No. 854,997. PATENTED MAY 28, 1907.

E. GATES.

APPARATUS FOR SEPARATING GOLD FROM MAGNETIC SANDS.

APPLICATION FILED MAR. 19, 1900.

3 SHEETS—SHEET 1.

Fig. 2.

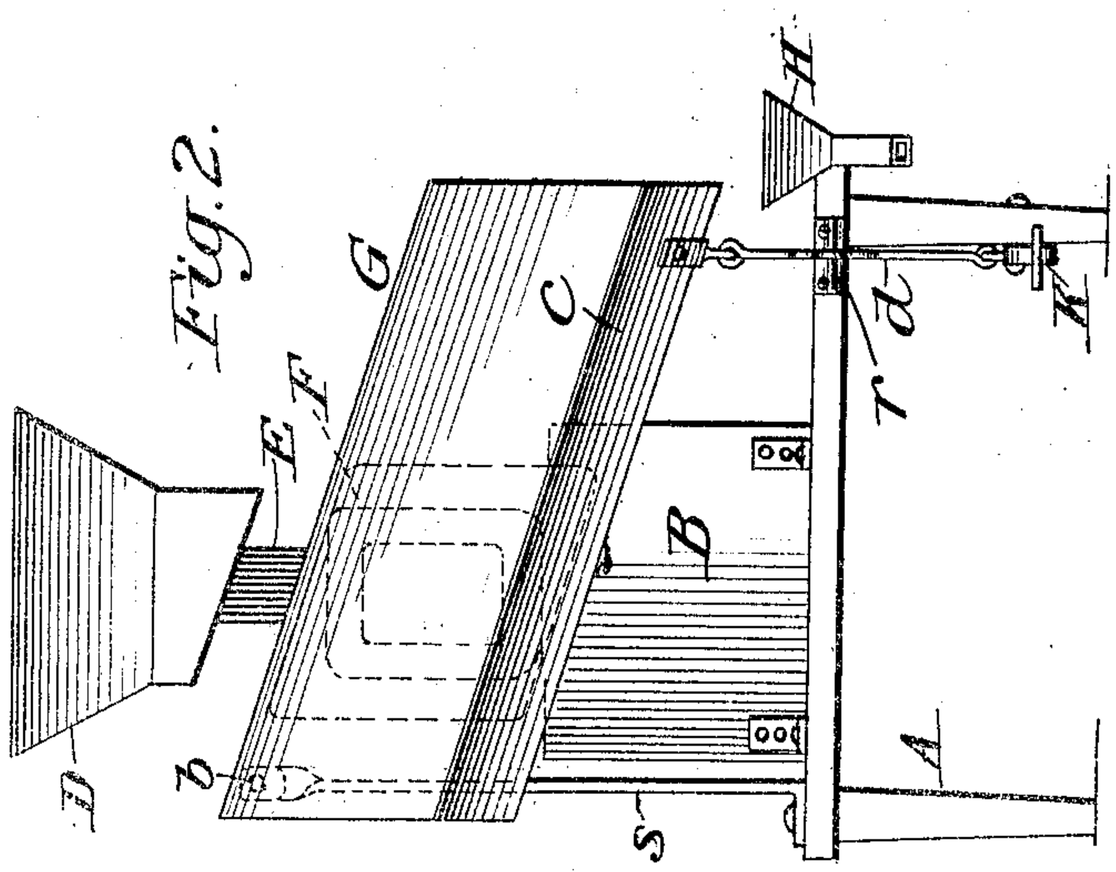


Fig. 2a.

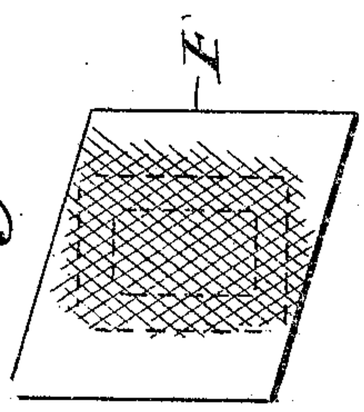


Fig. 1.

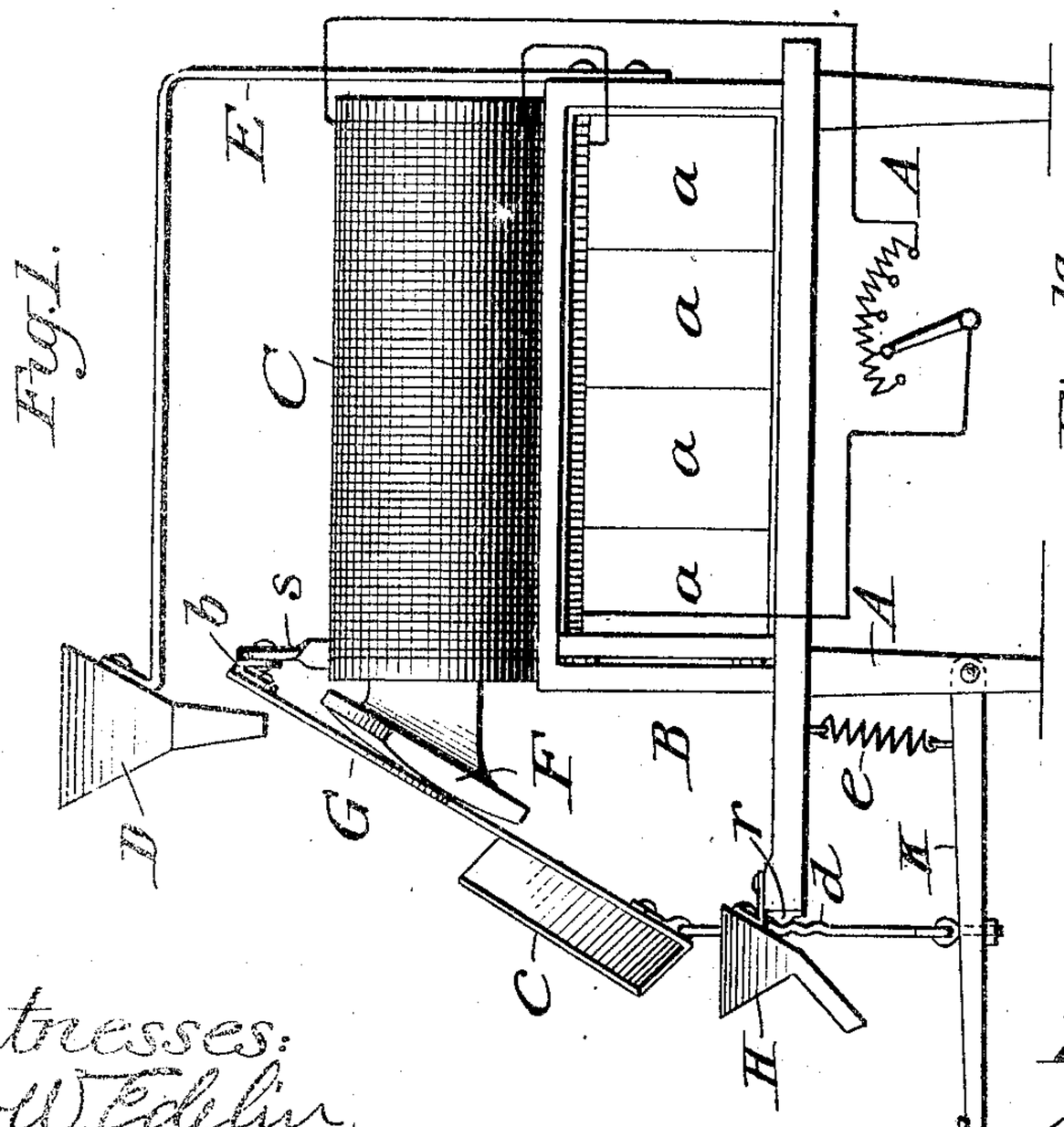
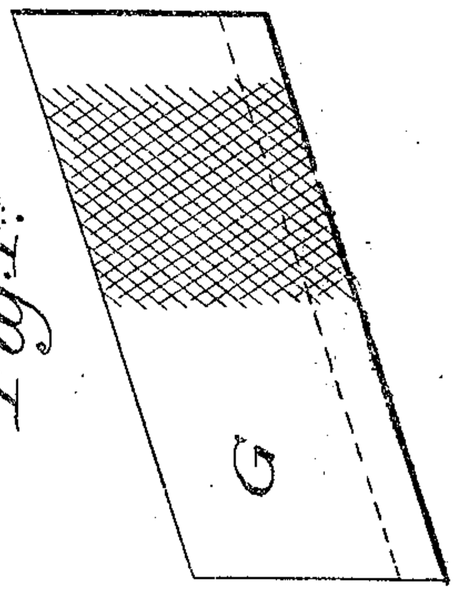


Fig. 1a.



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3 SHEETS—SHEET 2.

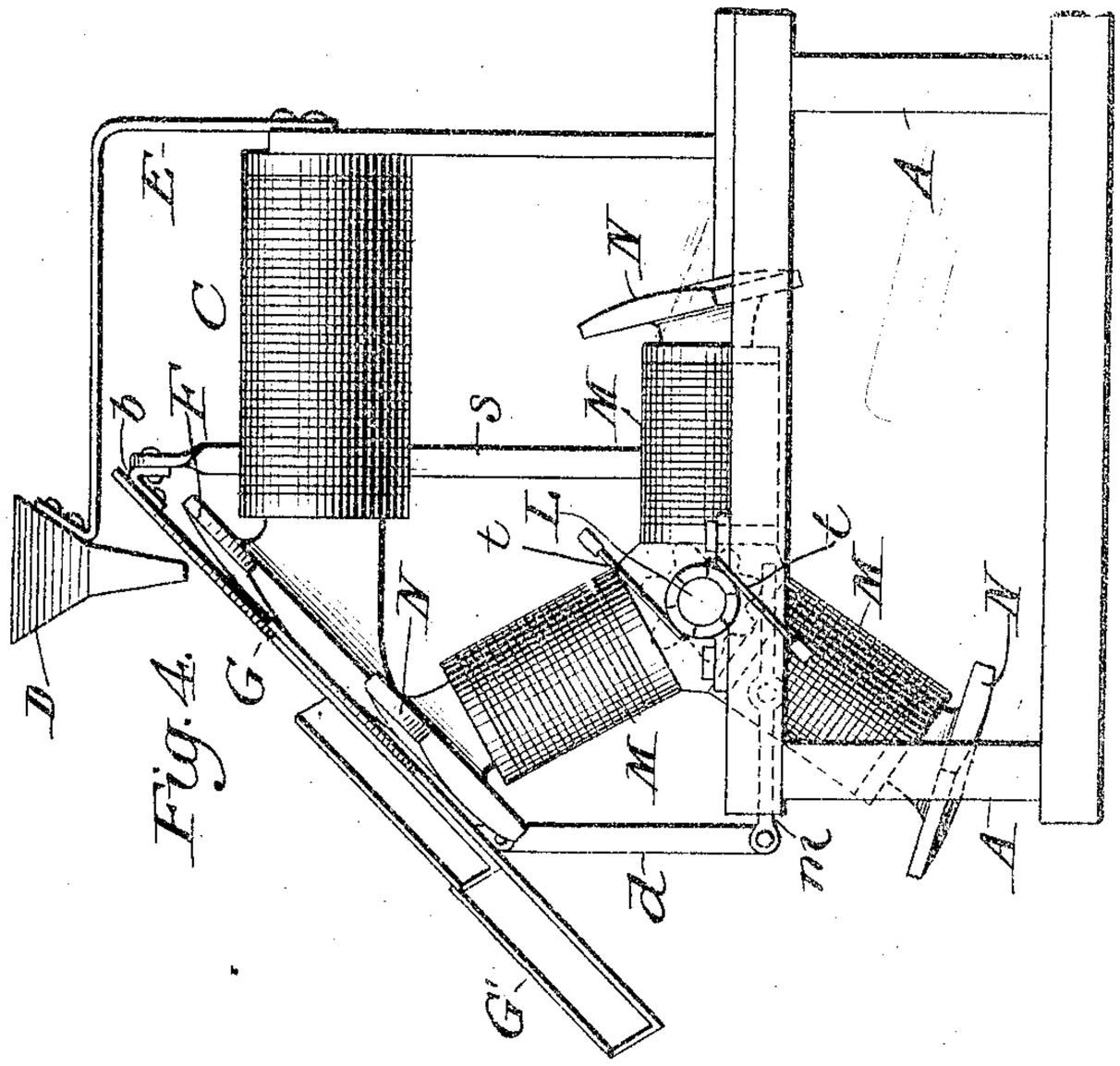

Fig. 4.

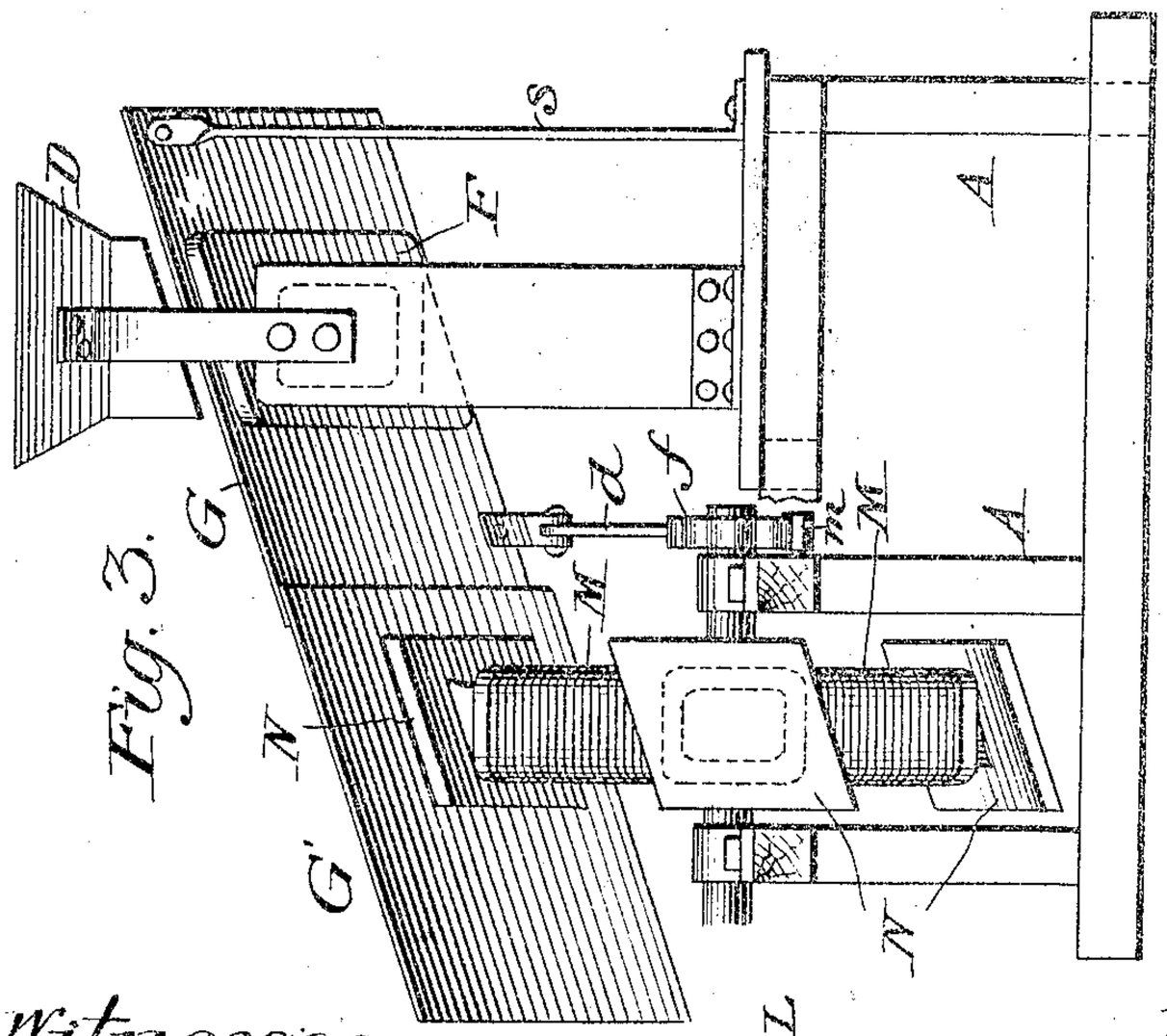

Fig. 3.

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No. 851,997. PATENTED MAY 28, 1907.

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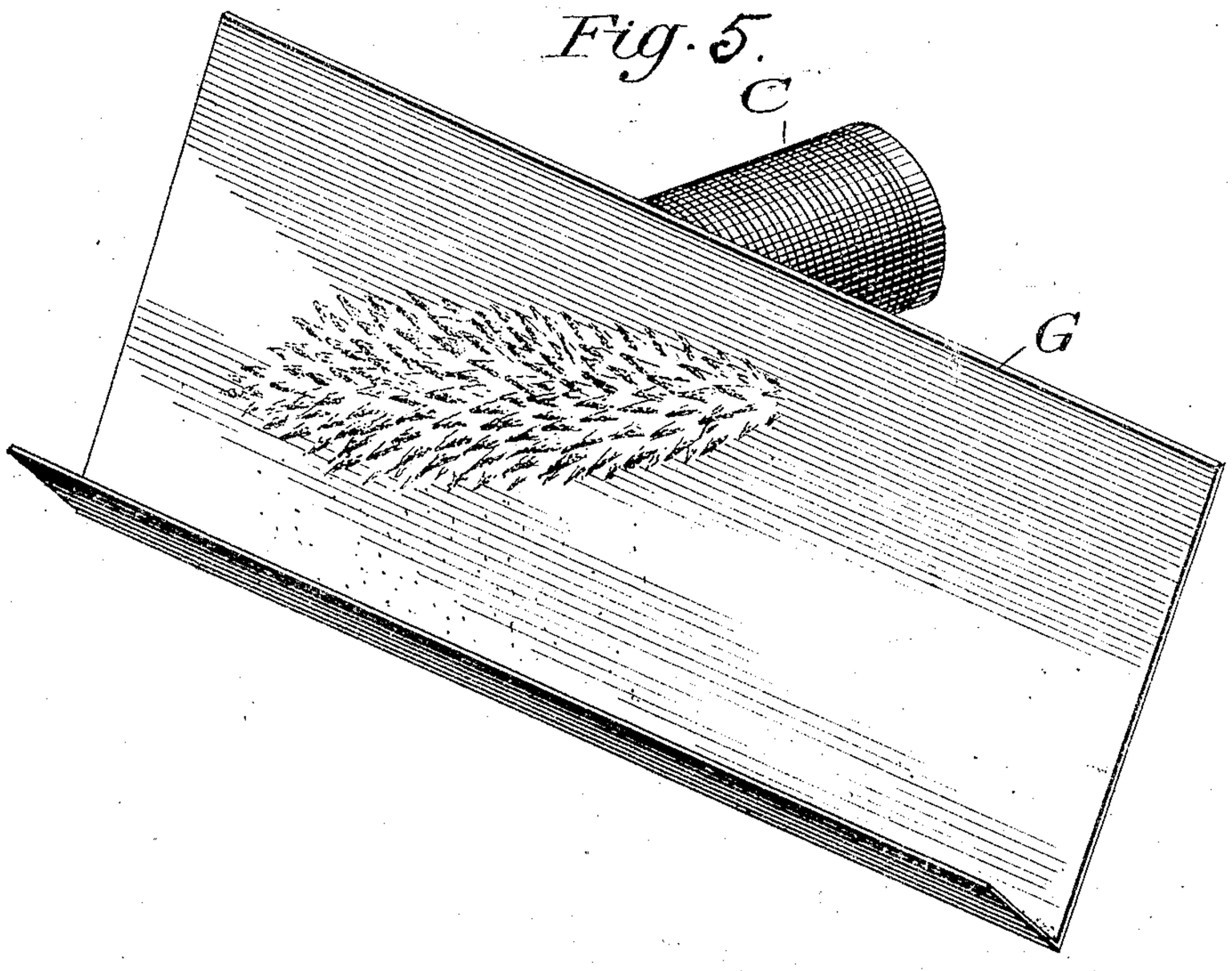
APPARATUS FOR SEPARATING GOLD FROM MAGNETIC SANDS.

APPLICATION FILED MAR. 19, 1900.

3 SHEETS—SHEET 3.

Fig. 5.



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UNITED STATES PATENT OFFICE.

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APPARATUS FOR SEPARATING GOLD FROM MAGNETIC SANDS.

No. 854,997. Specification of Letters Patent. Patented May 28, 1907.

Application filed March 19, 1900. Serial No. 9,268.

To all whom it may concern:

Be it known, that I, ELMER GATES, a citizen of the United States, residing at Chevy Chase, in the county of Montgomery, State of Maryland, have invented certain new and useful Improvements in Apparatus for Separating Gold from Magnetic Sands; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

My invention relates to the separation of gold particles from mixtures in which they appear in association with magnetic sand, as, for instance, in certain river and sea shore deposits. Prior to my invention, so far as I am aware, any attempts to recover the gold from such mixtures by magnetic separators have been attended with the difficulty that, although the magnetic sand responds readily to the separator magnets, it is so fed to these magnets and the magnets are so energized that the sand is held against the magnet, or against the intervening apron, in such a way as to enmesh the gold among the magnetic particles, and, being thus entrapped and entangled in the mass of magnetic sand, it is, in great measure, carried off with the sand: in fact, the mixture of magnetic sand and gold has generally been fed to the magnet in such a way that the gold is held between the magnet and a layer of said magnetic sand, as well as enmeshed with the magnetic sand particles. Thus, when the the mixture is fed to a belt which carries the gold to the magnets, the gold, owing to its greater specific gravity, settles down upon the belt and beneath the magnet sand, so that, when it passes over the magnet, the gold is held between the magnetic sand and the magnet. Furthermore, I attribute the failure of many former devices, in part, to improper energizing of the magnet; thus, if the lines of force be too intense the magnetic sand is held against the magnet, or the apron, as a solid amorphous mass, with the gold irremovably entrapped within that mass, and, if the magnetic force be too weak, the iron does not sufficiently adhere to be properly carried away.

The apparatus by which I obviate the difficulties above instanced, operates to energize the magnet to a degree which, for a given quality of magnetic sand, will not suffice to cause the magnetic sand to form an amorphous mass, but which will be just sufficient to cause it to be arrested by the magnet, and, under the influence of the lines of force, to arrange itself in built-up moss-like structures having the semblance of fronds of varying heights, projecting outwardly from the magnet. This arrangement of the particles causes the disintegration of the otherwise amorphous mass into a series of separate vertical structures, which, under the influence of the moving magnet, as it drags these structures after it over the apron, are constantly shifting, separating and re-forming, thereby permitting the enmeshed gold to fall out. To assist this action a minute jostling or vibratory motion may be given to the apron or magnet, or both combined, so as to shake the slightly adherent particles of gold out of the frond-like magnetic sand-structures.

In the accompanying drawings: Figure 1 represents a side elevation of a form of apparatus embodying the main underlying features of my invention; Fig. 1ª represents the roughening of the feed apron; Fig. 2 represents a front elevation of the apparatus; Fig. 2ª represents the roughening of the pole piece; Fig. 3 represents a rear elevation of the preferred form of the invention; Fig. 4 represents an end elevation thereof; Fig. 5 represents approximately the formation assumed by the magnetic sand in the practice of the invention and the manner in which the gold is liberated.

Similar letters of reference indicate similar parts throughout the several views.

Referring particularly to Figs. 1 and 2 of the drawing, A indicates suitable legs or standards upon which are mounted the operative parts of the apparatus, as, for instance, the box B, containing the secondary battery cells *a*, the electro-magnet C, and its adjuncts, and the feed hopper D supported by the arm or hanger E. The electro-magnet may, of course, be energized from any suitable source of electric energy, but, for use, by individual miners or prospectors at remote places, it will be found convenient to employ the secondary batteries for that purpose, as will be readily understood. By means of a

rheostat, operated by the right foot, or permanently adjustable by the usual means, the strength of the current may be varied to suit the case, or the coil C, Fig. 1, may be moved away from the pole piece F so as to energize it less.

The electro-magnet is provided with a core having a rounded pole piece F, (which may be roughened or corrugated, see Fig. 2ª) arranged at a double incline, and, in front of the pole piece and in close proximity thereto, is located the shelf G having a like double incline, and which may be likewise roughened, see Fig. 1ª. The purpose of roughening the face of the pole piece and the shelf is to secure an uneven distribution of the magnetic lines of force over the corresponding surfaces, thereby facilitating the shifting and shaking of the moss like or frond like structures. In the magnet face the lines of force will tend to concentrate along the high points and in the diamagnetic apron the lines of force will tend to crowd through the relatively thin places between the corrugations, and as these points are constantly shifting their positions relative to each other, the lines of force will correspondingly shift and move the magnetic material with them. The shelf is of non-magnetic material and is hinged at *b*, by a leather strap or otherwise attached to the long flexible arm *s*. At its lower end it is provided with the guard board *c*, thereby forming a lateral chute which discharges into the collecting hopper H, or the like. It is furthermore connected at its lower end, by the link *d*, to a foot treadle K, having a spring *e*, and pivoted to one end of the standards A, at the front of the machine, where the operator is stationed. It is evident that, by means of the treadle, the shelf G may be either slightly jostled, by a series of small shakes or may be caused to move downwardly, at a single stroke, through a considerable distance, so that the lower edge of the pole piece F shall move its load of magnetic sand upward to the top of the shelf, where it may be removed by a brush or otherwise. The magnetic sand may, in fact, before being brushed off, be caused to repeatedly thus move up to the top of the shelf or apron and then move down again, to near the bottom, and so on, as long as desired, thus prolonging the action and thoroughly sifting out the gold. The link *d* is preferably provided with a serrated edge, as shown, co-operating with a projecting plate *r* affixed to the main frame, so as to give an outward and inward vibratory jostling motion to the shelf while it is being moved up and down by the slow movement of the foot.

In practice, the magnetic sand, containing the gold particles, is fed through the hopper D in regulated quantity upon the shelf or apron G, the electro-magnet, of course, being first energized. The magnetic sand immediately arranges itself in the characteristic enlacement hereinbefore specified, and which is approximately indicated in Fig. 5. The operator thereupon works the treadle K, thus imparting both a vertical and transverse jigging motion to the shelf or apron G. This motion, which when rapid is intentionally slight, so that the magnetic sand may not be jarred off the apron, I find is accompanied with a continual re-arrangement of the particles of the arrested magnetic sand, and, as this re-arrangement and re-formation proceeds, the gold particles become disentangled from the mass and gradually work their way downward through it. The operator, by continuing the treadle movement can ultimately thoroughly sift out the gold from the magnetic sand, finally receiving the gold in the hopper H. The magnetic sand, deprived of its gold, remains as a waste material upon the shelf G, until it is brushed off laterally, preparatory to the treatment of a fresh charge; but before brushing it off, the apron is pulled down until the magnet has carried the sand to the top of the apron, during which time additional gold particles are free to escape, by reason of the continuous shifting and re-arrangement of the frond-like structures, due to the constant change in the application of the lines of force.

In the form of the invention shown in Figs. 3 and 4, the main elements of the prior structure are employed, as indicated by the corresponding reference letters. The link *d*, for jigging the apron G, is connected to a pivoted lever *m*, rocked by a cam *f*, upon a shaft L. Upon the same shaft are mounted a series of electro-magnets M, having rounded pole pieces N, and energized successively, as they pass one after another beneath the apron, as indicated by the contact brushes *t*. The function of these pole pieces, which move slowly, is to clean the gold from any small particles of magnetic sand, which it may have entrained with it on its escape from the arrested mass opposite the pole piece F. The magnetic sand, when it reaches the upper portion of the incline, may be brushed off laterally, either by hand or automatically. In order to provide for conveniently locating these cleaning magnets, I may, as shown, extend the apron chute G in the form of a supplementary chute, G'.

Having thus described my invention, what I claim is:

1. Apparatus for separating gold from magnetic sand, comprising a magnet producing a non-uniform field, an inclined screen or apron extending within the magnetic field and upon which the material is fed, and means for imparting a succession of rapid but slight vibrations to the screen or apron, whereby the magnetic sand is arrested upon the screen and is caused to undergo a series of re-arrangements thereby liberating the gold

particles and permitting them to fall down the incline, to be separately collected; substantially as described.

2. Apparatus for separating gold from magnetic sand, comprising a magnet, a screen or apron extending within the magnetic field, and having a double incline, the lower end of said screen forming a lateral chute, and means for imparting a succession of rapid but slight vibrations to the screen or apron; substantially as described.

3. Apparatus for separating gold from magnetic sand, comprising an electro-magnet having a core terminating in an inclined pole piece, a screen or apron located in front of said pole piece and having a double incline, the lower end of said screen forming a lateral chute, and means for imparting a succession of rapid but slight vibrations to the screen or apron; substantially as described.

4. Apparatus for separating gold from magnetic sand, comprising a magnet, a screen or apron extending within the magnetic field and upon which the material is fed, said screen having a double incline and having a lateral chute at its lower end, and a supplemental magnetic element located at a lower level and mounted to move below the screen thereat so as to attract and remove from the recovered gold any remaining particles of magnetic sand; substantially as described.

5. Apparatus for separating gold from magnetic sand, comprising a magnet, a screen or apron extending within the magnetic field and upon which the material is fed, said screen having a double incline and having a lateral chute at its lower end, and a supplemental magnetic element located at a lower level and mounted to move below the screen thereat so as to attract and remove from the recovered gold any remaining particles of magnetic sand, said magnetic element consisting of a plurality of electro-magnets upon a rotary shaft, and having widened pole pieces; substantially as described.

6. Apparatus for separating gold from magnetic sand, comprising a feed apron and a magnet pole piece relatively movable with respect to each other, both of them having roughened surfaces; substantially as described.

7. Apparatus for separating gold from magnetic sand, comprising a feed apron and a magnet having roughened surfaces, and means for imparting to the apron a rapid series of short up and down movements; substantially as described.

8. Apparatus for separating gold from magnetic sand, comprising a feed apron and a magnet, means for feeding upon the apron the gold and magnetic sand, and means for imparting an up and down movement to the one relatively to the other and separate means for simultaneously jostling the apron; substantially as described.

9. Apparatus for separating gold from magnetic sand, comprising a feed apron and a magnet said feed apron passing through the field of the magnet, a hinge upon which the feed apron has a limited capacity of up and down movement, a flexible arm upon which the hinge is mounted so as to give the apron a further range of up and down movement when desired and means for imparting movement to said apron; substantially as described.

10. Apparatus for separating gold from magnetic sand, comprising an electro-magnet having a core terminating in an inclined pole piece, a screen or apron located in front of said pole piece and having a double incline, the lower end of said screen forming a lateral chute, and means for imparting a succession of rapid but slight vibrations to the screen or apron, said means consisting of a spring treadle connected by a link to the screen or apron; substantially as described.

In testimony whereof I affix my signature, in presence of two witnesses.

ELMER GATES.

Witnesses:

JOHN C. PENNIE,

A. E. GRANT.