

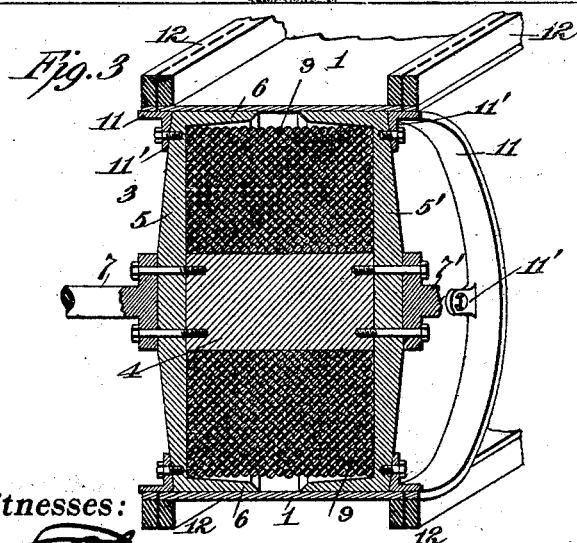
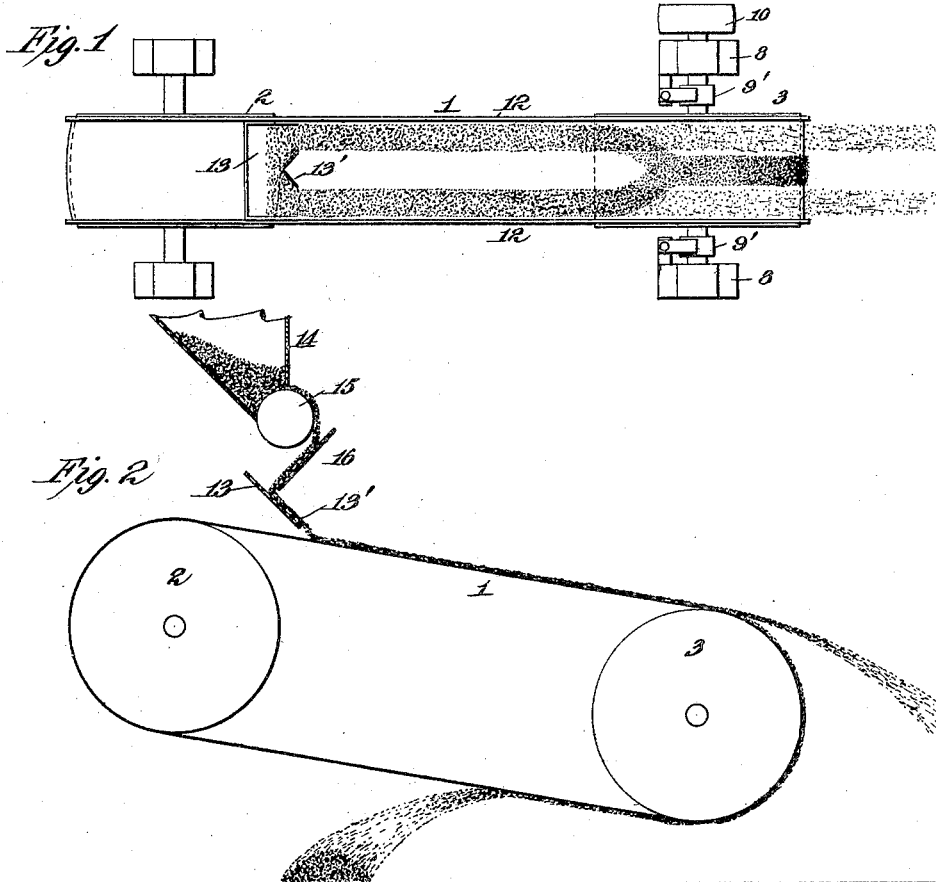
No. 676,841.

Patented June 18, 1901.

T. A. EDISON.
MAGNETIC SEPARATING APPARATUS.

(Application filed July 2, 1900.)

(No Model.)



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UNITED STATES PATENT OFFICE.

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MAGNETIC SEPARATING APPARATUS.

SPECIFICATION forming part of Letters Patent No. 676,841, dated June 18, 1901.

Application filed July 2, 1900. Serial No. 22,259. (No model.)

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, a citizen of the United States, residing at Llewellyn Park, in the county of Essex and State of New Jersey, have invented a certain new and useful Improvement in Magnetic Separating Apparatus, (Case No. 1,040,) of which the following is a description.

My invention relates to an improved apparatus for separating the more or less magnetic particles from the non-magnetic gangue with which they are intermixed; and my invention is particularly adapted for use in the concentration of magnetic iron ore, such as magnetite.

One of the difficulties in magnetic separation is that non-magnetic particles become entangled with the magnetic particles and are carried through the apparatus, and a common expedient at the present time is to subject the material to agitation during the concentrating operation, so as to prevent the entrainment or entanglement of the non-magnetic particles with the magnetic particles.

My object generally is to provide a magnetic separating apparatus by which the operation may be performed expeditiously and a more perfect separation secured than is now possible.

In carrying my invention into effect I employ a properly-supported endless belt which at one end passes around or moves concentrically with respect to a powerful magnetic field, so as to generate centrifugal force in lines extending tangentially from the magnetic field, the latter being preferably formed by utilizing the supporting wheel or pulley which carries the belt as a rotating magnet, as I will more fully hereinafter describe. By operating the belt at a sufficiently high speed as to result in the generation of considerable centrifugal force the non-magnetic particles fed to the belt will be actually disentangled from the magnetic particles by the centrifugal force and thrown off, so as to be effectively separated from the magnetic particles, which are attracted by the magnetic field and ultimately removed by the stripping action of the belt. In order to further facilitate the complete separation of the magnetic particles, I cause the belt to travel concentrically with respect to a zone of maximum magnetic at-

traction, and I feed the material to the belt in one or more areas arranged out of line with such zone, whereby as the material approaches the magnetic field the magnetic particles will be caused to progress laterally with respect to the non-magnetic particles and toward such zone. In this way a preliminary agitation of the mixed magnetic and non-magnetic particles is secured, so that when the centrifugal effect is experienced the separation will be facilitated, while the magnetic particles will be drawn toward the zone of maximum magnetic attraction, so as to be less influenced by the centrifugal effect. In order to further facilitate the complete separation of the magnetic and non-magnetic particles, I prefer to pass the feed-belt around a rotating cylindrical magnet inclosing a magnetizing-coil, its outer periphery forming two magnetic poles, with a relatively narrow gap between them, the ampere-turns of the coil being preferably sufficient to nearly magnetically saturate the poles, whereby lines of force will be developed between the poles, said lines of force extending up through the feed-belt, so as to influence the magnetic particles thereon, and I deliver the material in two zones at the side of the belt, whereby the magnetic particles will not only progress laterally toward the gap between the poles, but by reason of such lines of force they will form into magnetic hairs or lines extending laterally away from the surface of the belt and progressing toward the polar gap in that form.

In order to properly feed the material to the belt, which runs at a very high surface speed, and to cause the material to be properly distributed thereon in contracted areas which are located out of line with the zone of maximum magnetic attraction, I find it desirable to deliver the material to the belt at approximately the same speed as that at which the belt is running, so that the particles will not be appreciably disturbed after they have been delivered to the belt and before reaching the magnetic field. I also prefer to employ at each side of the belt a flexible rim made, for instance, of rubber and which prevents material from escaping therefrom.

In order that my invention may be better

understood, attention is directed to the accompanying drawings, forming part of this specification, in which—

Figure 1 is a plan view of an apparatus embodying my present invention, showing the feeding of the material to the belt in two streams or zones; Fig. 2, a longitudinal sectional view; Fig. 3, a section through the preferred construction of rotating magnet, showing the belt in place thereon; and Fig. 4, an enlarged sectional view of a portion of the magnet and belt, illustrating the lines of force diagrammatically.

In all of the above views corresponding parts are represented by the same numerals of reference.

1 represents a belt, which at one end passes over a pulley or wheel 2, suitably crowned, as shown, so that the belt will run true thereon, and at the other end preferably over a rotating magnet 3. The pulley 2 is made by preference of wood mounted on a brass shaft, so as to be non-magnetic. The preferred construction of the magnet 3 is shown more clearly in Fig. 3, said magnet being formed of a cylindrical core 4, to each end of which is bolted a disk 5 5', said disks being formed with overhanging extensions 6, forming the magnetic poles. Preferably the disks 5 5' are tapered, as shown, in order that the magnetic capacity thereof may be practically uniform at all points. In order to support the magnet, the shaft-sections 7 7' are bolted to the disks 5 5', as shown, the shaft-sections being made of brass mounted in babbitted non-magnetic bearings 8, whereby any tendency of the magnetic material to adhere to the shaft and bearings, as would be the case if these elements were of iron or steel, is prevented.

9 represents the coil, which usually has sufficient ampere-turns to nearly saturate the magnetic poles 6 6, said coil being supplied with current in any suitable way—as, for instance, by means of collecting-rings and brushes 9'. Power may be applied to the shaft-sections to rotate the magnet by a pulley 10. The gap formed between the magnetic poles 6 6 may be filled with some non-magnetic material, such as wood or cord, or be left open. On the outside of each disk 5 5' is a ring 11, made of brass or other non-magnetic metal, said ring being formed with lugs 11', by which it is bolted in place, and the rings forming non-magnetic extensions of the poles 6 6, as shown. The belt 1 extends practically the entire width of the magnetic face of the rotating magnet 3, as well as of the non-magnetic extensions 11, as shown, and is made of leather, canvas with a calendered surface, or any other suitable smooth material. At its sides it is preferably provided with rims 12, made of any suitable flexible material, such as rubber, sewed in place, as shown in Fig. 3. By making these sides of a flexible material they will be permitted to pass radially around a rotating magnet of

small diameter in order that a powerful centrifugal force may be generated. Preferably the belt 1 is inclined, as shown, and material is fed thereto from a chute 13 or in any other suitable way, the inclination of the chute and belt being such that the material delivered by the chute will at the instant it strikes the belt be moving at approximately the surface speed of the belt, so as to be deposited thereon without disturbance in the desired zone or zones. The gap between the magnetic poles 6 6 constitutes the zone of maximum magnetic attraction, and preferably the material is fed to the belt at each side of said zone, as shown. To effect this, the chute 13 is preferably provided at its bottom with deflecting-partitions 13', by which the material will be subdivided, as will be understood. The mixed pulverized magnetic and non-magnetic particles are supplied to a hopper 14, from which they are delivered by a roller-feed 15 and strike against a checking-plate 16, falling thence upon the chute 13.

The operation will be as follows: Power is applied to the shaft-sections 7 7' to rotate the magnet and drive the belt 1, and the mixed magnetic and non-magnetic particles are fed to the belt in two streams, as shown, by means of the chute 13. The speed at which the belt is driven is very high, being about five hundred feet per minute for ordinary magnetite; but this speed should be so proportioned to the magnetic attraction of the magnet, to the magnetic affinity of the magnetic materials, and to the diameter of the magnet as not to result in the generation of a greater centrifugal force than is necessary to throw off the non-magnetic particles from the belt as it passes around the magnet. As the mixed magnetic and non-magnetic particles approach the magnet the magnetic particles will be attracted toward the zone of maximum magnetic force and will be caused to progress laterally with respect to the non-magnetic particles, as shown in Fig. 1, while by reason of the special construction of rotating magnet illustrated lines of force will be formed, as shown in Fig. 4, by reason of which the magnetic particles will be caused to aggregate together in lines or hairs as they progress toward the gap between the poles 6 6, so as to effectively disengage themselves from the non-magnetic particles. By thus causing the magnetic particles to move laterally with respect to the non-magnetic particles, while at the same time both the magnetic and non-magnetic particles are subjected to centrifugal effect, the non-magnetic particles will be thrown off from the belt, as shown, by the centrifugal force which is developed, while the magnetic particles will be caused to tenaciously adhere to the belt by the magnetic attraction and will be gradually carried by the belt away from the lines of magnetic force as the particles pass beyond the vertical diameter of the magnet until they finally are thrown off. By thus utilizing in a magnetic separator the effect of centrifugal

force and by so proportioning the centrifugal force that it tends to positively throw off of the belt all non-magnetic particles, without, however, affecting the magnetic particles, and by causing the magnetic particles to progress laterally with respect to the non-magnetic particles while the latter are subjected to the effect of the centrifugal force, I secure a very perfect and rapid separation. In fact the effect of the centrifugal action in the apparatus is sufficient to cause the non-magnetic particles which would otherwise be entangled and entrained with the magnetic particles and carried through the apparatus to be actually disentangled therefrom and to be thrown out by the centrifugal force.

Having now described my invention, what I claim as new, and desire to secure by Letters Patent, is as follows:

1. Magnetic separating apparatus comprising the combination with an endless belt supported at both ends and caused at one end to travel concentrically with respect to a magnetic field, the linear travel of the belt being substantially parallel to the zone of maximum magnetic attraction, of means for feeding magnetic and non-magnetic material to said belt in an area out of line with such zone, whereby the magnetic particles will be caused to move laterally with respect to the non-magnetic particles while the latter are subjected to centrifugal force, substantially as set forth.

2. Magnetic separating apparatus comprising the combination with a rotating magnet having two adjacent poles forming a gap between them, and an endless belt passing over said magnet and properly supported at its other end, of means for feeding material to said belt out of line with the gap between the magnetic poles, substantially as and for the purposes set forth.

3. Magnetic separating apparatus comprising the combination with a rotating magnet having two adjacent poles forming a gap between them, and an endless belt passing over said magnet and properly supported at its other end, of means for feeding material to said belt on either side of the gap between the magnetic poles, substantially as and for the purposes set forth.

4. Magnetic separating apparatus comprising the combination with a rotating magnet having two adjacent poles forming a gap between them, and an endless belt passing over

said magnet and properly supported at its other end, of means for feeding material to said belt out of line with the gap between the magnetic poles and at a speed of delivery corresponding approximately to the surface speed of the belt, substantially as and for the purposes set forth.

5. Magnetic separating apparatus comprising the combination with a rotating magnet having two adjacent poles forming a gap between them, and an endless belt passing over said magnet and properly supported at its other end, of means for feeding material to said belt on either side of the gap between the magnetic poles and at a speed of delivery corresponding approximately to the surface speed of the belt, substantially as and for the purposes set forth.

6. In magnetic separating apparatus, the combination with a rotating magnet having two adjacent poles forming a gap between them, of a belt passing over said magnet and properly supported at its other end, a feed-chute for delivering material to the belt, and a deflecting-partition on the feed-chute for subdividing the material into two streams or zones on either side of said gap, substantially as set forth.

7. In magnetic separating apparatus, the combination of a rotating magnet having two adjacent poles forming a gap between them, an endless belt passing over said magnet and properly supported at its other end, means for supplying material to said belt out of line with said gap, and an elastic rim at each side of the belt, substantially as and for the purposes set forth.

8. In magnetic separating apparatus, the combination of a rotating magnet having two adjacent poles forming a gap between them, a non-magnetic extension or ring at each end of said magnet, an endless belt passing over said magnet and non-magnetic extensions and properly supported at its other end, means for supplying material to the belt, and an elastic rim secured at each side of the belt, substantially as set forth.

This specification signed and witnessed this 11th day of June, 1900.

THOMAS A. EDISON.

Witnesses:

J. F. RANDOLPH,
FRANK L. DYER.