June 19, 1923.

1,459,147

A. DINGS

MAGNETIC SEPARATOR

Filed Aug. 5, 1918

Fig. 1

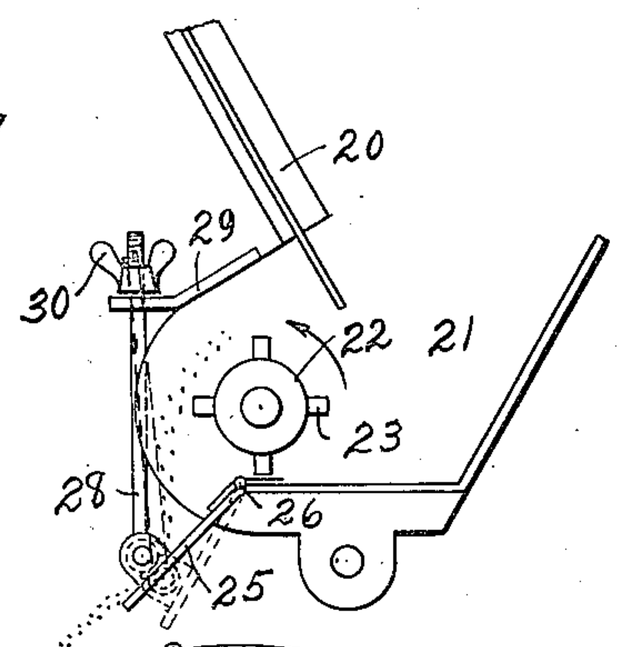


Fig. 4

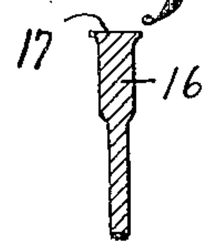
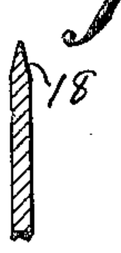


Fig. 6

Fig. 5



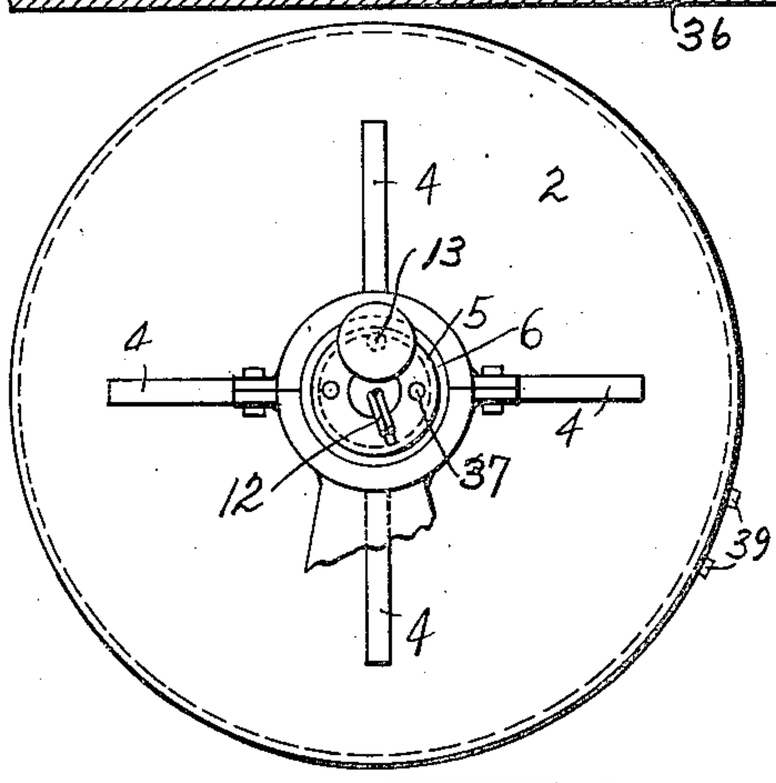


Fig. 2

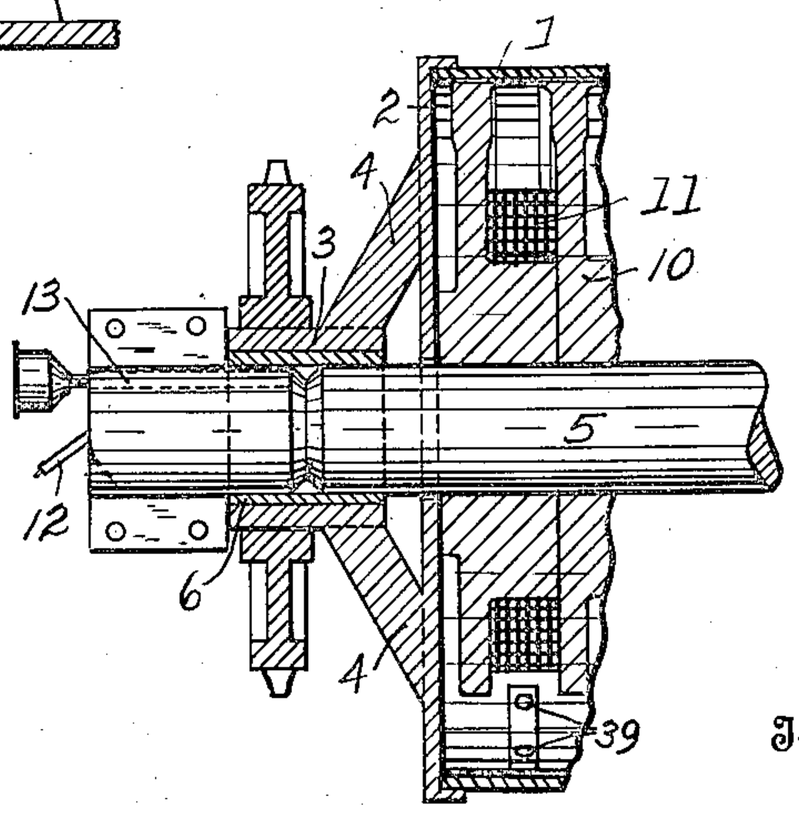


Fig. 3

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Patented June 19, 1923. 1,459,147

UNITED STATES PATENT OFFICE.

ALVIN DINGS, OF MILWAUKEE, WISCONSIN, ASSIGNOR TO MAGNETIC MANUFACTURING COMPANY, OF MILWAUKEE, WISCONSIN, A CORPORATION OF WISCONSIN.

MAGNETIC SEPARATOR.

Application filed August 5, 1918. Serial No. 248,311.

To all whom it may concern:

Be it known that I, ALVIN DINGS, a citizen of the United States, residing at Milwaukee, county of Milwaukee, and State of Wisconsin, have invented new and useful Improvements in Magnetic Separators, of which the following is a specification.

My invention relates to improvements in magnetic separators of the drum type, and magnetic separating processes.

The objects of my invention are:—

First: To provide improved means for feeding material to be separated thru the magnetic field,—the improvement consisting in providing a hopper with an adjustable feed slide arranged in such a manner that the material may be continously cascaded over the surface of a rotary drum having its receiving side located in the magnetic field, and the rate of feed distribution of material and its position in the magnetic field during the separating operation, effectually varied and controlled.

Second: To provide a separator of the drum type having an internal magnet provided with a segmental pole piece which will utilize the magnetic force to the best possible advantage and deflect, concentrate, and deliver the separated material into a receiver in partially graded condition.

Third: To provide means whereby the magnet may be protected from oil or other foreign matter which might otherwise enter the drum at the ends along the bearing surfaces.

In the drawings:—

Figure 1 is a view, partly in vertical section and partly in elevation, of my improved magnetic separator.

Figure 2 is an end view of the drum and its outboard bearing.

Figure 3 is a fragmentary view of the drum in horizontal section showing the shaft in full.

Figures 4 and 5 are fragmentary, sectional views of one of the magnetic pole pieces drawn respectively on lines 4—4 and 5—5 of Figure 1.

Figure 6 is a view of the outer margin or working face of one of the pole pieces.

Like parts are identified by the same reference characters thruout the several views.

The drum 1, is preferably composed of brass or other suitable material, is provided with end caps 2. An outboard bearing sleeve 3 is supported from each end cap 2 by arms 4, whereby the drum may be mounted on a supporting shaft 5 with an interposed bushing 6. The cap 2 is centrally apertured to receive the shaft 5, and this apertured portion of the cap is located at a substantial distance from the bearing, whereby the lubricant may be excluded from the interior portion of the drum. The arms 4 are spaced apart, as clearly shown in Figure 2, and whenever the drum is at rest, any lubricant tending to flow along the shaft 5 in the direction of the drum may be readily removed.

The shaft 5 is stationary and is a hollow shaft. Within the drum magnets 10 are mounted on this shaft and each provided with a winding 11, preferably concentric with the axis of the drum. The lead wires 12 are preferably extended into the drum thru the hollow shaft, and the wall of the shaft may be provided with a longitudinal bore 13 thru which lubricant may be fed into the bearing.

The magnet poles 15 are extended on one side into close proximity to the drum on the downwardly moving side. The outer margins of these pole pieces 15 conform in curvature to the curvature of the drum and are preferably located in the lower quadrant, altho preferably extending for a short distance above a horizontal plane thru the axis of the drum. The pole pieces are in the form of flat plates of relatively thin material, and the intermediate portions of their outer margins are thickened at 16 and expanded along their peripheral surfaces to form comparatively wide working faces 17. The lower ends of the working faces are preferably wedge-shaped, as shown at 18 in Figures 5 and 6.

The material to be separated is delivered along a feedway 20 into a feed controlling hopper 21 provided with a rotary feeder 22 having wings 23 adapted to deliver material outwardly from the hopper opening upon an adjustable slide 25 in hinge connection with the base of the hopper at 26. One or more link bolts 28 connect the slide 25 with a bracket 29 carried by the upper wall of the hopper, and these link bolts are provided with thumb nuts 30, whereby the feed slide 25 may be raised or lowered to control the feeding operation.

A partition 35 extends upwardly from the

floor 36 underneath the downwardly moving side of the drum, this partition being so located that the portion of the drum which lies in the horizontal plane of its axis will overhang the partition slightly, whereby the non-magnetic material falling along this side of the drum will reach the floor beyond the partition, whereas magnetizable material may be deflected by the magnet pole pieces to the other side of the partition and allowed to fall beneath the drum.

It will be observed that the upper margin of the upwardly extending segmental member of the pole pieces projects from the magnet spool substantially radially from the circular end of the core, whereas the lower margin follows a curved line extending from the lower end of the part 17 of the working face backwardly and inwardly from said face until it meets the circular end of the core. It is along this curved line that the pole piece becomes wedge-shaped along its working margin instead of being flat or cylindrical as above described.

In operation, the material to be separated is cascaded from the hopper slide 25 over the downwardly moving side of the drum and either falls on the surface of the drum or a little beyond it, the exact path of the material being dependent upon the adjustment of the slide. As the material approaches the horizontal plane coinciding with the center line of the drum, it enters the magnetic field and the magnetizable material is deflected toward or into contact with the periphery of the drum and is carried to a point underneath the drum and dropped on the side of partition 35 opposite that on which the non-magnetizable material drops. When material held to the drum by magnetic force reaches the zone where the pole piece recedes and becomes wedge-shaped, as indicated at 18, the more weakly magnetic material will drop, and the more strongly magnetic material will tend to collect along a line opposite the edge of the pole piece, and will be carried farther underneath the drum, thus grading the material to some extent and preventing it from all falling in a concentrated pile at one point. The gradual reduction in magnetic flux prevents the material from massing.

The adjustable hopper slide 25 is a feature of great importance, as it can be utilized to control the rate of delivery, and to distribute the material longitudinally in a thin stream, the rotary feeder 23 tending to deliver it in masses or streams of varying thickness. The hopper slide may also be utilized to deliver the material over the drum without contact of the non-magnetizable material therewith, or it may be adjusted to so feed the material as to cause it to follow the drum periphery for a substantial distance. When adjusted to the dotted line position of Figure 1, it will strike the drum and follow it to the horizontal plane of the axis, while the magnetite will be carried down along the surface to the point of discharge.

The shaft being stationary, and the magnet being secured thereto, it is obvious that, by employing a spanner wrench which may be applied to the end of the shaft in holes 37, the shaft may be adjustably rotated to raise or lower the magnetic pole pieces.

In Figure 1, the pole pieces are adjusted in positions which they will occupy for the separation of strongly magnetic material. In such cases, particularly where there is a heavy burden of strongly magnetic iron, it is desirable to allow the material to strike the drum and rebound before subjecting it to any strong magnetic pull, such as to cause non-magnetic material to become entrained or held to the drum by the iron.

For more weakly magnetic material, the shaft will be rotatively adjusted to swing the pole pieces upwardly, toward the hopper, and, in some cases, the pole pieces may be adjusted into close proximity to the point where the material contacts with the drum, whereby the weakly magnetic material may be kept from rebounding to any great extent, its response to the magnetic force being insufficient to entrain the remainder or prevent it from rebounding.

The method above described of separating material while cascading on rebound, by utilizing magnetic force, on the one hand, to restrict or destroy the rebounding tendency of the magnetic material, while allowing the other materials to separate therefrom actively under momentum pressure exerted to cause the rebounding effect, involves a new principle, whereby the capacity of a magnetic separator may be greatly increased, the separation being much more rapidly and effectually accomplished, than in cases where the magnetic material is drawn from a comparatively compact stream flowing directly from the hopper.

In the construction illustrated, the wall of the drum may be composed of a thin sheet of magnetizable material, such as steel, or sheet iron. I have found that, by this construction, a more intense magnetic field may be developed in the pole pieces in close proximity to the drum, the lines of force following the drum wall instead of reaching out as far as is the case where a brass drum is used. I also find that the lines of force are spread more evenly across the conveyor face while passing the pole pieces, and that upon passing out of proximity to the pole pieces, the few weak lines of force which reach the drum will be absorbed or deflected by the metal of which the drum is composed and will not reach the outer surface of the drum, or at least will not extend beyond it in such a manner as to retain the particles of mag-

netite. Therefore, the portions of the drum leaving the pole pieces will discharge the material even more freely than will be the case were a brass drum used.

It will be observed, in Figure 3, that the magnet comprises a series of spool members, the cores of which are each provided with one head, from which the pole piece projects. These spool members are successively slipped into position on the shaft, after the energizing coils have been adjusted over the unheaded ends of the cores. The pole pieces are sufficiently spaced apart to allow a split drum to have its edges connected by connecting plates which are made narrow enough to pass between the pole pieces. Rivets or screws 39 are employed to attach these connecting pieces to the abutting margins of the sheet which constitutes the wall of the drum, and the heads of these rivets or screws are allowed to project outwardly from the periphery of the drum, whereby, when the separator is in operation, any cylindrical body, such as a nail, bolt, or rod which adheres to the periphery of the drum and tends to roll backwardly along the periphery in the direction of the pole pieces so that it is not carried downwardly to the point of discharge, will be struck by these rivet heads or projections and dislodged. Similar projections 40 may be provided on the periphery of the drum, and some of these may, if desired, be so located as to pass directly over the pole pieces, but where the projections constitute heads of rivets or screws used for the purpose of attaching connecting plates, it is necessary that these should be located between the pole pieces, since the plates project interiorly from the surface of the drum, and it is desirable that the pole pieces should be brought as close to the surface of the drum as possible. It is to be noted that the projections are relatively small and are separated. In this manner, it becomes possible to dislodge material, such as cylindrical objects or other magnetic material, from a temporarily fixed position in front of the pole pieces and to cause such material to travel with the drum and to finally be discharged in the appropriate compartment. It is obvious that the total amount of magnetism retained by these relatively small projecting portions is not sufficient to cause magnetic material to adhere thereto after such projections have passed the magnetic field or zone.

I claim:—

1. A magnetic separator, consisting of the combination of a revoluble drum, a magnet located therein, and having its axis substantially coinciding with the axis of the drum, and provided with a segmental pole piece disposed with its outer margin in close proximity to the interior wall of the drum on the descending side, and adjustable means for cascading material in free air along that side of the drum in the magnetic field established by said pole piece.

2. In a magnetic separator of the drum type, the combination with a revoluble drum carrier, of an interior magnet having flat pole pieces provided with curved edge margins in close proximity to the wall of the drum on the downwardly moving side, and thickened in the upper, outer portion thereof, the lower portion of each pole piece being wedge shaped in cross section with its edge margin progressively receding downwardly and inwardly from the drum wall.

3. In a magnetic separator of the drum type, the combination with a revoluble cylinder, of an interior magnet having pole pieces provided with curved edge margins in close proximity to the wall of the drum on the downwardly moving side, a plurality of separated, relatively small projections on the outer surface of the drum adapted to disturb the rolling movements of objects composing a portion of the material to be separated, by causing such objects to move outwardly away from the axis of the drum.

4. In a magnetic separator of the drum type having interior magnetic pole pieces, a cylindrical drum comprising a split cylinder having its abutting margins connected by plates secured to the inner surface of the drum and spanning said margins, said plates being disposed to travel in annular zones extending between the magnetic pole pieces.

5. In a magnetic separator of the drum type, the combination with a supporting shaft, of a revoluble drum around the outer periphery of which the material to be separated may freely travel, and provided with supporting means having outboard bearings spaced from the ends of the drum, and an interior magnet having pole pieces in close proximity to the wall of the drum on the downwardly moving side.

6. In a magnetic separator of the drum type, the combination with a supporting shaft, of a revoluble drum carrier provided with outboard bearings spaced from the ends of the drum, an interior magnet having pole pieces in close proximity to the wall of the drum on the downwardly moving side, and end walls carried by said drum and projecting inwardly into close proximity to the shaft between the outboard bearings and the magnet.

7. In a magnetic separator, the combination with means for producing a magnetic field, of a conveyor movable thru said field, means for feeding material against the conveyor with sufficient force and in a direction to cause non-magnetizable portions of said material to rebound from the conveyor along lines extending generally in the direction of conveyor movement and within the magnetic field, whereby separation may oc-

cur while said material is freely moving and in a finely divided state.

8. The method of separating magnetizable from non-magnetizable materials, consisting in developing a magnetic field, discharging materials against a surface from which such materials may rebound and cascade thru the magnetic field, whereby separation occurs while said material is freely moving, highly agitated and in a finely divided state.

9. The method of separating magnetizable from non-magnetizable materials, consisting in actuating a conveyor along a downwardly extending path within a magnetic field and delivering material to the conveyor in such a manner as to cause the non-magnetizable material to rebound and descend by gravity in the form of a cascade along the conveyor, whereby portions of the magnetizable material may adhere to the conveyor and other portions rebounding with the other materials may be deflected by the magnetic force in the direction of the conveyor.

10. The method of magnetically separating magnetizable from non-magnetizable materials, consisting in utilizing an electromagnet to develop a magnetic field, interposing a conveyor between the magnet and the outer portion of the magnetic field, and discharging material to be separated against the conveyor above the zones of greatest intensity existing in said field and with sufficient force to cause non-magnetizable portions of the materials to rebound from the conveyor and cascade thru the more intense portions of the magnetic field.

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

ALVIN DINGS.

Witnesses:
LEVERETT C. WHEELER,
O. C. WEBER.