R. A. MANEGOLD AND G. H. FOBIAN.

MAGNETIC SEPARATOR.

APPLICATION FILED MAR. 30, 1917.

1,310,802.

Patented July 22, 1919.

2 SHEETS—SHEET 1.

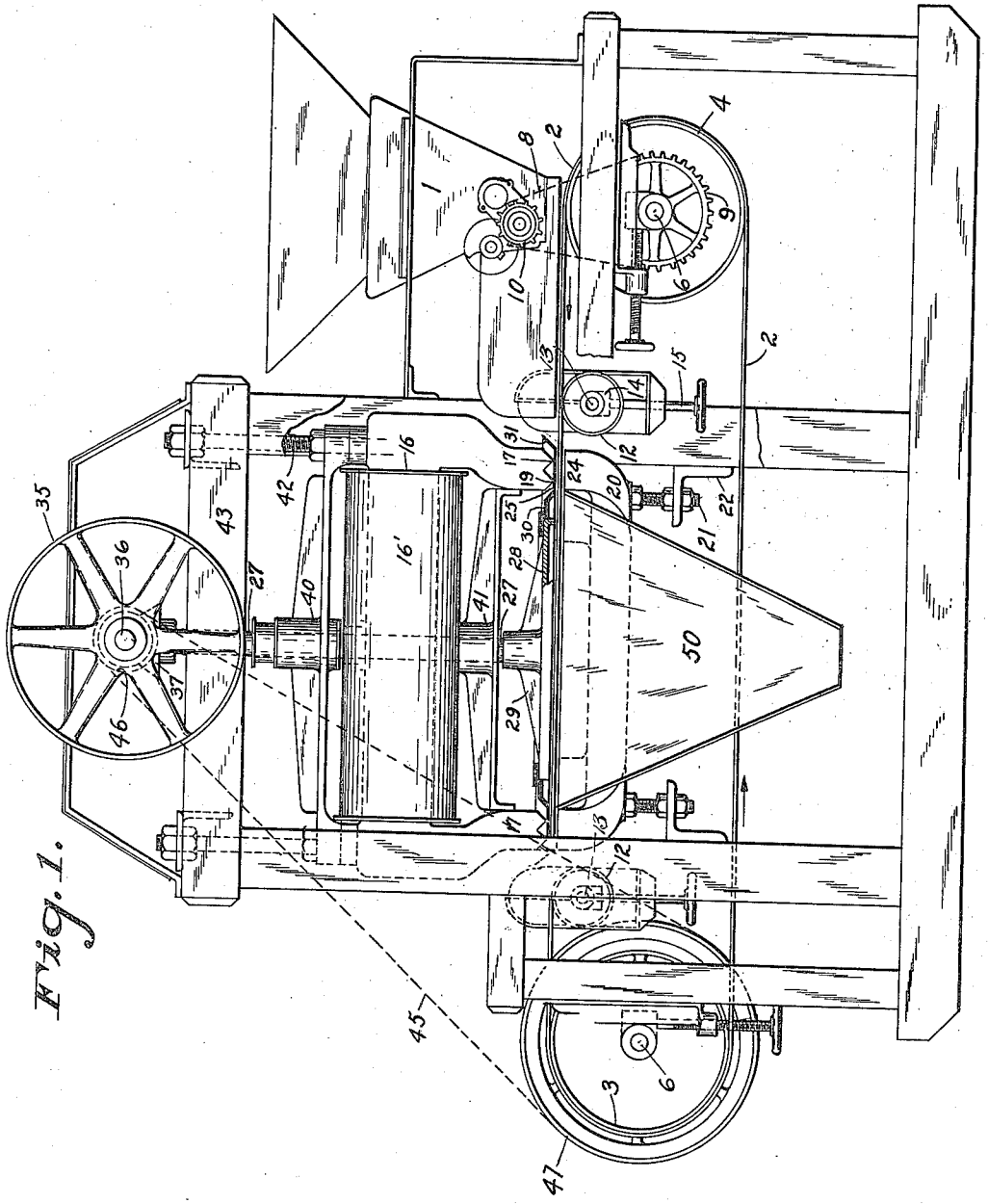


Fig. 1.

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2 SHEETS—SHEET 2.

Fig. 2.

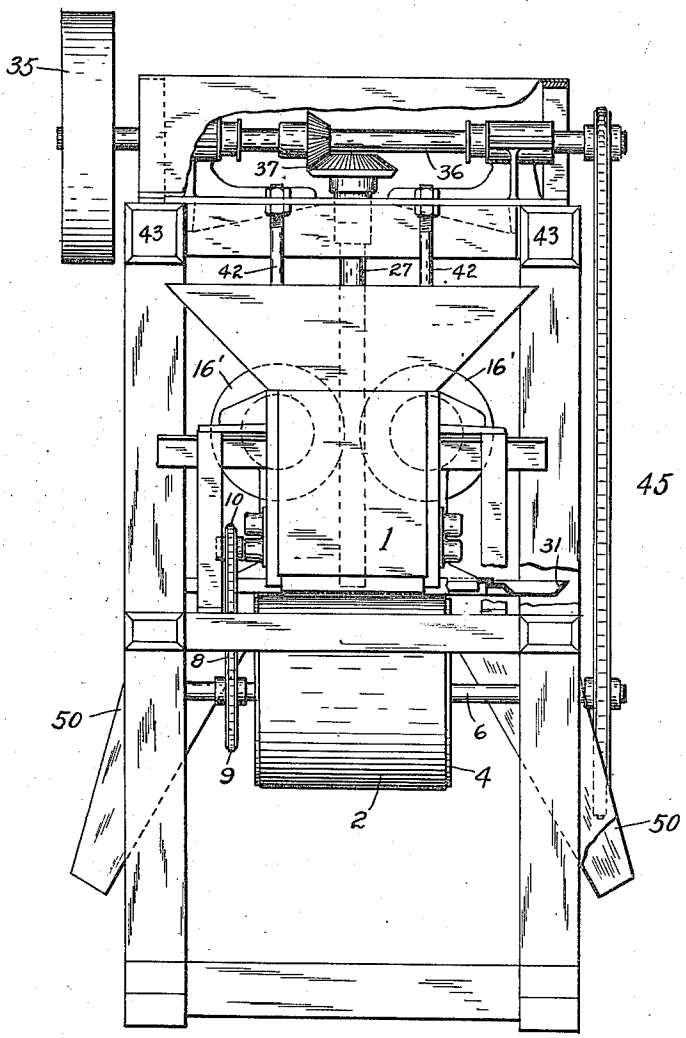
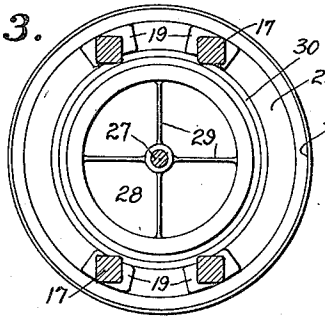


Fig. 3.



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MAGNETIC SEPARATOR.

1,310,802. Specification of Letters Patent. Patented July 22, 1919.

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To all whom it may concern:

Be it known that we, ROBERT A. MANEGOLD and GEORGE H. FOBIAN, citizens of the United States, residing at the city of Milwaukee, county of Milwaukee, and State of Wisconsin, have invented new and useful Improvements in Magnetic Separators, of which the following is a specification.

Our invention relates to improvements in magnetic separators.

The object of our invention is to provide means for utilizing a non-magnetic carrier rotating substantially in a horizontal plane through a magnetic field of high intensity to convey magnetic material out of said field, and deposit it in a suitable hopper or receiver, whereby material (including both magnetic and non-magnetic material) may be conveyed into the magnetic field by any suitable conveyer, such, for example, as an endless belt or apron extending underneath said rotary carrier, and the magnetized material lifted from the apron or belt into contact with said horizontally rotating carrier and held in contact therewith by magnetic attraction, until conveyed by the carrier beyond the zone or field of magnetic influence, or to a point where the magnetic attraction is no longer sufficient to retain the magnetite against the under side of such carrier.

We are aware of the fact that horizontally rotating conveyers, provided with pole pieces which become induction magnets by traversing the magnetic field, have heretofore been used to lift and convey magnetite from a traveling apron, or other form of conveyer, stationary magnets being located above and below the conveyer, and arranged to establish a magnetic field traversed by the conveyer and by the induced magnets of the horizontally rotating carrier. But, our invention has for its object to provide a form of construction in which powerful stationary magnets, or their pole pieces, may be brought into close proximity to the apron, leaving a narrow gap between the upper and lower pole pieces through which the apron may pass in one direction, and the carrier in a direction substantially at right angles thereto. Said carrier comprising a thin non-magnetizable disk revolving in extremely close proximity to the lower surface of the upper pole piece, or pole pieces.

We find that such disk will not be subjected to any great strain, and may therefore be made extremely thin and light. But little power is required to actuate it, and the operating cost of magnetic separators is not only reduced to a minimum, but an extremely high efficiency is attained, since by employing stationary magnets we are able to make them of any desired size and intensity and reduce the dimensions of the gap, or gaps, to a minimum by providing carriers, the thickness of which has been reduced to a minimum.

In the drawings:—

Figure 1 is a side elevation of a magnetic separator, embodying our invention, with a portion of the horizontally rotating carrier illustrated in section and part of the frame broken away.

Fig. 2 is an end elevation, also showing a portion of the carrier in section, and a portion of one of the receiving chutes in section.

Fig. 3 is a detail plan view of the horizontally rotating carrier on a reduced scale, showing the pole pieces of the upper magnet in horizontal section.

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

The material to be separated by removing the magnetizable portion, herein referred to as magnetite, is fed from a hopper 1 to the upper surface of the revolving apron 2, whereby the material is conveyed by the apron in the direction indicated by the arrow in Fig. 1, the non-magnetic material being delivered at the rear end of the apron, where it passes over a drum 3. The front end of the apron is supported by a similar drum 4. Feeding mechanism in the hopper 1, of any desired type, may be actuated from a shaft 6 of the drum 4, by means of a sprocket chain 8 operating over sprocket wheels 9 and 10. The conveying portion (or upper horizontal portion), of the apron extends over a set of idle rollers 12, the shafts 13 of which are journaled in vertically adjustable bearings 14, these bearings being adjusted by means of screws 15 to raise or lower the shafts and rollers 12, whereby that portion of the apron between the front and rear rollers 12 may be accurately supported in the desired horizontal plane.

A stationary magnet 16 is provided with

pole pieces 17 projecting downwardly from each end of the magnet into close proximity to the apron 2, the lower ends of these pole pieces being preferably provided with segmental ribs 19. These ribs are preferably V shaped in cross section, whereby the lines of force may be concentrated along the edges projected toward the apron 2. Below the apron we employ an induced magnet 20, mounted upon and supported by a set of adjusting screws 21, supported by frame brackets 22. The ends of this induced magnet 20 are upturned, as shown at 24, and are located directly underneath the pole pieces 17, leaving a gap of sufficient width to be traversed by the apron and by the horizontally rotating carrier annulus 25.

The carrier is supported and actuated by a depending shaft 27. The central portion comprises a disk 28 which may be suitably reinforced by ribs 29. The annulus 25 is supported from the disk 28 by a thickened supporting annulus 30, and the outer margin of the annulus 25 is provided with an upturned flange 31, preferably inclined outwardly, as shown. This flange 31 stiffens the annulus 25, which can be made very thin since it is subjected to but little strain.

It will be observed that the annulus 25 is interposed between the pole pieces 17 and the working portion of the apron 2. The magnetite is lifted against the under surface of this annulus 25 while traversing the magnetic field. The most powerful attraction, will, of course, be exerted when the magnetite passes directly underneath the V shaped segmental ribs 19. A plurality of ribs are preferably employed on each pole piece in order that the material may be subjected to more than one powerful magnetic pull while traversing the magnetic field. The removal of the more strongly magnetic materials will be accomplished by the first magnetic pull, and this causes some agitation of the non-magnetic material which frequently, partially or wholly, covers the magnetite. The less magnetic material will be shifted so as to expose its more strongly magnetic portions to the action of the second rib 19. This shifting movement is caused in part by the agitation above referred to while the material is subjected to magnetic influence. Further agitation will also result on account of the raking effect of the magnetite which is traveling with the annulus 25, and the apron is made wide enough to permit the material to be thus dragged laterally without discharging the non-magnetic material from the side margins of the apron. This dragging effect, of course, tends to distribute the material over a wider area upon the apron, thereby also more effectually exposing the material to the action of the second rib 19. The material will be also subjected to further separation while passing underneath the rear pole piece 19, if the magnets are arranged, as illustrated in the drawings, since the apron passes underneath both pole pieces of the magnet 16.

The diameter of this horizontally rotating carrier, composed of disk 28, annulus 25 and its supporting portion 30, is greater than the width of the apron 2, and is sufficient to allow the annulus 25 to drop the magnetite beyond the side edges of the apron, while traversing the neutral zone.

The machine is driven from any suitable source of power applied through a main driving pulley 35, this pulley being mounted on overhead cross shaft 36, suitably geared at 37 to the vertical shaft 27, which supports the horizontally rotating carrier 28—25. This shaft 27 preferably passes downwardly between the winding spools 16′ of the magnet 16, and it may have bearings in the bars 40 and 41 of the magnet frame. The magnet 16 may be adjustably supported from overhead frame bars 43, by means of hanger screws 42. These screws allow the magnet 16 to be raised or lowered.

The apron 2 is driven from shaft 36 by means of a belt or chain 45 passing over pulleys or sprocket wheels 46—47 respectively.

It will be observed that we have provided receiving chutes 50 having flaring upper ends to receive the magnetite dropped from the conveying annulus 25 while traversing the neutral zones between the respective pole pieces of the magnet 16. These chutes deliver the magnetite at the sides of the machine, or into any suitable receiver, whereas the non-magnetizable material is discharged at the rear end of the apron 2, as above stated.

It will, of course, be understood that the annulus 25 is not only formed of non-magnetizable material, but that its supporting disk 28 will also be preferably formed of similar material, made sufficiently thick to provide the required strength. The apron 2 and also the idle rollers 12 are non-magnetizable, the lines of force being therefore concentrated across the gap between the pole pieces of the electro-magnet, and the pole pieces 24 of the induced magnet below the apron. It is not essential whether the magnet below the apron be wound or not. If wound, the pole pieces must, of course, be of opposite polarity from the opposed pole pieces above the apron.

We claim:—

1. A magnetic separator, including the combination with a main horizontally disposed conveyer for the material to be separated, of a magnet having segmental pole pieces and a coöperating inductor magnet arranged to establish a magnetic field

through the conveyer, and a cross conveyer of thin, non-magnetizable material having an annular depressed portion, traversing the magnetic field immediately above the first mentioned conveyer and substantially in contact with the magnet, said cross conveyer comprising a revolving disk provided with a flat annular carrier portion having a segment in the magnetic field insufficient in thickness to afford the requisite mechanical strength, and reinforced by an outer annular rim adapted to travel in close proximity to said pole pieces, whereby the carrier portion of the disk may be utilized to convey magnetizable material from the main conveyer while maintaining a magnetic gap of minimum dimensions and maximum intensity.

2. A structure as set forth in claim 1, in which the cross conveyer is also provided with a stiffening rib adjacent to the interior edge of the annular portion, and the outer rim being conically expanded to its upper margin.

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

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