Oct. 4, 1938. L. O. STIRN 2,132,195

APPARATUS FOR THE RECOVERY OF PRECIOUS METALS SUCH AS GOLD

Filed Dec. 31, 1935 2 Sheets-Sheet 1

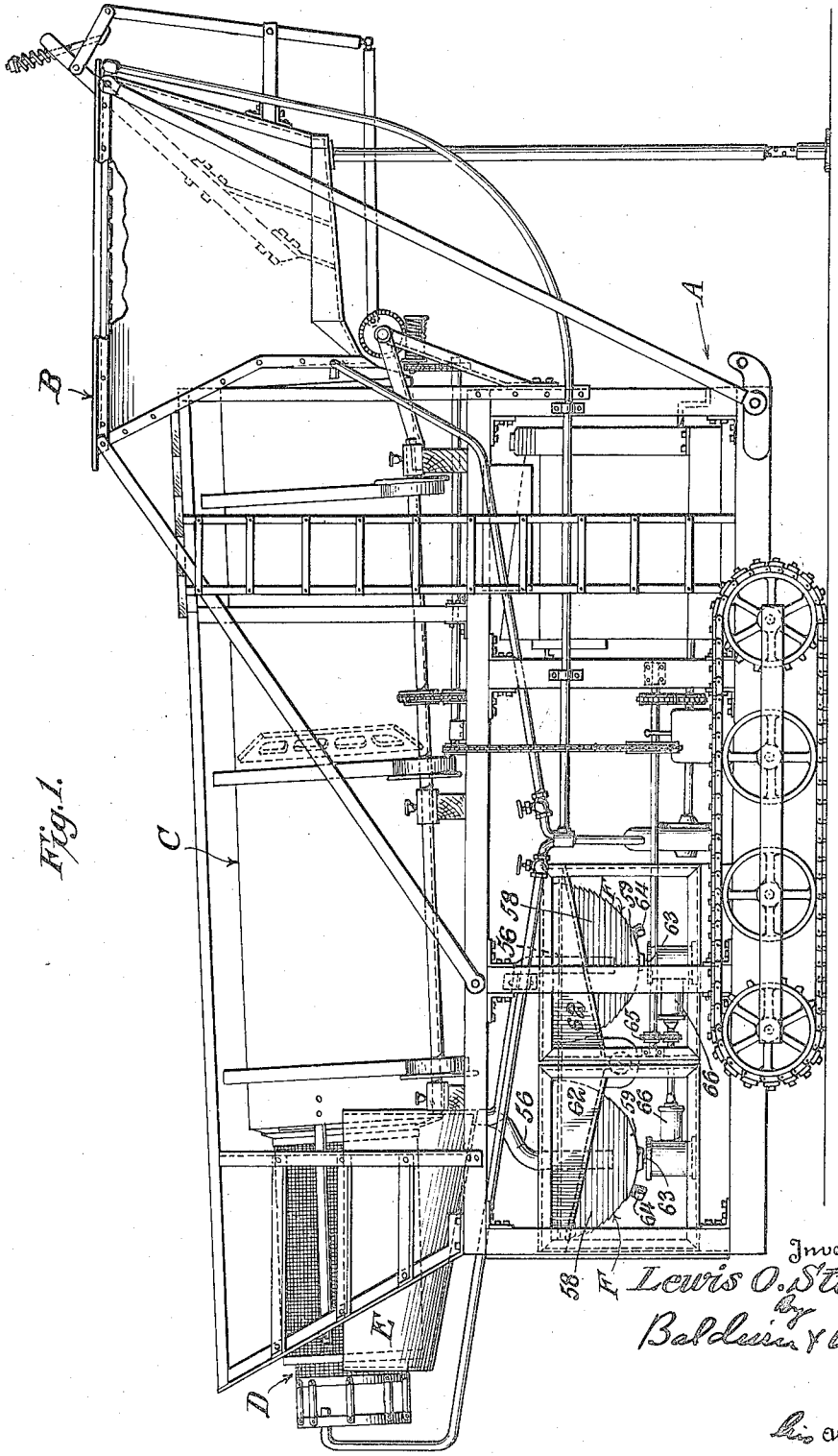


Fig. 1.

Inventor,
Lewis O. Stirn.
By
Baldwin & Wight
His Attorneys.

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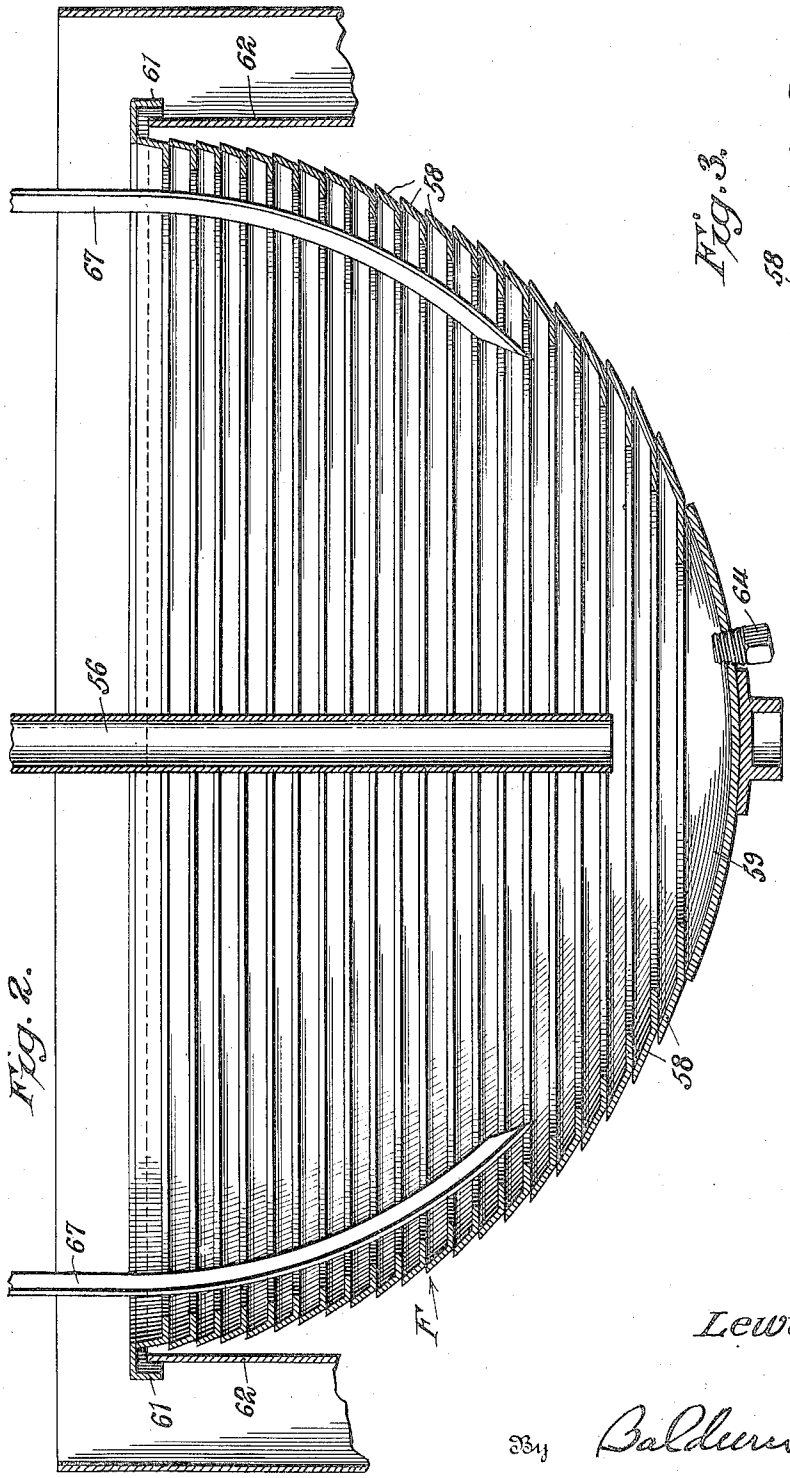


Fig. 2.

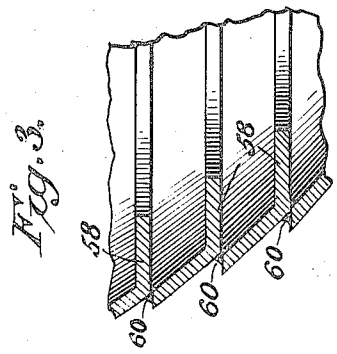


Fig. 3.

Inventor,
Lewis O. Stirn,

By Baldwin & Wright
his Attorneys

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UNITED STATES PATENT OFFICE

2,132,195

APPARATUS FOR THE RECOVERY OF PRECIOUS METALS SUCH AS GOLD

Lewis Oscar Stirn, Woodlawn, Md., assignor of one-fourth to Emil Gathmann, and one-fourth to Harry M. Ramey, both of Baltimore, Md.

Application December 31, 1935, Serial No. 57,023

1 Claim. (Cl. 233—27)

This invention relates to apparatus for the recovery of precious metals such as gold, and more particularly to apparatus for the recovery of such metals from surface or semi-surface strata of sand, gravel or the like.

Apparatus embodying the invention is particularly adapted for use in recovering finely divided gold found, in some localities, dispersed in and intimately intermixed with strata of sand, gravel or similar loose material usually lying under a layer or covering of non-gold bearing top soil at a depth of about four to six feet, the gold bearing strata being from about six to ten inches in thickness. In the recovery of gold from such strata it is necessary first to remove the non-gold bearing top soil, and then to treat the gold-bearing material so as to segregate the gold itself from the sand, gravel and the like. Since the percentage of gold in such strata is quite small it is necessary to handle and treat a large volume of the gold bearing material in order to recover a worth-while amount of gold. Furthermore, in order to obtain returns justifying the cost of treating the material, it is necessary that the gold removal be very complete.

A particular object is to provide an improved centrifugal bowl separator especially useful in apparatus of the character mentioned. Other objects will become apparent from a reading of the following description, the appended claim, and the accompanying drawings, in which:

Figure 1 is a view in side elevation of apparatus embodying the invention;

Figure 2 is a view in vertical section of the novel centrifugal bowl separator drawn on a large scale; and

Figure 3 is a fragmentary detail sectional view of said centrifugal bowl separator drawn on an enlarged scale.

A preferred embodiment of the invention as illustrated in the drawings comprises a track-laying type tractor or carriage A the details of which per se constitute no part of the invention; and apparatus supported upon the tractor for breaking up gold-bearing material and washing large rocks and lumps, for forming a suspension of the finely divided material in water, for screening the material to separate the very fine particles from the larger ones, and for then separating the fine particles of high specific gravity from those of relatively low specific gravity.

As shown in Figure 1, the apparatus in general comprises a hopper B mounted in elevated position to receive material from above and discharge it to the left as viewed in Figure 1; a rotary breaker and washer drum generally designated C arranged to receive material discharged by the hopper and to deliver the material at its left hand end to screen means generally designated D; a catch basin E for receiving finely divided material in suspension passed through the screen means D; and centrifugal bowl separators F adapted to receive the fine material in suspension and to separate the particles of high specific gravity from those of relatively low specific gravity. The drum C is arranged on an incline so as to facilitate continuous movement of material from the hopper through the drum and thence through the screen means and to the bowl separators.

Finely divided solid matter and water which pass through the screen means D into the basin E are delivered to the bowl separators F by means of pipes 56. As shown in Figures 2 and 3 each bowl comprises a plurality of annular members 58 which preferably are of rolled metal and which are arranged in superposed relation above a dished bottom plate 59, the annular members 58 increasing progressively in diameter from bottom to top of the bowl and being welded as at 60 to form a unitary bowl structure. Each of the annular members is of modified L-shape cross section, the longer leg of the L being turned outwardly so that the angle between the legs is between 90° and 180°. The assembled bowl thus includes a plurality of substantially horizontal shelves or ledges which preferably decrease in width from bottom to top of the bowl. The uppermost annular member is formed with a lip 61 which overhangs the inner edge of a launder 62. Preferably in order to fill up cracks between the several annular members 58 the whole bowl is galvanized after assembly. In operation the bowl is rotated at about 90 revolutions per minute. The material of high specific gravity, such as gold, travels along and over the shelves or ledges, better known as riffles, on the inside of the bowl and is trapped in the riffles by the centrifugal force of the bowl, while the water and solid material of relatively low specific gravity are thrown outwardly and upwardly by the centrifugal force generated by the rotation of the bowl so as to flow over the lip 61 and into the launder 62, from whence they are delivered either to a waste or to a settling tank. The shelves or ledges projecting into the bowl prevent the material from rising too rapidly which, if permitted, might result in the loss of considerable gold. The centrifugal action forces the material under the sev-

eral ledges thereby giving the heavy particles, i. e. gold, a further opportunity to become dislodged from adhering lighter material and to settle to the bottom of the bowl. I have found that the gold-bearing material usually does not rise to a level higher than about one-third the height of the bowl. Consequently, it is not necessary to retard the upward movement of the material to so great an extent near the top of the bowl as at the bottom, and for this reason the ledges may be more narrow at the top of the bowl than at the bottom. By narrowing the ledges near the top of the bowl useless retarding of the upward travel of the non-gold-bearing material is dispensed with.

I have found that if the bowl is rotated with a perfectly smooth, symmetrical movement, there is a tendency for material to become lodged under the inwardly extending ledges. To overcome this difficulty I so mount and equip the bowl as to cause it to vibrate very slightly during its rotation. The correct amount of vibration is obtained by mounting the bowl on a stub shaft 63 so that it is supported below the bowl but not above it, and by unbalancing the bowl about its axis of rotation. This may be conveniently done by locating the drain plugs 64 eccentrically of the axes of rotation as shown in Figure 6. It is important that the bowl be mounted on a shaft having support only below the bowl since if a support were provided both above and below the bowl, the unbalanced condition would not result in sufficient vibration. The amount of vibration produced by the arrangement shown has been found just sufficient to prevent material from becoming lodged underneath the ledges without being sufficiently great to harm the machinery. The bowls may be driven by any suitable means and in the form shown are adapted to be driven from the jack shaft 18 through a chain 65 and gear boxes 66.

I have found it desirable also to supplement the vibratory motion of the bowl by providing means located within the bowl for producing eddy currents and a generally agitated condition of the water adjacent to the inside of the bowl. Preferably, such means includes a plurality of angle irons 67 extending downwardly into the bowl and being curved to conform to the curvature of the latter. The angle irons should be disposed about three-fourths inch or one inch from the inside edges of the shelves or ledges and should be so located that one leg of each angle iron is substantially parallel to the adjacent surface of the bowl and the other leg substantially perpendicular thereto. With this arrangement and location of the arms they create a disturbed, agitated, and turbulent condition of the liquid suspension which prevents any small particles of gold from being carried over the edge of the bowl due to the velocity of the liquid as it rises. It is important that the angle irons be arranged as described so as to produce a turbulent condition of a compound nature as distinguished from merely deflecting the water smoothly towards or away from the bowl. Preferably, four such angle irons equally spaced should be employed although the number is not critical.

At intervals during the operation of the apparatus the bowls F are stopped, the drain plugs 64 are removed and the material remaining in the bowls is taken out and the gold removed from the other material by hand panning, amalgamation, or other process.

Considering the operation of the apparatus as an organized entirety, the tractor serves to move the other parts over the ground from which material to be treated is removed. A steam shovel or the like moves along the ground adjacent to the tractor, first skimming off the non-gold-bearing top soil, and then depositing gold bearing material into the hopper B. This material is fed to and discharged from the hopper continuously, with the exception of those intervals during which the entire apparatus is stopped to permit removal of the concentrate from the bowls F. Material discharged by the hopper passes into the breaking and scrubbing or washing drum C in which the loose material is reduced to a finely divided state and mixed with water entering under appropriate control. The rocks travel continuously over and off the screen means D while the gold bearing slurry continuously passes through the screen mesh, into the basin E, and thence to bowl separators F. The separators operate continuously during the operation of the drum and means D so that the entire operation of feeding, washing, breaking up, mixing with water, screening, and centrifugally classifying or separating is continuous. This permits material of relatively low gold content to be treated in sufficiently large volume to result in substantial gold recovery at such low cost that the treating of the material is profitable. Apparatus as shown and described herein has been used for the recovery of gold from semi-surface strata in the State of Virginia for more than a year and United States Government inspectors have reported that material worked by the apparatus has yielded 98 per cent of its total gold content.

The apparatus shown for the purposes of illustration is the at present preferred form which has been found to produce consistently good results over an extended period of actual operation. However, it will be understood that changes may be made in the specific construction and arrangement of the parts without departing from the invention as defined in the claim.

I claim:

In a centrifugal bowl separator for apparatus for classifying materials of different specific gravities, a portion of said bowl separator comprising an assembly of initially separate superposed ring members of rolled metal successively increasing in diameter in the direction of the top of the bowl and each consisting of an upwardly and outwardly extending flange and an inwardly extending lateral flange, the first mentioned flanges at their lower extremities terminating inwardly of the upper extremities of the adjacent first mentioned flanges, welds securing the first mentioned flanges together inwardly of the margin of the upper portion of the first mentioned flanges to form part of the main wall of the bowl, said lateral flanges being relatively wide compared to the thickness of the material of the rings.

LEWIS OSCAR STIRN.