No. 882,158. PATENTED MAR. 17, 1908.

R. R. MOFFATT.

MAGNETIC ORE SEPARATOR.

APPLICATION FILED MAY 6, 1905.

3 SHEETS—SHEET 1.

Fig. 1

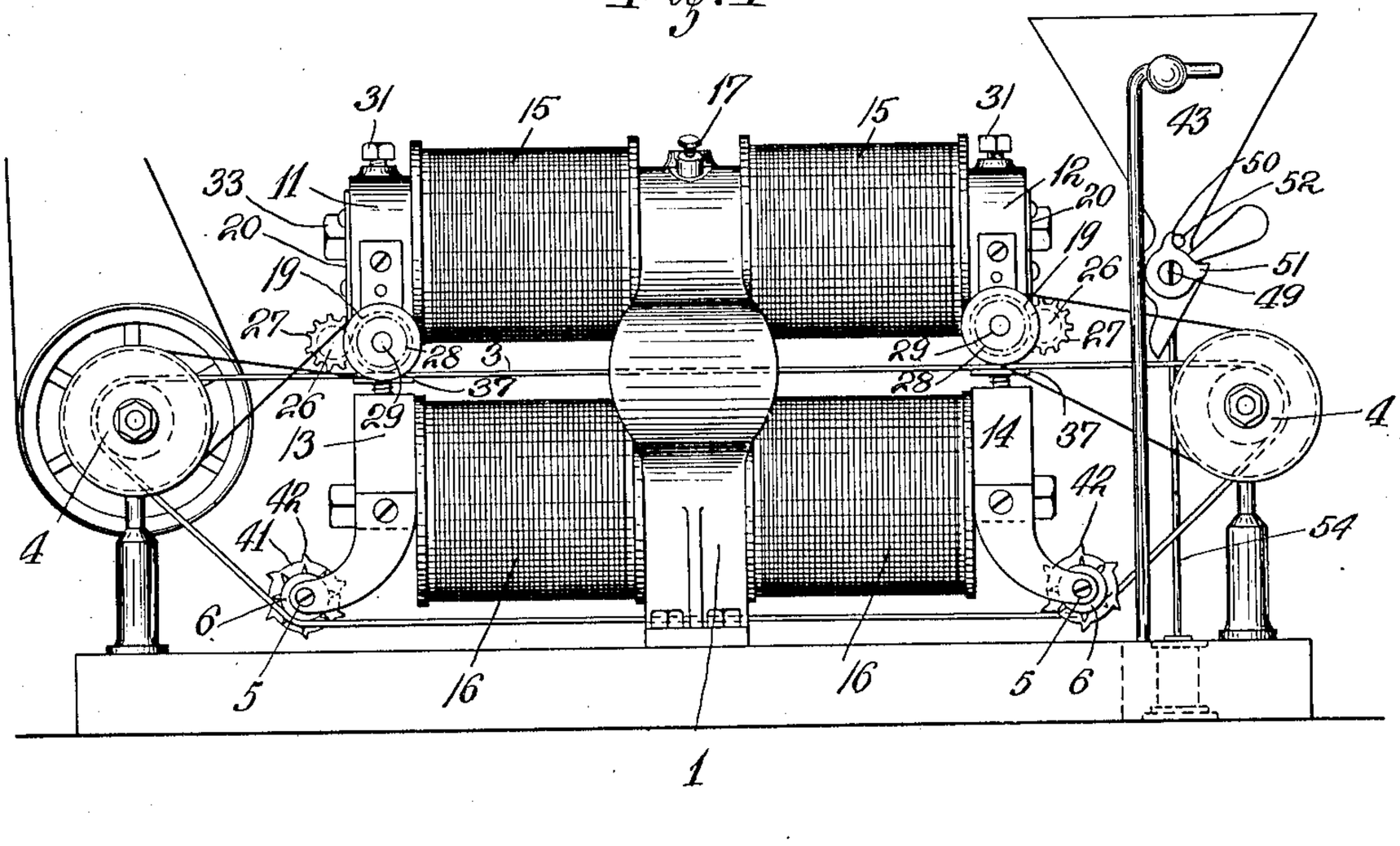
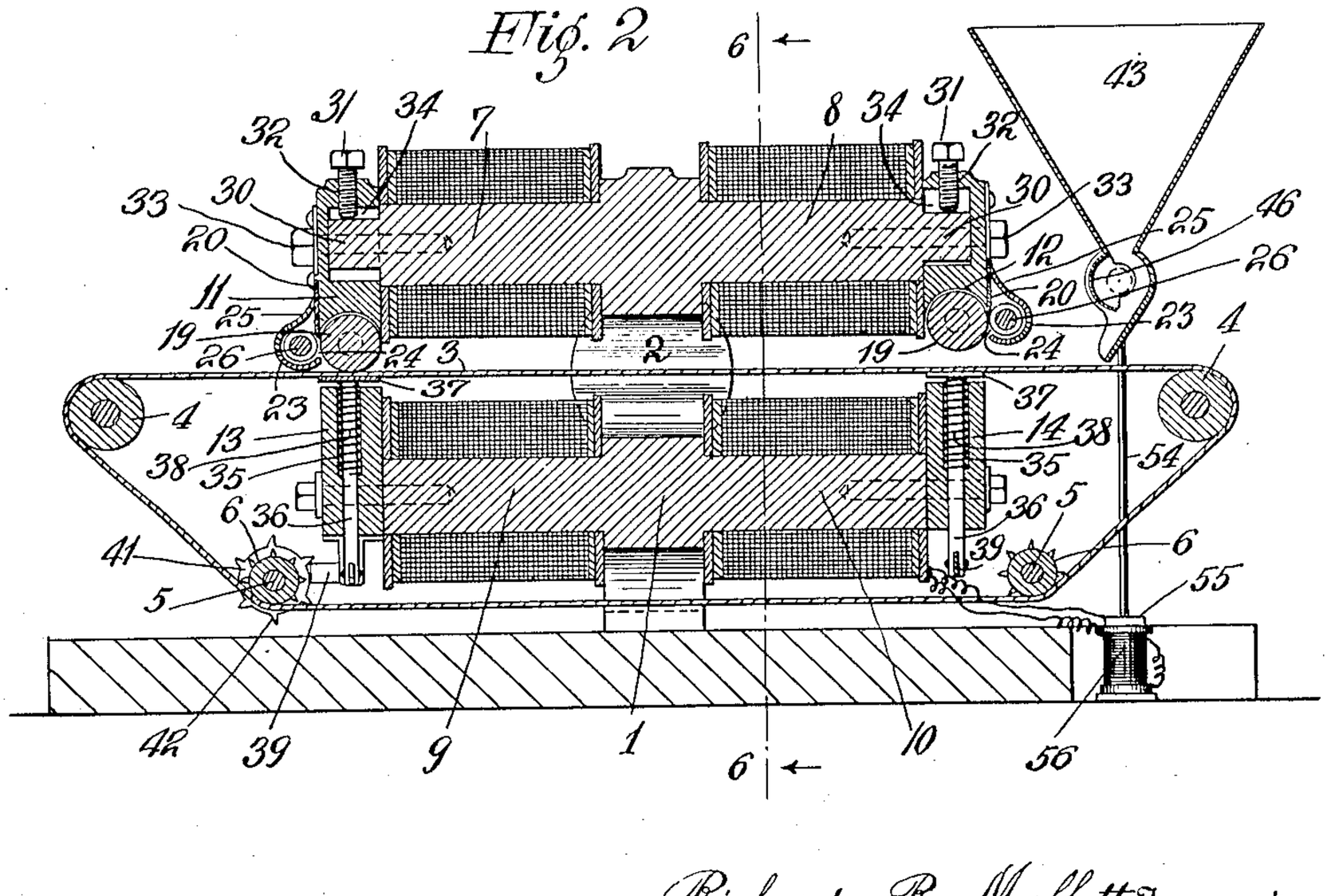


Fig. 2



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3 SHEETS—SHEET 2.

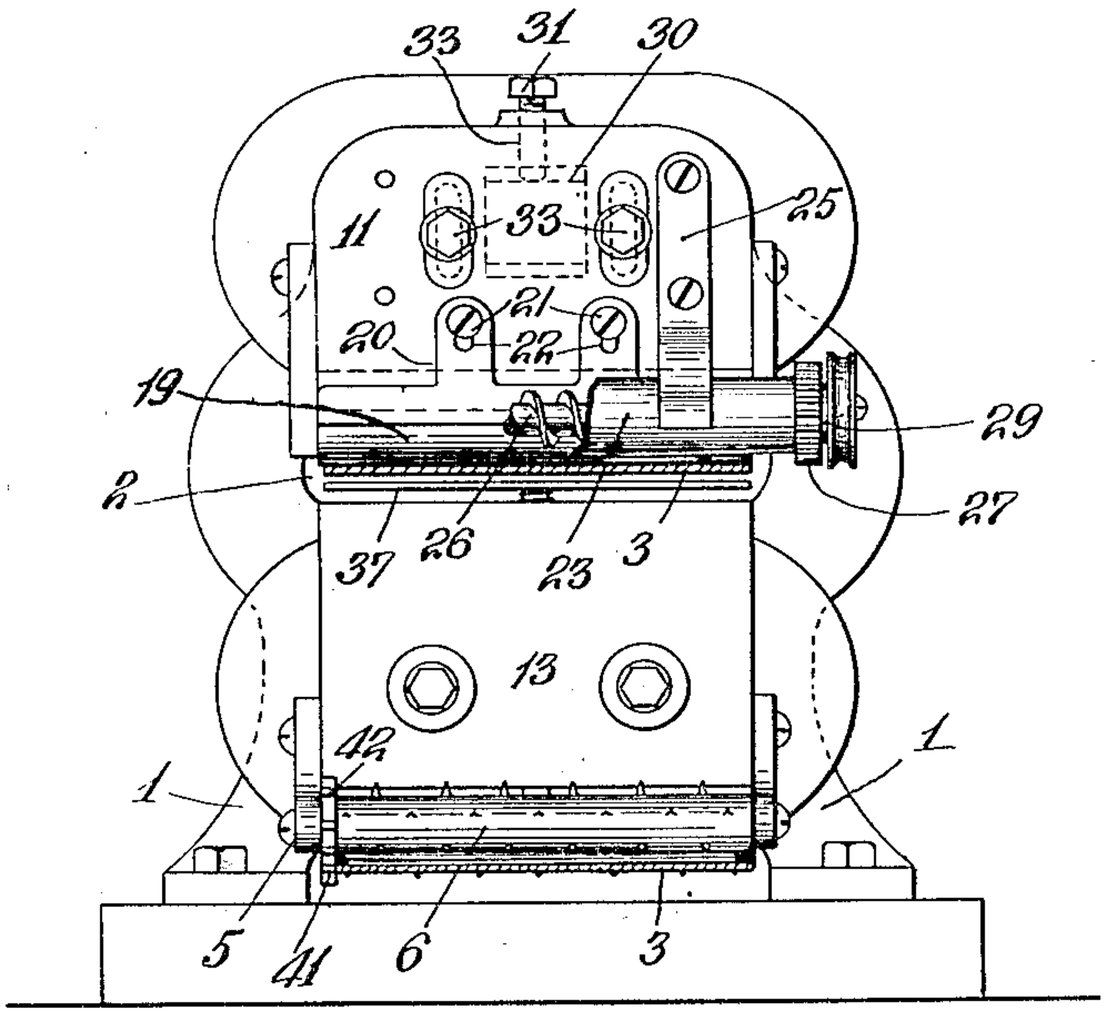

Fig. 3

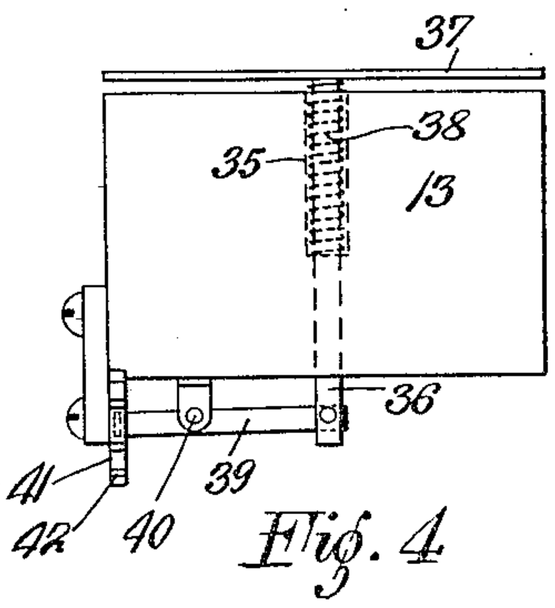

Fig. 4

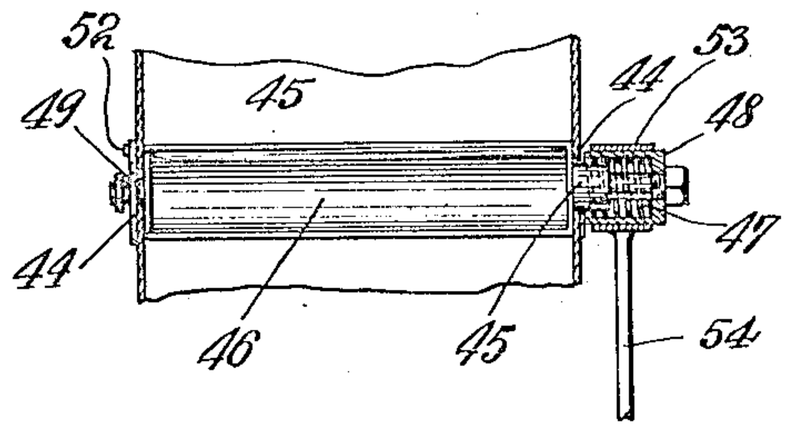

Fig. 5

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3 SHEETS—SHEET 3.

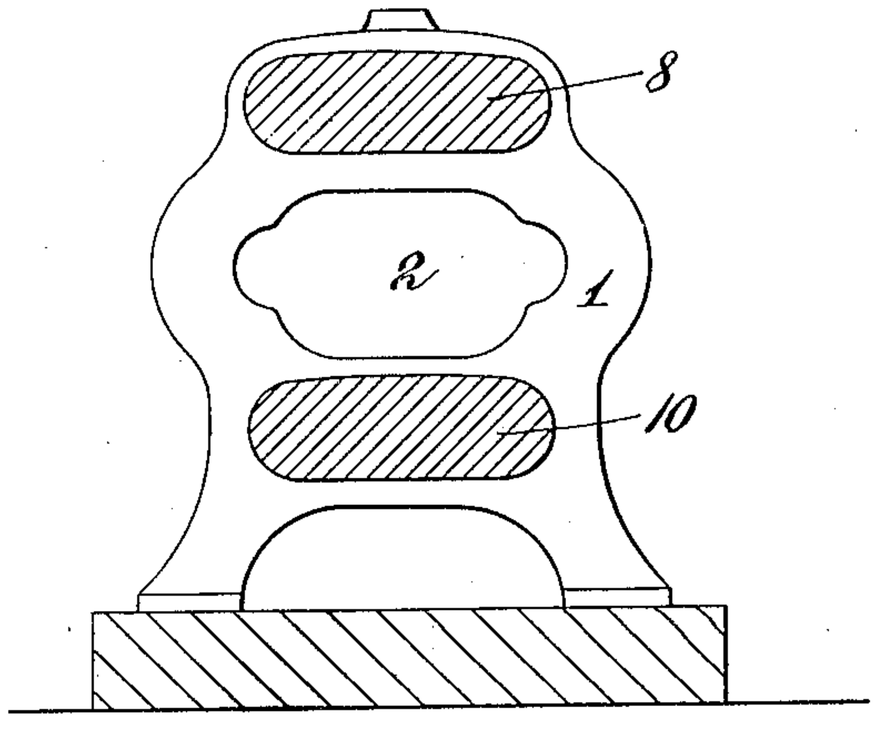

Fig. 6

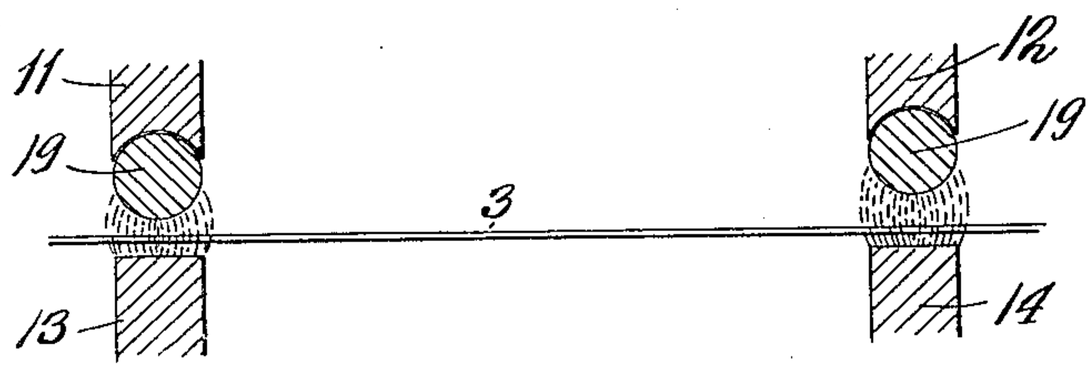

Fig. 7

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UNITED STATES PATENT OFFICE.

RICHARD R. MOFFATT, OF NEW YORK, N. Y., ASSIGNOR TO IMPERIAL ORE SEPARATOR COMPANY, A CORPORATION OF NEW YORK.

MAGNETIC ORE-SEPARATOR.

No. 882,158. Specification of Letters Patent. Patented March 17, 1908.

Application filed May 6, 1905. Serial No. 259,116.

To all whom it may concern:

Be it known that I, RICHARD R. MOFFATT, a citizen of the United States of America, and a resident of the borough of Brooklyn, city of New York, county of Kings, and State of New York, have invented certain new and useful Improvements in Magnetic Ore-Separators, of which the following is a specification.

My invention relates generally to magnetic ore separators, and has more particular reference to an apparatus for separating feebly magnetic particles from the ore.

In an application heretofore filed by me on October 6, 1904, Serial No. 227,349, there was disclosed a structure in which was employed magnets united with their free ends, each magnet having poles located in vertical alinement above and below the conveyer, and so arranged as to form a plurality of fields. These magnets were arranged with their backs extending outwardly; that is with the poles between the backs of the magnets. There are preferably two standards supporting the machine at the ends or below the back of the magnets. Intersecting the conveyer belt at a point between the upper and lower poles are cross belts for conveying the separated material out of the machine.

In practice, difficulty is sometimes experienced in conveying the attracted material out of the separating zone because of a tendency on the part of the ore particles to bridge the space between the belts due to the accumulation of the ore as the cross belt moves over the conveyer. One object of my invention is to produce a cross conveyer for conveying the separated material positively out of the machine. In order to exclude the influence of the poles, as much as possible from the separated ore, this cross conveyer will preferably be located at a point outside the space between the two opposed poles where there are few lines of force.

The general arrangement of the device also presents novel features notably in the fact that the two fields with opposed upper and lower poles are produced by placing two U-shaped magnets back to back; the poles on the same side of the conveyer being of like sign but of unlike sign to the poles on the opposite side of the conveyer. The two magnets may of course be cast in one piece, or made in several pieces in magnetic circuit. Preferably the magnets are supported by an extension forming a central standard or yoke having an opening through which the conveyer passes while the end of the magnets or poles are suspended freely.

In the particular structure here disclosed, the upper poles are made in the form of rotatable cylinders, preferably moving in a direction parallel with that of the conveyer, at one field in the same direction, and at the other field in an opposite direction to the movement of the conveyer. The cylinders are adapted to discharge the separated material into a suitable cross conveyer such as an endless screw or worm which positively moves the material out of the machine. This cross conveyer is preferably located outside the space between the upper and lower poles, and suitable means, as a scraper or brush, is provided for removing the material from the rotating pole to the cross conveyer. The fields are so arranged that while they are in circuit with each other, one is of greater intensity than the other, and means are provided for varying this relative intensity of the fields by varying the open space or distance between the poles of the field or fields. The conveyer should preferably pass through the machine at a point above the neutral zone, but this is not essential to the operation of the device, as I provide means for agitating the ore in the fields or for forcibly projecting the particles against or towards the upper pole, or at least across the neutral zone so as to bring them under the influence of the upper pole where the lines of force are more dense, due to the cylindrical surface of the roller pole. In this type of magnetic ore separators which employs a conveyer, it frequently happens that the magnetic circuit is broken through accident or design, while the conveyer continues to carry ore through the separator. This results in great annoyance and loss of valuable ore. One object of my invention has therefore been to control the outflow from the hopper onto the feed belt by some means controlled by the magnetic circuit of the separator, so that when the latter is broken the flow from the hopper will be stopped.

In the accompanying drawings I have illustrated my invention in separate views, in which like numerals of reference have been employed to designate like parts.

In these drawings: Figure 1 is a side elevation of a separator embodying my invention. Fig. 2 is a longitudinal sectional view of the

same. Fig. 3 is an end elevation, with parts broken away. Fig. 4 is a detail view showing one means for agitating the ore in the field. Fig. 5 is a detail view showing the specific means by which I control the outflow from the hopper. Fig. 6 is a cross sectional view taken on line 6—6 of Fig. 2 showing the magnet core yoke with its opening for the conveyer and the feet for central supports. Fig. 7 is a longitudinal sectional view with parts removed showing the lines of force in the fields, and being diagrammatical in character.

In the drawings are shown two magnets placed back to back and suitably supported by the standard 1 located at their backs and allowing their poles to be freely suspended. Between the poles of the magnets and passing through an opening 2 formed in the magnet yoke is the conveyer 3, suitably operated by the drums 4 and the shaft 5 carrying the spurred cylinder 6. The cores 7 and 8 of the magnets are placed above the conveyer, while the cores 9 and 10 are placed below. The poles 11 and 12 connected to the upper cores are of like sign, while the poles 13 and 14 are also of like sign but of opposite sign to the poles on the other side of the conveyer. 15 and 16 indicate the windings of the upper and lower cores respectively and lead to the binding screws 17.

In magnetic circuit and forming part thereof are collecting cylinders 19 rotating in a parallel direction opposite to or with that of the feed conveyer and acting as the upper poles to attract the magnetic particles from the conveyer and to carry them with them in their rotation. As the cylinders revolve, the scraper 20 or other means, such as brushes, suitably attached to the pole pieces of the separator and adjustable by means of the screw 21 in the slot 22, forces the magnetic particles from the cylinder into the receptacle 23, here shown in the form of a hollow tube having an open portion 24 facing the cylinder. This receptacle is connected by the bands 25 or other suitable means to the pole pieces, and is located outside of the space between the upper and the lower poles in order to exclude it as far as possible from the magnetic fields between the poles. In this receptacle I place means for positively conveying the attracted particles removed from the magnetic fields out of the machine. This means here shown takes the form of an endless screw or worm 26 operated by any suitable method, but preferably as shown by a gear 27 meshing with the gear 28 carried by the shaft 29 which rotates the collecting cylinder. It will thus be seen that as the latter rotates and its ore is forced into the receptacle, the endless screw will operate to positively deliver the magnetic particles out of and away from the magnetic field. A similar arrangement is provided for each upper pole, and since it may be desired to vary the proximity of the poles to the conveyer so that the intensity of both fields may be increased or decreased as desired, or that the succeeding field through which the belt passes may be made of greater intensity than the preceding field, I provide means for individually adjusting and securing in their adjusted position these upper poles. I accomplish this in the present instance by forming projections or lugs 30 on the upper cores and secure to these projections the screw 31, the latter, however, being free to revolve on the projections. This screw passes through a threaded opening 32 formed in a portion of the pole piece, and will, when operated, move the latter in relation to the fixed core and also, since the core is fixed in relation to the conveyer, bring the magnet rollers into nearer or farther proximity to the conveyer as desired. When the pole piece is adjusted to the desired position, it is secured by means of the bolts 33 passing through the pole piece into threaded engagement with the core. The slots 34 must be provided in the pole piece to allow the latter to be adjusted vertically. One means for agitating the ore as it passes through the fields on the conveyer belt in this instance takes the following form. Through the lower poles I provide a passage 35. In this passage operates the plunger 36 formed at its upper portion into the head plate 37. In this passage I place a spring 38 adapted to hold the head normally in contact with the conveyer belt. The opposite end of the plunger is connected to the lever 39 pivoted at 40. On the shaft which carries the spurred drum for operating the conveyer belt I mount a collar 41 provided with spurs 42 which are adapted, as the shaft rotates, to act intermittently against the lever to move the same about its pivot, thereby compressing and overcoming the influence of the spring, and thus imparting a jogging motion to the plunger, thereby agitating the ore upon the conveyer belt as it passes through the fields and projecting the ore over the neutral zone or against the upper revolving pole to which the magnetic particles are attracted and cling.

43 indicates the hopper from which the material is fed to the conveyer belt. I have here provided automatic means controlled by the electric circuit adapted to close the discharge opening of the hopper whenever the magnetic circuit, by accident or design, is broken. This means takes the following form in the present instance. At the discharge opening of the hopper and mounted in the bearings 44 beneath the same, I place the member 45 adapted to revolve, and having a portion 46 trough-shaped. The spring 47 mounted in the cup 48 carried by the pro-

jecting hub of this member, holds the latter normally across the discharge end of the hopper or in what may be called its closed position. At the opposite end of the member I provide a rockshaft 49 engaging with the member and adapted, when operated, to turn the latter into what may be called its open position; that is, into the position where the material is free to pass through the discharge opening of the hopper onto the conveyer belt. To limit the movement of the rockshaft, I provide the stop 50 formed in the rockshaft and the stop 51 carried by the latter and a pin 52 secured to the hopper.

It will be seen that by turning the rockshaft, the action of the spring is counteracted and the member turned to its open position, where the material is free to flow from the hopper to the conveyer belt. I have found in practice that when the magnetic circuit is broken either by accident or design, the conveyer belt may continue to carry ore through the fields, which is undesirable. I have therefore provided means controlled by this magnetic circuit adapted to hold the member in its open position so long as the magnetic current is active, but when the current is broken or interrupted, adapted to allow the action of the retractable spring to return the member to its closed position, thus shutting off the feed of ore. I accomplish this by means of the band brake 53 formed over and contacting with the cap 48 in which is seated the spring. This brake is connected by means of the rod 54 to the armature 55 which is attracted by the electro magnets 56 in circuit with the electric system of the machine.

The operation of the hopper is as follows: Assuming the member to be in its closed position so that any outflow from the hopper is prevented, the rockshaft is operated, thereby counteracting the spring and turning the member to any desired open position where the material is free to flow from the hopper to the conveyer belt. The magnetic circuit active, the brake armature is attracted by the electro magnet and through the rod and band brake holds the member against the action of the spring with sufficient force to retain it in the position to which it has been turned by means of the rockshaft. The instant the magnetic circuit, however, is broken, the armature and brake are released, and since there is nothing to counteract the tension of the spring, the latter instantly revolves and moves the member to its closed position, thereby shutting off the feed from the hopper.

The general operation of the machine is as follows: The ore being fed upon the conveyer belt as it travels in the direction of the arrows, is brought within the influence of the magnetic fields, the second field being preferably more intense than the first field in order to attract any feebly magnetic particles not attracted by the first field. The ore in the fields is thoroughly agitated on the conveyer and thrown upward either against the upper pole or across the neutral zone so that it may be acted upon by the upper pole. The upper pole being in the form of a cylinder, carries the ore particles clinging to it to the receptacle where they are forced from the face of the cylinder to the worm or endless screw and conveyed away at either side of the machine as desired. The poles on opposite sides of the conveyer belt being of opposite polarity create an active magnetic field, and since the poles on one side of the belt are of the same polarity, there is a minimum tendency to form longitudinal escapage of lines of force and the full magnetic energy is utilized to the fullest extent for doing service in the field, the lines of force extending at right angles through the conveyer belt. After the ore has been subjected to the action of the fields, the conveyer is utilized to carry away and deposit in the proper place the tailings or non-magnetic matter which remains.

What is claimed is:

1. In a magnetic ore separator, a central yoke standard having an aperture, two sets of upper and lower poles arranged on opposite sides of the central yoke standard, upper and lower core pieces extending laterally from both sides of said yoke standard and in magnetic circuit with the poles and yoke standard, a feed conveyer passing between the two sets of poles and through the aperture of the yoke standard, and cross conveyers intersecting the feed conveyer.

2. In a magnetic ore separator, an upper pole, a lower pole having a passage, a feed conveyer passing between the two poles, a plunger located in the passage of the lower pole, and means for actuating said plunger to strike the feed conveyer.

3. In a magnetic ore separator, the combination with upper and lower poles, of a feed conveyer passing between the said poles, means for removing the material attracted by the upper pole and means extending through the lower poles for agitating the feed conveyer.

4. In a magnetic ore separator: the combination of an upper and a lower pole, means for removing the material attracted by the upper pole, a feed conveyer passing between the poles and below the neutral zone of the field, and means for projecting the particles of ore above the neutral zone of the field of force.

5. In a magnetic ore separator: the combination with a feed belt and means for operating the same, of a hopper, a revoluble member adapted to close the discharge end of the hopper, a rockshaft adapted to turn said member to its open position, a cap on the projecting hub of the member, a spring mounted therein and adapted to hold the

member normally in its closed position, a brake adapted to contact with the cap, and, when operated, to hold the member in its open position, and means controlled by the magnetic circuit adapted to operate said brake.

6. In a magnetic ore separator: the combination with a feed belt, and means for operating the same, of a hopper, a revoluble member adapted to close the discharge end of the hopper, a rockshaft adapted to turn said member to its open position, a cap on the projecting hub of the member, a spring mounted therein and adapted to hold the member normally in its closed position, a brake operating on said cap and adapted to hold the member in its open position, an armature connected to said brake and adapted, when attracted, to operate the brake.

7. In a magnetic ore separator: a hopper, and means adapted to control the outflow therefrom, comprising: a revoluble member adapted to close the discharge end of the hopper, a spring adapted to hold said member normally closed, a rockshaft adapted to turn said member to its open position, a brake adapted, when operated, to hold the member in its open position, an armature connected to the brake and adapted, when attracted, to operate the latter.

8. In a magnetic ore separator: the combination of a feed hopper, means for regulating the passage of ore therefrom, a retractable spring for shutting off the feed, and a magnetic brake for holding the regulating device in position against the force of the retractile spring while the magnetic circuit through the separator is closed and operative.

Signed at New York city this 3d day of May, 1905.

RICHARD R. MOFFATT.

Witnesses:
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ANNA WISSEMANN.