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C. F. HILDER & E. SCOTT.

MAGNETIC SEPARATOR.

No. 315,028. Patented Apr. 7, 1885.

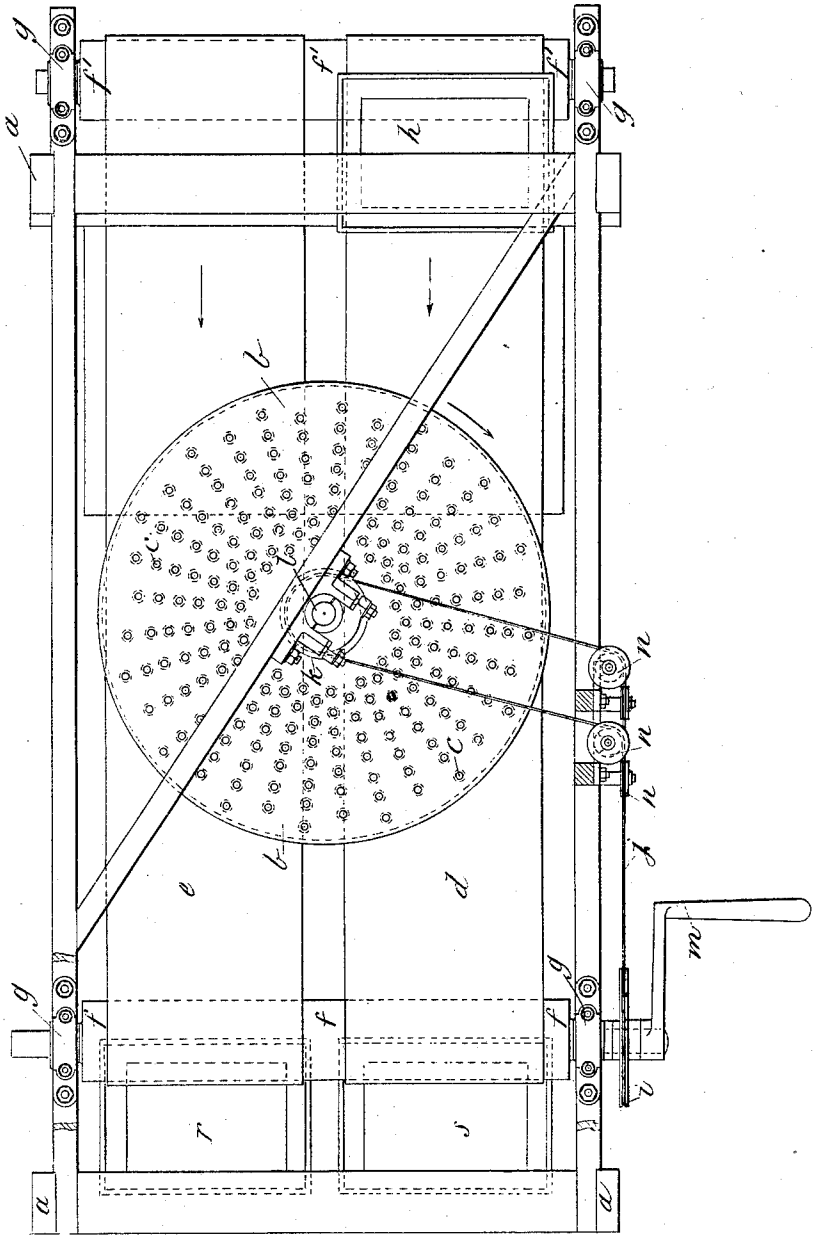

Fig. 1.

Witnesses:
Willard R Haight.
W. S. McArthur.

Inventors:
Charles Frederick Hilder
and Ernest Scott
by Wm H Babcock
Attorney

N. PETERS. Photo-Lithographer, Washington, D. C.

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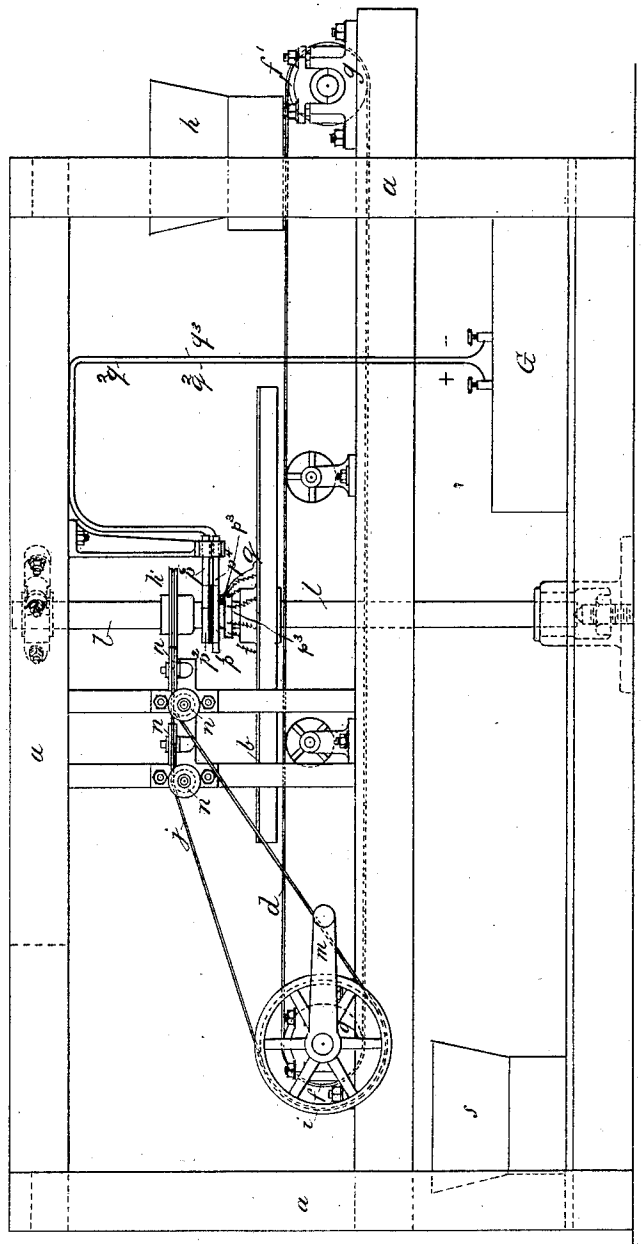
Fig. 2.



Witnesses:
Willard R Haight
H. S. McArthur

Inventors:
Charles Frederick Hilder
and Ernest Scott
by Wm H Babcock
Attorney

N. PETERS, Photo-Lithographer, Washington, D. C.

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MAGNETIC SEPARATOR.

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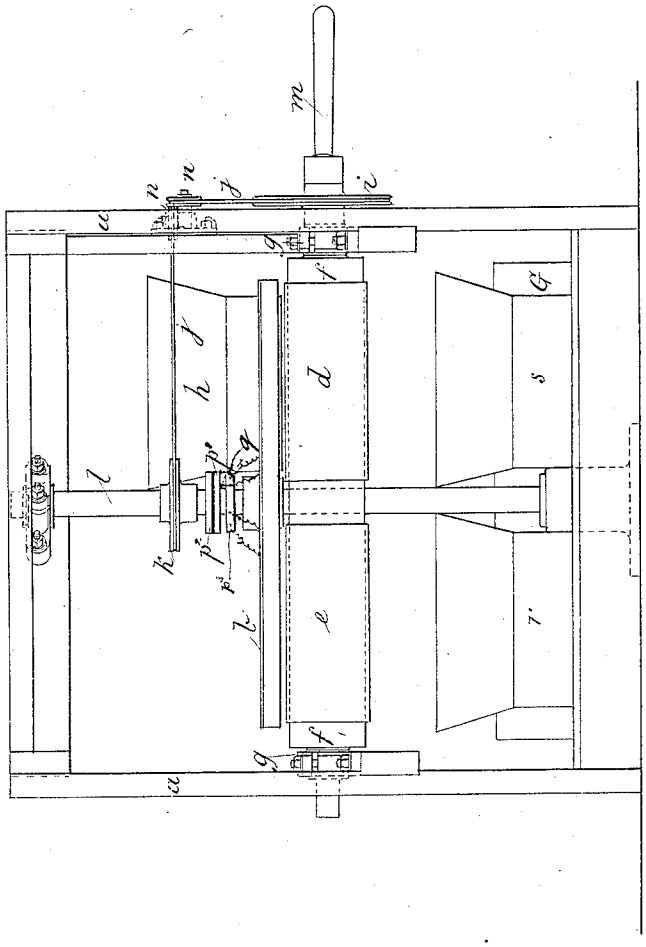
Fig. 3.



Witnesses:
Willard R. Haight
H. S. McArthur

Inventors:
Charles Frederick Hilder
& Ernest Scott
by Wm H Babcock
Attorney.

N. PETERS. Photo-Lithographer, Washington, D. C.

(No Model.) 4 Sheets—Sheet 4.

C. F. HILDER & E. SCOTT.

MAGNETIC SEPARATOR.

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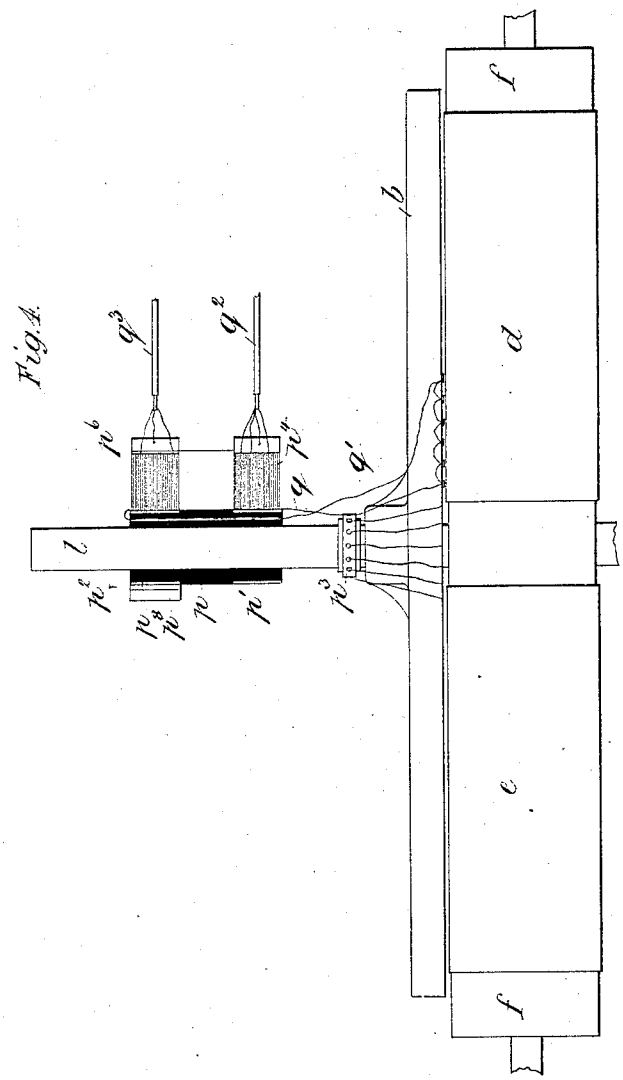

Witnesses.
W. B. Haight
R. E. Trout

Inventors
Charles F. Hilder
and Ernest Scott
by W. H. Babcock
Attorney.

N. PETERS, Photo-Lithographer, Washington, D. C.

UNITED STATES PATENT OFFICE.

CHARLES FREDERICK HILDER AND ERNEST SCOTT, OF NEWCASTLE-UPON-TYNE, ENGLAND.

MAGNETIC SEPARATOR.

SPECIFICATION forming part of Letters Patent No. 315,028, dated April 7, 1885.

Application filed November 26, 1884. (No model.) Patented in England July 19, 1884, No. 10,371.

To all whom it may concern:

Be it known that we, CHARLES FREDERICK HILDER, journalist, and ERNEST SCOTT, engineer and brass founder, subjects of the Queen of Great Britain, and both residents of Newcastle-upon-Tyne, England, have invented an Improved Magnetic Separator, (for which we have obtained a patent in Great Britain, No. 10,371, bearing date July 19, 1884,) of which the following is a specification.

This invention relates to machines for separating particles of iron or steel from other substances by means of electro-magnetism; and it consists, chiefly, in the combination of a rotary disk and electro-magnets carried thereby with automatic circuit making and breaking devices and a feed-belt from which said disk picks up the particles of iron, the magnets of said disk being successively demagnetized as they pass from above said belt in order that they may drop said particles.

The invention consists, further, in the combination of two belts, one being a feed-belt and the other a delivery-belt, with a magnet-carrying disk which turns above said belts, and circuit making and breaking devices, whereby the magnets of said disk are successively magnetized as they pass over said feed-belt and demagnetized as they pass over said delivery-belt, substantially as set forth.

Our said invention is chiefly designed to afford the means for recovering from the sweepings or refuse of workshops or factories portions of comparatively valuable metals or alloys—such as copper or brass—which in such refuse are mixed with iron or steel filings or the like. It is, however, applicable for separating particles of iron or steel from sand or other substances mechanically combined therewith. For example, it can be very advantageously applied for extracting or separating the particles of iron from magnetic ore or from titaniferous sand, such as the Taranaki "iron sand" found in New Zealand; or it may be employed for separating iron ores—such as Staffordshire red ores—which can be attracted by magnets from other materials, the ores being previously crushed or ground.

For the purpose of our invention we make use of the principle of electro-magnetism—that is to say, the workshop-sweepings, ore, sand, or other substances to be treated are brought into the vicinity of an electro-magnet or series of electro-magnets whose coils are connected with any suitable generator of electricity through the medium of contact making and breaking devices. Contact being made, the said electro magnet or magnets will attract the particles of iron or steel, and thus eliminate or separate the same from the mass and hold them while carrying them away or until a suitable carrier comes into position to receive them. The contact being then broken, the electro-magnets release the particles of iron or steel and permit them to fall into a suitable receptacle or upon the said carrier. When workshop-sweepings are treated to recover the valuable materials which they contain, these sweepings, after the iron or steel has been eliminated therefrom, are subjected to washing or other treatment to extract the said valuable materials.

In the accompanying drawings, we have illustrated a machine or apparatus constructed in accordance with our invention. Figure 1 is a plan, Fig. 2 a side elevation, and Fig. 3 an end elevation, of the said machine. Figs. 4 and 5 represent detail views of the circuit making and breaking devices and some of the proximate parts of the machine.

Like letters indicate the same parts in these figures.

a is the frame of the machine, which is made of wood or other suitable material. *b* is a circular plate or disk provided with a series of electro-magnets, *c*, and arranged to rotate in a horizontal plane above two endless traveling belts or aprons, *d e*. These belts are placed upon rollers *f f'*, carried in bearings *g*. They are arranged parallel to each other and in such position relatively to the disk *b* that some of the electro-magnets on the said disk are over the belt *d*, while others are over the belt *e*. *h* is a hopper which is arranged above the belt *d* near the roller *f'*, and through which the refuse sweepings or other substances to be treated are fed upon the said belt. The disk *b* may be rotated in any suitable manner. In the apparatus shown in the drawings we employ for this purpose a pulley, *i*, fixed on the

axle of the roller *f*, and a belt, *j*, passed around the said pulley and also around a pulley, *k*, fixed on the vertical shaft *l*, carrying the disk *b*. A crank-handle, *m*, is also shown fixed on the axle of the roller *f*, so that the movement of the belts *d e* and the rotation of the disk *b* can be effected simultaneously by hand. We may, however, provide a pulley on the said shaft, instead of the crank-handle, and arrange for driving the machine by steam or other power. *n n* are pulleys for guiding the belt *j*.

The contact making and breaking device which we prefer to employ is most clearly shown in Figs. 4 and 5.

p is a tube of insulating material fixed on the shaft *l*.

p' is a ring or collar, and p^2 p^2 are segments carried by the said tube of insulating material. The said ring and segments are made of brass or other good conducting material. The ring *p'* is connected by a wire, *q*, with a metal ring, p^3, which is also fixed on the shaft *l*, but is insulated therefrom. One end of each of the circuits in which the magnets are included is connected with this ring p^3. The other ends of these circuits are connected each with a separate segment, p^2, by means of a wire, *q'*, which is passed through an aperture or hole in the insulating-tube *p*. p^4 is a brush bearing upon the ring *p'*, and connected by the wire q^2 with one pole of a battery.

p^5 p^6 p^7 p^8 are brushes, each of which bears upon a separate segment, p^2, and all of which are connected by the wire q^3 with the other pole of the said battery. Each of the aforesaid circuits is therefore completed while the corresponding segment, p^2, remains in contact with one of the brushes p^5 p^6 p^7 p^8, and is broken when not in contact with either of the said brushes.

The operation of this apparatus is as follows, that is to say: The materials are fed upon the belt *d* in a thin layer. As this layer is carried by the belt under the disk *b* the circuit in which the electro-magnets *c* above the said belt are included is closed and the magnets are energized or magnetized by the electric current. These magnets, therefore, attract the particles of iron or steel or other material capable of being thus attracted, and separate them from the brass, copper, silica, gangue, or other materials constituting the remainder of the said layer, and hold the said particles until, by the rotation of the disk on its axis, such particles are carried over the belt *e*. The contact making and breaking device then opens the circuit in which the electro-magnets carrying the said particles are included, so that the said magnets are demagnetized, and the particles of iron or steel are released and allowed to fall upon the belt *e*. From this belt they fall into the receptacle *r*. During the working of the machine the circuits are repeatedly closed and opened or made and broken, as above described, so that the operations of picking up the particles of iron or steel from one belt and dropping them upon the other are carried on continuously. The copper, brass, or other substances which have been left on the belt or carrier *d* are carried forward thereby and fall therefrom directly into a receptacle, *s;* or they are carried by the said belt to another endless belt or apron, which deposits them in a washing apparatus or elsewhere, to be washed or otherwise treated, as desired. We usually arrange the disk *b* so that the magnets, when attracting the iron or steel, will move in the same direction as the belt *d*, as indicated by the arrows in Fig. 1, and so that the magnets, midway between the center and circumference of the disk, will move at the same speed as the belt, and will therefore for a short time be stationary relatively to the said belt. The attraction of all the particles of iron or steel is thus insured. We prefer that the opening and closing of the circuit should be effected by automatic contact devices. We prefer, moreover, that the magnets should be arranged in, say, six or eight series, each occupying a segment of the disk *b*, and that the said contact devices should be so adjusted that before one of these segments is moved over the belt *d* the circuit will be closed and the magnets in the said segment energized or magnetized by the current, and as soon as the said segment is moved over the belt *e* the circuit will be opened and the said magnets demagnetized. The said contact devices may, if desired, be actuated by other means than those above described, properly arranged in connection with the said disk to co-operate therewith for the purpose specified.

What we claim is—

1. In combination with a feed-belt and a discharge-belt traveling side by side, a series of magnets which rotate over said belts, and devices which free the particles of iron from said magnets as the latter pass above said discharge-belt, as set forth.

2. In combination with a feed-belt and a discharge-belt arranged in proximity to one another, a series of electro-magnets rotating above said belts, and circuit closing and breaking devices whereby said magnets are caused to pick up the particles of iron as they pass above the feed-belt and to drop the said particles as they pass over the discharge-belt, substantially as set forth.

3. The combination of the disk *b*, carrying the magnets *c*, with contact making and breaking devices, and the belts *d e*, which are moved simultaneously with the rotation of said disk, substantially as set forth.

CHARLES FREDERICK HILDER.
ERNEST SCOTT.

Witnesses:
R. Y. GREERE,
Solr. Newcastle-upon-Tyne.
ROBINSON LOCKE,
Newcastle.