No. 686,835. Patented Nov. 19, 1901.

M. RUTHENBURG.

MAGNETIC SEPARATOR FOR ORE OR CONCENTRATES.

(Application filed May 28, 1900.)

(No Model.) 3 Sheets—Sheet 1.

FIG. 5.

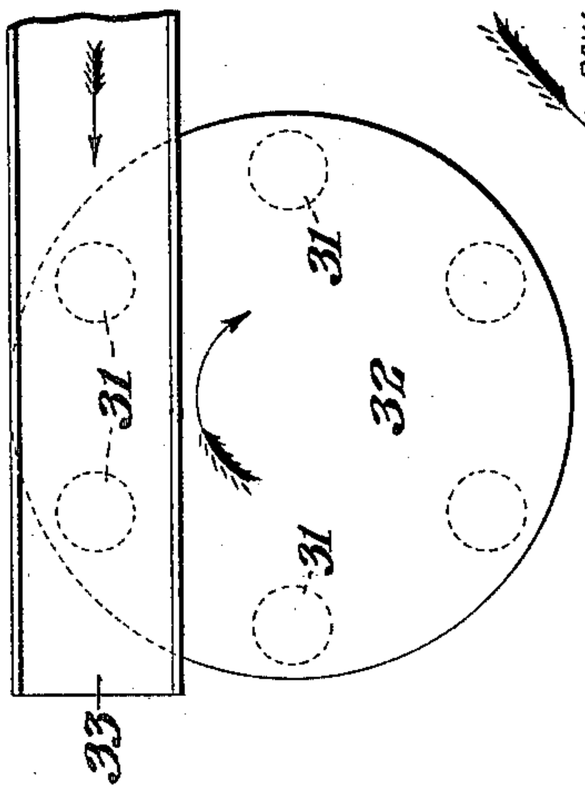

FIG. 4.

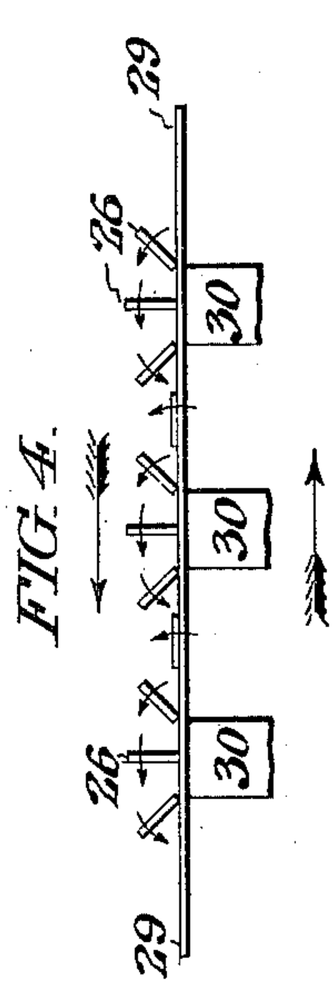

FIG. 1.

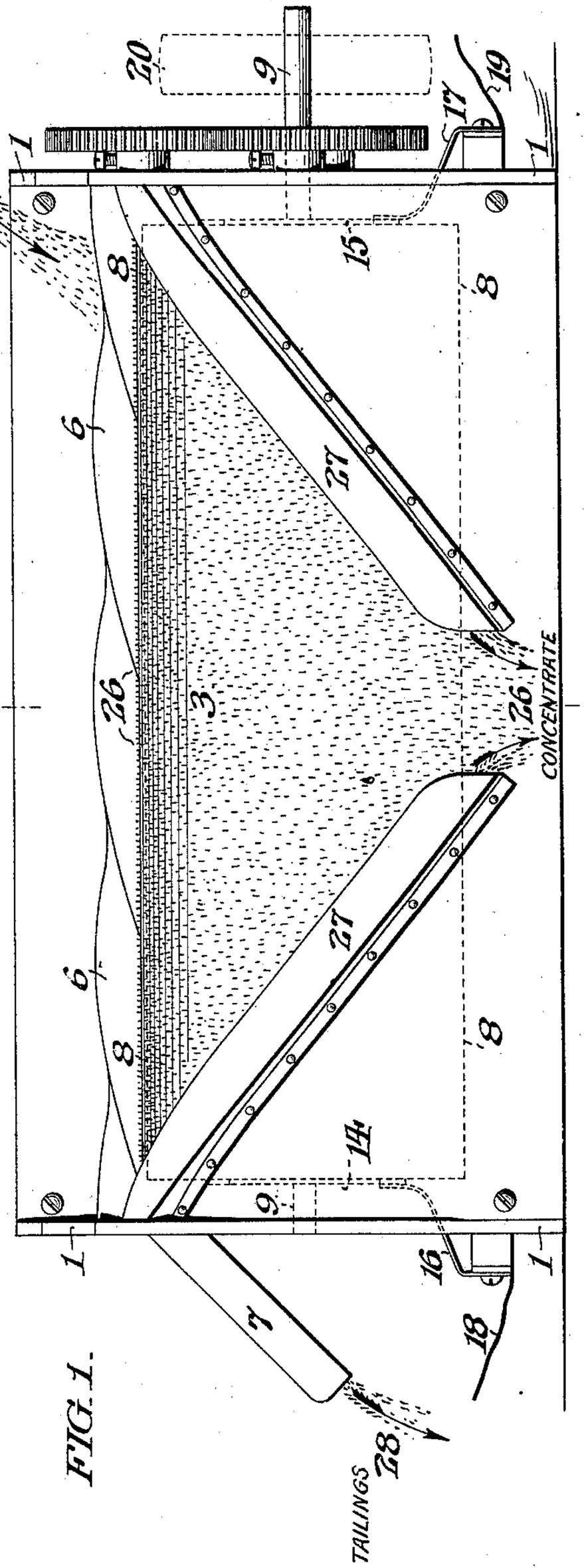

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FIG. 2.

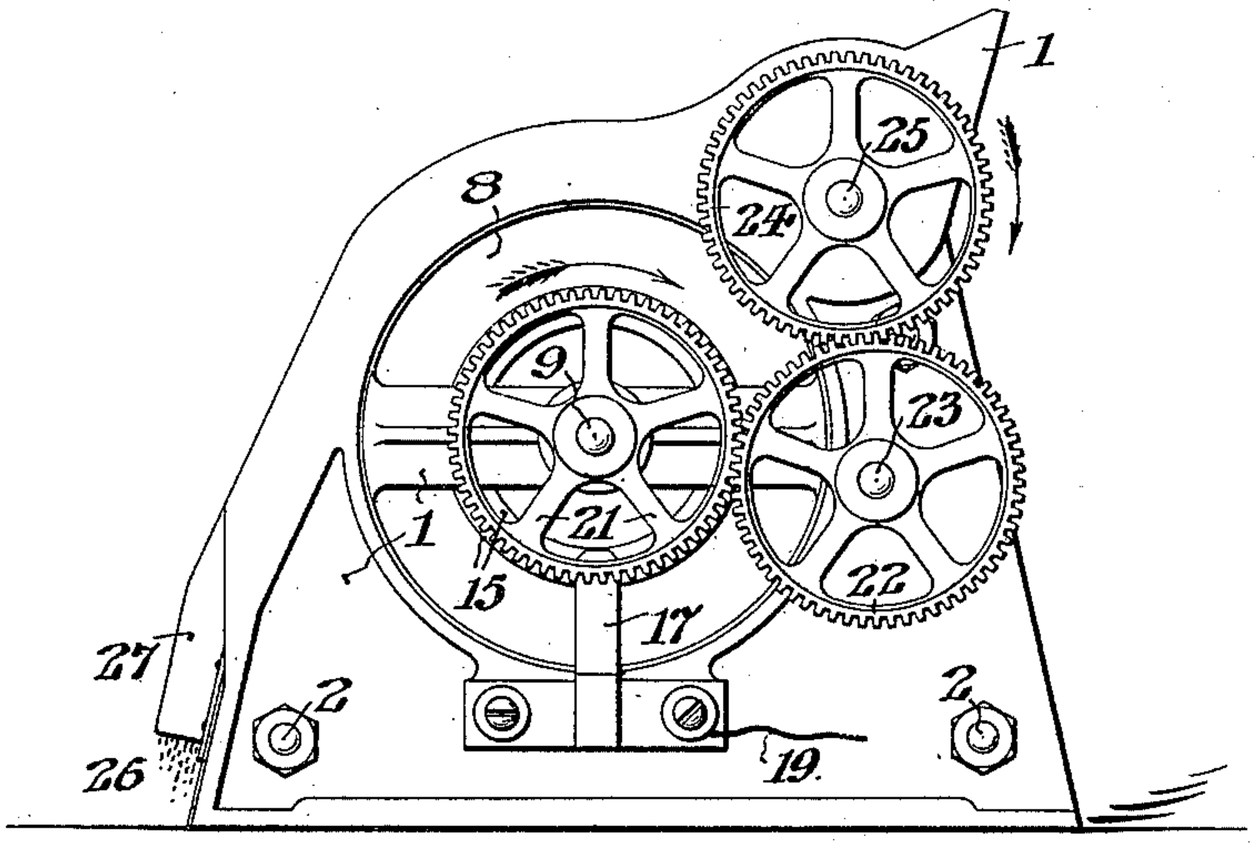

FIG. 3.

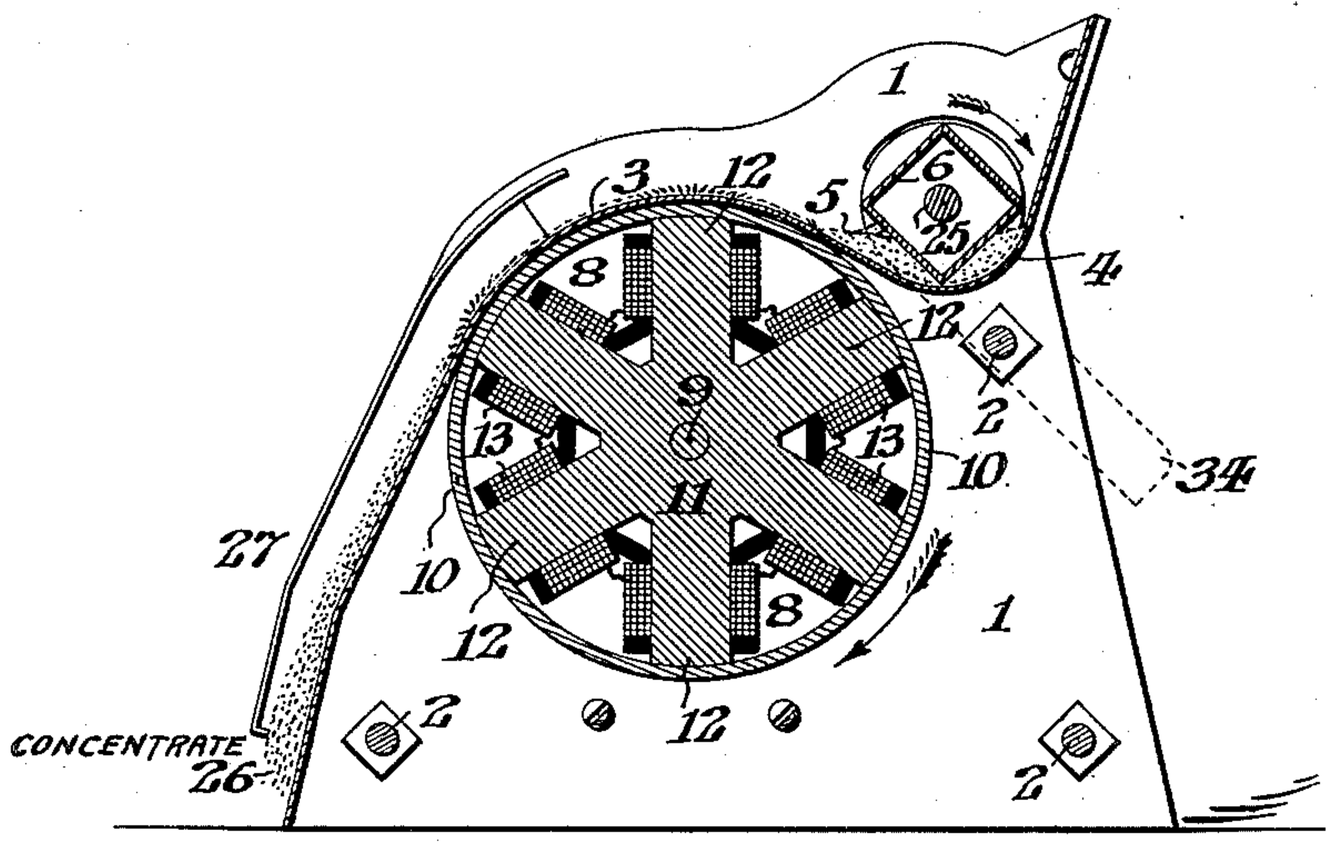

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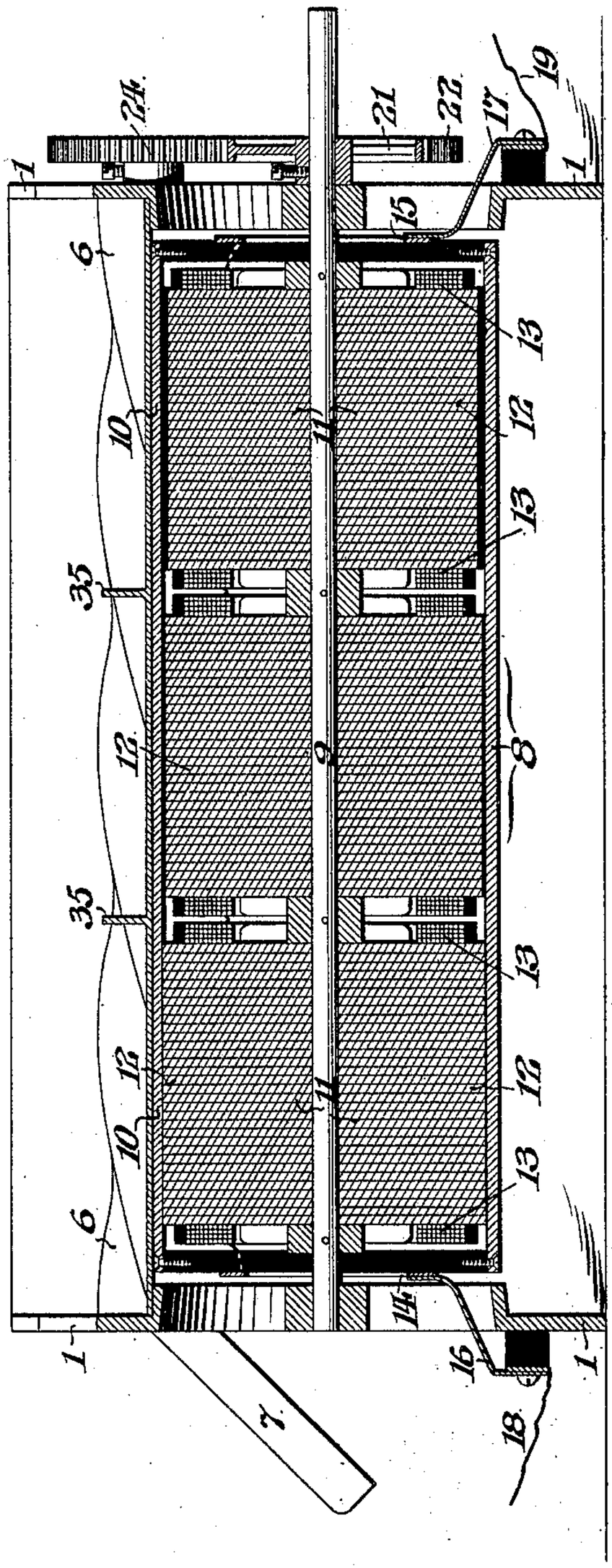
FIG. 6.



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UNITED STATES PATENT OFFICE.

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MAGNETIC SEPARATOR FOR ORE OR CONCENTRATES.

SPECIFICATION forming part of Letters Patent No. 686,835, dated November 19, 1901.

Application filed May 28, 1900. Serial No. 18,197. (No model.)

To all whom it may concern:

Be it known that I, MARCUS RUTHENBURG, of Philadelphia, in the State of Pennsylvania, have invented certain new and useful Improvements in Magnetic Separators for Ore or Concentrates, whereof the following is a specification, reference being had to the accompanying drawings.

Generally stated, my invention relates to machines arranged to receive raw material, such as comminuted ore or concentrate, comprising particles of different magnetic permeability and to divide and separately discharge the constituent elements of said material in accordance with the magnetic permeability thereof. My improvements are, however, particularly applicable to such separators as are of the class comprising relatively movable parts.

In various machines of the class specified as hitherto constructed a large proportion of the magnetic force used is expended in bodily uplifting the particles of magnetizable material from the accompanying gangue and sustaining the weight of said particles during their progress through the machine without other support than the stress of the magnetic field.

It is the object of my invention to provide a magnetic separator wherein the magnetizable portion of the material treated is supported during the process of its extraction from the gangue by means independent of the magnet-field, one advantage of my improvements being the economy of magnetic force which results from such independent support of the material treated.

My invention also comprehends other features of construction and arrangement hereinafter described and claimed.

In the accompanying drawings, Figure 1 is a side elevation of a convenient embodiment of my invention. Fig. 2 is an elevation of the right-hand end of the machine shown in Fig. 1. Fig. 3 is a sectional view of said machine, taken on the line A A in Fig. 1. Fig. 4 is a diagrammatic view showing the manner in which the magnetizable particles are progressed. Fig. 5 is a plan view showing a modified form of my invention. Fig. 6 is a longitudinal sectional view showing a modified form of my invention.

In said figures the end frames 1 are connected by the bars 2 and the shell 3. Said shell comprises a trough-like receptacle 4 for the raw material 5, which receptacle extends from end to end of the machine, and said material is progressed from the right-hand end of the machine shown in Fig. 1 to the left-hand end thereof by means of the feed-screw 6, and the tailings or gangue portion of said material is discharged by said screw down the chute 7. The rotatable magnet 8 is supported upon the driving-shaft 9 and comprises a cylindrical casing 10, of non-magnetizable material, connected with said shaft by means of the core 11, having a plurality of radial poles 12. The coils of electric conductors 13 are so disposed with respect to said core as to create a magnetic field comprising said poles. As a matter of convenience said coils 13 are connected in series within the drum, and the respective annular terminals 14 15 of the drum-circuit are connected by any convenient means, such as the brushes 16 17, with the exterior circuit 18 19, comprising a source of current. Said core 11 is conveniently formed of laminations, comprising stampings of sheet metal of the shape indicated in Figs. 3 and 6, assembled in any convenient manner in fixed relation with the shaft 9 and with the casing 10. Said shaft 9 is supported in bearings in the housing end frames 1 and is arranged to be rotated in the direction of the arrow upon Fig. 3 by means of the band-wheel 20. (Indicated in Fig. 1.) The gear-wheel 21 is fixed to rotate with said shaft 9 and connects with the idle gear 22, mounted upon the stud-shaft 23, extending from the frame 1. Said gear 22 engages with the gear 24 upon the shaft 25 of the feed-screw 6 and serves to rotate the latter contemporaneously with the rotation of the drum 8 and in the direction indicated by the arrow upon Fig. 2.

The operation of the device is as follows: The magnet being energized, a magnetic field is produced, comprising lines of force which radiate from the outer extremities of the poles 12 and are deflected from pole to pole, said lines being practically concentric with the axis of the drum 8 at a point midway between said poles. Said magnetic field being rotated toward the thin layer of raw material 5 existing at the margin of the receptacle 4,

as shown in Fig. 3, the individual particles of magnetizable material are induced to approximate to the lines of magnetic force—that is to say, each magnetizable particle 26 is first caused to stand on end radially with respect to the pole 12 passing beneath it, is then caused to lie down toward the left-hand side of said Fig. 3, and is by the next succeeding pole caused to rise upon its opposite end and is thus progressed over and over end for end up the incline presented by the shell 3, which supports its weight until it gravitates down said shell and is caught by the discharge-chutes 27, which are conveniently fixed upon said shell to deliver the concentrate intermediate of the length thereof. The non-magnetizable portions of the raw material 5 are retained in the receptacle 4 by the force of gravity, while the magnetizable particles are uplifted therefrom, as aforesaid, and any fine dust entrained by the uplifted particles is threshed out by the rising and falling of said particles before the crest of the shell 3 is reached, so that the separation of the magnetizable material is completely effected by the single operation described. The raw material 5 in said receptacle 4 being continuously agitated and progressed by means of the feeding mechanism, comprising the screw 6, is deprived of all of its magnetizable constituents before the left-hand extremity of the machine shown in Fig. 1 is reached, and the worthless tailings or gangue 28 is discharged, as aforesaid, by the feed-screw down the chute 7.

It is obvious that a selective discharge of the product in accordance with its magnetic permeability may be secured by making the magnetic field in longitudinal sections of different force and providing suitable chute-partitions 35 upon the shell 3 to separate the product in accordance therewith.

Fig. 6 shows in longitudinal section a form of my invention embodying a magnetic field having three such longitudinal sections. The respective sections of said field may be caused to exert different magnetic force upon the material treated by any convenient means. For instance, the number of turns in the coils 13 may be different upon the respective cores 11, or the poles 12 of the respective sections may be of different radial extent, as indicated.

Although I find it convenient to employ the type of machine which I have illustrated in Figs. 1, 2, and 3, it is obvious that the relative movement of the field and the support for the material treated may be otherwise produced. For instance, in Fig. 4 the support 29 is planular instead of being cylindrical, as is the shell 3 in Fig. 3, and the poles 30 may be progressed in parallelism with said support by any convenient means. In the form of my invention shown in Fig. 5 the magnetic poles 31 extend in parallelism with the axis of rotation of the drum 32 and cause the magnetizable material to progress upon the support 33 in the direction of the arrow shown thereon when said drum is rotated in the direction indicated by the arrow upon it.

I find it advantageous to connect in alinement a series of machines such as I have shown in Figs. 1, 2, and 3 and to provide the same with a common drum-shaft 9 and a common screw-shaft 25, each machine in the series being supplied with raw material at the right-hand end, as described, the tailings from the opposite end being discharged by separate chutes extending laterally, as indicated in dotted lines at 34 in Fig. 3.

I believe it to be broadly new to provide a magnetic separator of the class specified wherein the material treated is supported by means independent of the magnetic force employed, and therefore I do not desire to limit myself to the precise details of construction and arrangement which I have shown and described, as it is obvious that various modifications may be made therein without departing from the spirit of my invention.

I claim—

1. In a magnetic separator, the combination with a rotatable magnetic field; of a support for the material treated, independent of said field; means to rotate said field with respect to said support; means to energize said field and thereby induce progression of the magnetic particles of said material in a direction opposite to the direction of rotation of said field; and means to progress the gangue aside from the path of the magnetic particles, substantially as set forth.

2. In a magnetic separator, the combination with a magnet; of a housing arranged to uphold the material treated independently of said magnet; means to progress said magnet with respect to said housing; means to energize said magnet and thereby induce progression of the magnetic particles of said material in a direction opposite to the movement of said magnet; and means to progress the gangue aside from the path of the magnetic particles, substantially as set forth.

3. In a magnetic separator, the combination with a rotatable magnet; of a stationary housing arranged to uphold the material treated independently of said magnet; means to rotate said magnet with respect to said housing; and means to energize said magnet and thereby induce the traverse of the magnetic particles of said material in a direction opposite to the movement of said field; and means to mechanically progress the gangue aside from the path of the magnetic particles, substantially as set forth.

4. In a magnetic separator, the combination with a rotatable magnetic field, comprising a plurality of poles; of a stationary housing covering the elements of said field, and arranged to support the material treated independently of said field; a receptacle for the raw material, fixed with respect to said housing; feeding mechanism arranged to progress said material within said receptacle; means to contemporaneously rotate said field, and

operate said feeding mechanism; means to energize said field and thereby induce progression of the magnetic particles of said material in a direction opposite to the direction of rotation of said field; and means to progress the gangue aside from the path of the magnetic particles, substantially as set forth.

5. In a magnetic separator, the combination with a rotatable magnet, comprising a core having a plurality of radial poles; of electrical conductors, arranged to energize said magnet; a driving-shaft fixed concentrically in said core; a housing provided with bearings for said shaft, and arranged to inclose said magnet; a trough-shaped receptacle for the material treated fixed with respect to said housing, at the upper portion thereof; feeding mechanism, comprising a shaft mounted in bearings in said housing, and arranged to progress said material longitudinally with respect to said receptacle; and means arranged to contemporaneously rotate the shaft of said magnet and the shaft of said feeding mechanism, substantially as set forth.

6. In a magnetic separator, the combination with a magnet-drum, comprising a cylindrical casing, of non-magnetic material; of a supporting-shaft arranged in concentric relation with said drum; a magnet-core comprising a plurality of radial poles, connecting said shaft and said casing; electrical conductors arranged upon said core to produce a magnetic field comprising said poles; a housing provided with bearings for said shaft, and arranged to cover the elements of said field, and uphold the material treated independently of said field; a trough-shaped receptacle for the raw material fixed with respect to said housing; an inlet for the raw material at one end of said receptacle; an outlet for the raw material at the opposite end of said receptacle; a screw-shaft provided with spiral conveyers, mounted to rotate in said housing, and arranged to progress said material within said receptacle from said inlet to said outlet; means to contemporaneously rotate said drum and said screw-shaft; means to energize said magnetic field during the rotation of said drum, and induce the progression of the magnetic particles of the material treated, upon said housing, in a direction opposite to the direction of rotation of said field; means to discharge the concentrated magnetic particles; and means to discharge the gangue, substantially as set forth.

7. In a magnetic separator, the combination with a magnet-drum, comprising a cylindrical casing; of a supporting-shaft arranged in concentric relation with said drum; a magnet-core connecting said shaft and casing; electrical conductors arranged to produce a magnetic field comprising said core; a housing provided with bearings for said shaft and arranged to uphold the material treated; a trough-shaped receptacle for the raw material fixed with respect to said housing; a screw-shaft provided with spiral conveyers, mounted to rotate in said housing, and arranged to progress said material within said receptacle in a direction parallel with said shaft; means to contemporaneously rotate said drum and said screw-shaft, in definite relation; means to energize said magnetic field during the rotation of said drum, and induce the progression of the magnetic particles of the material treated, upon said housing, in a direction opposite to the direction of rotation of said field; means to discharge the concentrated magnetic particles; and means to discharge the gangue, substantially as set forth.

8. In a magnetic separator, the combination with a rotatable magnetic field; of a support for the material treated, independent of said field; means to rotate said field with respect to said support; means to energize said field and thereby induce progession of the magnetic particles of said material in a direction opposite to the direction of rotation of said field; and means arranged to progress the gangue in a direction parallel with the axis of rotation of said field, and aside from the path of the magnetic particles, substantially as set forth.

MARCUS RUTHENBURG.

Witnesses:
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E. L. FULLERTON.