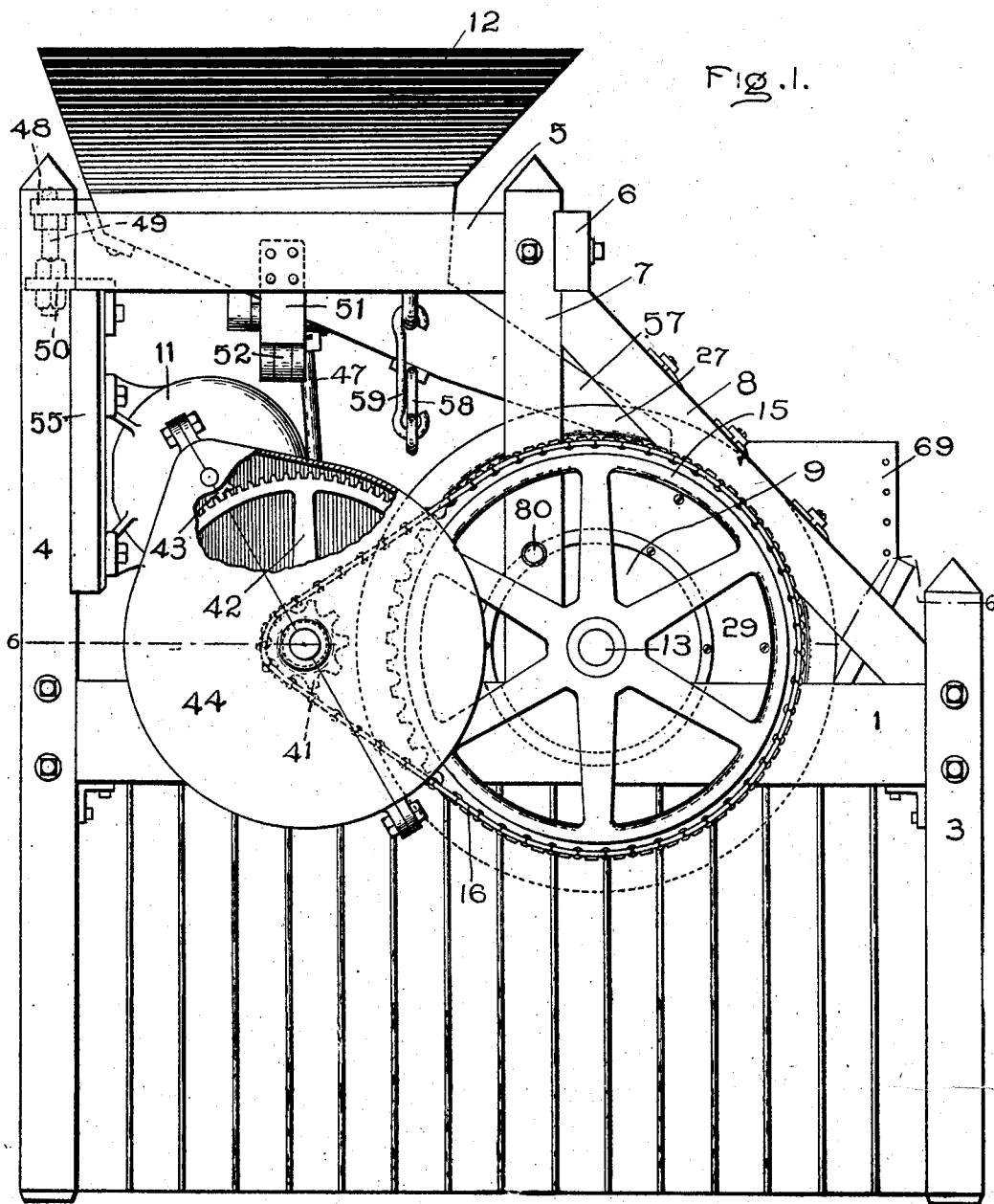


No. 800,370.

PATENTED SEPT. 26, 1905.

C. M. GREEN.
MAGNETIC SEPARATOR.
APPLICATION FILED OCT. 17, 1901.

5 SHEETS—SHEET 1.



Witnesses:

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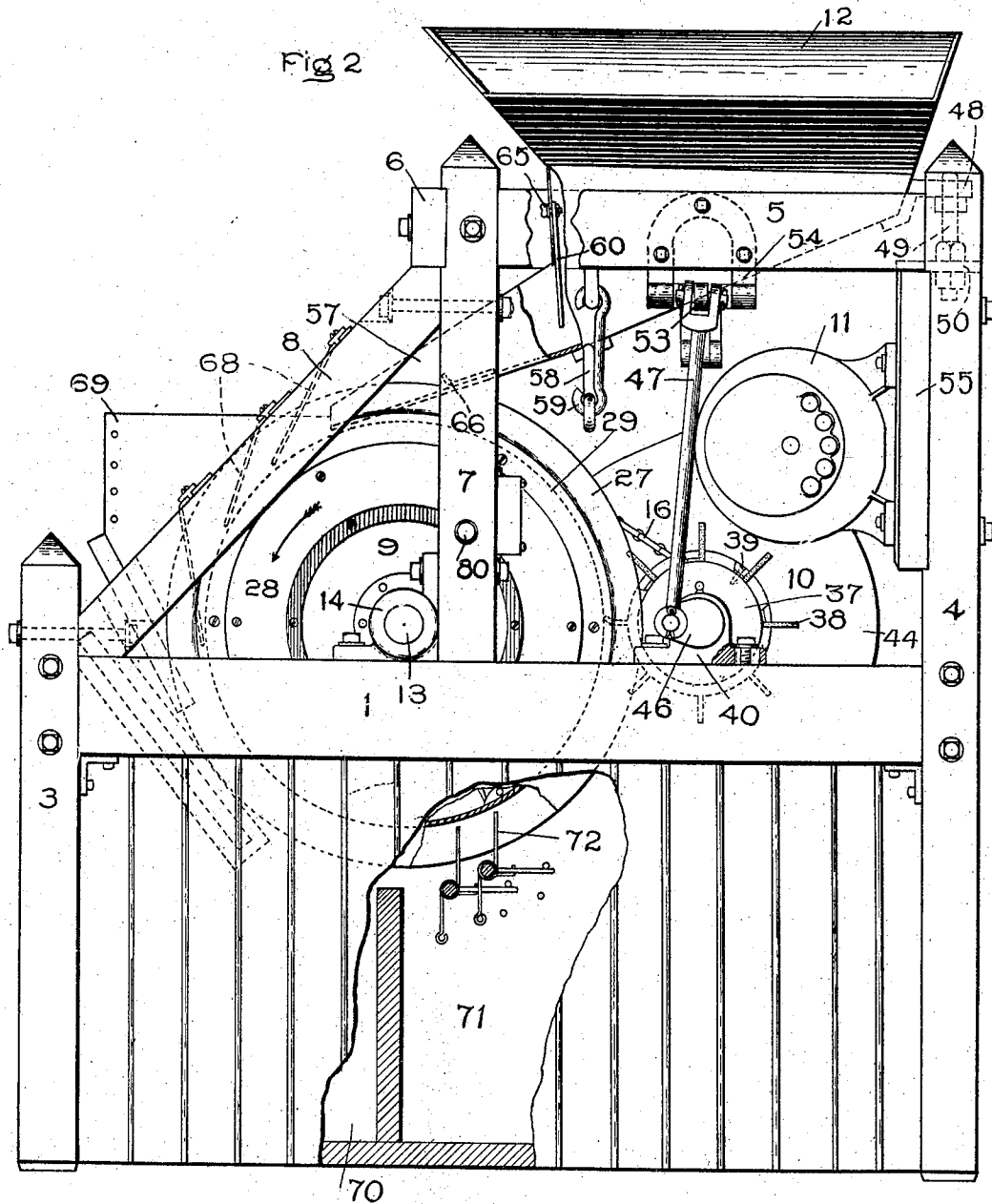
By *Albert Davis*
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No. 800,370.

PATENTED SEPT. 26, 1905.

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APPLICATION FILED OCT. 17, 1901.

5 SHEETS—SHEET 2.



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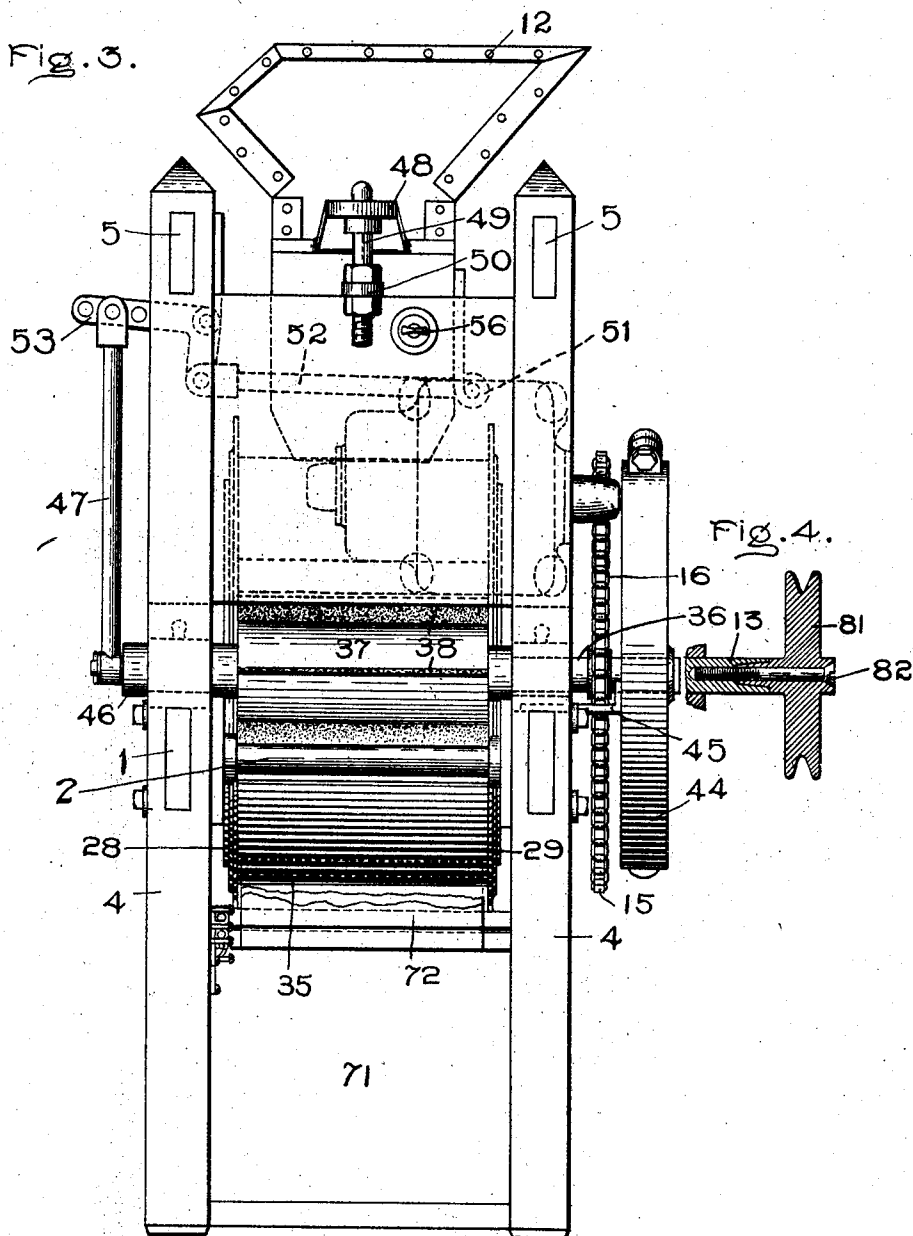
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5 SHEETS—SHEET 3.



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PATENTED SEPT. 26, 1905.

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APPLICATION FILED OCT. 17, 1901.

5 SHEETS—SHEET 4.

Fig. 5.

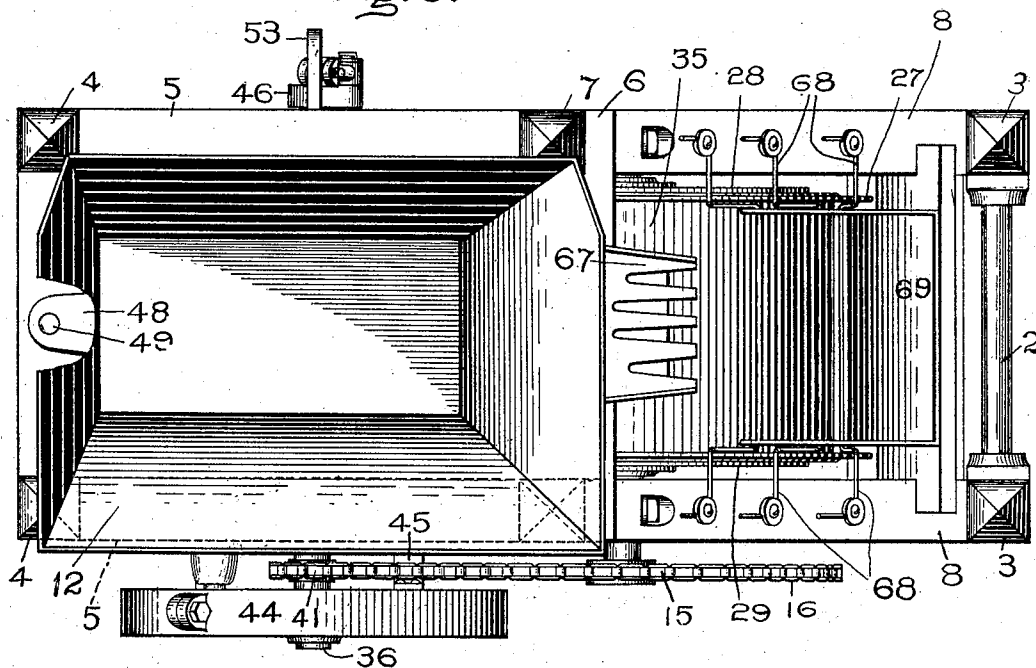
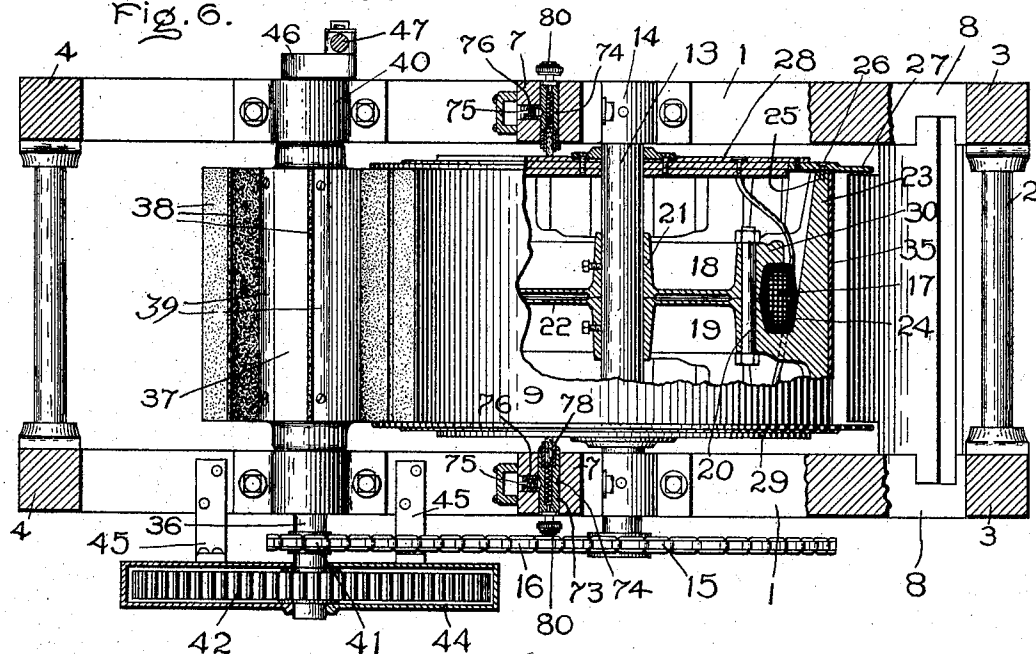


Fig. 6.



Witnesses:
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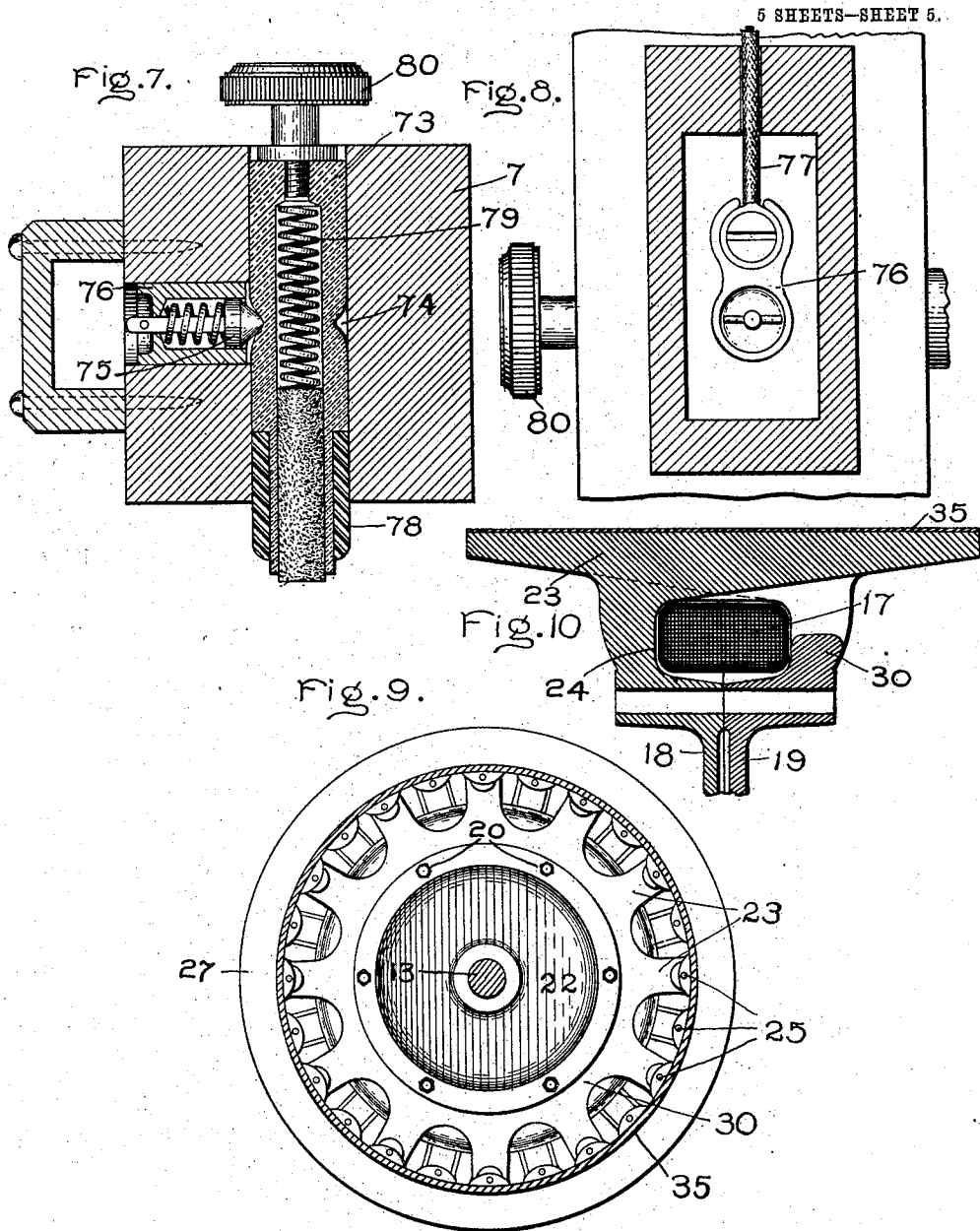
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5 SHEETS—SHEET 5.



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UNITED STATES PATENT OFFICE.

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MAGNETIC SEPARATOR.

No. 800,370.

Specification of Letters Patent.

Patented Sept. 26, 1905.

Application filed October 17, 1901. Serial No. 78,947.

To all whom it may concern:

Be it known that I, CHARLES M. GREEN, a citizen of the United States, residing at Lynn, in the county of Essex, State of Massachusetts, have invented certain new and useful Improvements in Magnetic Separators, of which the following is a specification.

The present invention relates to magnetic separators designed particularly for use in machine-shops and foundries for separating iron from brass, copper, babbitt, and other turnings or chips of a like nature.

The invention may also be employed in separating iron ore from other foreign particles.

The object of the invention is to provide a separator which is capable of handling metal particles of various kinds and configurations and separating the iron from the remainder and this in an efficient and inexpensive manner.

The scope of my invention will be more fully set forth and claimed hereinafter.

In the accompanying drawings, which illustrate a form of my invention, Figure 1 is a side elevation of a magnetic separator broken away in parts. Fig. 2 is also a side elevation of the separator broken away in parts, but viewed from a point opposite to that of Fig. 1. Fig. 3 is a rear elevation. Fig. 4 is a detail view of a modified form of driving mechanism. Fig. 5 is a plan view. Fig. 6 is a longitudinal section taken on line 6 6 of Fig. 1. Fig. 7 is a detail view in section of one of the brush-holders. Fig. 8 is a detail view of the circuit-terminals. Fig. 9 is an end elevation of the magnet, and Fig. 10 is a sectional detail of the magnet.

The frame for the separator is made of wood, and consists of two parallel side beams 1, which are united at opposite ends by the metal braces 2. The front ends of the beams are supported by vertically-extending posts 3 and the rear ends by vertically-extending posts 4. The rear posts are extended above the beams 1 in order to form a support for certain of the operating parts of the separator. Situated above the main frame is a secondary and smaller frame, which supports the hopper and certain other parts of the separator. The secondary frame consists of side beams 5 and the front beam 6. The front end of this frame is supported by short vertical posts 7,

which rest on the main side beams 1, and the rear end by the posts 4, which support the main frame, the parts being secured together in any desired manner. Extending from the junctions of the beams 6 and the posts 7 to the junctions of the beams 1 and the front posts 3 are inclined braces 8. These braces also act as supports for certain of the parts to be hereinafter described. The inclined braces 8 are bolted at the top and bottom to the frame. By detaching these braces the magnet can be readily removed for inspection or repairs without disturbing the main parts of the frame.

The separator consists, essentially, of a revolving magnet 9, having a covering of non-magnetic material; a rotating brush-wheel 10; a motive-power agency 11, such as an electric motor, and a hopper 12, for receiving and distributing the metal and other particles over the surface of the magnet.

The construction of the magnet is best shown in Figs. 6, 9, and 10. The shaft 13 for the magnet is mounted in bearings 14, which are secured to the side beams 1 and to the vertical beams 7. The bearings 14, in addition to supporting the magnet-shaft, act as a brace between the horizontal beams 1 and the vertical beams 7, thus making the structure very rigid. One end of the shaft is provided with a sprocket-wheel 15 and is geared to brush-shaft 36 by a sprocket-chain 16. The brush-shaft is geared to the electric motor. Mounted on the shaft 13 is an electromagnet comprising a coil 17 and two steel castings 18 and 19, which are united by the bolts 20. The two parts of the core are similar in construction, each being provided with a hub 21, which is secured to the shaft by set-screws or keys in the ordinary manner. Extending outward from the hub is a web 22, which is divided near its outer edge into a series of arms 23, which form the pole-pieces. Each part of the core is provided with a socket or receptacle 24 to receive the coil 17. From this socket each arm or pole-piece extends in two directions, as is clearly indicated in Figs. 6 and 10, the portion of the pole-piece on one side of the center of the supporting-web being longer than that on the other. The arms or pole-pieces of one portion of the magnet-core alternate with those of the other portion, and the ends of the short poles of one portion oc-

cupy the same transverse plane as the ends of the long poles of the second member. By reason of this arrangement all of the poles occupy such positions that they will act on all of the material dropped on the drum. The long and short pole-pieces of the core are tapped, as at 25, to receive the screws 26, which hold the end plates 27 in place. These end plates prevent the material from the hopper falling down between the ends of the drum and the frame. Mounted on the end plates are contact-rings 28 and 29. These contact-rings are connected to the energizing-coil 17 by flexible leads. Surrounding the arms of the magnet is a thin metal cylinder 35 of non-magnetic material. In constructing the magnet the coil 17 is separately wound and insulated, and the portions of the core 18 and 19 are machined in the ordinary manner, after which the parts are assembled and secured by bolts 20. The coil makes a snug fit in the sockets and is thus prevented from shifting in any direction under the action of the apparatus. As an additional retaining means the ribs 30, which connect the several arms of each half of the magnet, are arranged to engage with the end faces of the coil. In addition to acting as a coil-retaining means, the ribs furnish a path for the magnetic lines of force and also strengthen the structure as a whole.

The magnet is continuously energized while the apparatus is in operation, and for that reason it is necessary to provide some means for mechanically removing the iron particles from the brass drum or cylinder 35, which surrounds the pole-pieces, the said particles being held by the magnetism due to the coil 17. In the present instance I have shown a rotating brush or wiper 10, comprising a shaft 36, a drum 37, and a plurality of removable wings 38, made of some flexible material—such as leather, for example. These wings are retained in place by detachable pieces 39, that extend parallel with the shaft. The brush is so set with respect to the cylinder and is provided with such a number of arms that it will remove all of the iron from the periphery of the magnet as they are revolved. In order to compensate for the wear of the brush-wings, the bearings 40 are made adjustable, so that they can be moved toward or away from the cylinder. This feature is best illustrated in Fig. 2. One end of the brush-shaft 36 is extended outward beyond the side frame-beams 1, Figs. 5 and 6, and is provided with a sprocket-wheel 41, by means of which motion is transmitted to the shaft of the magnet by the sprocket-chain 16. On the end of the shaft is mounted a spur-gear 42, which meshes with a pinion 43, the latter being mounted on the end of the armature-shaft of the electric motor 11. The gears are inclosed in a gear-casing 44, which is supported by brackets 45

from the side beam 1. By inclosing the gears in this manner all danger due to particles of metal dropping into the gear-teeth is obviated, and by placing the gear-casing outside of the sprocket there is no chance for the clothing of the workmen to be caught in the teeth. On the opposite end of the brush-shaft is a crank 46, Figs. 2 and 3, to which is pivotally secured a connecting-rod 47, that is employed to shake or oscillate the hopper 12. The means employed for this purpose are best shown in Fig. 3. The hopper is provided at its rear end with a bracket 48, which is provided with an opening to receive the vertically-extending bolt 49, the latter being mounted in an angle-iron 50 and retained in place by suitable nuts. The angle-iron is mounted on the support 55 of the electric motor. The right-hand side of the hopper, as viewed from the back, Fig. 3, is provided with a downwardly-extending plate 51. To this plate is hinged a connecting-rod 52. The left-hand end of this rod is pivotally connected to the bell-crank lever 53, which in turn is supported by the U-shaped hanger 54, Fig. 2. The outwardly-extending arm of the bell-crank lever is provided with a series of holes to permit of the adjustment of the connecting-rod 47. By changing the position of the connecting-pivot of the rod with respect to the center of the bell-crank lever the lateral movement of the hopper can be varied. For different kinds of work it will be found desirable to use different adjustments of this rocking device.

The electric motor for driving the apparatus is mounted on a base 55, which in turn is bolted to the rear posts 4 and forms a support or brace therefor. The motor itself is provided with four feet, and these feet are bolted to the support 55. By means of this construction the motor is out of the way and all danger and inconvenience of traveling belts is obviated. At the same time the floor-space occupied by the apparatus is materially reduced. This arrangement is also highly desirable, as it permits of the installation of the separator at any convenient point without regard to the arrangement of the shafting in the shop. On the back of the support 55 is a small switch 56 for controlling the circuit of the motor. It will be seen that the brush-shaft is directly geared to the motor and that the magnet and hopper receive motion therefrom. By reason of this arrangement I am enabled to make a compact machine and also to reduce the number of parts, and consequently the cost of production.

The hopper is provided with a downwardly-extending chute or spout 57 for distributing the particles of material to be separated on the periphery of the magnet-drum. Extending underneath the chute is a U-shaped support 58, which is secured in any suitable manner. The ends of the support are pro-

vided with rings for receiving the supporting-links 59, the latter being supported at their outer ends from the side beams 5. These parts are arranged to make a relatively loose fit, so that the hopper can be rocked from side to side by the bell-crank lever 53 in the manner described. The two links 59 constitute a parallel-motion device by means of which the end of the spout is permitted to move over the drum from side to side.

In order to prevent the metal particles from leaving the hopper too rapidly, an adjustable gate 60 is provided, Fig. 2. The gate consists of a flat piece of metal which is provided with thumb-screws 65, that work in slots formed in the front of the hopper. The lower end of the adjustable piece may be provided with a series of prongs or fingers, if desired. Located in the chute are small metal plates 66, Fig. 2, having upturned ends. These assist in separating or breaking up the mass of metal as it is delivered by the hopper. The end of the chute is provided with a series of fingers or serrations 67, as indicated in plan in Fig. 5. The object of this arrangement is to distribute the metal particles more evenly over the surface of the drum than would be the case if the end were made square. Secured to the inclined braces 8 on the front of the separator are mixers consisting of U-shaped pieces of spring metal 68, which, engaging with the small masses of metal and other material held thereby on the periphery of the drum, tend to break them up and distribute the material more evenly over the surface of the drum. In the present instance three of these devices are shown; but the number may be varied to suit the character of the materials to be separated. Situated in front of the drum is a hopper 69 for directing the downward passage of the non-magnetic metal and foreign matter into the front bin 70. The front bin is arranged to receive the non-magnetic material, while the rear bin 71 receives the magnetic material.

In order to prevent the magnetic material from being deflected by the magnetism of the drum into the bin 70 after it has been removed by the brush, spring-pressed deflectors 72 are provided, which are situated below the drum in bin 71. In the present instance two such devices are provided; but the number can be varied to suit the conditions. In event of any large mass of material being retained on the surface of the drum as it revolves the deflectors will give way by bending backward and permit the same to pass, after which they will return to the position shown.

In Fig. 7 I have shown a sectional view of the brush-holders employed to convey current from the main circuit to the energizing-coil of the electromagnet. The vertically-extending post 7 is slotted or bored to receive

the brush-box 73. The sides of the box are provided with depressions 74, into which the spring-pressed plunger 75 can drop and hold the box in place. This spring-pressed plunger is inclosed in a metal bushing or thimble 76, which is connected to the circuit-wire 77 and is shown in Fig. 8. The end of the brush-box adjacent to the revolving magnet is provided with a shoulder, and surrounding this shouldered portion is an insulating-bushing 78 to reduce the liability of short-circuiting. The carbon brush is pressed toward the contact-ring on the magnet-drum by a coil-spring 79. The brush-box is provided with a handle 80, by means of which it can be inserted or withdrawn from the opening in the post 7.

In some instances it may be found desirable to drive the apparatus from a power-shaft and also to employ the same shaft for driving the generator furnishing current to the magnet. To accomplish this, the magnet-shaft 13 is extended, as shown in Fig. 4, and mounted on the end thereof is a grooved pulley 81, which is retained by the bolt 82. In this case the motor 11 would be driven as a generator through gearing, as shown, to supply current to the magnet.

In operating my improved separator the mixture is placed in the hopper, and as the hopper is shaken by the connecting-rod 47 and other parts the mixture is slowly distributed over the periphery of the revolving magnet. The non-magnetic metals—such as brass, copper, and Babbitt, and dirt, if there be any—drop into the front bin immediately below the magnet, while the magnetic material, such as iron, adheres to the surface of the drum and is carried around to the back or opposite side of the magnet and removed by the revolving brush. With ordinary dry mixtures the different metals have little or no tendency to stick together, and the separation will be complete the first time they are passed through the apparatus; but in mixtures containing coiled pieces that stick together it will sometimes happen that iron will carry with it some brass, thus requiring that the metal from the rear compartment shall be passed through the separator a second time. Mixtures containing coiled pieces sticking together and having some oil on them, together with fine iron, will require to be passed through the apparatus several times in order that all the magnetic and non-magnetic materials may be separated. Oily mixtures may frequently be improved by mixing with dry mixtures for the purpose of absorbing the oil. Small particles of iron will sometimes stick to heavy brass pieces and small brass pieces will sometimes stick to heavy pieces of iron and be carried into the wrong bin. For this reason it is desirable to pass the mixture through the apparatus more than once where complete separation is desired.

Some of the mixtures described above are very hard to separate; but I have found that it pays very well to pass the material through the separator a number of times. Whether the materials in the separate bins are passed through the apparatus more than once will depend on how important it is to separate every particle of magnetic from the non-magnetic material.

10 The apparatus illustrated has been found to work satisfactorily when the hopper makes one hundred and ten complete throws per minute. With ordinary mixtures, such as will be found in the average machine-shop, 15 the separator will handle fifteen pounds per minute.

I have illustrated and described my improved separator as being intended for separating metal chips of one kind from another, 20 such as are found in machine-shops and foundries; but it is within the scope of my invention to utilize the same apparatus for separating iron ore from other metals and impurities, and I aim to embrace such a use in the 25 claims.

What I claim as new, and desire to secure by Letters Patent of the United States, is—

1. In a magnetic separator, a frame, a magnet mounted thereon comprising two similar 30 interlocking core-bodies having pole-pieces formed thereon, a coil inclosed by said core-bodies, means for connecting the coil in circuit, a hopper for feeding material to the magnet, and a revolving brush for removing 35 magnetic material from said magnet.

2. In a magnetic separator, the combination of a frame, an electromagnet mounted thereon comprising two similar interlocking core-bodies having pole-pieces formed thereon and 40 a coil inclosed by said core-bodies, a non-magnetic cover for said magnet, contact devices for conveying current to the magnet, a hopper pivotally supported at one end, means for moving the hopper to distribute the material 45 to be separated over the magnet, means in the hopper for breaking up masses of material after leaving the hopper, and a revolving brush for removing the magnetic material from the 50 magnet.

3. In a magnetic separator, a frame, a revolving electromagnet mounted thereon comprising two similar interlocking core-bodies having pole-pieces formed thereon, a coil inclosed by said core-bodies, means for connecting 55 the coil in circuit, a hopper movably mounted at one end, means for moving the hopper to distribute the material to be separated over the magnet, a revolving brush for removing the magnetic material from the 60 magnet, and means for driving the magnet and brush.

4. In a magnetic separator, the combination of a revolving magnet, a hopper for feeding

the material to be separated, means to break 65 up masses of the material before leaving the hopper, a second hopper for guiding the material, and mixers extending across the face of the magnet within said second hopper for breaking up masses of the material. 70

5. In a magnetic separator, the combination of a revolving magnet, a hopper, and a plurality of spring-metal pieces held near said magnet and parallel thereto for breaking up 75 masses of the metal being separated.

6. In a magnetic separator, the combination of a revolving magnet, a hopper for feeding material to be separated to the magnet, spring-metal pieces extending across the face of the magnet adjacent thereto for distributing the 80 metal over the surface of the magnet as it revolves, and a second hopper for receiving and directing the passage of the non-magnetic materials.

7. As an article of manufacture, a magnet 85 comprising a shaft, a two-part core, each part being provided with a hub and a plurality of radial arms, the arms of one part alternating with those of the other, a coil mounted in pockets formed in the arms, and bolts for securing the coil and the parts of the core in 90 place.

8. In combination, a pair of similar core-bodies, each being provided with a plurality of pole-pieces, which are longer on one side 95 of their supporting-web than on the other, a coil-pocket formed in each part of the core-body, and bolts which pass through the bodies and hold them and the coil in place.

9. In combination, a pair of similar core-bodies, each having a plurality of pole-pieces extending from points around a cylindrical web and parallel with the axis of rotation, the pole-pieces of the two parts alternating when 100 assembled, in such manner that the short ends of the pole-pieces of one body occupy the same transverse plane as the long ends of the other body, an energizing-coil, and plates which close in the ends of the magnet and are 105 carried by the parts of the core.

10. In combination, a pair of core-bodies of similar construction, each having pole-pieces which extend at right angles to the supporting-web, a coil-socket formed by the two parts 110 of the core, a coil, and end plates for closing in the ends of the magnet which are each secured partly to the pole-pieces of one core-body and partly to the other.

11. In a magnetic separator, the combination of a magnet, a brush, bins for magnetic 120 and non-magnetic material, and a spring-pressed deflector capable of moving backward and situated below the shaft of the magnet, and between the brush and the bin for non-magnetic material, for preventing the particles 125 of material detached by the brush from being carried into the last-mentioned bin.

12. In a magnetic separator, the combina-

tion of a magnet, a brush, bins for magnetic
and non-magnetic material, and a plurality of
spring-pressed deflectors situated in prox-
imity to the magnet-drum for preventing par-
5 ticles of material detached by the brush from
entering the bin containing non-magnetic ma-
terial.

In witness whereof I have hereunto set my
hand this 11th day of October, 1901.

CHARLES M. GREEN.

Witnesses:

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ALEX F. MACDONALD.