No. 871,298. PATENTED NOV. 19, 1907.

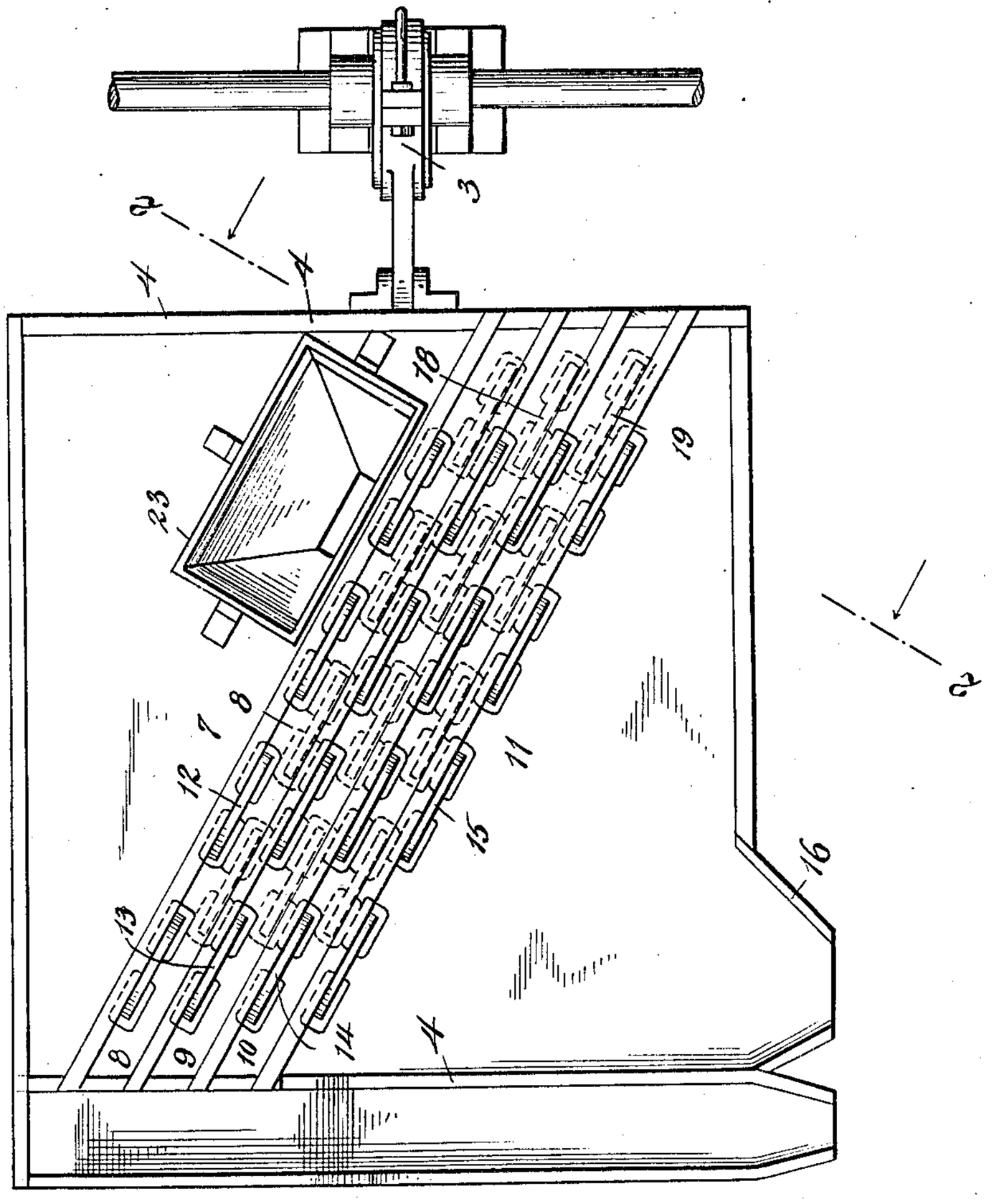
A. SCHWARZ.

MAGNETIC SEPARATOR.

APPLICATION FILED FEB. 1, 1906.

2 SHEETS—SHEET 1.

Fig. 1.



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2 SHEETS—SHEET 2.

Fig. 3.

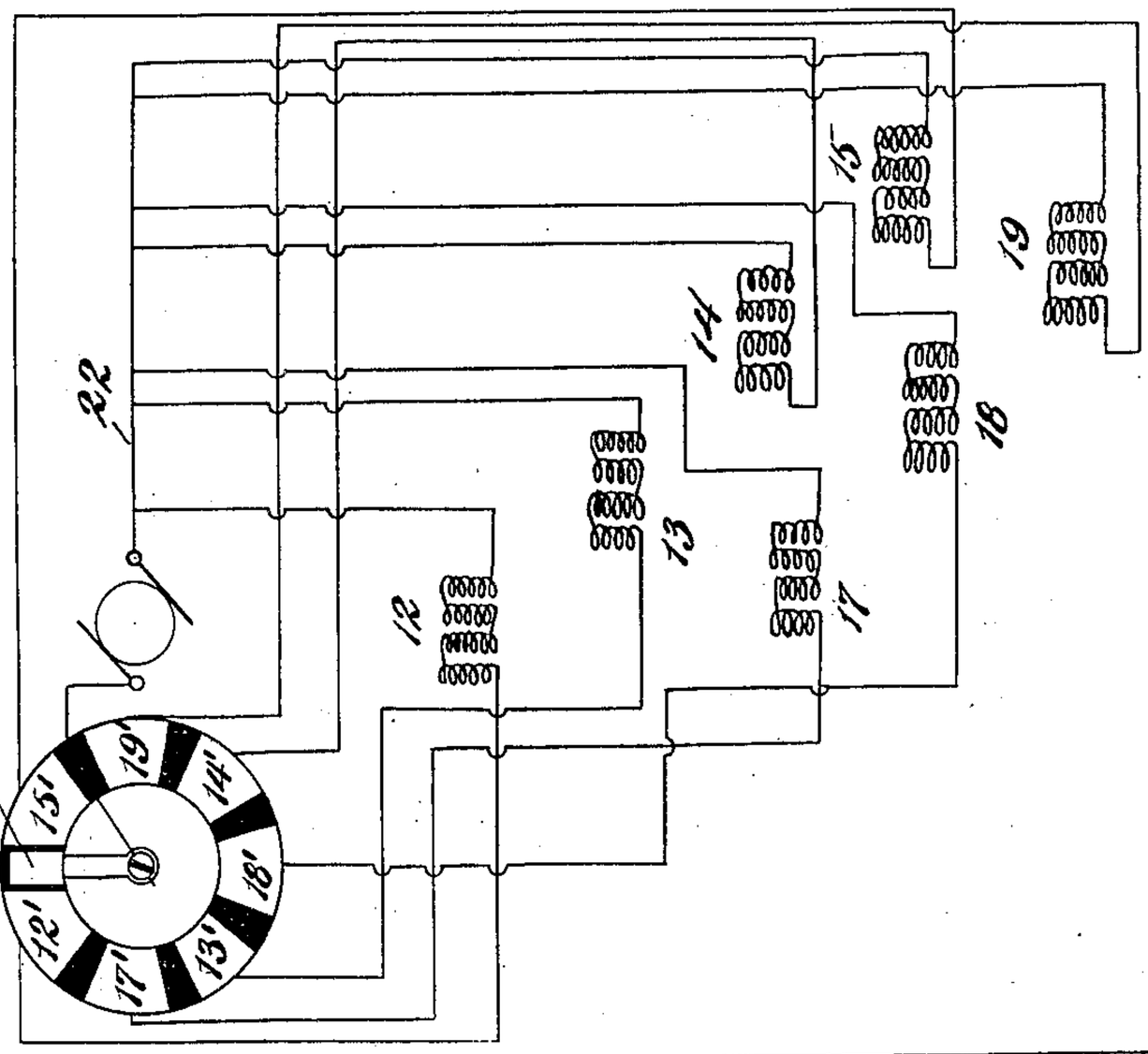
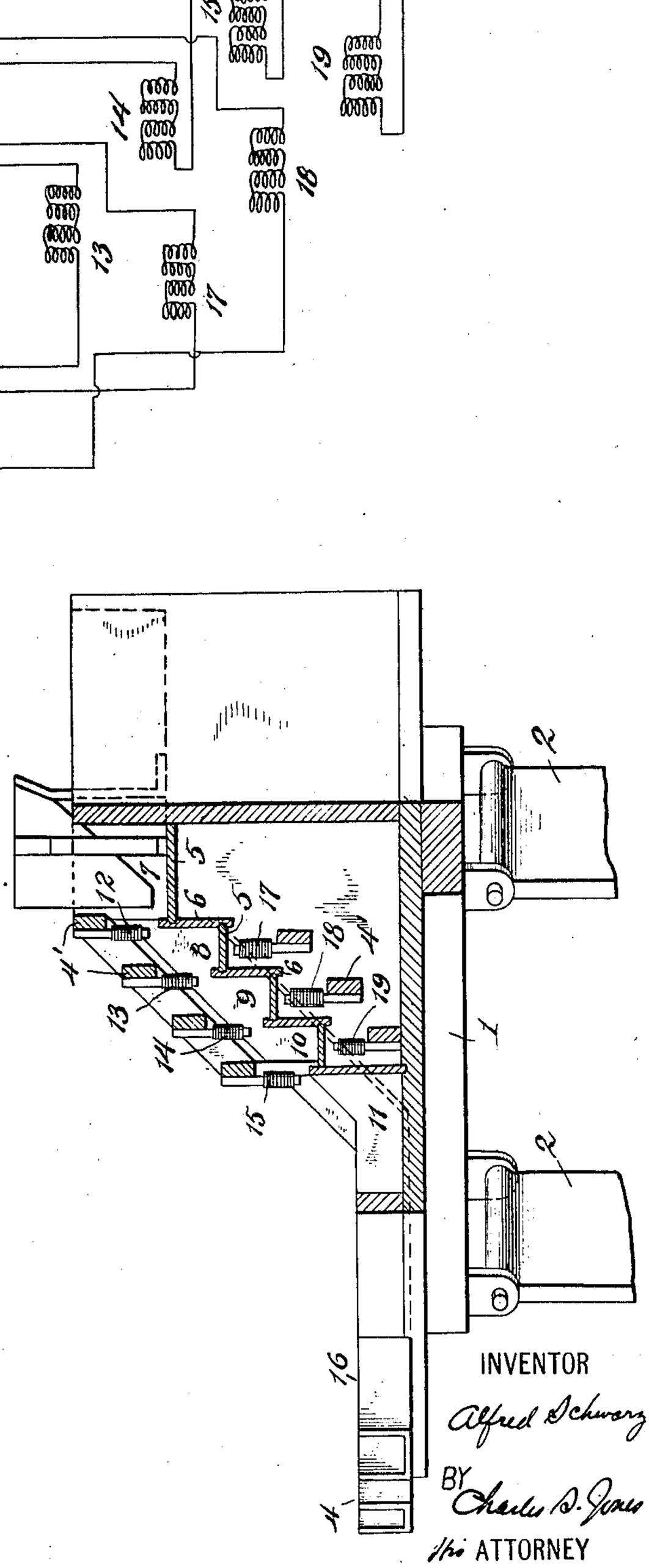


Fig. 2.



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MAGNETIC SEPARATOR.

No. 871,298. Specification of Letters Patent. Patented Nov. 19, 1907.

Application filed February 1, 1906. Serial No. 298,978.

To all whom it may concern:

Be it known that I, ALFRED SCHWARZ, a subject of the Emperor of Germany, and a resident of the borough of Manhattan, city, county, and State of New York, have invented certain new and useful Improvements in Magnetic Separators, of which the following is a specification.

In an application of even date herewith Serial Number 298,977, I have described a magnetic separator the essential elements of which are a riffle-board and banks of electromagnets arranged above and below said board. The magnets are disposed in rows running obliquely of the riffle-board and by a suitable commutator the magnetic fields of force are developed in successive rows of the upper bank alternately with those of the lower bank so as to cause the magnetic particles to be carried in an oblique path substantially transverse to the longitudinal direction of the riffles.

The present invention is directed to a modification of the system described in said application and will be understood by reference to the accompanying drawings in which

Figure 1 is a top view of the separator; Fig. 2 a vertical section on the plane of the line 2—2 of Fig. 1; and Fig. 3 a diagrammatic view of the commutator and circuit connections.

Similar reference letters indicate similar parts in the several views.

Referring to the drawings the numeral 1 designates a table which is mounted on rocking supports 2 and reciprocated by any suitable means, preferably in a horizontal direction by an eccentric or crank 3. Secured to said table is a separator proper which consists of a frame having end pieces 4 into which steps are cut. Between these step sections horizontal and vertical strips 5 and 6 respectively are secured so as to constitute riffles designated respectively 7, 8, 9, 10 and 11, in which the separation hereafter described is effected. The vertical strips 6 extend above the planes of the strips 5 in order to prevent the material in the riffles being thrown to the next lower riffle by the jogging motion of the table.

Extending longitudinally of the frame both above and below the riffles are parallel slats 4′ to which are secured any convenient number of electromagnets. These magnets are preferably of U shape so as to utilize the entire magnetic field, and those of the bank below the riffles are preferably weaker than those of the upper bank. For the purpose of illustration I have shown the upper bank of magnets as comprising four rows designated respecitvely 12, 13, 14 and 15, and so disposed that the polar faces are substantially over and a short distance above the edges of the vertical strips 6. By this arrangement when the rows of the upper bank of magnets are successively energized they will attract the magnetic particles from the corresponding riffle and when deënergized said particles will fall into the next lower riffle. From the magnets 15 constituting the lowermost row the separated magnetic particles will be deposited in riffle 11 along which they will be carried by the jogging motion of the table to a chute 16 and thence to a suitable bin.

The lower bank of electromagnets is shown as divided into three rows designated respectively 17, 18 and 19, and these are so disposed that their polar faces are in close proximity to the under sides of the riffles 8, 9 and 10 respectively and extend below substantially the center thereof.

The magnets of contiguous rows of the upper bank may be so arranged that poles of like or opposite polarity face each other. The same condition may obtain in the rows of magnets of the lower bank. Similarly magnets of the upper and lower banks relative to each other may be so disposed that a pole of the former is above one of like or opposite polarity.

The magnets of both banks are controlled by a commutator 20, the circuits being shown diagrammatically in Fig. 3. This commutator is mounted on a shaft and rotated by any suitable means at a speed adapted to the effective operation of the separator. It is divided into sections by suitable insulation, the sections corresponding to the total number of rows of magnets in both banks, these sections being designated respectively in the order of rotation 12′, 17′, 13′, 18′, 14′, 19′ and 15′. A stationary brush 21 in contact with the face of the commutator is connected to one terminal of the source of current. The feed line 22 connected to the other terminal has branches leading therefrom to the several rows of magnets as shown. The rows of magnets above described are separately grouped in series, each row being connected to a cor-

responding commutator section, that is magnets 12 to section 12′, magnets 17 to section 17′ and so on, it resulting therefrom that during a single rotation of the commutator the rows of magnets will be energized in the following order 12, 17, 13, 18, 14, 19, 15. That is the magnets are energized in rows alternately above and below the riffles, only one row being energized at a time.

The method of operation of the above described separator is as follows: The material to be treated is first ground to any desired mesh and fed to the separator near one end of the uppermost riffle 7 through a chute or hopper 23. Assuming that the brush 21 is in contact with section 12′ of the commutator the row of magnets 12 will be energized and when that occurs the magnetic particles will be attracted and remain attached to the poles thereof during their period of magnetization. As soon as magnets 12 are deënergized by the section 12′ of the commutator passing from under the brush 21 the attracted particles will be released and at the moment of demagnetization of said magnets the magnets 17 will be energized by reason of the contact of section 17′ of the commutator with brush 21. Under the combined attractive force of magnets 17 and the jogging motion of the table the particles released from magnets 12 will be deposited in riffle 8. From the latter the magnetic particles will be lifted out when magnets 13 are energized by the contact of section 13′ of the commutator with brush 21, and deposited in riffle 9 under the attractive force of magnets 18 and the jogging motion of the table when the former magnets are deënergized and the latter energized in the course of the rotation of the commutator. The above described operations will be repeated by magnets 14 and 19 as they are successively energized and deenergized. From the riffle 10 the magnetic particles will be raised by magnets 15, and when the latter are deënergized the released particles will fall into the lowermost riffle 11 along which they will be carried to the chute 16.

The speed of rotation of the commutator and the intensity of the successive magnetic fields from the uppermost to the lowermost riffle may be varied according to the character of the material treated and the thoroughness of the separation desired. In practice these conditions have been so adjusted that the magnetic particles are swept from the uppermost to the lowermost riffle in rapidly succeeding wave-like formations. The interval of time elapsing between the magnetization of successive rows of the upper bank with the intervening fields of force developed alternately therewith in the rows of the lower bank is of such short duration that a given mass of magnetic particles separated by the magnets 12 barely touches the riffles as it is swept onward by the fields successively developed in magnets 12, 13, 14 and 15.

The reciprocations of the separator as the material is fed to it tend to throw the latter in the longitudinal direction of the separator. This results in the non-magnetic particles being carried along the riffles in the direction of their length, a large percentage of such particles being set free at the first separation by the magnets 12 and they will be gradually carried by the jogging motion of the separator along the riffle 7 within the fields of magnets 12 so that by the time a given mass reaches the end of the riffle it will be practically freed of all magnetic particles. More or less non-magnetic particles will be carried over mechanically in the masses separated by the magnets 12 but as such masses are turned over and over during their progress toward the lowermost riffle 11 the non-magnetic particles will be set free and will fall into the riffles along which they will be carried. As many riffles may be provided as will in practice insure the complete separation of all of the magnetic particles by the time a given mass reaches the lowermost riffle 11. A separator constructed in accordance with the present specification has been found in practice to give good results with four separating riffles, it being found that a very small percentage of non-magnetic particles is carried as far as the riffle 10. During the sweep of the magnetic particles between the magnets 12, 13, 14 and 15, the lower magnets 17, 18 and 19, tend to hold said particles from being thrown forward by the jogging movement of the table so that such motion acts primarily to release the non-magnetic particles and to facilitate their travel toward the outlets of the riffles. The magnets 17, 18 and 19 may therefore be made weaker than the magnets of the upper bank.

The outlet ends of the riffles 7, 8, 9 and 10 open into an inclined chute 24 at one end of the frame and from said chute the non-magnetic particles are delivered to a suitable bin.

The frame comprising the banks of magnets and riffles may run in the same direction as the table or it may be placed obliquely of the longitudinal direction of the table 1. An angle of about 30° has been found in practice to give good results. However this may be it will be noted that successive fields of force are developed along lines parallel with the riffles and that the separation is effected by causing the non-magnetic particles to travel along the riffles and the magnetic particles to be carried in paths transversely thereof.

It will be noted that the separation of the magnetic from the non-magnetic particles is effected by the upper bank of magnets.

The lower bank of magnets is not absolutely essential to the successful operation of the separator and may be omitted.

What I claim and desire to secure by Letters Patent is:

1. In a magnetic separator the combination of a table having riffles thereon arranged successively in different horizontal planes, means for feeding the material to be treated to the uppermost riffle, electromagnets disposed above and below said riffles, and means for energizing and deënergizing said magnets successively alternately above and below the riffles from the uppermost to the lowermost to effect the transportation of the magnetic particles from one riffle to the next lowermost.

2. In a magnetic separator the combination of a table having riffles thereon arranged successively in different horizontal planes, means for feeding the material to be treated to the uppermost riffle, electromagnets having their polar faces substantially over and in proximity to the outer edge of said riffles, electromagnets having their polar faces in proximity to the under side of said riffles, and means for energizing and deenergizing said magnets successively alternately above and below the riffles from the uppermost to the lowermost to effect the transportation of the magnetic particles from one riffle to the next lowermost.

In witness whereof I have signed my name to this specification in the presence of two subscribing witnesses.

ALFRED SCHWARZ.

Witnesses:
OLIN A. FOSTER,
M. E. MCNINCH.