No. 673,172. Patented Apr. 30, 1901.

R. McKNIGHT.

MAGNETIC SEPARATOR.

(Application filed Mar. 15, 1900.)

(No Model.) 2 Sheets—Sheet 1.

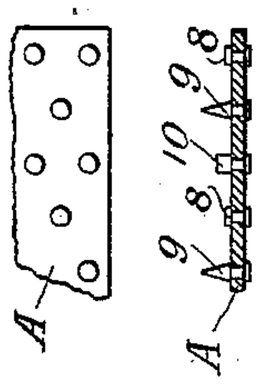

Fig. 3

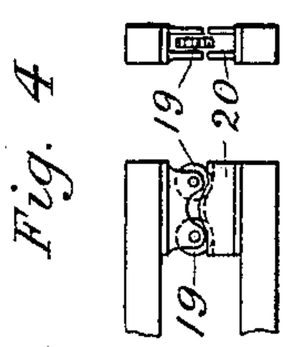

Fig. 4

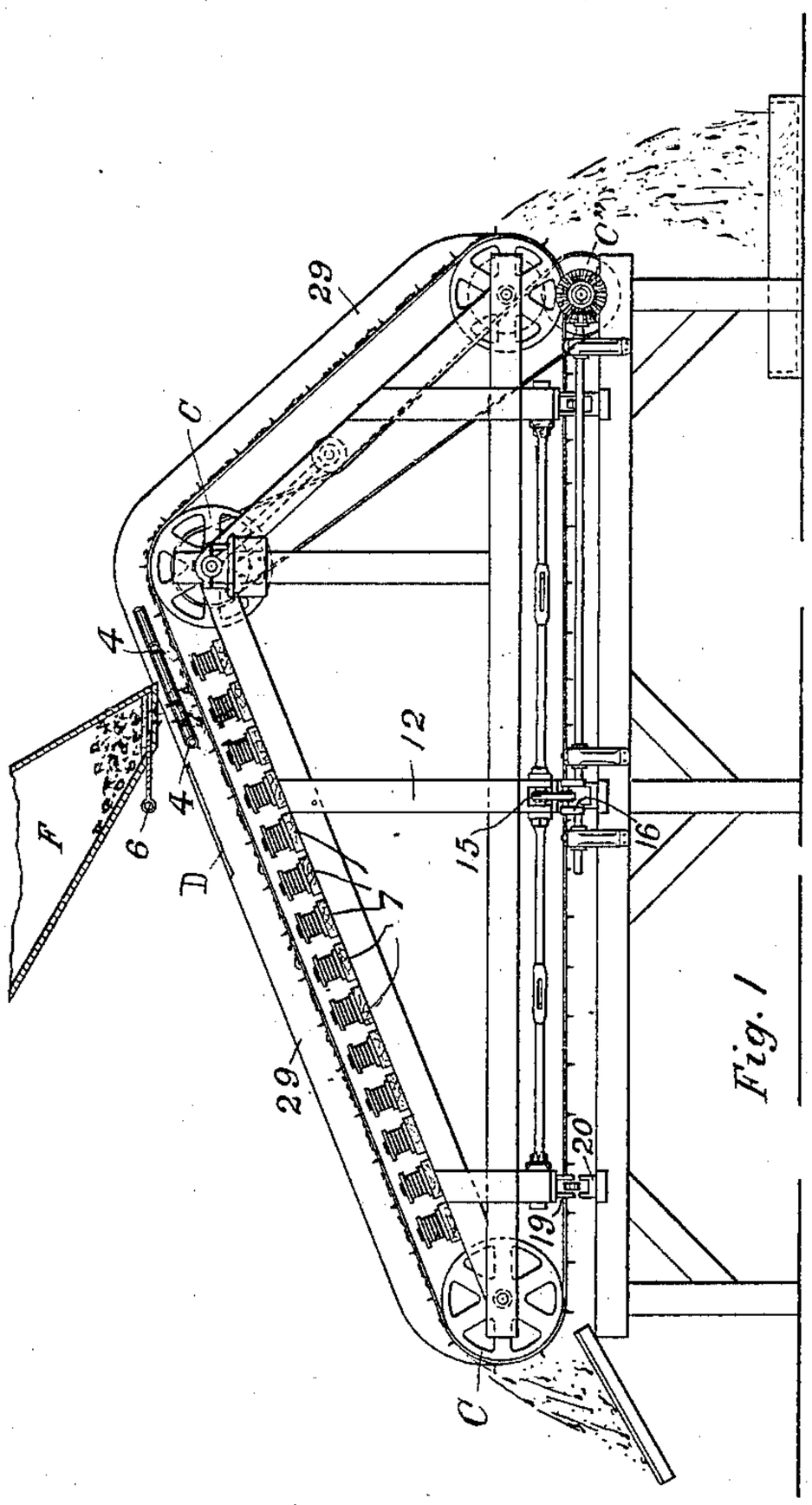

Fig. 1

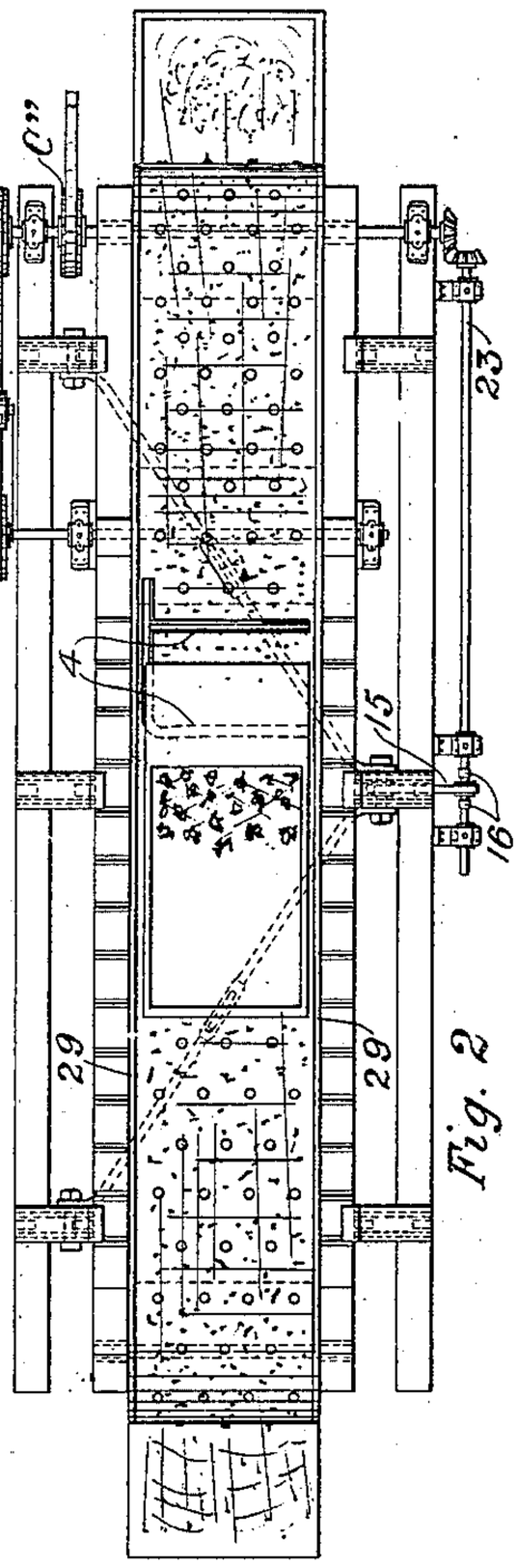

Fig. 2

WITNESSES:
C. E. Butland
Andrew Zane

INVENTOR:
Robert McKnight
BY Munn & Co
ATTORNEY.

No. 673,172. Patented Apr. 30, 1901.

R. McKNIGHT.

MAGNETIC SEPARATOR.

(Application filed Mar. 15, 1900.)

(No Model.) 2 Sheets—Sheet 2.

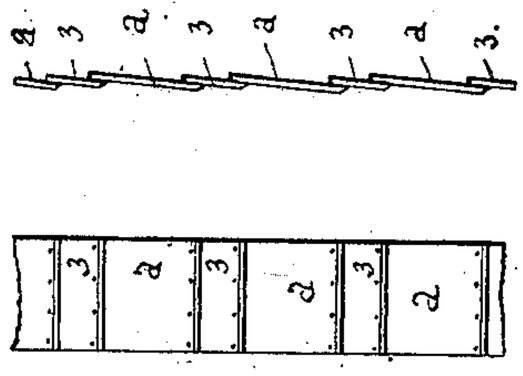

Fig. 4

Fig. 5

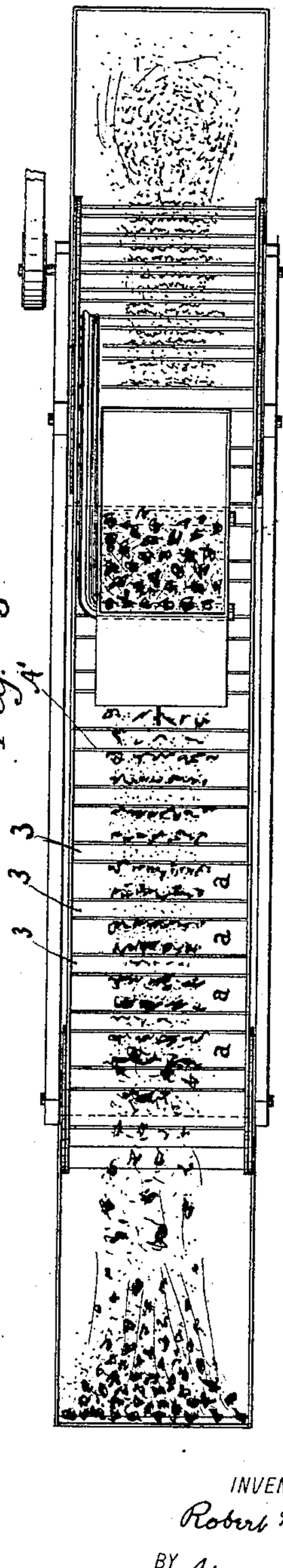

Fig. 6

WITNESSES:

Fred. R. Ryan

Andrew Jase

INVENTOR

Robert McKnight.

BY Mark Wilkes Colley.

ATTORNEY

UNITED STATES PATENT OFFICE.

ROBERT McKNIGHT, OF NEW YORK, N. Y.

MAGNETIC SEPARATOR.

SPECIFICATION forming part of Letters Patent No. 673,172, dated April 30, 1901.

Application filed March 15, 1900. Serial No. 8,711. (No model.)

To all whom it may concern:

Be it known that I, ROBERT McKNIGHT, a citizen of the United States, and a resident of the city, county, and State of New York, have invented a new and useful Improvement in Magnetic Separators, of which the following is a clear and sufficient specification, reference being had to the drawings annexed.

In magnetic separators where the material containing the magnetic particles which were to be removed by the separator from the rest of the ore flowed downward over an inclined upwardly-moving apron the apron has hitherto been made of a non-magnetic material moving in front of fixed magnets. The magnetic particles, therefore, were only made to cling to the apron and to be carried up by it because the friction between them and the surface of the belt or apron was greater than the friction between the other particles and this surface. In my device, on the contrary, the apron is either made of a magnetic material or is provided with magnetic portions or portions that may be magnetized, so that when the magnetic particles come into direct contact with these portions of the belt they will remain in direct contact with them, being held in position by direct magnetic attraction between them and the above-mentioned magnetic particles of the ore. As the mass of deposited ore rolls down the belt or apron practically every portion of the mass will come into contact with the magnetized surface of the apron or with the magnetized pieces attached thereto, according to the construction of the apron, and consequently the magnetic particles be completely removed from the ore. This is the fact whether the ore is fed dry onto the apron or mixed with water or with other liquid.

Describing now the best way of which I am aware of constructing my invented device, Figure 1 is a side elevation of my invented device, and Fig. 2 is a plan view of the same. Figs. 3 and 8 are a detail of the apron. Fig. 4 is a detail of the shaking device. Figs. 5 and 9 are a side elevation of a modification of which Fig. 6 is a plan view and Figs. 7 and 10 a detail of the apron.

The apron A has the portion upon which the material to be separated is placed inclined and traveling upward and forms the bottom of a chute down which the material deposited near the upper end thereof will flow. The material therefore deposited upon the apron has the tendency to move downward on it, except such particles as are magnetic and are attracted to and held by the same. These latter will travel with the apron. The apron consists, essentially, of a belt, which may be of any convenient material that is studded with the magnetizable pieces 8 9 10, which can project upward from the surface of the belt, as 9 and 10, or lie flush with the same, as 8. All of these forms can be placed upon the same apron, and there is, as will be hereinafter described, an advantage in using both those that project and those that do not. These pieces are made in practice of soft iron and are magnetized by the magnets 7 7 7 7, placed behind the upwardly-traveling portion of the apron A. I carry the apron over the pulleys C″ C C, that are arranged very conveniently, as shown in the drawings, Fig. 1. As the magnetism of a magnet is strongest near its poles the advantage of distributing upon the apron magnetizable pieces that will project above the surface of the apron, and thus catch the magnetizable particles in the upper part of the mass moving down the apron, is readily seen. The magnets 7 7 7 7 are placed beneath the apron and sufficiently close thereto to induce magnetism in the pieces 8, 9, and 10.

Other means for giving a complete removal of the magnetic particles of the ore are the devices for shaking the chute. They can be made to shake it transversely in the direction of its length or at any angle desired, and many devices can be used for this purpose. The one I use in practice is as follows: It is shown in Figs. 1, 2, and 4. Letting the lower back pulley C″ be the driving-pulley for the apron, the framework 12, on which the other two pulleys are mounted, is moved sidewise by the link 15, which is driven by the crank 16. The wheels 19, traveling on the cam 20, give the apron at the same time an upward and downward motion. The hopper F can also be shaken by a link which can be operated from the same shaft 23 as operates the crank 16. This hopper F is placed above the upwardly-traveling portion of the belt or apron A, and the distri-

bution of the ore from it is regulated by the gate 6.

To prevent the apron from carrying upward the lighter particles which might be taken along with the magnetic particles, jets of air or water can be projected against the material on the apron, preferably in a direction opposite to that of the apron's travel, from pipes 4 4. The number of these pipes and their position are varied according to the material that is to be separated and according to whether air or water is projected from them.

To prevent the ore from falling off the sides of the apron A, I place at the sides of the apron the shields 29 29, which in practice are pieces of non-magnetic material standing at the side of the apron.

A cover D is provided for the apron A to prevent the lighter particles, especially when a blast of air is used, from being blown away, because a good deal of flour-gold is often contained among these finer particles. This cover consists in practice of a bent sheet of material.

After the apron has passed the highest point of its travel it is no longer necessary for it to retain the magnetic particles, which so soon as the magnetism ceases will fall off from the pieces 8, 9, and 10 into a convenient bin, as E.

The operation of the device is as follows: The ore is carried down the apron aided by the shaking above mentioned, and in the downward passage practically every portion of the magnetic particles will be brought into contact with the magnetic portions of the surface of the apron. These magnetic portions will then be carried with the apron over the highest portion of the apron's travel and when the magnetism is withdrawn from the latter will fall or be suitably dislodged therefrom.

In Fig. 5 is shown a side elevation, in Fig. 6 a plan, and in Fig. 7 a detail, of the apron of a modification of my invented device. The apron A′ is made of a magnetizable material, to which the magnetic material in the ore will be attracted. I make it in practice of a series of sheets of soft iron *a a*, connected together by diamagnetic or non-magnetic material forming connections 3 3 3. I carry the apron A over the wheels C″ C C, which are of sufficient diameter not to permanently flex the sheets *a a a* and are very conveniently arranged, as shown in the drawings. To remove the magnetic particles positively from the apron, a brush 13 and a scraper 14 can be used.

Of course several of the parts mentioned can be dispensed with, with the omission of their functions. For instance, where the ore is fed wet to the device no cover will be needed, and in some cases the jet-pipes and in others the shakers can be omitted.

Having now described my invention and the best way of which I am at present aware of embodying the same, what I claim, and desire to secure by Letters Patent, is—

1. In a magnetic separator, the combination of an upwardly-traveling belt presenting an extended inclined surface provided with a series of projections of magnetizable material, ore and water feeds for the material near the top of the inclined portion of the belt, and means for magnetizing the projections, said belt being adapted to subject the material to a prolonged washing operation, and the projections being adapted to create eddies in the downflowing current, and attract the magnetic portions of the ore, and carry the same over the upper end of the incline, substantially as described.

2. In a magnetic separator, the combination of an upwardly-moving belt presenting an extended inclined surface provided with a series of magnetizable parts inserted therein means for magnetizing said parts said belt being adapted to subject the material to a prolonged rolling contact with said belt and the magnetizable parts therein inserted, and to cause agitations in the flow of the ore, and the belt being so inclined that the ore will flow down the same by gravity, and an ore-feed for the ore to be treated near the top of said incline, substantially as described.

3. In a magnetic separator, the combination of an upwardly-moving belt, presenting an extended inclined surface, said surface being provided with a series of pins of magnetizable material, ore and water feeds near the top of the incline, and means for magnetizing the pins, said belt being adapted to subject the material to a prolonged washing operation, and the pins being adapted to create eddies in the downflowing of the current and to attract the magnetic portions of the ore and carry the same over the upper end of the incline, substantially as described.

4. In a magnetic separator, the combination of an upwardly-traveling belt, presenting an extended inclined surface provided with a series of pins inserted therein, means for magnetizing said pins and an ore-feed for the ore, near the top of the incline, said belt having an incline such as will cause the material to travel down the same by gravity and the pins being adapted to cause an agitation in the downflowing ore, and to attract the magnetic portions of the ore, and carry the same over the upper end of the incline, substantially as described.

5. In a magnetic separator the combination of an upwardly-moving belt, presenting an extended inclined surface provided with a series of pins set in a staggered relation to each other, ore and water feeds for the material near the top of the incline, and means for magnetizing the pins, said belt being adapted to subject the material to a prolonged washing operation, and the projections being adapted to create eddies in the downflowing current, and to attract the magnetic portions of the ore, and convey the same over the up-

per end of the incline; substantially as described.

6. In a magnetic separator, the combination of an upwardly-moving belt, presenting an extended inclined surface provided with a series of pins inserted therein in a staggered relation to each other, an ore-feed near the top of the incline and means for magnetizing the pins, said belt having such an incline as will cause the material to travel down the same by gravity, and the pins being adapted to cause an agitation of the downflowing ore, and to attract the magnetic portions of the ore and carry the same over the top of the incline substantially as described.

Having now described my invention and claimed the same, I hereunto set my hand this 27th day of January, 1900.

ROBERT McKNIGHT.

Witnesses:

GEO. W. REED,

M. W. COLLET.