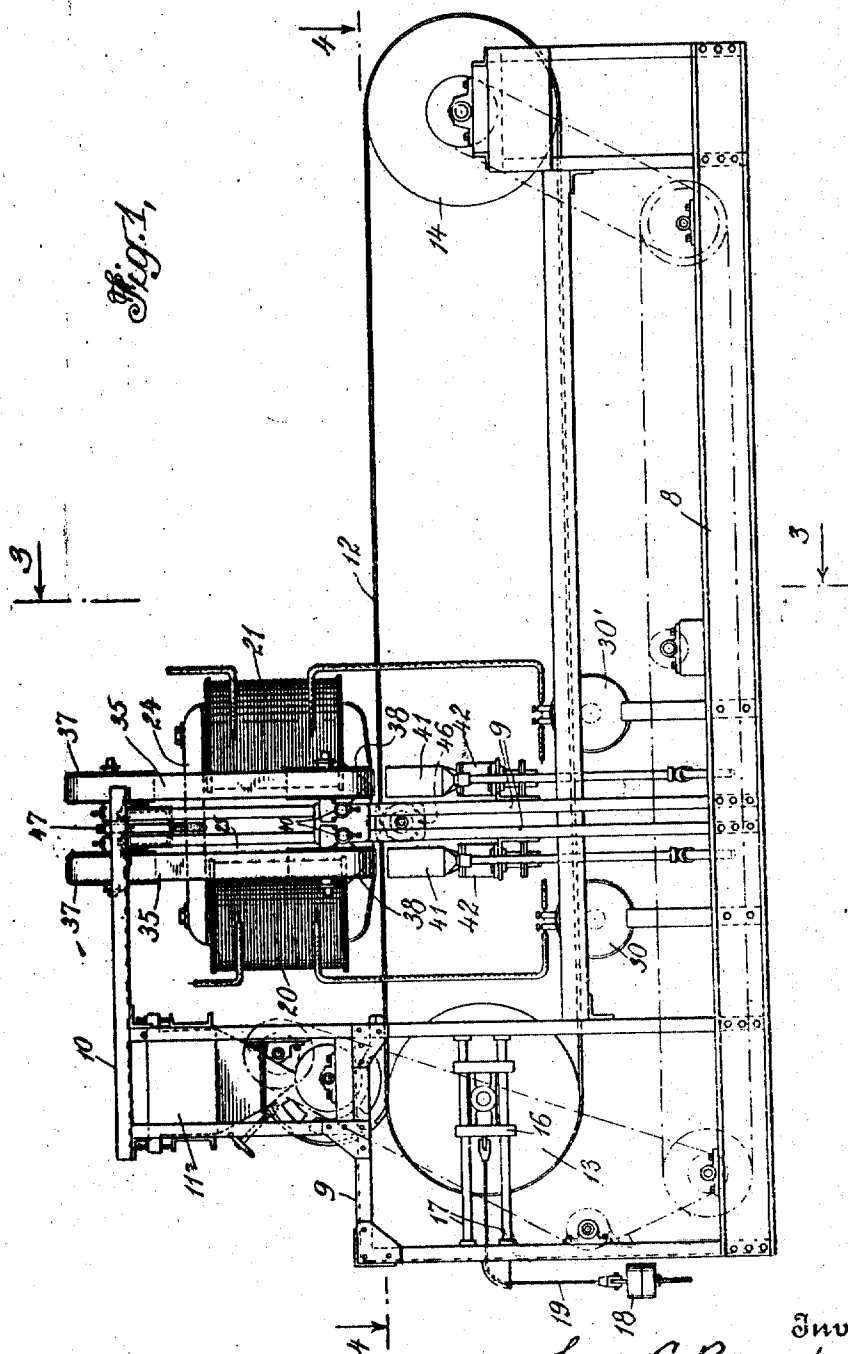


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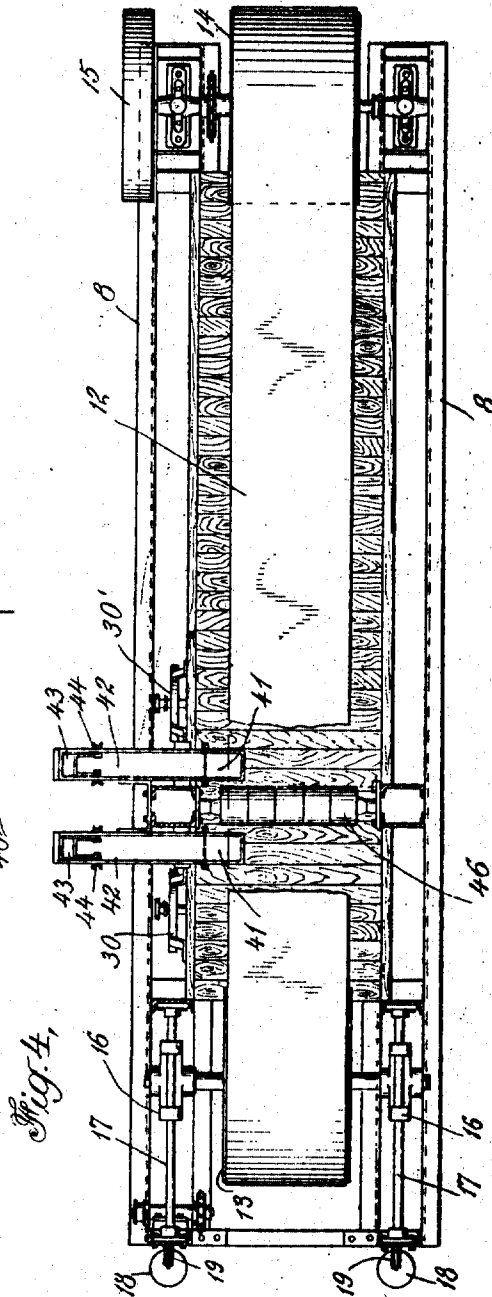
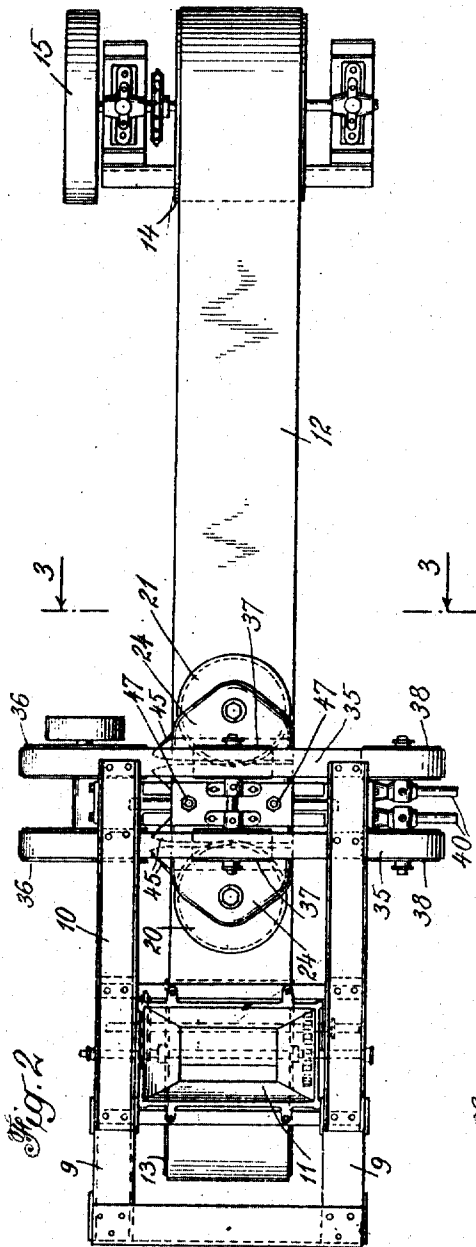


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MAGNETIC ORE SEPARATOR.
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Patented May 13, 1919.
3 SHEETS—SHEET 2.

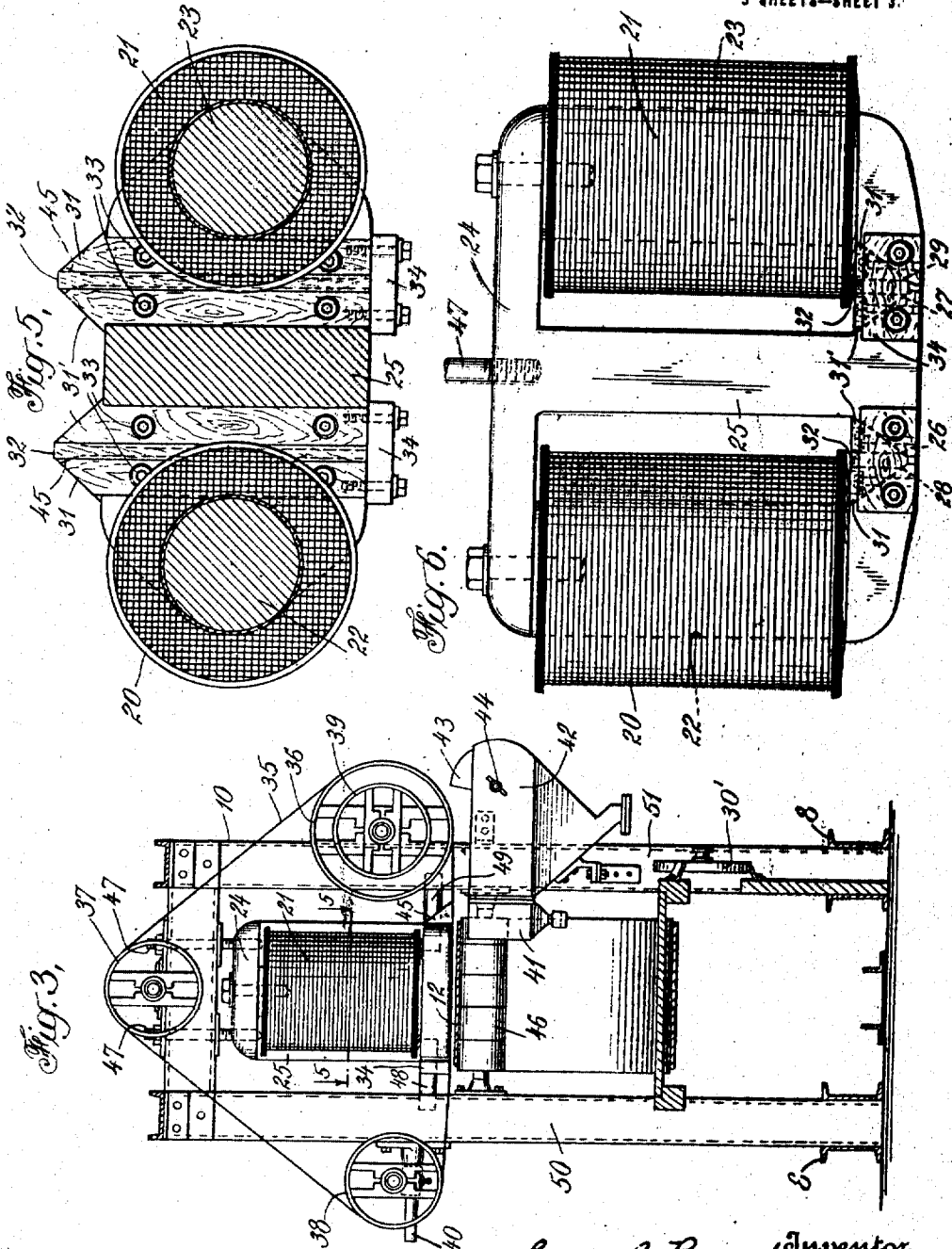


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UNITED STATES PATENT OFFICE.

LEWIS G. ROWAND, OF BROOKLYN, NEW YORK, ASSIGNOR TO THE NEW JERSEY ZINC COMPANY, OF NEW YORK, N. Y., A CORPORATION OF NEW JERSEY.

MAGNETIC ORE-SEPARATOR.

1,303,398.

Specification of Letters Patent.

Patented May 13, 1919.

Original application filed June 21, 1917, Serial No. 176,027. Divided and this application filed April 1, 1918. Serial No. 225,894.

To all whom it may concern:

Be it known that I, LEWIS G. ROWAND, a citizen of the United States, residing at Seagate, borough of Brooklyn, in the county of Kings, State of New York, 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.

The present invention relates to electromagnets for use in ore separators of the type in which the ore in finely divided condition is carried by a conveyer belt into a magnetic field which is so disposed as to lift the magnetic particles out of the gangue and against the bottom of another conveyer belt disposed at right angles to the ore conveyer and operating to divert these lifted magnetic particles laterally with respect to the ore conveyer and finally discharge them into a suitable receptacle. A separator of this general type is disclosed in U. S. Letters Patent No. 596,719, issued to me January 4, 1898.

It is an object of the present invention to improve the construction of electromagnetic units particularly adapted for use in such ore separators, by producing an electromagnet by which a plurality of magnetic fields may be set up, each of which may be independently adjusted in intensity and in which alterations of field strength due to changes in the relation of the parts of the electromagnet are effectively prevented.

There are certain other objects to be accomplished and certain inherent advantages in the apparatus of the present invention, all of which will be appreciated by those skilled in this art, and to the more important of which reference is particularly made in the following detailed description.

In the accompanying drawings—

Figure 1 is a side elevation of an ore separator containing an electromagnet embodying the present invention;

Fig. 2 is a plan view of the same, certain of the underlying elements being omitted for the sake of clearness;

Fig. 3 is a transverse elevation on the line 3-3 of Figs. 1 and 2;

Fig. 4 is a plan view on the horizontal section 4-4 of Fig. 1, a part of the ore-carrying belt being broken away to disclose elements beneath;

Fig. 5 is a horizontal section through the electromagnet on the line 5-5 of Fig. 3;

Fig. 6 is an elevation of the electromagnet.

In the embodiment illustrated, the ore separator has for its foundation, suitable girders 8. At the front end of the machine is a rectangular framework 9, superimposed on which is a smaller framework 10, whereon is mounted the ore feeding hopper 11. Ore from the hopper is fed in regulated amount by a feed roller suitably driven and for which no novelty is claimed herein, the ore being finally delivered to a substantially horizontal belt 12 of duck or other suitable fabric, stretched rather tightly between cylindrical drums 13 and 14, one of which is at the rear end of the machine and suitably driven, as by a belt pulley 15, and the other of which is carried in a pair of bearings 16, each mounted to slide on a pair of horizontal supporting bars 17. A counterweight 18 and a flexible tension band 19 serve, as shown in Fig. 1, to keep the ore carrying belt suitably taut under all conditions of operation.

In delivering the finely divided ore to the conveyer belt, it should fall upon the belt in a thin, well distributed layer, and preferably the particles should at the instant of delivery to the belt, be traveling in the same direction as the belt and at about the same speed. This is easily arranged for by adjustable deflectors and other like expedients well known in the art.

The electromagnetic device into the field or fields of which the ore is first transported by the conveyer belt, has vertically disposed coils or windings 20 and 21 which are provided respectively with cylindrical iron cores 22 and 23 suspended by bolts from a magnetizable yoke 24. But in addition to the cylindrical outer cores on which the coils are mounted, there is a third or intermediate core or pole 25 integral with or attached to yoke 24, and preferably of rectangular cross-section, as shown in Fig. 5, but with an enlarged bottom end, as shown in Fig. 6, to

form constricted pole tips 26 and 27, which respectively are positioned opposite the similarly shaped pole tips 28 and 29 with which the cylindrical cores 22 and 23 are provided, as shown in Fig. 6.

The electrical current in winding 20 is controllable by a rheostat 30, and a similar rheostat 30' is in circuit with coil 21. The two coils 20 and 21 can, if desired, be connected in series, but I prefer that their circuit shall be independent so that thereby I can, by suitable regulation of the current, make the magnetic flux or field between pole faces 27 and 29 greater than that between pole faces 26 and 28. Coils 20 and 21 are of course so connected as not to neutralize one another, but on the contrary, to supplement one another in magnetizing the intermediate core 25, and the latter is for this reason equal to or larger than the cross-section of the two adjacent cylindrical cores.

With windings 20 and 21 fully energized, there is a strong tendency for the pole faces to approach one another and a heavy lateral strain is thereby put on the bolts whereby their cores are supported. Any slight variation in the distance between adjacent pole pieces would, of course, have a pronounced effect on the magnetic field, and I therefore adequately protect the electromagnetic structure by abutments of wood or other non-magnetic material introduced in each air gap. The abutment also keeps dirt out of the air gap.

Each abutment comprises a pair of wedge-shaped blocks 31 and 31', between which is interposed a flat strip 32. Vertical bolts 33, threaded into the pole tips, serve to hold the tapering blocks firmly against the inclined face of the metal pole and tightly wedged against the intervening flat strip 32. The lower edge of this flat strip is flush with the bottom face of the pole tips, and by its presence gives a smooth bearing surface for the transverse belts hereinafter described. A wooden or other non-magnetic block 34, bolted to each wedge block, as shown in Fig. 5, gives greater security to the structure and a rounded face for the belt.

It is, of course, the function of this combined electromagnet to lift from the upper face of the adjacent conveyer belt the more easily magnetizable particles or grains of the ore, and, if desired, the magnetic field between the pole faces 26 and 28 may be weaker than the magnetic field between pole faces 27 and 29, thereby giving a selective action on particles which have different capacities for magnetization. As a means for receiving the particles and transporting them laterally for deposit in a suitable receptacle or chute, there is provided under each air gap of this electromagnetic unit a discharging belt 35. Each of these belts is mounted as shown in Fig. 3 on three drums

36, 37 and 38. Drum 36 is on a shaft to which a pulley 39 is secured for driving. The bearings for drum 38 are adjustable along a horizontal bar 40 to vary the length of the conveyer belt and thereby compensate for its stretching. Each discharging belt 35 slides along the under-face of the electromagnetic structure just beneath one of the air gaps, and when an ore particle is lifted by the electromagnets, it strikes against the under-face of discharging belt 35 and thereby is conveyed at right angles to its previous path and ultimately is delivered into a hopper at the side of the main ore conveying belt 12.

In the embodiment illustrated in Fig. 3, two hoppers are provided, a small one marked 41 being positioned just under the edge of the ore conveyer to collect such particles or grains of non-magnetic material as may become entangled with the truly magnetic material, and thereby diverted from the ore-laden belt. The truly magnetic material is, however, carried over into a larger hopper 42, or, at least is given such impetus in that direction that when released from the influence of the magnetic field, it falls therein. A hood 43 may be provided at the extreme outer end of this hopper to catch such particles as might otherwise be projected beyond the hopper. This hood can be pivotally mounted at 44 with a sand and wing nut to govern the distance of its front edge from the adjacent conveyer and pulley.

As a means for prolonging the time during which the magnetizable particles are under the influence of the magnetic field, and thereby insuring their delivery beyond the tangles hopper 41, I provide all four of the pole faces with a tapering lateral projection 45, somewhat after the principle disclosed in my above identified Patent No. 596,719. There is, therefore, a gradual diminution of the magnetic effect on the particle as it is moving laterally away from the electromagnet and into the receiving hopper, and with proper adjustment of conveyer speeds, electromagnetic strength and size and position of hoppers, there is no danger of a truly magnetizable particle dropping back on ore conveyer 12 or into hopper 41 instead of into hopper 42.

For reasons which will now be apparent, the double electromagnetic unit above described must be maintained at a proper and relatively definite height above the ore conveyer 12, and to attain this end, there is provided a drum or roller 46 (Fig. 3) to support the ore conveyer at a definite height under the electromagnetic unit, and the unit itself is adjustably supported from above on a plurality of bolts 47. Anchoring lugs or jacks, indicated somewhat diagrammatically at 48 and 49 (Fig. 3), may, by engagement with

the vertical steel support columns 50 and 51, serve to steady or anchor the lower end of the electromagnetic unit.

With the electromagnetic unit constructed as shown and described the belts 35 may be removed without disconnecting or changing the adjustment of any parts, except the wires leading to the coils of the magnets, if these wires are arranged as shown in Fig. 1. In practice, however, the wires will be so disposed, as for instance by being placed between the belts, that the latter may be removed without even disconnecting the wires.

As indicated in the plan view (Fig. 4), each discharging belt 35 has its own pair of hoppers 41 and 42, and as both the belts 35 can with convenience be driven from the same pulley 39 (Fig. 2), it is advantageous to have all four of these hoppers on the same side of the machine, even though the material gathered by one pair may be somewhat different in grading from the material gathered by the other pair.

While I am aware that various changes in detail may be made in the apparatus without departing from the spirit of the present invention as defined by the appended claims, the preferred embodiment above described and illustrated in the drawings is one which has been used with success.

I claim:—

1. An electromagnetic unit comprising a pair of coils, each provided with a magnetizable core, and a magnetizable pole magnetically cooperating with said cores and positioned between said coils to form a pair of elongated magnetic air gaps, of substantially the same size and shape and rigid spacers of non-magnetic material filling said gaps and holding said cores and intermediate pole in proper spaced relation, substantially as described.

2. An electromagnetic unit comprising a pair of windings each having a magnetizable core, an intermediate core magnetized by said windings and having a cross section at least equal to that of both of said cores, said intermediate core being adapted to cooperate with the other cores to form a pair of elongated magnetic air gaps, and means associated with the air gaps to maintain a predetermined width thereof.

3. An electromagnetic unit comprising a pair of coils, each provided with a magnetizable core, a magnetizable pole magnetically cooperating with said cores and positioned between said coils, said cores and said pole being provided with enlarged pole pieces converging toward each other to form nar-

row air gaps, and means inserted in the air gaps to maintain a predetermined width thereof.

4. An electromagnetic unit comprising a pair of windings the current in each of which may be independently controlled, a magnetizable core for each winding, an intermediate pole cooperating magnetically with the cores, said cores and said enlarged pole being formed with pole pieces converging toward each other to form narrow air gaps, the intensity of the magnetic fields of which may be independently controlled and means inserted in each gap to prevent variations in the width thereof when the windings are energized.

5. An electromagnetic unit comprising a pair of coils, a magnetizable core for each coil, an intermediate pole cooperating magnetically with the cores, said cores and said pole being formed with tapering pole tips converging toward each other at right angles to the longer axes of said cores and said pole, and means inserted between the pole tips to maintain them in predetermined spaced relation.

6. An electromagnetic unit comprising a pair of coils, a magnetizable core for each coil, an intermediate pole cooperating magnetically with the cores, and forming with the free ends thereof elongated magnetic air gaps, a spacer of non-magnetic material in each air gap and members of non-magnetic material fastened to the ends of said cores and pole and between which said spacers are clamped.

7. An electromagnetic unit comprising a pair of windings, a magnetizable core for each winding provided with inwardly directed tapering pole pieces, an intermediate core cooperating magnetically with the other cores and provided with an enlarged pole piece having tapering extensions terminating adjacent the pole pieces of the first mentioned cores to form relatively narrow magnetic air gaps.

8. An electromagnetic unit comprising two outer cores each provided with enlarged pole pieces, tapering toward each other, an intermediate core having a cross section at least equal to the combined cross sections of the outer cores and provided at its free end with tapering extensions terminating near the pole pieces of the outer cores to form relatively narrow magnetic air gaps, and a magnetizing winding associated with each of the outer cores.

In testimony whereof I affix my signature.

LEWIS G. ROWAND.