deposit.

When in place, the sluice box should be perfectly level across its width and have firm support and constant grade throughout its length.

Although usually placed on the ground, sluices are sometimes elevated on trestles to attain grade and/or to provide space for tailings. Grades have varied from 1/2" to 1-1/2" drop per foot of length. Too-steep a grade will carry values out of the box, yet it should be enough so that the water will wash the material through unaided. In Interior Alaska, the average grade used is around 1-1/4"/ft. The depth of water should be sufficient to move all but the largest rocks, but should not be greater than one-half the box width.

Gold recovery is hard to determine due to the difficulty of accurately sampling the sluice feed and tailings. Generally, the distribution of gold in the riffles is used as an indication. For instance, roughly 80% of the gold recovered should be in the first few feet of riffles, and if gold in significant amounts is found near the tail of the sluice, either the riffle arrangement or the grade needs altering. The amount of water, the slope of the boxes, the type and spacing of the riffles, all effect the gold recovery, packing of the riffles, etc. Determining the most efficient combination of factors is a matter of experimentation for each different deposit.

General

The average value of all gold-bearing gravel mined in Alaska for the last few years has been around 40¢ per cubic yard. Small selected deposits might run several times this much. Even at, say, the unlikely figure of $3.00 per yard, it is obvious that no great amount of money can be earned by hand placer mining because of the limitations on the amount of gravel that can be washed. In this regard, highly advertised mechanical gold savers should be evaluated by the amount of gravel they can wash. Even though a machine might save more gold than hand methods, it is of no avail if its yardage-handling capacity is limited to a few, or even several, yards per day. Hand placer mining is interesting and fun as a hobby or for a vacation pursuit, but should be thoroughly investigated and thoughtfully considered before being taken up as a means to make a living.

Additional Reading

This circular is intended to serve as an introduction to the basic types of hand placer equipment and makes no attempt to discuss any of the refinements or any mining methods and equipment arrangements. For additional and more extensive treatments on placer mining, the reader is referred to the following U. S. Bureau of Mines Information Circulars:

IC 6787 - Hydraulicking, Treatment of Placer Concentrates, and Marketing of Gold

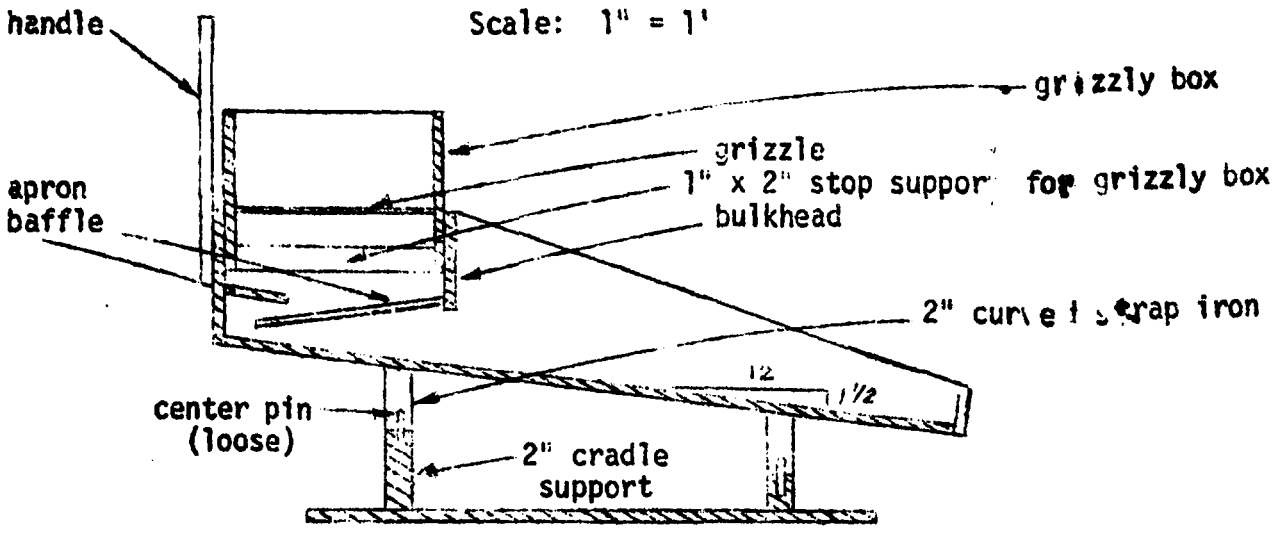
IC 6786 - General Information, Hand-Shoveling, and Ground-Sluicing

IC 6788 - Dredging and other forms of Mechanical Handling of Gravel, and Drift Mining

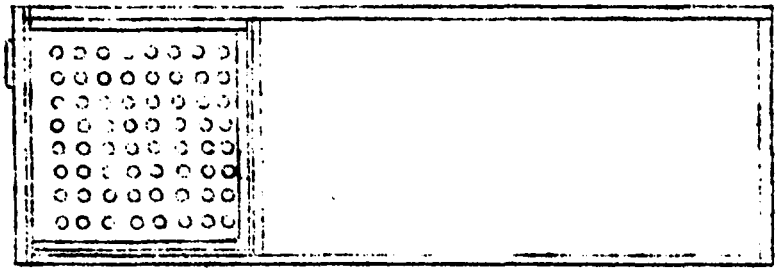
IC 6611 - Small Scale Placer Mining Methods

IC 7926 - Placer Mining in Alaska

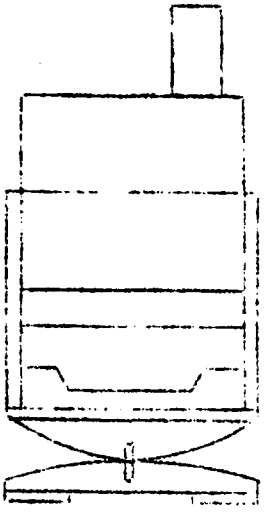
Figure No. 1: The Rocker



(a) Cutaway Elevation



(b) Plan



(c) Front End View

Notes: All lumber, with the exception of the cradle supports, is 1-inch dressed material.

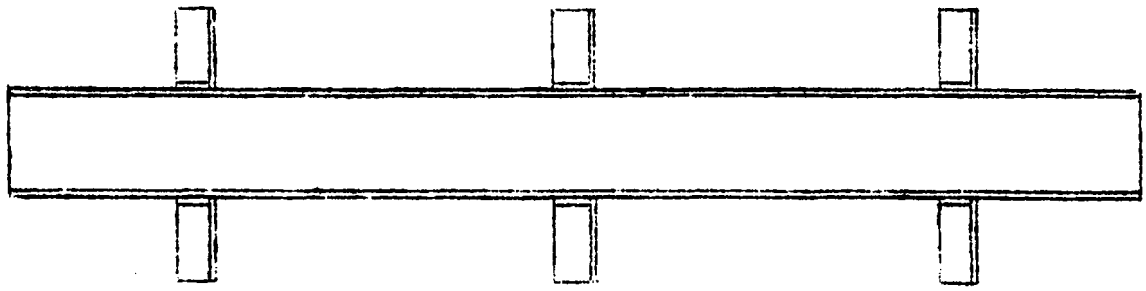
Apron consists of a frame covered with canvas slack enough to form a slight belly. Apron slope is 1-1/2" per foot.

Center pins should be loose enough to allow a free rocking movement.

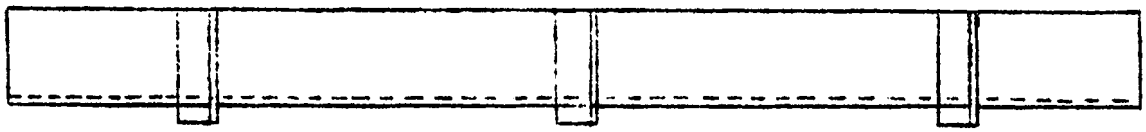
Grizzly holes are 1/2 inch in diameter.

Figure No. 2: Sluices

Scale: 1/2" = 1'



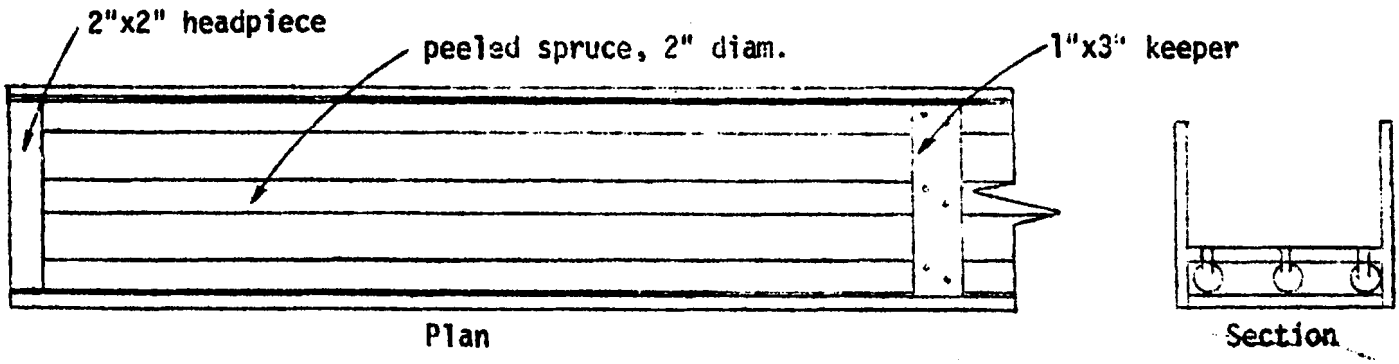
(a) Plan



(b) Elevation

(c) Section

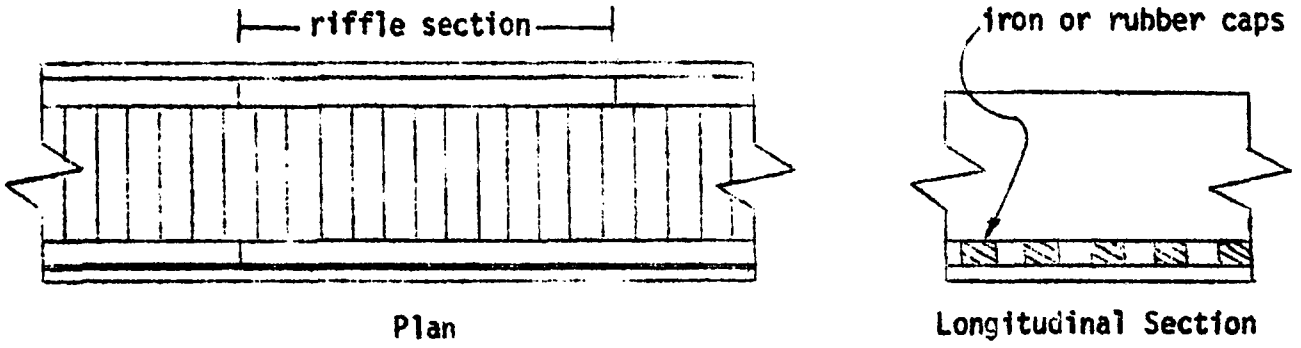
Figure No. 3: Riffles



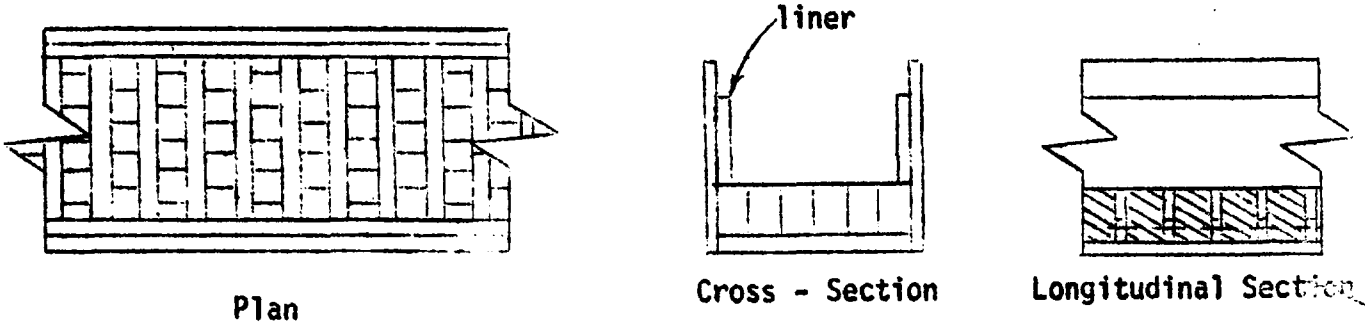
(a) Pole Riffle: Scale: 1" = 1'

Figure No. 3: Riffles

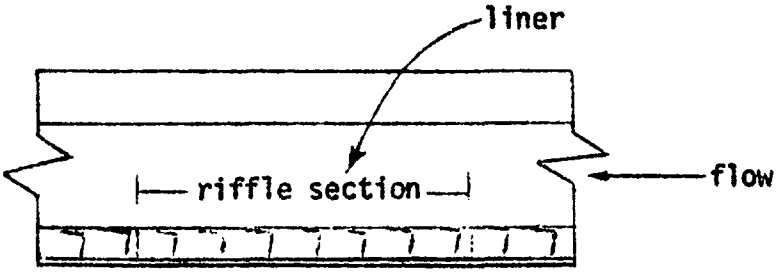
Scale: 1" = 1'



(b) Hungarian or Transverse Riffle



(c) Block Riffle



(d) Angle Iron Riffle