(No Model.) 3 Sheets—Sheet 1.

H. S. CHASE.

MAGNETIC SEPARATOR.

No. 488,064. Patented Dec. 13, 1892.

Fig. 1.

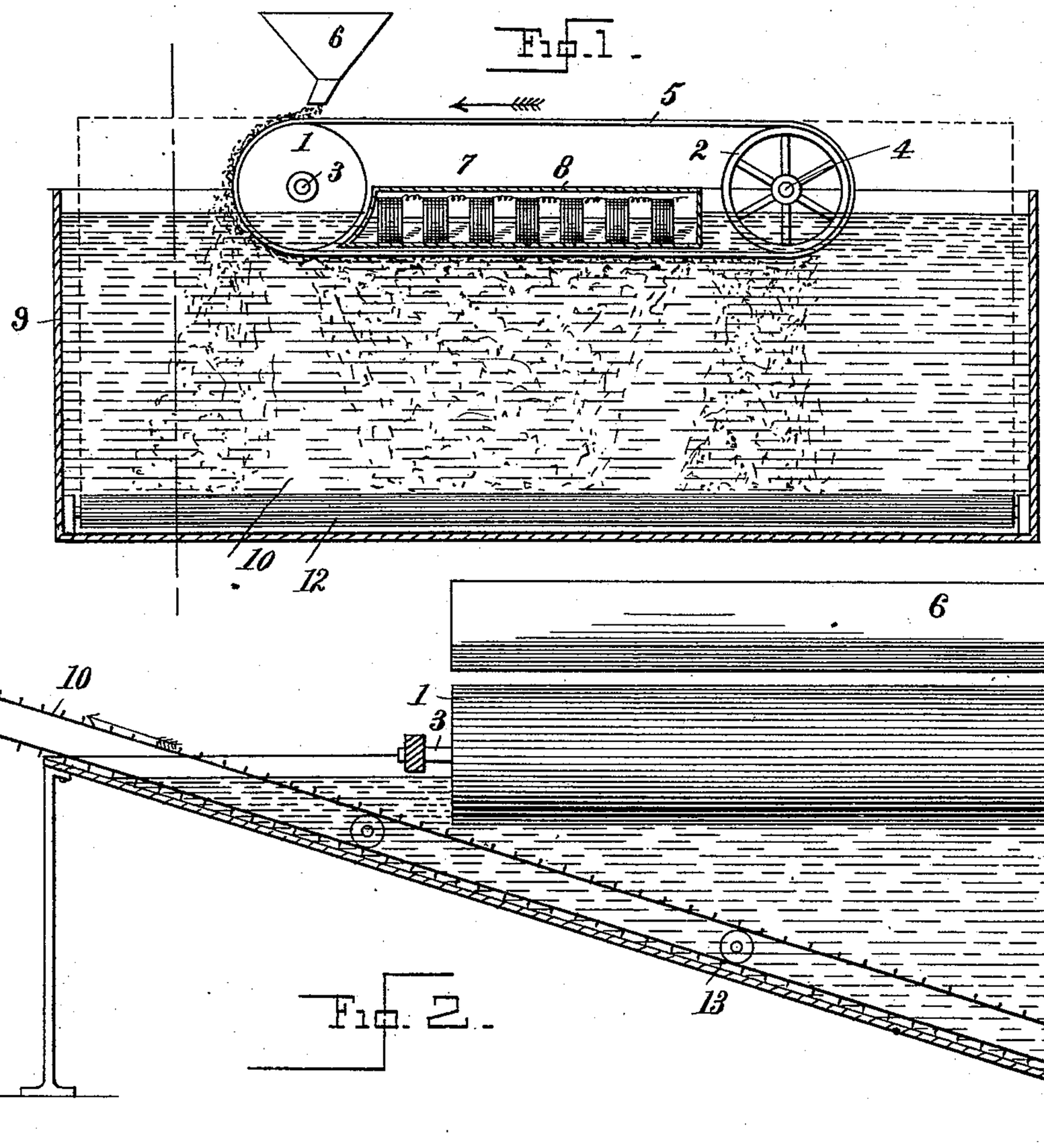

Fig. 2.

Witnesses
W. A. Courtland
Richard & Mitchell

Inventor
Harvey S. Chase
by E. P. Smith
Atty

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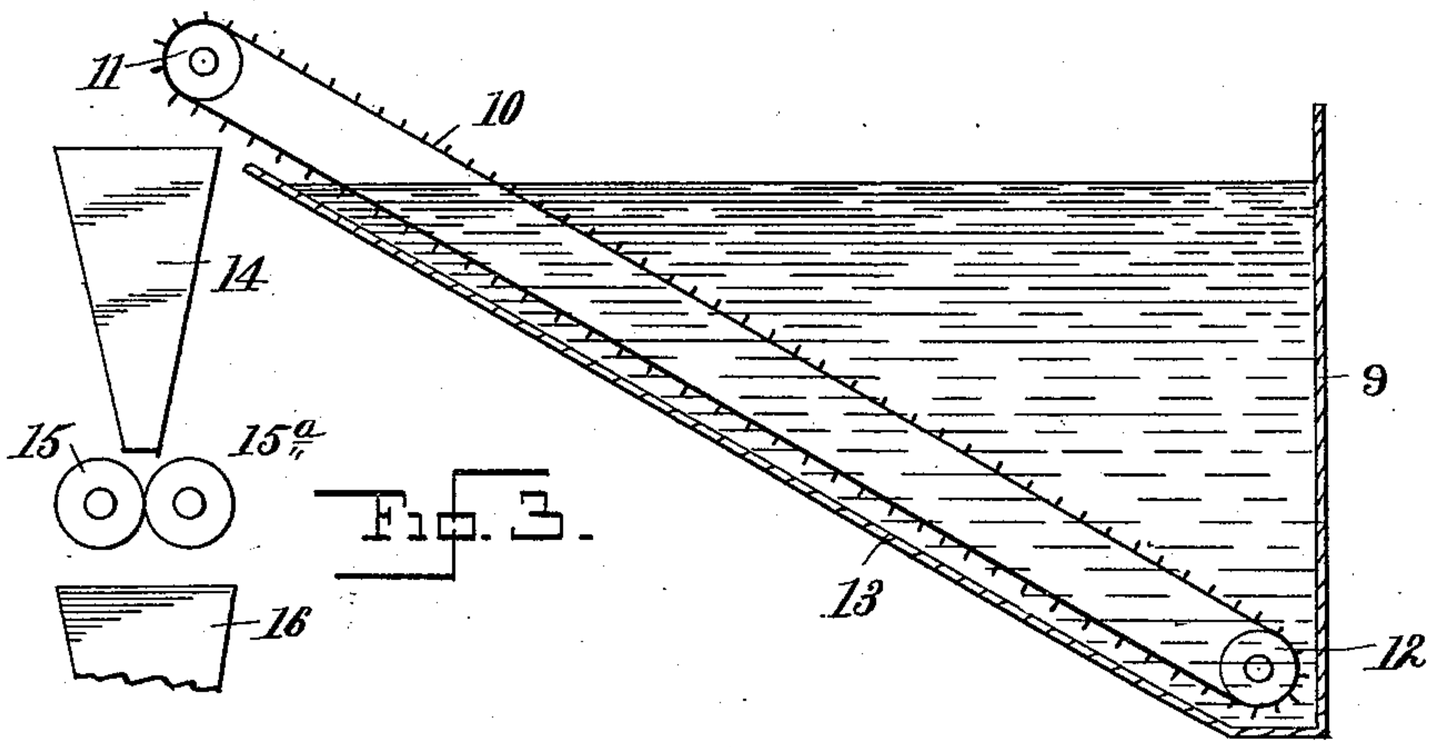

FIG. 3.

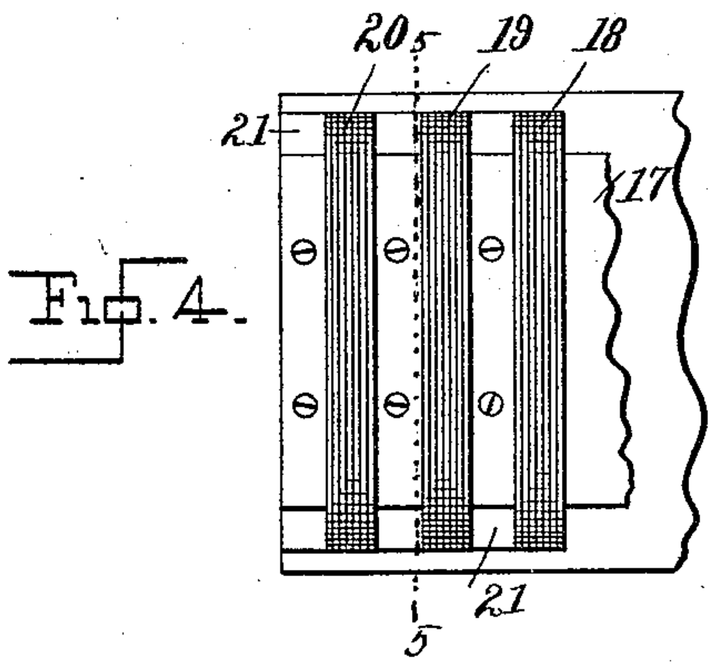

FIG. 4.

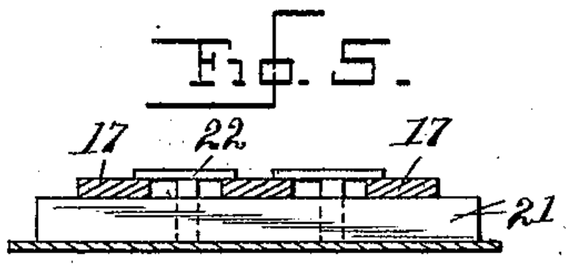

FIG. 5.

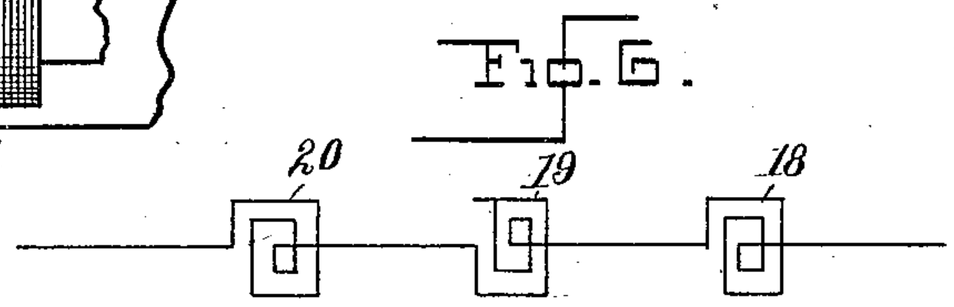

FIG. 6.

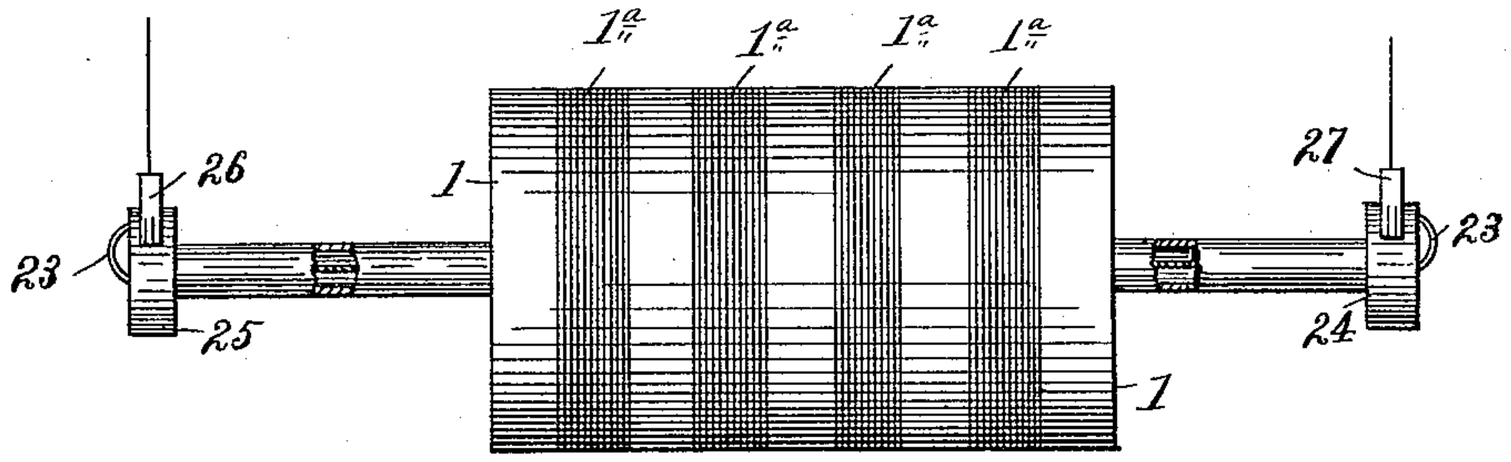

FIG. 7.

Witnesses
W. F. Courtland
Richard L. Mitchell.

Inventor
Harvey S. Chase
by A. P. Smith
Atty.

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H. S. CHASE.

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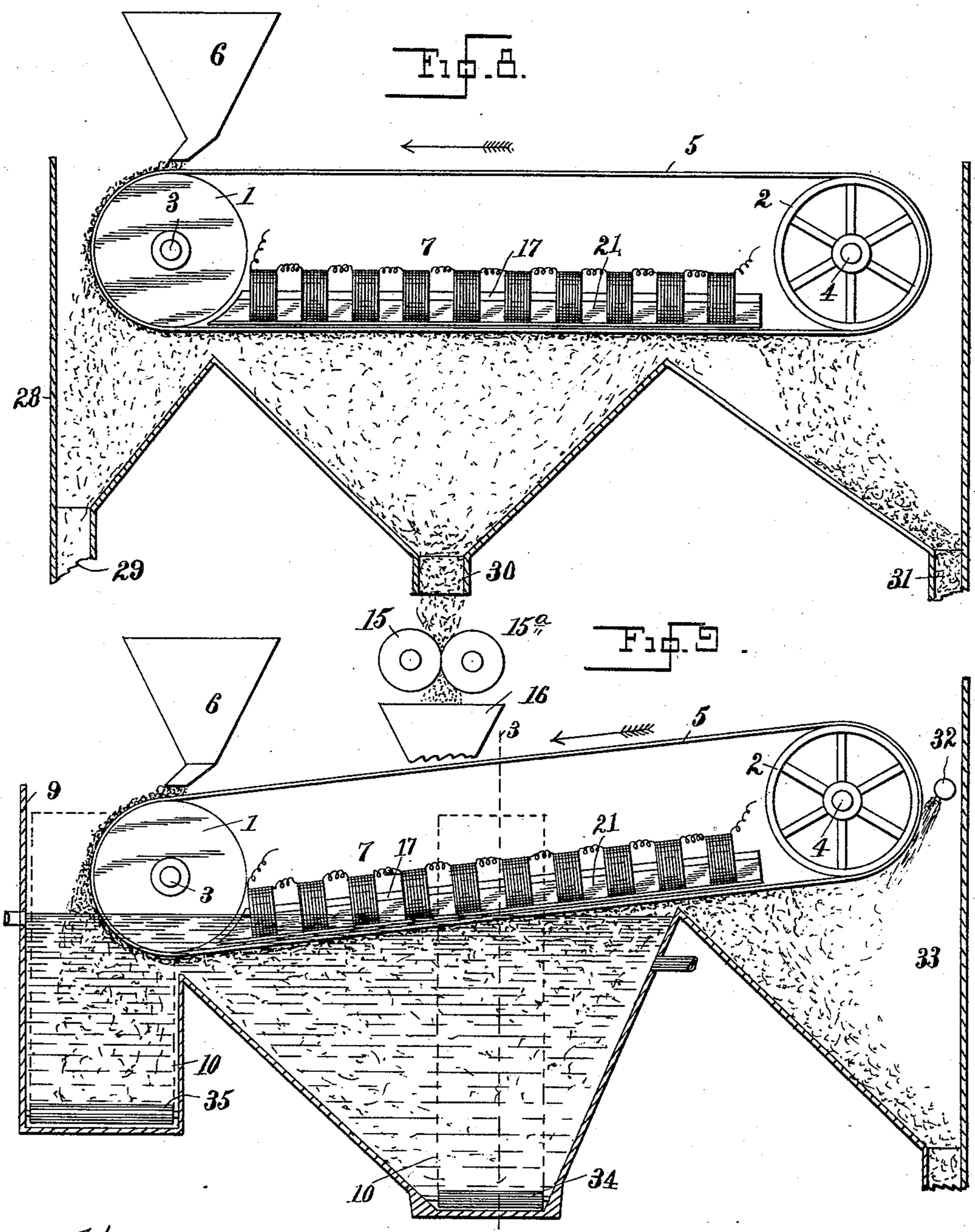

Witnesses
W. F. Courtland
Richard S. Mitchell.

Inventor
Harvey S. Chase
by A. P. Smith
Atty.

UNITED STATES PATENT OFFICE.

HARVEY S. CHASE, OF BOSTON, MASSACHUSETTS, ASSIGNOR, BY MESNE ASSIGNMENTS, TO THE INTERNATIONAL ORE SEPARATING COMPANY, OF NEW JERSEY.

MAGNETIC SEPARATOR.

SPECIFICATION forming part of Letters Patent No. 488,064, dated December 13, 1892.

Application filed January 29, 1892. Serial No. 419,668. (No model.)

To all whom it may concern:

Be it known that I, HARVEY S. CHASE, a citizen of the United States, residing at Boston, in the county of Suffolk and State of Massachusetts, have invented certain new and useful Improvements in Magnetic Ore-Separators; 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 that class of separating-machines in which an endless belt is caused to pass around and under a series of magnets, so that the magnetic particles of ore fed to said belt are held against it by the magnets in opposition to the attraction of gravitation and carried to a point beyond that at which the non-magnetic particles drop off. There has been heretofore two types of this class of machine, one in which the belt passes around a magnetic cylinder, where the separation must take place on a small arc of the circumference of said cylinder, and a second in which an inclined belt running around simple pulleys has its under side passing under a battery of magnets. Both these types have their disadvantages. In the former it is difficult to get more than a ninety-degree arc of the magnetic cylinder to become operative, and in the second type the ore comes down a chute below the magnets and at a speed that renders the escape of some of the magnetic particles possible by shooting past. Moreover, the last type of machine cannot be used in wet-process separation. By combining these two types of apparatus in one machine I have a separator in which the ore can be subjected to magnetic action for a long time, in which there is no possibility of any particle avoiding the magnetic field, and which may be used in either the wet or dry process.

In the three sheets of drawings submitted, Figure 1 is a side view and partial section of the preferred form of my invention. Fig. 2 is a cross-section of same. Figs. 3 and 9 are cross-sections of a modification, Fig. 3 being a section on line 3 3 of Fig. 9. Figs. 4 and 5 are details of the flat system of magnets, Fig. 4 being a plan view of a portion of said flat magnet and the lower part of the belt, and Fig. 5 a cross-section of the magnet-core and belt on line 5 5 of Fig. 4, showing a pole-piece in elevation, the coils being removed. Fig. 6 is a diagram showing the winding of said flat magnets. Fig. 7 is a detail of the cylindrical magnet. Fig. 8 is a sectional view of a modification of my machine adapted for use in the dry process.

Throughout the drawings the same reference-figure refers to the same part.

1 is a magnetic cylinder, having its field of force about its cylindrical surface. It may be made in any convenient manner, but preferably in the form illustrated in Fig. 7, with circumferential coils 1^a 1^a.

2 is a pulley, and the endless belt 5 runs around this pulley and around the magnetic cylinder. The shafts 3 and 4, on which the cylinder and pulley respectively are mounted, are arranged in or nearly in the horizontal plane. In some cases it might be advisable to give the shafts or axes an inclination to the horizontal plane; but usually they would be arranged as shown. In the modification shown in Fig. 9 the pulley 2 would be higher than the magnetic cylinder and outside of the water-tight tank, as the concentrates are delivered outside the tank by this form of machine.

6 is the feed-hopper, situated over the belt, so that the stuff is fed down upon the belt.

7 is a flat series of magnets so placed that their continuous magnetic field extends along the under side of the endless belt 5, and 8 is a water-tight case in which said magnets are contained.

9 is a water-tight tank in which the under side of belt 5 is immersed. In the bottom of the tank 9 are one or more carrier-belts 10, running ever pulleys 11 and 12. The tank 9 has an inclined bottom 13 to facilitate the action of the carrier-belt in removing the concentrates, middlings, and tailings from the tank. A hopper 14 may be arranged to collect the middlings and feed them to a set of rolls 15 15^a, which will deliver them to a receptacle 16, from which they may be returned

to the feed-hopper 6. The flat series of magnets 7 are preferably formed on a flat core 17, on which coils 18, 19, and 20 are slid, said coils being wound alternately in opposite directions, as shown in Fig. 6. Between the coils and crosswise of the core are arranged the pole-pieces 21, which may be held to the core by rivets 22 or in any other convenient manner.

23 23 represent the terminals of the wire with which the magnetic cylinder 1 is wound. They are connected to the connecting-rings 24 25, on which the brushes 27 26 bear. In this way current is conveyed to the coils 1^a on the rotating cylinder 1.

In Fig. 8, 28 represents the walls of a compartment in which the separator is arranged to work by the dry process. The floor of the compartment is divided into portions to receive the tailings, middlings, and concentrates and keep them separate. 29 is the outlet for the tailings, 30 the outlet for the middlings, and 31 the outlet for the concentrates. The set of fine rolls 15 15^a would in this case be placed under outlet 30.

In Fig. 9 is shown another arrangement for the wet process. The pulley 2 is put higher than the magnetic cylinder 1, so that the belt 5 will run out of the water and over the edge of the tank 9, delivering the concentrates into a chute 33. The water-pipe 32 furnishes a spray to insure the cleaning of said belt. Thus portions of the downwardly-traveling end of said belt 5 and of its under side are immersed in the tank 9. From these portions drop the tailings and middlings into the respective receptacles 35 and 34, formed in the bottom of the tank. Elevator-belts 10 carry these up over the edge of the tank.

The operation of my invention is clear from the foregoing description. The crushed ore is fed from the hopper 6 down upon the belt 5. As soon as it reaches the upper portion of the magnetic cylinder 1 it comes within the magnetic field, and the magnetic particles are held tightly against the belt. During the trip along the downwardly-traveling end of the belt, which is an entire half of the circumference of the magnetic cylinder, the attraction of gravitation acts to pull away the non-magnetic particles, and they fall to the bottom of the tank or other compartment and form the tailings. The solvent action of the water in the tank 9, when the wet process is used, accelerates this separation. The magnetic particles—those half-magnetic and some entirely non-magnetic particles entrained with the others—then pass along the under side of the belt. The constantly-changing polarity of the magnetic field, to the influence of which they are here subjected, causes the magnetic particles to turn over and over and free themselves from the non-magnetic and partially-magnetic particles, which drop off into the receptacle provided for the middlings. The pure magnetite is carried on until it gets beyond the magnetic field, when it drops into the receptacle or chute provided for the concentrator. The middlings, as before stated, are ground to a finer mesh by rolls 15 15^a and sent through the separator again. It would probably be advisable to have the magnetic field of the flat magnets 7 grow weaker as the distance from the magnetic cylinder 1 increases. This can be accomplished in various ways—by putting fewer coils on the magnets, by putting the poles farther apart, and by gradually withdrawing the magnets from the belt 5, &c.

There may be one elevator-belt 10, as shown in Fig. 2, the tailings, middlings, and concentrates being taken from different portions thereof, or there may be separate belts, as shown in Fig. 9.

Various changes could be made in the construction of the magnets and in the arrangement of chutes and receptacles without departing from the spirit of my invention. The magnetic cylinder 1 could be made stationary and the belt 5 allowed to slide over it, &c.

Having therefore described my invention, what I claim as new, and desire to protect by Letters Patent, is—

1. In a magnetic ore-separating machine, the combination of an endless belt traveling around pulleys whose axes are arranged horizontally and in or nearly in the same horizontal plane, a system of magnets creating a magnetic field about the under side of said belt and about the downwardly-traveling end thereon and the feed-hopper arranged above said belt, together with a water-tight tank in which the under portion of said belt is immersed, and means for removing separately the particles falling upon different parts of the bottom of said tank, substantially as described.

2. In a magnetic ore-separating machine, the combination of an endless belt traveling around pulleys whose axes are arranged horizontally and in or nearly in the same horizontal plane, a system of magnets creating a magnetic field about the under side of said belt and about the downwardly-traveling end thereof, and the feed-hopper arranged above said belt, together with a water-tight tank with an inclosed bottom in which the under portion of said belt is immersed, and a carrier-belt running up said inclined bottom and over the edge of the tank, substantially as described.

3. In combination with the operative parts of a magnetic separating-machine, a magnet composed of a flat core, a series of coils wound alternately in opposite directions on said core, and a series of pole-pieces placed crosswise of said core between said coils, substantially as described.

4. In a magnetic ore-separating machine, the combination of a water-tight tank, an endless belt traveling around pulleys having

horizontal axes, a portion of the under side of said belt and of the downward-traveling end thereof being immersed in said tank, a system of magnets creating a magnetic field about the under side of said belt, and the feed-hopper situated above said belt, substantially as described.

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

HARVEY S. CHASE.

Witnesses:
H. D. HEATHFIELD,
FRED P. PALMER.