P. WRIGHT & G. LAND.

MAGNETIC SEPARATOR.

APPLICATION FILED MAY 26, 1913.

1,208,880.

Patented Dec. 19, 1916.

2 SHEETS—SHEET 1.

Fig. 1.

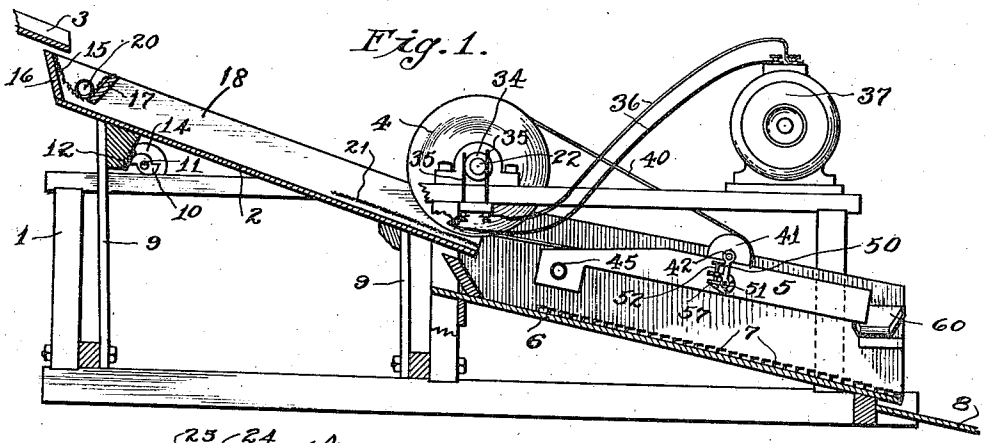


Fig. 2.

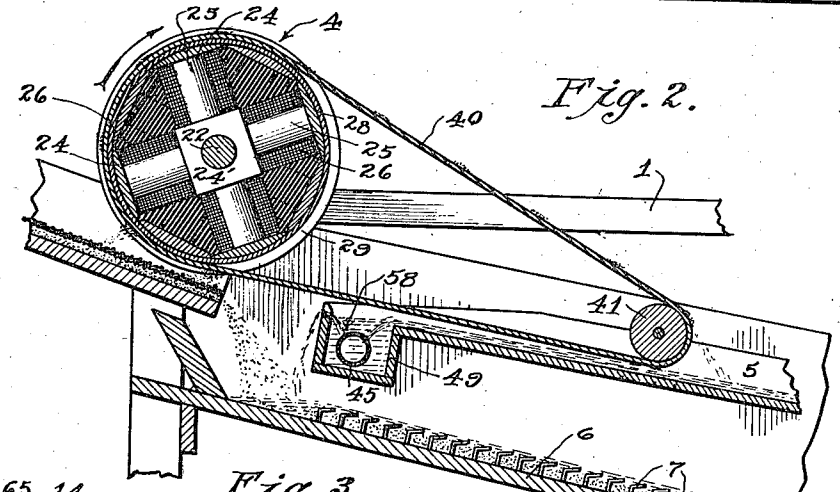
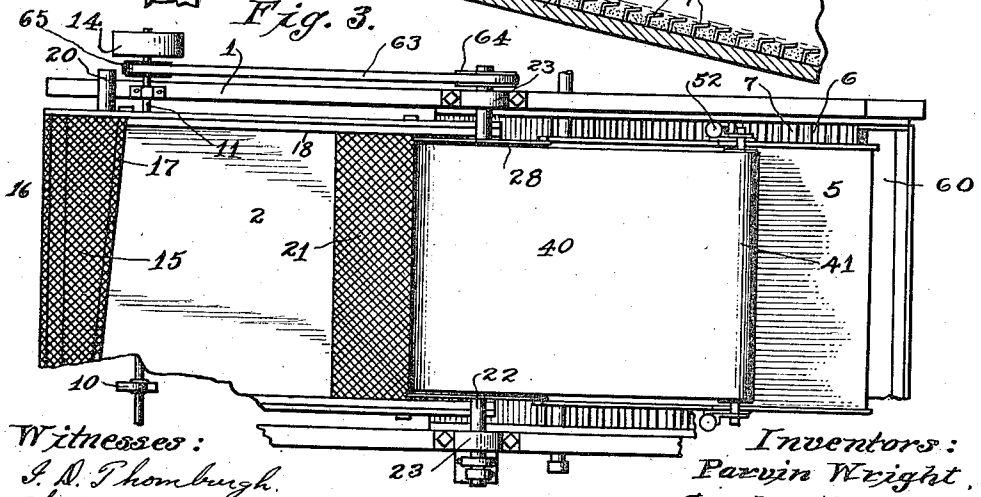


Fig. 3.



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2 SHEETS—SHEET 2.

Fig. 4.

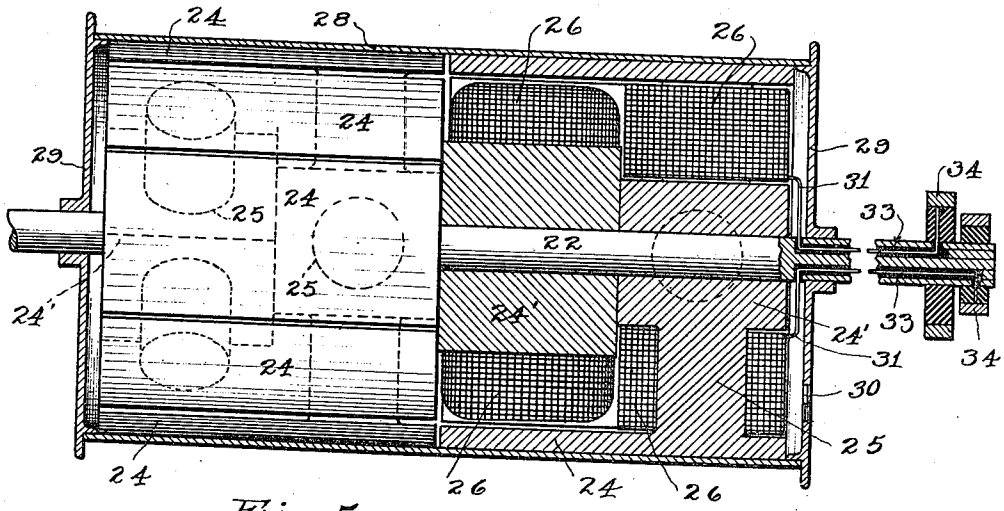


Fig. 5.

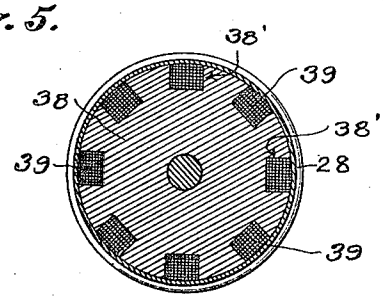
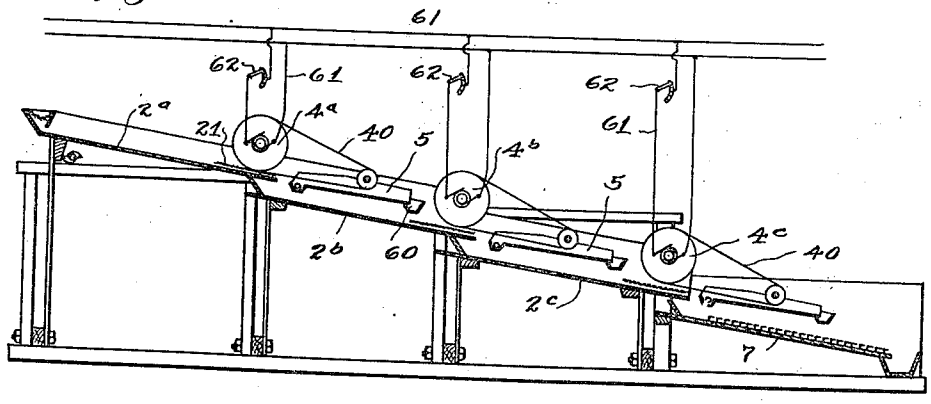


Fig. 6.



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UNITED STATES PATENT OFFICE.

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MAGNETIC SEPARATOR.

1,208,880. Specification of Letters Patent. Patented Dec. 19, 1916.

Application filed May 26, 1913. Serial No. 769,895.

To all whom it may concern:

Be it known that we, PARVIN WRIGHT and GORDON LAND, citizens of the United States, residing at Seattle, in the county of King and State of Washington, have invented a new and useful Magnetic Separator, of which the following is a specification.

This invention relates to apparatus for separating magnetic material from sand, gravel, etc., and the main object of the invention is to provide a magnetic separator which will be capable of operating with wet material.

A further object of the invention is to prevent non-magnetic material from being picked up along with the magnetic material in the separating operation.

Another object of the invention is to provide for effective removal of the magnetic material from the collecting means.

Other objects of the invention will appear hereinafter.

The accompanying drawings illustrate embodiments of our invention, and referring thereto:

Figure 1 is a longitudinal section of the apparatus, showing the magnetic collecting means in elevation. Fig. 2 is a longitudinal section, showing the magnetic collecting means in section. Fig. 3 is a plan view of the machine with portions broken away. Fig. 4 is a plan view partly in section of the magnetic devices for producing the magnetic field in the collecting means. Fig. 5 is a section showing a modified form of the magnetic drum. Fig. 6 is a longitudinal section of another form of the apparatus.

The apparatus is mounted on a frame 1 and comprises a table or plate 2 adapted to receive the material from a suitable flume or chute 3, a magnetic collecting means 4 adapted to pick up the magnetic material from said table, a discharge flume 5 for said magnetic material, and a discharge table or flume 6 for the non-magnetic material. The machine is shown as adapted for use in separating magnetic material from gold bearing sands and the discharge flume 6 is shown as a riffle table, being provided with riffles 7, this table discharging at its lower end onto suitable means indicated at 8 for performing further operations upon the material for separating gold therefrom.

The receiving table 2 is preferably formed as a shaking table, said table 2 being inclined downward from the feed end to the discharge end thereof, and being mounted on resilient plates or boards 9 fixed at their lower ends to the frame 1, and at their upper ends to the table so as to permit longitudinal reciprocation of the table. Such reciprocation of the table is effected by cams or tappets 10 on a shaft 11, said cams or tappets engaging with a bearing plate 12 in rigid connection with the table 2. The shaft 11 is driven by any suitable means, for example, by a pulley 14 thereon. At the upper end of the table a screen 15 is preferably provided, said screen being bent downwardly to form a foraminous trough which is retained in position between inclined downwardly convergent boards 16 and 17, the boards 16 forming the upper end wall for the table 2, and the boards 17 extending across between the side walls 18 of the table 2, leaving a space or opening 19 below said board 17 for passage of the screened material. The board 17 extends obliquely across the table 2 so that the trough formed by screen 15 has sufficient downward inclination toward one end to cause the sand accumulated on said screen to gradually work toward one end of the trough and an opening 20 is provided at that end through which such material is discharged. Near the lower end of the table 2 is provided a screen or foraminous plate 21 consisting, for example, of wire mesh or wire cloth of non-magnetic material, having meshes or openings of sufficient size to permit the magnetic particles to be drawn therethrough, but preventing such particles from being drawn through in bunches or cohering masses.

Above the screen 21 is mounted a cylinder, constituting the magnetic collecting device. Said cylinder may be of any suitable construction adapted to present magnetic poles of sufficient intensity. The construction which we have found suitable for this purpose is shown in the drawing and consists of a series of magnetic elements arranged on a shaft 22; journaled in bearings 23 on the

frame 1; each of said magnetic elements comprising a hub 24′, cores 25 extending radially from said hub, and pole-pieces extending from said cores longitudinally with respect to the shaft 22. The pole-pieces 24 of adjacent magnetic elements, extend in opposite directions; and the cores of said elements are in staggered relation, so that the pole-pieces of adjacent elements overlap. Said cores are provided with windings 26 connected to an energizing circuit, in such manner that the adjacent pole-pieces are magnetized oppositely. A casing is provided for the magnetic cylinder, consisting of a cylinder 28 of copper or other non-magnetic material, surrounding the series of magnetic elements, and heads 29 of non-magnetic material, brazed or otherwise secured to said cylinder 28; a hole 30 being left in one of said heads, through which suitable insulating material, such as pitch, is run into the cylinder, to completely fill the same and form, when said material is solidified, a solid, waterproof body. The wires 31 connected to the windings for the magnetic elements, are carried through a longitudinal bore 33 in the shaft 22, and are connected to collector rings 34 on said shaft. Brushes 35 contact with said collector rings, and are connected by wires 36 to an electric generator 37 driven by any suitable means. Shaft 22 for the magnetic device is driven by any suitable means, for example, by belt and pulley connection 63, 64 and 65 from shaft 11 aforesaid. Any other suitable construction of the magnetic device may be used, for example, as shown in Fig. 5. The same may consist of cylindrical armature body 38 of iron having longitudinal slots 38′ for receiving the magnetizing windings 39, which are wound on said body so as to develop magnetic poles at the surface of said body, the said body and coils being inclosed in a cylindrical casing 28. The cylinder so constructed is mounted to rotate in the machine in the manner above described.

An endless, flexible conveyer member, consisting, for example, of an endless canvas belt 40, extends around the cylinder 28, and around a roller 41 mounted in bearings 42 on a flume 5, which is pivotally supported on a pipe 45, extending transversely through the delivery or discharge flume 6, the mounting being such that the said flume 5 acts as a thrust member and the belt 40 acts as a tensible member whereby the belt is tensioned by the weight of the flume 6, the roller 41 and the belt itself. The bearings 42 are preferably adjustable to regulate the tension of the belt and the distance between the lower run of the belt 40 and the flume 5, said bearings being, for example, formed in the upper ends of levers 50, pivoted at 51, on the sides of the flume 5 and adjusted by set screws 52 screwing through said levers, and engaging stops 57 on the flume. By adjusting one or the other of these screws 52, the belt may be tightened at that side so as to cause it to run true. Pipe 45, on which the flume 5 is pivotally mounted, serves as a water supply pipe, said pipe being connected to any suitable source of water supply, under definite head, and having perforations 58 through which water is discharged into a box 49 at the upper end of the flume 5, the upper edge of said box serving as a spillway over which any surplus water will flow directly to the flume 6, the rest of the water flowing over the lower edge of said box and down along the flume 5. The flume 5 discharges at its lower end into a chute 60 for conveying the magnetic material to any desired place.

The operation is as follows: The sand or gravel which has been screened in a suitable manner so as to remove the coarse gravel and bowlders, is delivered together with water by the flume 3 to the screen 15 which allows only the sand to pass under the table 2, all the coarser materials passing through the outlet 20, the sand passing through the screen including not only the ordinary silica sand and other non-magnetic sand, but also including any black sand that may be present in the deposit which is being worked, this black sand consisting generally of magnetite, but also comprising in some cases chromite, monazite and other magnetic materials. Any finely divided gold and paltinum which may be present also passes through this screen. The shaking movement of the table 2 and the inclination of the table cause the sand and water passing thereonto to travel toward the lower end of the table and to pass beneath the cylinder 4 and between said cylinder and the table. The shaking motion of the table in conjunction with the action of the water passing along with the material also tends to stratify the material to some extent, the black sand and the gold, platinum, etc., if any be present, accumulating in a lower layer and the lighter materials tending to pass along the top of the bed of material on the table 2. The black sand therefore tends to pass beneath the screen 21, said screen 21 being spaced above the table 2 a sufficient distance to permit of substantially all of the black sand passing beneath the same. The cylinder 4 being set in rotation and the magnetic devices therein being energized by current from the generator 37, a strong magnetic field or a series of magnetic fields is produced directly above the screen 21, causing the particles of magnetic material below the screen to be drawn up through the meshes of the screen, such meshes insuring that the particles will be picked up individually and not in the form of chains or

bunches. For this reason only the magnetic particles are drawn up to the cylinder 4 and said cylinder does not pick up any non-magnetic particles entangled with such magnetic particles. The particles so picked up accumulate against the canvas belt 40, being held against said belt by the magnetic attraction due to the fields between the pole-pieces for the magnetic devices in this cylinder. In the movement of the belt, the portions of the belt carrying the magnetized particles eventually pass away from the cylinder on entering the upper straight run of the belt and are thereby removed from the magnetic fields produced by the cylinder. These particles are carried down by the belt and over the lower roller which is partly immersed in water flowing downwardly in the flume 5 from the supply pipe 45. The current of water passing down the flume from this supply pipe tends to sweep off any particles of magnetic material that may adhere to the belt and to carry the same down the flume 5, such magnetic material being discharged through the discharge flume chute 60.

The invention has especial adaptability to the separation of magnetic material from gold bearing sands so as to facilitate the subsequent treatment of the sand in the separation of gold therefrom, and in such connection we prefer to use the form of riffles shown in Figs. 1 and 2, said riffles consisting of angle bars having their upper faces extending obliquely upward and forward with reference to the riffle floor, this construction causing the water and sand as they pass over the riffle to be given an eddying motion which tends to keep the riffle spaces cleared and prevents clogging thereof.

In cases where the magnetic material comprises several different constituents, such for example, as magnetite, chromite, and monazite, we prefer to provide for separation of such different constituents from one another, and in that case the construction shown in Fig. 6 may be adopted, the same comprising a series of shaking tables 2^a, 2^b, 2^c, each provided with a screen 21, said tables being preferably connected together and mounted to reciprocate in unison, and the last table discharging onto a riffle table 7. At the lower end of each of the tables 2 is provided a magnetic collecting device 4^a, 4^b, 4^c, having a belt 40 and a washing flume 5 is provided for clearing the belt of each magnetic device. The respective magnetic collecting drums are connected to branch circuits 61 of an energizing circuit 62, said branch circuits including rheostats 63 to enable the current through the respective magnetic devices 4^a, 4^b, 4^c, to be regulated independently. By such regulation or by making the magnetic devices of different resistance, the magnetic device 4^b is made to present stronger magnetic action than the device 4^a, and the device 4^c is made to present stronger magnetic action than the device 4^b. The operation of this form of the invention is as follows: The material supplied to the first shaking table 2^a is brought under the first magnetic collecting device 4^a and is there subjected to magnetic field sufficient to pick up the more readily magnetizable constituents, for example, the magnetite which is thereby removed from the body of sand and discharged through the first discharge means 60. The remaining material passes beneath the second magnetic separating device 4^b whereby it is subjected to a stronger magnetic field, causing another constituent, for example, the chromite, to be picked up and separated, this operation being repeated, subjecting the material at each operation to a stronger field so as to separate the different constituents.

What we claim is:

1. In a magnetic separator, a material receiving table, a cylinder mounted to rotate adjacent said stable and provided with magnetic devices for producing magnetic poles at the periphery of said cylinder, means for supplying material and water to said table, means for conveying away the discharge from said table, a flume mounted over said discharge means, a roller journaled on said flume, and a belt passing around said cylinder and said roller to convey the magnetic material from said cylinder to said flume, said flume being pivotally mounted so that its weight is sustained by said belt and tensions the belt.

2. In a magnetic separator, a material receiving table, a cylinder mounted to rotate adjacent said table and provided with magnetic devices for producing magnetic poles at the periphery of said cylinder, means for supplying material and water to said table, means for conveying away the discharge from said table, a flume mounted over said discharge means, a roller journaled on said flume, a belt passing around said cylinder and said roller to convey the magnetic material from said cylinder to said flume, said flume being pivotally mounted so that its weight is sustained by said belt and tensions the belt, and means for adjusting the ends of said roller relatively to said cylinder.

3. In a magnetic separator, a material receiving table, a cylinder mounted to rotate adjacent said table and provided with magnetic devices for producing magnetic poles at the periphery of said cylinder, means for supplying material and water to said table, means for conveying away the discharge from said table, a flume mounted over said discharge means, a roller journaled on said flume, a belt passing around said cylinder and said roller to convey the magnetic material from said cylinder to said flume, said

flume being pivotally mounted so that its weight is sustained by said belt and tensions the belt, and a water supply pipe on which said flume is pivotally mounted, provided with openings for discharging water into said flume.

In testimony whereof, we have hereunto set our hands at Seattle, Wash., on this 21st day of May, 1913.

PARVIN WRIGHT.
GORDON LAND.

In presence of—
J. B. MACHANS,
JONATHAN GIFFORD.