(No Model.) 2 Sheets—Sheet 1.

J. WENSTRÖM.

MAGNETIC SEPARATOR.

No. 455,809. Patented July 14, 1891.

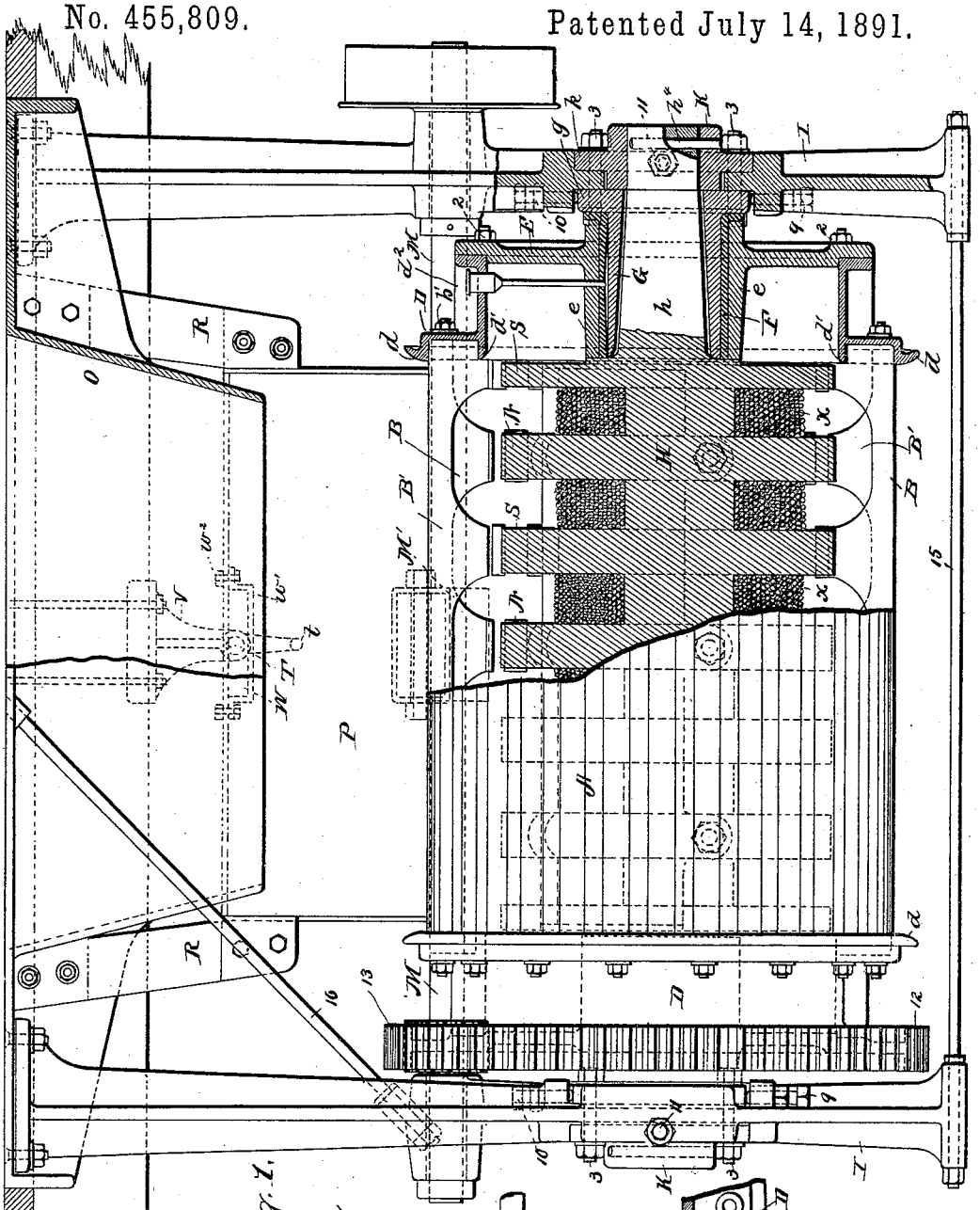

Fig. 1.

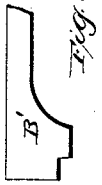

Fig. 7.

Fig. 8.

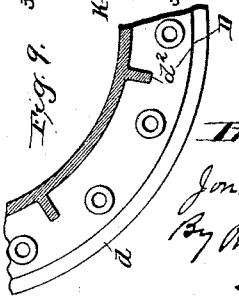

Fig. 9.

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(No Model.) 2 Sheets—Sheet 2.

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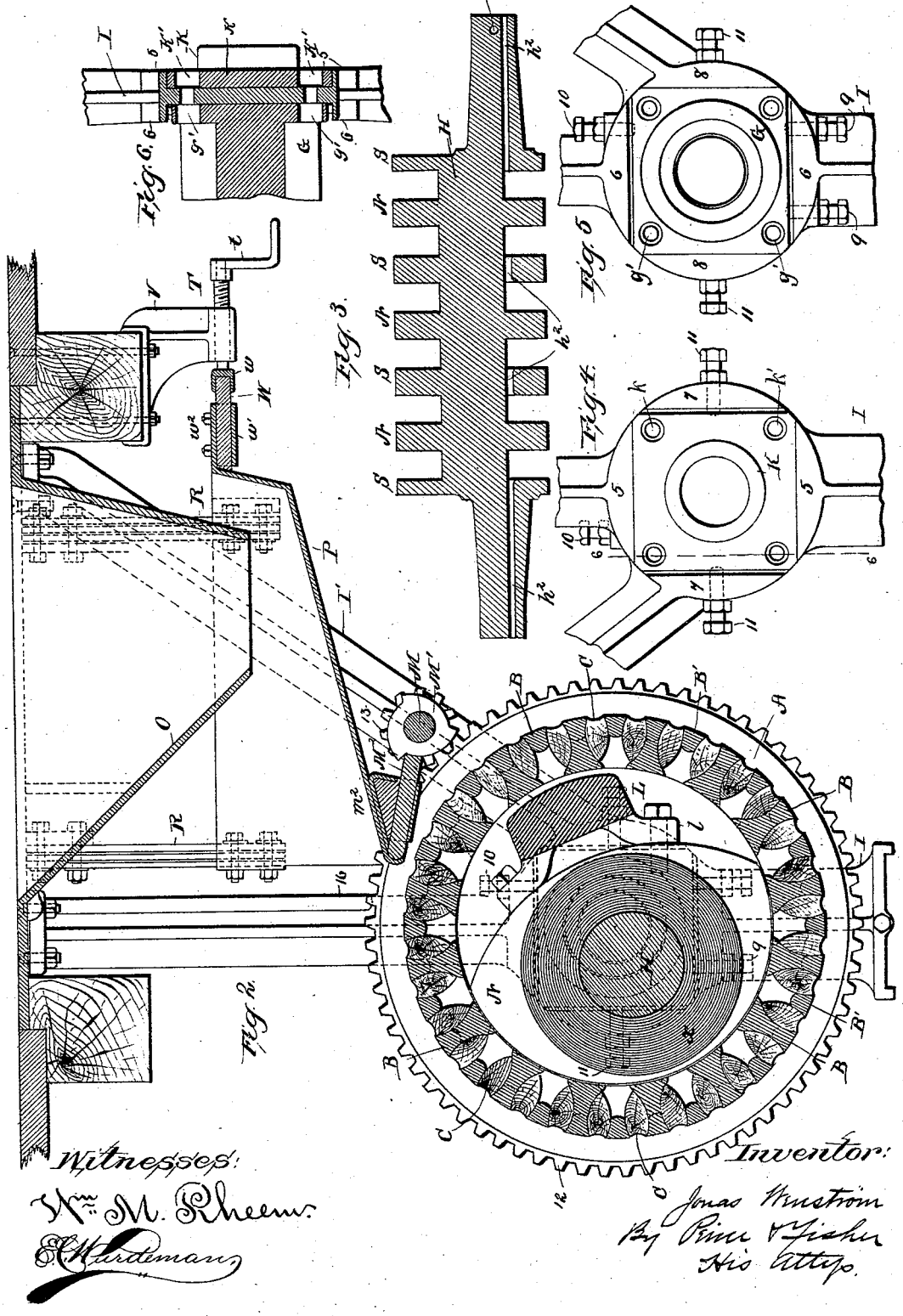

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UNITED STATES PATENT OFFICE.

JONAS WENSTRÖM, OF ÖREBRO, SWEDEN, ASSIGNOR, BY DIRECT AND MESNE ASSIGNMENTS, OF TWO-THIRDS TO OLOF WENSTRÖM AND WILLIAM W. MANNING, OF MARQUETTE, MICHIGAN.

MAGNETIC SEPARATOR.

SPECIFICATION forming part of Letters Patent No. 455,809, dated July 14, 1891.

Application filed December 24, 1890. Serial No. 375,753. (No model.)

To all whom it may concern:

Be it known that I, JONAS WENSTRÖM, a citizen of Sweden, and a resident of Örebro, in the Kingdom of Sweden, have invented certain new and useful Improvements in Magnetic Separators, of which the following is hereby declared to be a full, clear, and exact description, sufficient to enable others skilled in the art to which such invention appertains to make and use the same.

The invention relates to machines for separating magnetic particles from ore, slag, brass filings, or other material, and is designed more especially to improve the construction of separators set forth in my Letters Patent No. 373,211, dated November 15, 1887.

The nature of the improvements will appear from the description following, and be particularly pointed out by claims at the conclusion thereof.

§ [Figure 1 is a view in front elevation (parts being shown in vertical section) of a magnetic separator embodying my invention. Fig. 2 is a view in vertical transverse section on line 2 2 of Fig. 1. Fig. 3 is a view in vertical longitudinal section through the core of the electro-magnet. Fig. 4 is a detail view in side elevation of the frame whereby the magnet and armature-barrel are sustained. Fig. 5 is a view similar to Fig. 4, but taken from the opposite side of the machine. Fig. 6 is a view in vertical section on line 6 6 of Fig. 4. Figs. 7 and 8 are fractional views showing the manner of forming the ends of the armature-bars. Fig. 9 is a view of a portion of the ring or flange of the armature-barrel.

By my present invention, as by that set forth in my hereinbefore-mentioned Letters Patent, the separation of the magnetizable portion is effected by feeding the mixed material, reduced to proper size, over the periphery of a barrel or drum that is composed of armatures of soft iron suitably insulated from each other, these armatures being brought during a part of the revolution of the barrel into the field of a powerful electro-magnet, so that during the time the armatures are thus magnetized they will serve to retain the magnetizable portion of the ore, while permitting the non-magnetizable portion to be deposited separate from the parts temporarily attracted by the armature-barrel.

One feature of my present invention consists in improving the means whereby the armature-barrel is sustained.

Another feature of my invention consists in improving the construction of the electro-magnet, whereby the magnetization of the bars of the armature-barrel is effected, and in providing means whereby the counterpoise of this magnet is secured and an adjustment of the magnet is obtained in order to determine with exactness the intensity of the field of magnetic influence.

A further feature of my invention is to improve the mechanism whereby the ore is delivered to the periphery of the armature-barrel, and, finally, my invention comprises details of construction, all of which will be hereinafter described by reference to the accompanying drawings, and pointed out in the claims at the end of this specification.

A designates the armature-barrel, over which the ore to be worked after being crushed or broken will be fed, this barrel being preferably rotated by mechanism to be presently described. The armature-barrel A has its periphery formed of the series of soft-iron bars B B′, these bars being spaced by means of non-magnetic material, preferably bars of wood C, interposed between them. The set of armature-bars B, by preference, have their ends reduced and threaded, as at *b*, these reduced ends passing through suitable holes formed in the non-magnetic flanges or rings D, preferably of brass, and there retained by means of set-nuts *b*′. The set of armature-bars B′ have preferably their ends squared to abut against the flanges or rings D. The armature-bars B B′ are each cut away to form inwardly-projecting portions, as shown, the projecting portions of the bars B alternating with the projecting portions of the bars B′. The purpose of thus alternating the projecting portions of the armature-bars B and B′, as will presently more fully appear, is to enable the set of bars B to be influenced only by the positive or north-pole

plates of the magnet, while the set of bars B′ shall be influenced only by the negative or south-pole plates of the magnet, thus giving to each bar a magnetism opposite to that of the next bar, and thereby creating a powerful magnetic field throughout that portion of the barrel that is exposed to the influence of the electro-magnet.

While the form and arrangement of the armature-bars are preferably as illustrated in the accompanying drawings, it is obvious that the skilled mechanic can vary this form and arrangement without departure from the invention.

The flanges or rings D, to which are secured the ends of the armature-bars B B′, are furnished, preferably, with inwardly-projecting ribs or ledges *d d′*, between which the armature-bars will be held, and by preference also with the transverse ledges d^2 to better strengthen these flanges. The outer portion of the flanges or rings D are bolted, as at 2, to the barrel-disks E, these disks being furnished with hubs *e*, which afford a broad bearing for the barrel. Within each of the hubs *e* is preferably placed a lining F of Babbit-metal, that sets over the barrel-supports G, that encircle the journals *h*, projecting from the ends of the magnet H. Each of the supports G is furnished with an outwardly-projecting flange *g*, provided with bolt-holes *g′*, and through these bolt-holes pass the bolts 3, whereby the supports G are connected to the standards I of the suspending frame. Upon the outer ends of the journals *h* are placed the magnetic sockets K, having the flanges *k*, provided with holes *k′* to receive the bolts 3, whereby these sockets, as well as the barrel-supports G, are connected to the standard I. That portion of each standard I adjacent the opening for the journals *h* is furnished with the horizontal ribs or extensions 5 and 6 (see Figs. 4 and 5) and the vertical ribs or extensions 7 and 8, the area between these several ribs or extensions being such as to permit a slight adjustment in vertical direction of the supports G, that sustain the barrel, and an adjustment in horizontal direction of the sockets K, that sustain the magnet H, through the medium of the journals *h*. The holes in each standard I, through which pass the bolts 3, are simply large enough (say one inch) to receive the bolts; but the bolt-holes of the barrel-supports G and magnet-sockets K are somewhat larger (say one and one-half inch) than the bolts, so as to permit the adjustment of these plates. Through one of the flanges 6 of each standard I pass the set-screws 9, whereon the bottom edge of the supports G rests, and upon the upper edge of this support bears the set-screw 10, that passes through the upper rib or flange 6 of the standard I. Through the vertical ribs 7 of the standard pass the set-screws 11, these screws bearing against the edges of the magnet-sockets K and serving to adjust the sockets in horizontal direction.

The magnet H is provided with a series of flanges or pole-plates N S, a portion of the peripheries of these pole-plates corresponding in curvature to the inner face of the barrel and extending in proximity thereto, while the remaining portion of the pole-plates or flanges is reduced, so that the magnetic field shall extend around a portion only of the armature-barrel. The core of the magnet H is preferably set eccentrically with respect to the shafts *h*, in order to bring the magnetic poles in proper position with respect to that portion of the barrel to be magnetized and better remove the remaining portion of the barrel from the magnetic field. In order to counterbalance the magnet thus eccentrically set, I employ a suitable counterpoise L, preferably of lead or equivalent material, this counterpoise being furnished with arms *l*, whereby it can be conveniently bolted to the pole-plates of the magnet H. Between the pole-plates or flanges of the electro-magnet are coiled the insulated wire-conductors *x* for the electric current, and the shaft *h* and flanges or pole-plates of the magnet-core are suitably perforated, as at h^2, to admit the wire-conductors *x*, and these conductors *x* are wound in such way that the electric current through the wire shall excite like magnetism in the same pole-plates and opposite magnetism in successively adjacent pole-plates, thereby intensifying their magnetic force. Thus, for example, if the first coil is wound in such manner as to give a negative or south polarity to the first pole-plate and a positive or north polarity to the second pole-plate, the second coil of wire will be wound so as to impart a positive polarity to the second pole-plate and a negative polarity to the third pole-plate S. Hence it will be seen that the adjacent pole-plates of the magnet are of opposite polarity, and consequently the series of armature-bars B of the barrel present their extensions to the positive-pole plates N, while the series of armature-bars B′ present their extensions only to the negative-pole plates S, and as a consequence the full force of the various pole-plates of the magnet will be exerted upon the corresponding armature-plates of the barrel. My purpose in providing the adjustable sockets K for the shafts *h* of the magnet and in providing the adjustable supports G for the barrel is to enable the intensity of the magnetic force upon the armature-bars to be varied, as desired, to meet the requirements of different classes of material and different sizes to which they may have been crushed, and it will be seen that if the sockets K of the magnet be shifted by means of the set-screws 11 the pole-plates N S of the magnet will be withdrawn more or less from the inner surface of the armature-bars, and the force exerted upon these bars will be correspondingly decreased. So, also, if after the magnet-sockets K have been thus adjusted the barrel-supports G should be adjusted in vertical direction by means of the set-screws 9 and 10, the intensity of the mag-

netic force at the upper or lower part of the field can be varied. This adjustment of the sockets K and supports G is obtainable by reason of the fact that the bolt-holes of these parts are larger than the bolts 3, as hereinabove described It will be observed that while the shafts *h* of the magnet pass through the barrel-supports G, these shafts are of somewhat smaller diameter than the interior diameter of the supports, and consequently a vertical adjustment of the supports is permitted while the shafts remain fixed. The shafts *h* are snugly held in the magnet-sockets *k*, and are retained therein against rotation by means of suitable pins h^4, passing through the sockets and into the holes *h'* at the ends of the shafts *h*. It will be seen that one of the barrel-disks E is formed with a rack-bar 12 about its periphery, with which bar meshes a pinion 13, keyed to the driving-shaft M, the bearings of this shaft being preferably formed in suitable extensions I', projecting from the standards I, that support the magnet and armature-barrel. The standards I are preferably connected together at their base by a suitable tie-rod 15, and the tops of these standards I and the tops of the extensions I' serve to support the hopper O, that is bolted thereto, suitable brace-rods 16 being preferably extended from the flanged edge of the hopper O and the flanged edge or side rib of the standards I. Beneath the hopper O is the feeding-pan P, that is suspended by means of elastic bars R, preferably of wood, that are bolted at their lower ends to suitable ears projecting from the pan and at their upper ends to corresponding projections from the side of the hopper. Motion is imparted to the feed-pan P from the drive-shaft M by a tappet-wheel M', that contacts with a block M^2, mounted within a shoe m^2, fixed to the bottom side of the pan P near its front edge. The extent of movement imparted to the pan P is determined by means of an adjusting-screw T, that is sustained within a socket V and is operated by a crank *t*, the rear edge of the pan P being provided with a buffer W, adapted to contact with the inner end of the set-screw T. This buffer W is preferably of wood furnished with a metal cap *w* and held to the pan by means of an angular strap *w'*, bolted to the pan, as at w^2.

From the foregoing description it will be seen that when revolution is imparted to the drive-shaft M the tappet-wheel M' will contact with the wooden block M^2 at the base of the pan and will impart a reciprocating or shaking movement to the pan against the force of the elastic bars R, whereby the pan is sustained, and hence as the ore is delivered from the hopper O onto the pan P the shaking movement of the pan will cause the ore to be uniformly distributed over the periphery of the armature-barrel A. As the ore is thus delivered onto the barrel A, it will be carried downward by the barrel, and as the armature-bars with the ore resting thereon pass into the field of the electro-magnet they will become magnetized and will attract the magnetizable portions of the ore. The portions of the ore thus attracted by the armature-bars will be carried around with these bars until the bars pass from out the field of the magnetic influence, after which such portions will be dropped into suitable receptacles; but while the magnetizable portions of the ore are thus carried by the armature-bars the non-magnetizable portions of the ore will pass freely by gravity from the periphery of the barrel and away from the magnetizable portions of the ore.

Other means may be employed for effecting the relative adjustment of the armature-barrel and magnet without departing from the broad scope of my invention, and in various respects the details of construction may be changed by the mechanic skilled in the art to which the invention relates.

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

1. In a magnetic separator, the combination, with suitable armatures, of a magnet for said armatures, and means whereby the distance between said magnet and armatures may be varied, for the purpose set forth.

2. In a magnetic separator, the combination, with suitable movable armatures, of a fixed magnet past which said armatures are arranged to move, and suitable means whereby said armatures and magnets may be adjusted with respect to each other.

3. In a magnetic separator, the combination, with a stationary magnet, of an armature-barrel arranged to revolve around said magnet, and suitable means whereby said barrel and magnet may be adjusted with respect to each other.

4. In a magnetic separator, the combination, with suitable standards, of a stationary magnet, adjustable sockets for sustaining said magnet within said standard, an armature-barrel wherein said magnet is held, and adjustable supports for said armature-barrel, substantially as described.

5. In a magnetic separator, the combination, with suitable standards, of a magnet sustained by said standards, an armature-barrel wherein said magnet is held, and suitable barrel-supports encircling the shafts of the armature and whereon the barrel may be revolved, substantially as described.

6. In a magnetic separator, an armature-barrel comprising a series of soft-iron bars having threaded ends and a ring or flange through which said ends of the armature-bars extend, and suitable insulating-bars between said armature-bars, substantially as described.

7. In a magnetic separator, the combination, with an armature-barrel and a magnet eccentrically sustained within said barrel, of a counterpoise for said magnet, substantially as described.

8. In a magnetic separator, a feed mechanism comprising a delivery-hopper, a feed-pan provided upon its bottom sides near its front end with a block M^2, and a suitable tappet-wheel arranged to contact with said block M^2 for imparting a shaking motion to said feed-pan, substantially as described.

9. In a magnetic separator, a feed mechanism comprising a delivery-hopper, a feed-pan, and a suitable tappet-wheel for imparting a shaking motion to said feed-pan, said pan being provided also at its rear edge with a buffer and an adjusting-screw arranged to contact with said buffer for limiting the extent of movement of said feed-pan, substantially as described.

10. In a magnetic separator, the combination, with a magnet and its armatures, of a frame having standards for sustaining said magnet and armatures and having extensions, a drive-shaft journaled in said extensions, and a hopper connecting said uprights and extensions, substantially as described.

11. In a magnetic separator, the combination, with a magnet and its armatures adapted to be moved over said magnet, of standards for sustaining said magnet, a hopper connecting the upper ends of said standards, a feed-pan for delivering the ore onto the armatures, and a suitable tappet-wheel for imparting an adjustable shaking motion to said feed-pan, substantially as described.

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