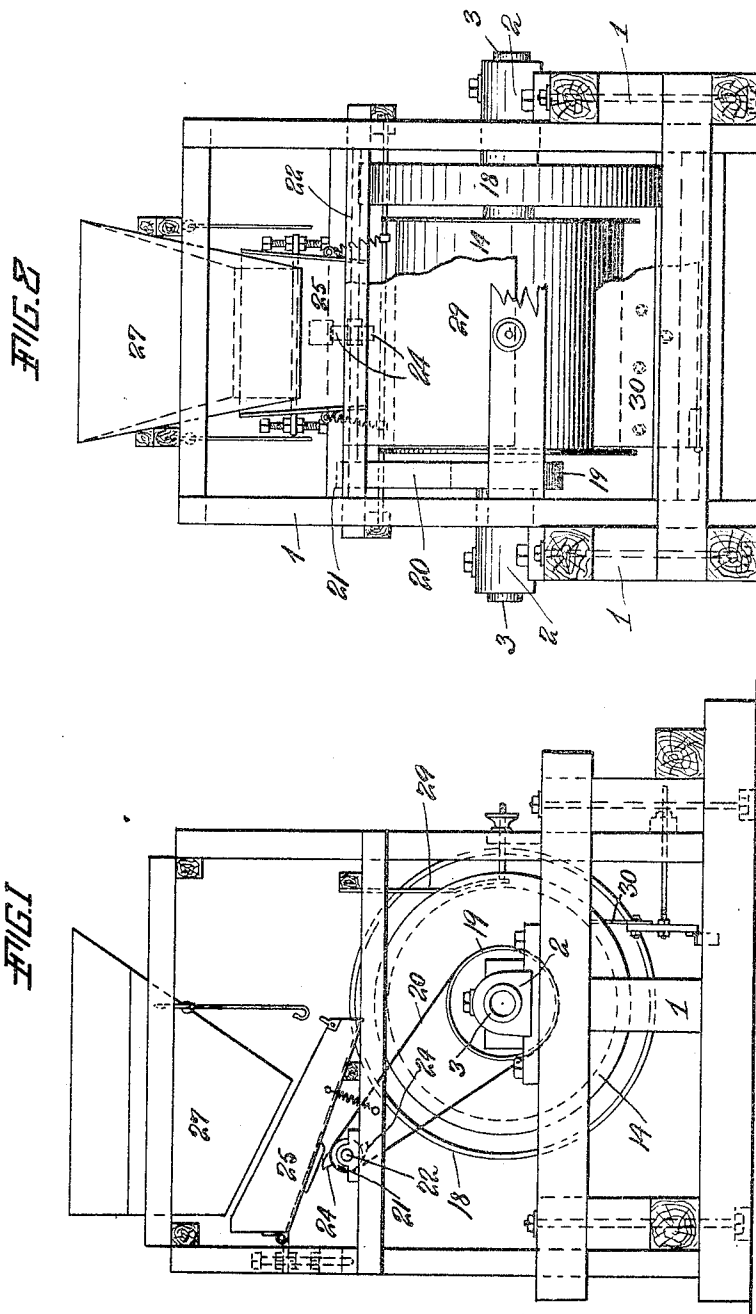


No. 893,606.

PATENTED JULY 21, 1908.

C. G. BUCHANAN.
MAGNETIC SEPARATOR.
APPLICATION FILED APR. 5, 1906.

2 SHEETS—SHEET 1.



Witnesses
Arnold Kelly
Geo. N. Kerr.

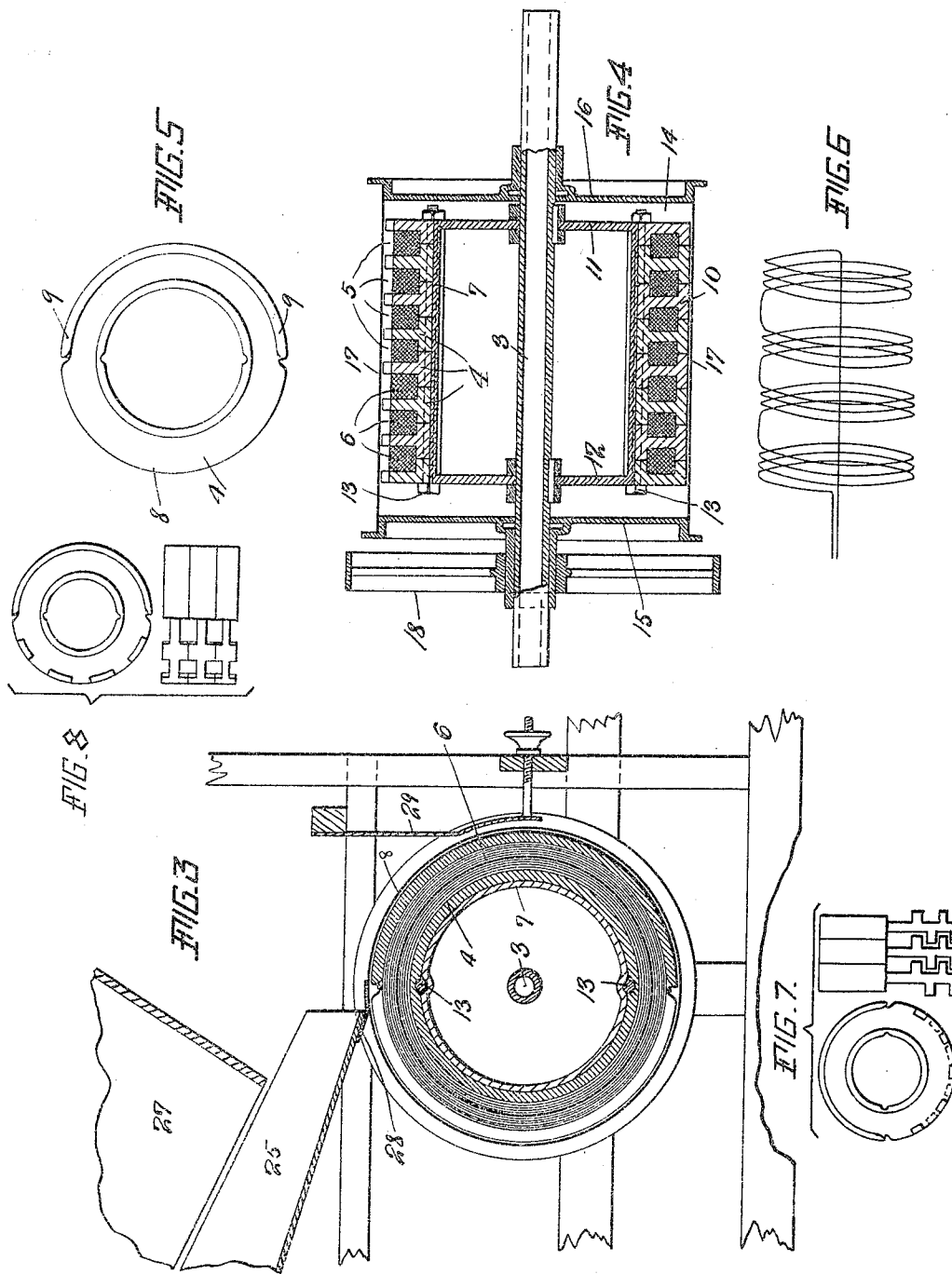
Inventor
Charles S. Buchanan,
By his Attorney
C. Edwards.

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UNITED STATES PATENT OFFICE.

CHARLES G. BUCHANAN, OF BROOKLYN, NEW YORK.

MAGNETIC SEPARATOR.

No. 893,606.

Specification of Letters Patent.

Patented July 21, 1908.

Application filed April 5, 1906. Serial No. 309,976.

To all whom it may concern:

Be it known that I, CHARLES G. BUCHANAN, a citizen of United States, residing at Brooklyn, in the county of Kings and State of New York, have invented certain new and useful Improvements in Magnetic Separators, of which the following is a full, clear, and exact specification.

This invention relates to magnetic separators and has especial reference to improvements whereby there shall be provided a uniform and dense magnetic field through which the material will be passed for the separation of magnetic from non-magnetic material.

According to this invention, the material is fed to a conveyer which passes it through a magnetic field to permit magnetic material to be attracted, and non-magnetic to drop off, and subsequently the magnetic material by the weakening of the field.

An important feature of the invention resides in the construction of the magnets, and their arrangement relatively to the conveyer, whereby a very dense and uniform magnetic flux is produced throughout the separating operation so as to prevent premature discharge of the magnetic material. The conveyer is shown as a revoluble drum, and the magnets are of annular form disposed within the drum. The magnets are interchangeable and so constructed that, during a portion of the path of the movement of the drum, a strong and uniform external flux is produced, and at another portion of the path the external flux is short circuited so as to release the magnetic material. By this general arrangement a minimum number of moving parts is required, permitting simplification of the electrical connections, and the use of switching devices for interrupting the magnetic field when the magnetic material is to be released, is avoided.

The invention comprises other features of improvement and advantage, all of which will be more fully pointed out in connection with the description and the accompanying drawings, wherein

Figure 1 is a side view of a machine embodying the invention. Fig. 2 is an end view; Fig. 3 is a transverse sectional view of one of the machines; Fig. 4 is a longitudinal section of the machine; Fig. 5 is a detail of one of the magnets; Fig. 6 is a diagram of

the magnet coil connections; Figs. 7 and 8 show modified pole tips.

The supporting frame of the machine may be built up as desired, according to its size and the character of material to be separated. The machine proper comprises the magnets, a movable conveyer and suitable chutes and guides for the material. 1, 1, are side frames carrying journals 2, 2, in which latter is mounted a stationary hollow shaft 3. The shaft is angularly adjustable, so as to vary the position of the magnets, and is locked by set screws carried by the journals 2. The magnets comprise a series of machined spools or cores 4, of magnetic material, formed to have annular channels in which the windings 6 are carried.

7 is a copper or brass drum keyed on the shaft and carrying the magnets. Each magnet is composed of two separable sections so that form wound coils may be used. It sometimes happens that a coil burns out, and this separable construction of core permits new coils to be substituted without the necessity of rewinding each coil individually.

Figs. 3 and 4 show the magnet sections partly cut away, as at 8, so as to form the separated poles 9, 9, and elsewhere the coils are entirely surrounded by the core, so that there is practically no exterior field, as at 10. Suitable end pieces 11, 12 keyed to the shaft 3 are provided and bolts 13 pass through all of the sections and hold the spools and drum 7 firmly together.

Fig. 5 shows one of the core sections, having notches adjacent the ends of the pole portions 10, which notches are provided for the leads to pass through. The coils are preferably connected in series, as shown diagrammatically in Fig. 6, in such manner as to form a succession of alternating north and south poles, substantially parallel to the path of the material. 14 represents a rotary drum mounted preferably on the shaft 3, comprising end pieces 15, 16 and the cylindrical side 17, the latter being of non-magnetic material, such as copper. 18 is a driving pulley for rotating the drum. 19 is a driven pulley connected by belt 20 with a pulley 21 on cam shaft 22. 24 are a series of cams adapted to oscillate the chute 25 so as to vibrate it for the purpose of evenly distributing the ore or other material to be separated. 27 is a hopper located above the

chute. The chute 25 has a flexible apron 28 bearing on the surface of the conveyer or drum so as to prevent the material from falling backwards when the chute is vibrated. 29 is an adjustable spreader or evener extending lengthwise of the drum, and 30 is a partition which divides the magnetic from the non-magnetic material.

In Figs. 7 and 8 a modification is shown in which fields of varying strength are produced by changes in the pole tips. Fig. 7 shows pole faces which produce a zig-zag field, and Fig. 8 shows an interrupted field. In Fig. 7 it will be seen that the lines of force at some points will be parallel to the path of the material, and at others will be transverse. The effect of this is to form a magnetic jig which agitates the material while on the conveyer. For coarse material, the uniform field is preferable, but for fine material, it is sometimes advantageous to agitate the material gently while in the magnetic field. In Fig. 8, a somewhat similar effect will be produced by alternately bridging the pole pieces, these bridges not being long enough to cause the material to drop off.

In the operation of the machine, the current is led to the various windings by leads preferably carried within the hollow shaft 3. Between the separated poles 9, 9 a strong and uniformly dense field will exist extending through the air from pole to pole, and this field is utilized for separating magnetic from non-magnetic material as it is carried around by the rotation of the conveyer. The non-magnetic material will drop to the right of the separator 30 as soon as it passes the evener 29, and the magnetic material will drop as soon as it reaches the point where the field is shunted or short circuited by bridging the pole pieces around the coil. There is consequently no gradual weakening of the magnetic field, but a practically instantaneous weakening, so that the material passes from the full strength of the field into no field at all. This construction of annular magnet has a number of practical advantages, the principal one of which is, that the field can be made uniform throughout the separating period, so that all tendency of heavy material to drop off because of the variation in the magnetic field is avoided. This non uniformity of field has been a very serious objection in various forms of magnetic separators heretofore used, in which the material passes successively through the fields of several magnets. A further advantage of the construction herein described resides in the construction of the magnets, by which the requisite field strength is secured with a relatively small number of magnets, and also avoiding the necessity of breaking the current to drop the material. Suitable current controlling rheostats and switches will be provided to control the current through the

magnets, and the various coils may be connected otherwise than in series, where found desirable. Ordinarily the coils in series provide the necessary resistance. The parts are all interchangeable, and those subject to deterioration, readily renewable.

Modifications and changes may be made without departing from the scope of the invention, and I do not restrict myself to the precise construction I have illustrated and described.

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

1. In a magnetic separator, the combination with a conveyer, of a plurality of magnets each producing a substantially uniform magnetic field through a portion of the travel of said conveyer, and means short circuiting field through the remainder of the travel, substantially as described.

2. In a magnetic separator, the combination with a conveyer, of an annular horseshoe magnet disposed within the conveyer and having separated pole pieces projecting towards the conveyer, said pole pieces having projections to distort the flux through a portion of the travel of the conveyer, whereby to agitate the material while passing through the magnetic field on the conveyer, and being in contact to short-circuit the flux to discharge the material at another portion of the conveyer travel.

3. The combination in a magnetic separator with a movable hollow drum, of a relatively fixed annular horseshoe magnet within the drum having its poles substantially parallel to the inner periphery thereof, segmental portions of said poles being in contact to short-circuit the magnetic flux at such portions.

4. In a magnetic separator, a magnet having an annular core with radial pole pieces, peripherally wound coils on said core, said pole pieces being in contact during a portion of their extent to short circuit the flux, substantially as described.

5. In a magnetic separator, the combination with a hollow non-magnetic rotary drum, of magnets within said drum having pole pieces adjacent the inner periphery thereof, segmental portions of said poles being in contact to short-circuit the magnetic flux at such portions.

6. In a magnetic separator, the combination with a hollow rotating drum, of an annular magnet within said drum having pole pieces substantially parallel to the inner periphery thereof, said poles being partially separated and partially in contact, substantially as described.

7. In a magnetic separator, the combination with means for feeding mixed magnetic and non-magnetic material through a magnetic field, of means comprising a closed

magnetic circuit for suddenly weakening the magnetic field by short circuiting the flux to discharge the magnetic material, substantially as described.

- 5 8. In a magnetic separator, the combination with a hollow rotating non-magnetic drum, and means for feeding material thereon, of a series of axially arranged annular magnets within said drum, said magnets
10 having radial pole pieces disposed adjacent said drum to form a magnetic field, and means within the drum for shunting the magnetic field to discharge the material, substantially as described.
- 15 9. In a magnetic separator, the combination with a hollow, movable non-magnetic drum, and means for feeding material thereto, of angularly adjustable annular magnets within said drum, said magnets having pole
20 pieces disposed adjacent the inner side of said drum to form a magnetic field, and means adjustable therewith for short circuiting said field to discharge the magnetic material, substantially as described.
- 25 10. In a magnetic separator, the combination with means for conveying material through a magnetic field, of a series of magnets having separated pole pieces extending
30 lengthwise of the travel of the material, said pole-pieces being joined to form a closed magnetic circuit whereby the magnetic field is shunted to discharge the material by gravity, substantially as described.
- 35 11. In a magnetic separator, the combination with a hollow, movable non-magnetic drum, and means for feeding material thereto, of a series of magnets within said drum having pole pieces adjacent the inner surface
40 thereof, said pole pieces being separated by an air gap where the material is to be held and magnetically connected where the material is to be discharged, substantially as described.

12. In a magnetic separator, the combina-

tion with a movable non-magnetic drum, of a 45 shaft within said drum carrying a series of annular magnet cores having peripheral grooves adapted to contain magnet coils, coils in said grooves, means for energizing said coils, said cores having separated mag- 50 net poles for a portion of their extent and connected poles for the remainder, substantially as described.

13. In a magnetic separator, the combination with a movable non-magnetic drum, of a 55 shaft within said drum carrying a series of annular magnet cores having peripheral grooves adapted to contain magnet coils, coils in said grooves and connected with a source of supply through said shaft, said 60 cores having separated magnetic poles throughout a portion of their extent and magnetically connected poles through the remaining portion, substantially as described.

14. In a magnetic separator, the combination with a drum, of an annular magnet core 65 composed of separable grooved halves having pole faces in partial contact, and a magnet coil adapted to be retained in said groove when said halves are together, and means for 70 securing the halves together, substantially as described.

15. In a magnetic separator, the combination of an annular magnet core composed of 75 separable peripherally grooved sections having pole faces in partial contact, a magnet coil adapted to be retained in said groove when said sections are secured together, means for securing said sections together, a shaft upon which said core is mounted, and 80 means for angularly adjusting the shaft with the core, substantially as described.

In testimony whereof I affix my signature, in presence of two witnesses.

CHARLES G. BUCHANAN.

Witnesses:

JULIAN S. WOOSTER,
GEO. N. KERR.