No. 805,854. PATENTED NOV. 28, 1905.

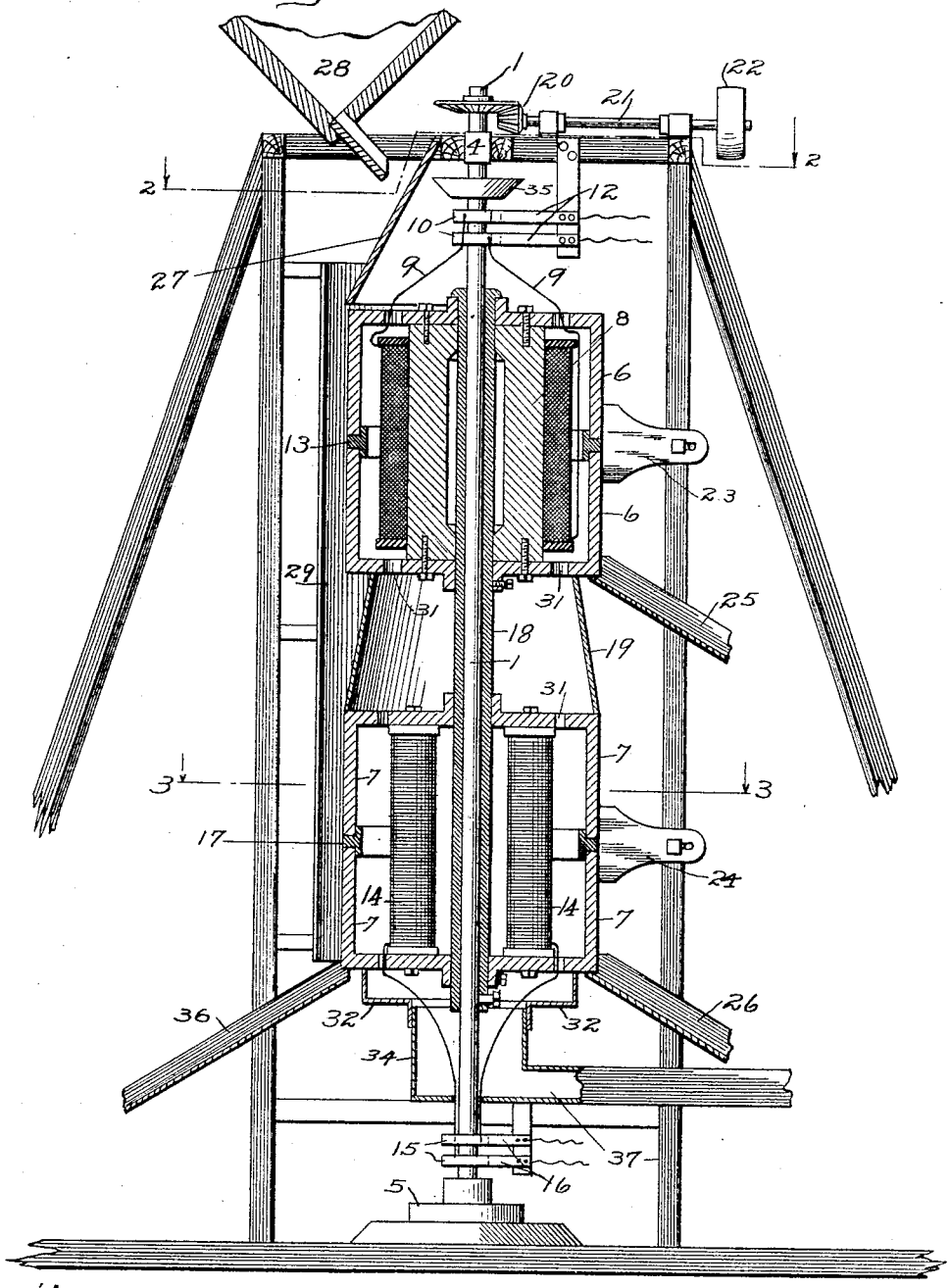
E. HEDBURG.

MAGNETIC ORE SEPARATOR.

APPLICATION FILED JAN. 15, 1904.

2 SHEETS—SHEET 1.

Fig. 1.



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2 SHEETS—SHEET 2.

Fig. 2.

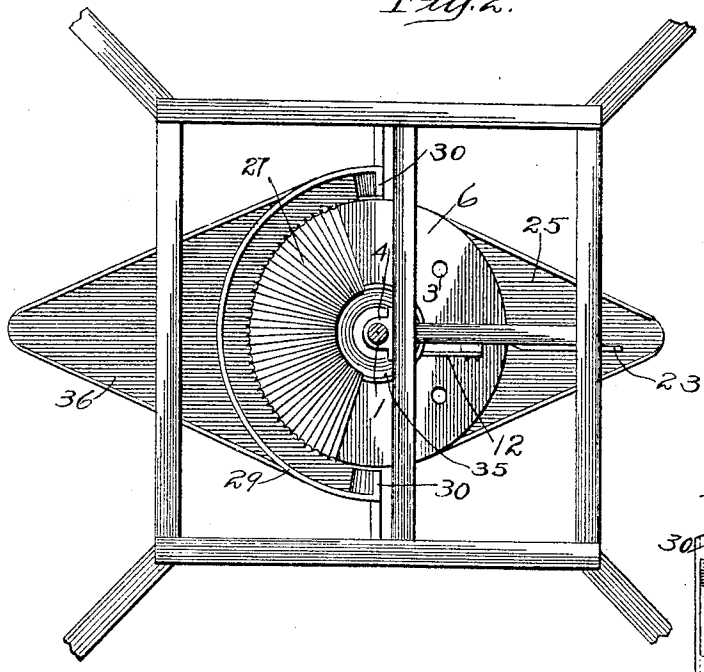


Fig. 4.

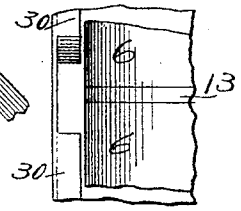


Fig. 3.

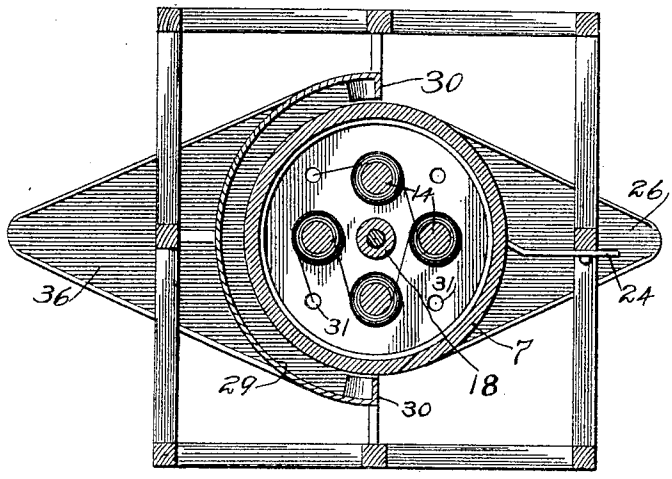
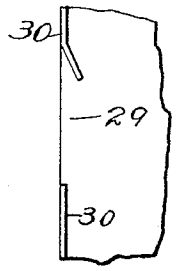


Fig. 5.



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UNITED STATES PATENT OFFICE.

ERIC HEDBURG, OF JOPLIN, MISSOURI, ASSIGNOR, BY MESNE ASSIGNMENTS, TO AMERICAN REDUCTION COMPANY, OF CHICAGO, ILLINOIS, A CORPORATION OF ARIZONA TERRITORY.

MAGNETIC ORE-SEPARATOR.

No. 805,854. Specification of Letters Patent. Patented Nov. 28, 1905.

Application filed January 15, 1904. Serial No. 189,081.

To all whom it may concern:

Be it known that I, ERIC HEDBURG, a citizen of the United States, residing at Joplin, in the county of Jasper and State of Missouri, have invented certain new and useful Improvements in Magnetic Ore-Separators, of which the following is a description.

The object of this invention is to provide a magnetic separator which will separate ores while the ores are moderately hot and which will separate gold, silver, nickel, copper, and iron ores from zinc and other ores in one operation and accomplish such separation without the use of conveyer-belts, as are common in other machines, in which the ore is lifted *en masse* by magnetic attraction from the conveyer-belts, causing a mechanical entanglement of magnetic and non-magnetic ores under treatment, a consequent loss of metal, and a very unsatisfactory separation of the various minerals.

With the above-named objects in view my invention consists in the novel construction, combination, and arrangement of parts, as hereinafter described and claimed.

Referring now to the accompanying drawings, Figure 1 is a central vertical section of a magnetic separator constructed in accordance with my invention. Fig. 2 is a sectional plan view of the same, taken on the irregular line 2 2 of Fig. 1. Fig. 3 is a horizontal section of the lower magnet and adjacent parts, taken on line 3 3 of Fig. 1. Fig. 4 is a detail view in elevation of one of the deflectors. Fig. 5 is an edge view of the deflector as seen from the inside.

1 designates a central vertical shaft having an upper and a lower bearing 4 and 5, respectively. Fixed upon said shaft are two electromagnets, the upper one of which will be hereinafter designated 6 and the lower magnet 7. The upper magnet comprises a single concentric iron core 8, upon which are wound a suitable number of turns of insulated copper wire. The terminals or leaders 9 of this wire are connected, respectively, to a pair of collector-rings 10, which are mounted on the shaft 1, (and insulated therefrom.) These rings are provided with electrical "brushes" 12, which are connected to a source of electricity, preferably a direct-current dynamo-electric machine. Secured to the lower end of the magnet-core 8 is a cup-shaped pole-piece 6′, and secured to the upper end of said core is a similar but inverted-cup-shaped pole-piece 6″. The proximate edges of these pole-pieces are separated for the purpose of providing a break in the magnetic circuit, and the annular gap thus formed is filled up with a ring 13 of non-magnetic material, preferably brass, zinc, or other non-magnetic material.

The lower magnet 7 may be identical in construction with that of the upper magnet just described; but I prefer to employ in the lower magnet a plurality of eccentrically-disposed cores 14. (Most clearly shown in Fig. 3.) The windings of these coils may be connected either in series or multiple or in multiple series, as preferred. A single pair of leaders pass through the lower pole-piece 7′ and are connected to collector-rings 15, having brushes 16, which are connected to a source of a direct electrical current in parallel with the feeders which supply the upper magnet 6. 17 is the ring which is interposed between the pole-pieces 7′ and 7″ of this lower magnet.

The sizes or number of turns of wire forming the windings of the upper and lower magnets are so proportioned that the lower magnet 7 will be more highly magnetized than the upper magnet 6. For example, the lower magnet may pass a current having a strength of fifteen amperes, while the upper magnet would pass only 7 amperes. The winding may easily be arranged, however, so that the lower magnet would require no more electrical energy than the upper magnet and yet would be more highly energized. This, however, is immaterial.

A sleeve or bushing 18, preferably of brass or zinc, may be tightly secured on the shaft 1, passing through both magnets, thereby partially insulating the cores magnetically from the shaft. A cylindrical piece 19, made of non-magnetic metal, should be interposed between the upper and the lower magnet to prevent the ore from lodging upon the top of the lower magnet and to confine the air which is used to cool the magnets.

The shaft 1 may be rotated in any preferred manner. As shown, it is driven through the intermediacy of bevel gear-wheels 20, a counter-shaft 21, and a pulley 22. The latter may be belted to a driving-pulley. (Not shown.)

A scraper 23 is placed in contact with the

pole-pieces of the upper magnet 6 equally above and below the dividing-ring 13, as shown, as the portions of the pole-pieces directly adjacent to said ring become the most strongly magnetized, and hence attract the largest quantity of the ore. A similar scraper 24 is provided for the lower magnet 7. Below the upper scraper 23 is a receptacle 25, adapted to receive the ore that is removed from the magnet by the scraper, and a similar receptacle 26 is provided below the lower scraper 24.

Above the upper magnet I secure a preferably-corrugated sector-shaped apron or spreader 27, the function of which is to deliver the ore to a point just above the upper magnet in the arc of a circle, so that the ore will fall from the lower edge of the spreader in contact with a considerable portion of the periphery of the magnet. (See Fig. 2.) The ore may be delivered to the spreader 27 through a spout or hopper-bottom 28, partly embracing the magnets.

Directly below the spreader 27, but suitably spaced outwardly a suitable distance therefrom, is a fixed semicylindrical housing 29, made preferably of non-magnetic material. The purpose of this housing is to prevent any of the falling ore from scattering away from the magnets. As shown in Figs. 2 and 3, the vertical edges of the housing are turned inwardly, forming flanges 30, the edges of which are in contact with the respective pole-pieces, excepting that one flange is cut away from a certain distance above each ring 13–17 to an equal distance below the same, as shown in Fig. 4, the object being to permit the magnetic ore adhering to the pole-pieces to be carried around to the scrapers 23 and 24. The said flange just above each of the aforesaid openings therein is bent or inclined laterally in such a direction as to prevent any non-magnetic ore from falling out through said openings (see Fig. 5) or into spout 25 or 26.

Any preferred means may be provided for preventing the magnets from becoming overheated, as the ores are delivered thereto at a temperature of about 250°. As shown in Fig. 1, I provide means for causing a current of air to traverse the interior of both the upper and the lower magnets. To this end I provide air holes or openings 31 through the magnet-head or pole-pieces, as shown, and secure to the bottom of the lower magnet an air-chamber 32, having a depending flange which fits rotatably the mouth of a stationary air-chamber 34, having a trunk 37, which is connected to a suitable blower. (Not shown.) The cooling effect of the moving air upon the magnets is well known and is obvious, the air escaping through the top of the upper magnet 6.

35 is an oil-receptacle or drip-cup fixed on the shaft 1 to receive the surplus oil that runs down the shaft from the bearing 4.

The lower bearing 5 may be of any of the well-known or improved types of antifriction-bearings.

The operation is as follows: Supposing that mingled ores are fed into the hopper 28, the shaft 1 is rotated and the magnets are energized by electrical currents supplied thereto through the brushes and rings aforesaid. The ores are spread out by the spreader 27 and fall past the upper pole-pieces 6, except the highly magnetic ores which adhere thereto and are removed by scraper 23. The less magnetic ores are caught by the lower pole-pieces 7 and are removed by scraper 24, while the non-magnetic ores fall into a spout 36, opposite spout 26.

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

1. In a compound magnetic ore-separator, and in combination a vertical shaft, an upper electromagnet mounted axially thereon said magnet including two pole-pieces forming a shell which incloses the windings of the magnet, a ring of non-magnetic material separating the proximate edges of the pole-pieces, a spreader-apron above said upper electromagnet, a lower electromagnet mounted axially on said shaft, said lower magnet having two pole-pieces which inclose its windings, a non-magnetic ring separating the proximate edges of the pole-pieces, the outer surfaces of the respective rings being in line with and forming continuations of the outer surfaces of the pole-pieces, means for rotating the magnets, and a flat-surfaced scraper arranged adjacent the outer surface of the magnets and overlapping the contiguous portions of the pole-pieces for removing adhering ores from the rotating pole-pieces.

2. In a compound magnetic ore-separator, and in combination a vertical shaft, an upper electromagnet mounted axially thereon, said magnet including two pole-pieces forming a shell which incloses the winding of the magnet, a ring of non-magnetic material separating the proximate edges of the pole-pieces, a spreader-apron above said upper electromagnet, a lower electromagnet mounted axially on said shaft, said lower magnet having two pole-pieces which inclose its windings, a non-magnetic ring separating the proximate edges of the pole-pieces, means for more strongly energizing the lower electromagnet than the upper one, means for rotating the magnets, and scrapers arranged adjacent said rings and extending upon opposite sides thereof for removing adhering ores from the rotating pole-pieces.

3. In a compound magnetic ore-separator and in combination a vertical shaft, an upper and a lower electromagnet mounted axially thereon, each magnet being provided with two pole-pieces which form a shell inclosing the windings, and with a non-magnetic ring having a central outwardly-extended flange upon

which the contiguous edges of the pole-pieces rest whereby the latter are separated, said pole-pieces having air-passages therethrough, means for supplying a current of air to the interior of the lower magnet, and means for conducting the current of air from the lower magnet into the interior of the upper magnet.

4. In a compound magnetic ore-separator, the combination of a vertical shaft, an upper electromagnet mounted axially thereon, said magnet including two pole-pieces forming a shell which incloses the windings of the magnet, and a ring of non-magnetic material separating the proximate edges of the pole-pieces and affording no obstruction beyond the outer surface of the same, with a lower electromagnet mounted axially on said shaft, said lower magnet having two pole-pieces which inclose its winding, a non-magnetic ring separating the proximate edges of the pole-pieces and affording no obstruction beyond the outer surface of the same, a spreader-apron above said electromagnet, a semicylindrical inclosing shield or guard arranged beneath the spreader-apron to conduct the falling material in proximity to the magnets, means for rotating the magnets, and means for removing adhering ores from the rotating pole-pieces.

5. In a compound magnetic ore-separator and in combination, a vertical shaft, an upper electromagnet mounted axially thereon, said magnet including two pole-pieces forming a shell which incloses the winding of the magnet, a ring of non-magnetic material separating the proximate edges of the pole-pieces, a lower electromagnet mounted axially on said shaft, said lower magnet having two pole-pieces which inclose its windings, a non-magnetic ring separating the proximate edges of the pole-pieces, a spreader-apron arranged above said upper electromagnet, a shield or guard spaced from the magnets having inwardly-extending flanges in proximity thereto below the spreader-apron, means for rotating the magnets, and means for removing adhering ores from the rotating pole-pieces.

6. In a magnetic ore-separator, a vertical shaft, an electromagnet mounted axially thereon, said magnet including two pole-pieces forming a shell which incloses the windings of the magnet, a ring of non-magnetic material separating the contiguous edges of the pole-pieces but affording a continuous outer surface for the magnet, a spreader-apron, and a scraper engaging said outer surface, said scraper extending over the non-magnetic ring and overlapping the adjacent edges of the respective poles, and an inclosing housing extending below said spreader, said housing having inwardly-extended vertical flanges in close proximity to the magnet, but cut away at the non-magnetic ring portion thereof.

7. In a magnetic ore-separator, a vertical shaft, an electromagnet mounted axially thereon, said magnet comprising two pole-pieces which form a shell inclosing the windings, and a non-magnetic cylinder abutting the inner surfaces of the respective pole-pieces, said cylinder having an annular flange upon which the adjacent edges of the pole-pieces rest, the outer edge of the flange forming a continuation of and offering no obstruction beyond the outer edge of the pole-pieces.

In testimony whereof I have hereunto signed my name in the presence of two subscribing witnesses.

ERIC HEDBURG.

Witnesses:
SAMUEL HANSON,
ERIC F. OBORG.