

No. 685,817.

Patented Nov. 5, 1901.

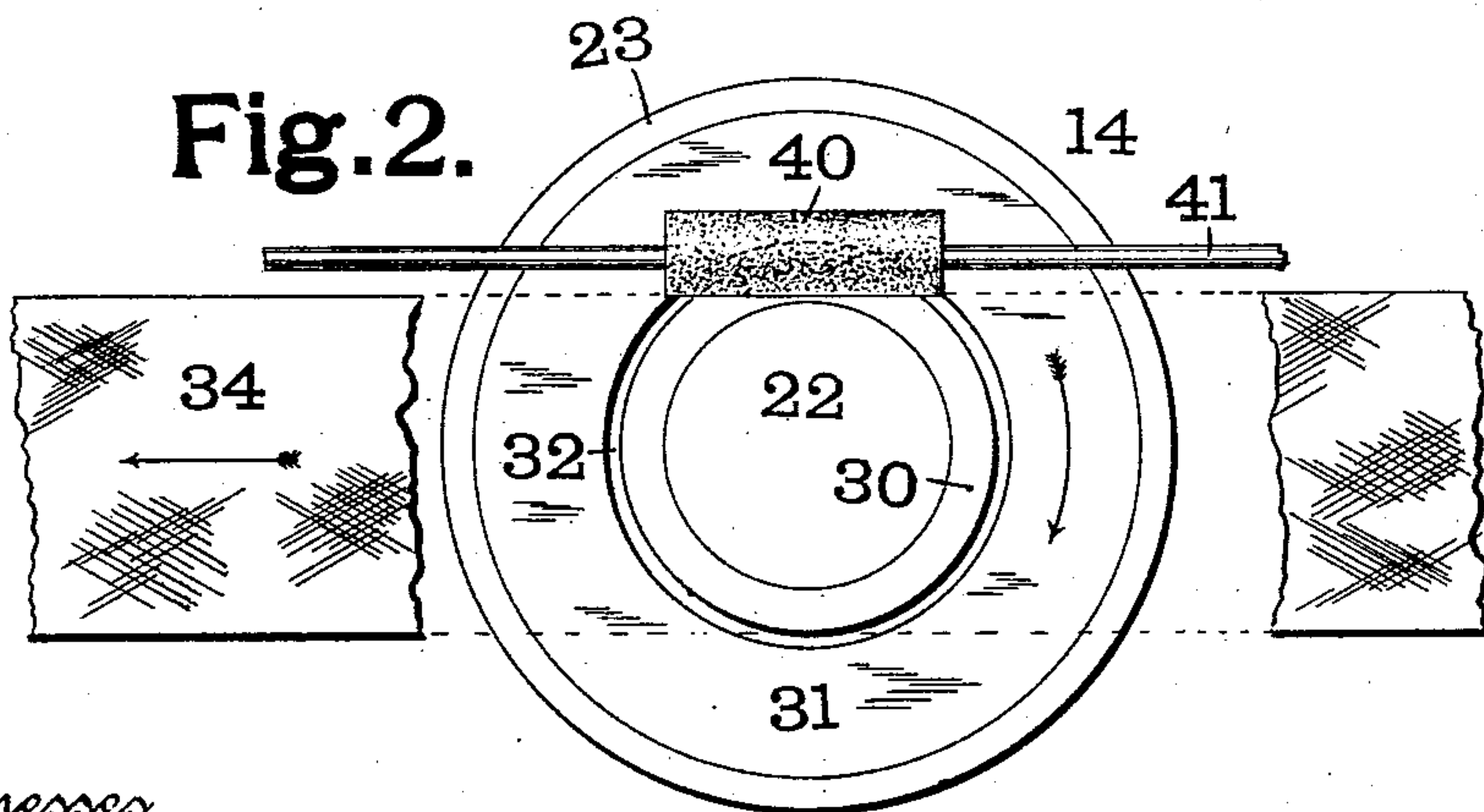
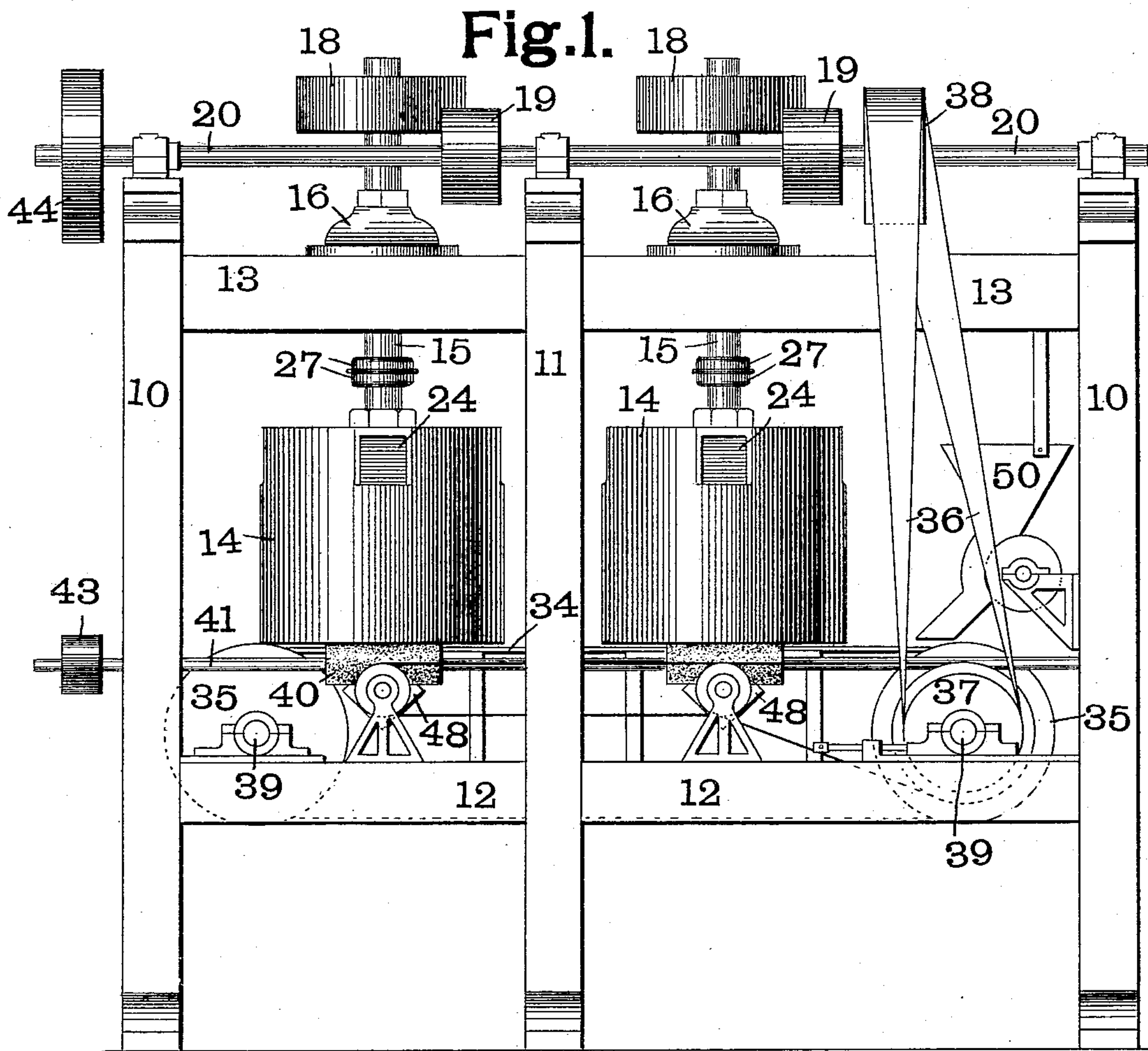
W. P. CLEVELAND & C. E. KNOWLES.

MAGNETIC ORE SEPARATOR.

(Application filed May 7, 1900. Renewed May 8, 1901.)

(No Model.)

2 Sheets—Sheet 1.



Witnesses

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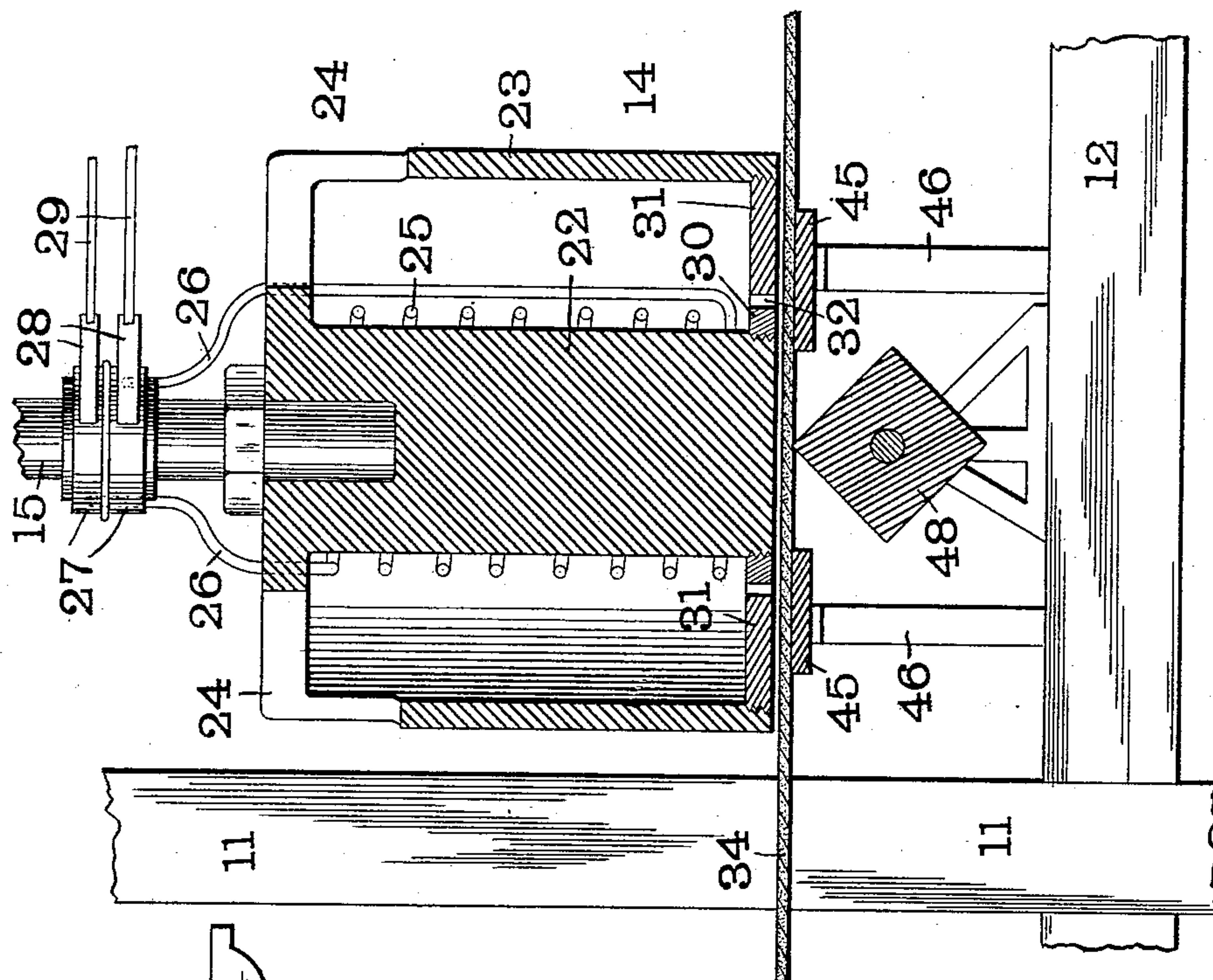
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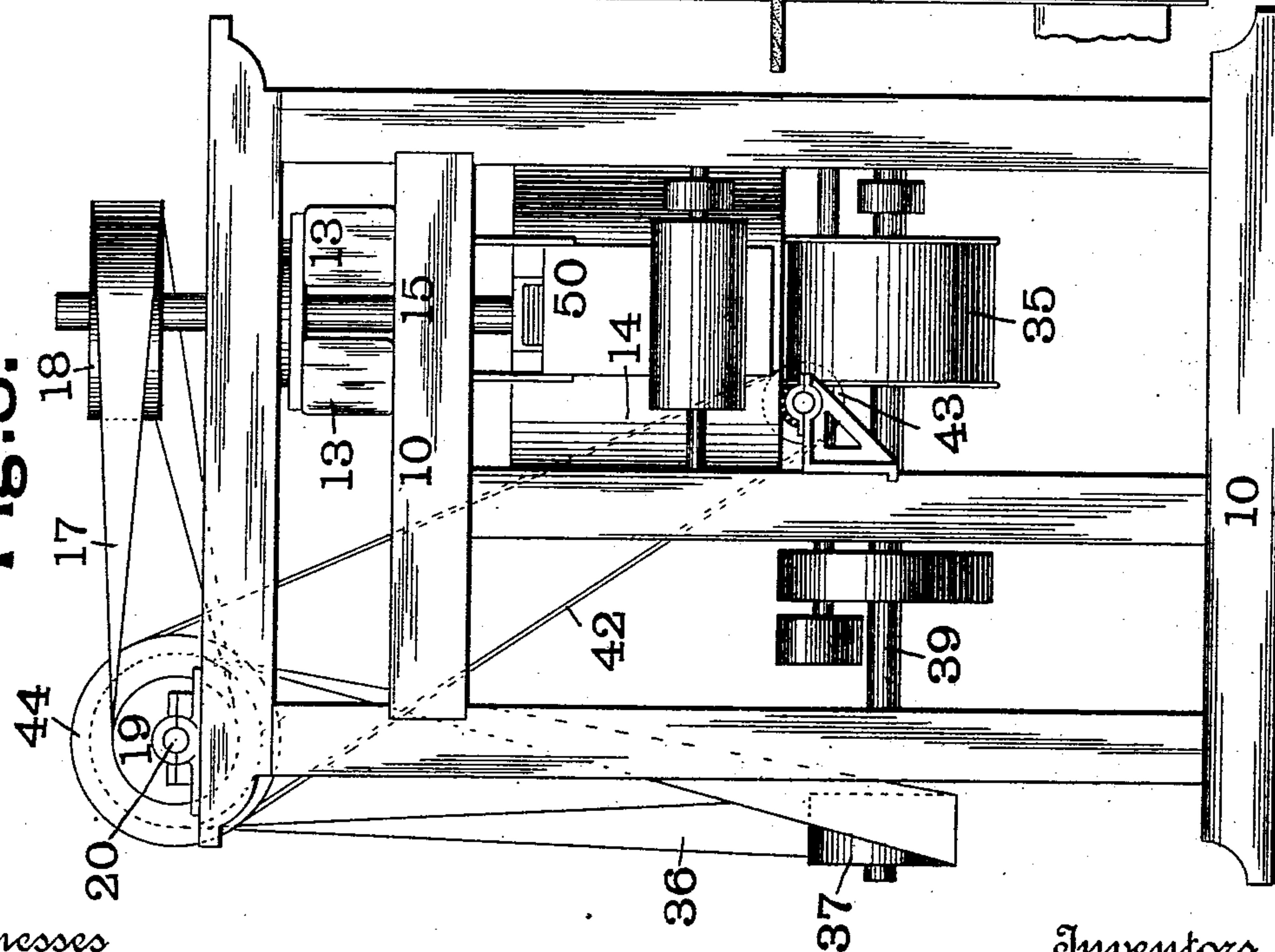
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2 Sheets—Sheet 2

Fig. 4.



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UNITED STATES PATENT OFFICE.

WILLIAM P. CLEVELAND AND CAMDEN E. KNOWLES, OF JOPLIN, MISSOURI,
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A CORPORATION OF MISSOURI.

MAGNETIC ORE-SEPARATOR.

SPECIFICATION forming part of Letters Patent No. 685,817, dated November 5, 1901.

Application filed May 7, 1900. Renewed May 8, 1901. Serial No. 59,307. (No model.)

To all whom it may concern:

Be it known that we, WILLIAM P. CLEVELAND and CAMDEN E. KNOWLES, citizens of the United States, residing at Joplin, in the
5 county of Jasper and State of Missouri, have invented a certain new and useful Magnetic Ore-Separator, of which the following is such a full, clear, and exact description as will enable any one skilled in the art to which it
10 appertains to make and use the same, reference being had to the accompanying drawings, forming part of this specification.

Our invention relates more particularly to that class of magnetic separators which are
15 used to separate magnetic ore from non-magnetic ore or from ore having lower magnetic permeability.

The object of our invention is to construct a magnetic separator which will be simple of
20 construction and in which the magnetic field will be highly concentrated and at the same time to dispense with belts or other appliances between the poles of the magnet or between the magnet and the material to be separated.
25

Our invention consists in various novel features and details of construction, all of which are described in the following specification and pointed out in the claims affixed hereto.

30 In the accompanying drawings, which illustrate one form of separator made in accordance with our invention, Figure 1 is a side elevation. Fig. 2 is an enlarged bottom plan view of one of the magnets and some of the
35 adjacent parts. Fig. 3 is an end elevation, and Fig. 4 is an enlarged vertical section through one of the magnets.

Like marks of reference refer to similar parts in the several views of the drawings.

40 10 represents two end frames between which is a similar frame 11. The frames 10 and 11 are connected by lower cross-timbers 12 and upper cross-timbers 13.

14 represents the magnets, which are suspended by rods or shafts 15 from the cross-timbers 13. The shafts 15 are provided with bearings 16, preferably of some antifriction type, such as ball-bearings. The shafts 15,
45 and consequently the magnets 14, are rotated by means of belts 17 passing around pulleys

18 at the upper end of the said shafts 15 and pulleys 19 on a main or driving shaft 20. The shaft 20 may be driven in any suitable manner.

The magnets 14 are shown in detail in Figs. 55 2 and 4. Each of the magnets 14 consists of a core 22 and a shell or casing 23. These are preferably formed integral, and the shell or casing 23 is preferably provided with openings 24 to allow for circulation of air through
60 the magnet to prevent heating. The space between the core 22 and casing 23 is filled by a coil 25, which is diagrammatically illustrated in Fig. 4. The ends 26 of the coil 25 are carried up through the top of the magnet
65 and are connected to slip-rings 27, which make contact with brushes 28, to which are attached feeding-wires 29. To the lower ends of the core 22 is attached a ring or flange 30, which forms one of the pole-pieces of the
70 magnet, and to the lower end of the casing is secured a ring or flange 31, which forms the other pole-piece of the magnet. Between the rings or flanges 30 and 31 is an angular magnetic gap 32. Owing to the construction of
75 the magnet, the magnetic field is highly concentrated in the magnetic gap 32.

Beneath the magnets 14 and in proximity to their lower faces passes an endless conveyor 34, of flexible material. The conveyor
80 34 passes around drums 35, one of which is driven by a belt 36, passing around a pulley 37 on the shaft 39 of said drum and a pulley 38 on the main or driving shaft 20. The conveyor 34 is arranged below the magnets, as
85 best shown in Fig. 2, so as to leave a portion of the magnetic gap 32 exposed at one side of the said belt.

40 represents rotary brushes which are carried on a shaft 41 and arranged so as to
90 bear against the lower faces of the magnets 14 at the points where the magnetic gaps 32 are exposed. The shaft 41 is rotated by means of a belt 42, passing around a pulley 43 on said shaft and a pulley 44 on the main
95 or driving shaft 20. The conveyor 34 is held in close proximity to the lower face of the magnets 14 by guides 45, carried on supports 46, attached to the lower cross-timbers 12. Below each of the magnets 14 is arranged an
100

angular drum 48, which is adapted to strike against the lower side of the flexible conveyer 34 and agitate the material thereon.

50 is a distributor, which may be of any suitable type for distributing a thin even layer of the ore on the conveyer 34.

The operation of our separator is as follows: The ore to be separated is fed into the distributor 50, from which it is fed in a thin even layer on the conveyer 34 and is thence carried under the first magnet 14. Owing to the construction of the magnet, an intense magnetic field is formed between the pole-pieces 30 and 31. This attracts all the particles of sufficient magnetic permeability, and as the magnets rotate said particles are carried to one side of the belt, where they are removed by the revolving brushes 40. As the conveyer passes over the angular drum 48 the material on the belt is agitated by the striking of the corners of said drum against the belt, and thus any particles which have been covered up, and so prevented from adhering to the magnet, are brought to the top and will adhere to the magnet adjacent to the magnetic gap 32 and be carried out and removed by the brushes 40. Any magnetic particles which are not removed by the first magnet will be carried under the second magnet and there removed. In some cases, however, it may not be necessary to use more than one magnet.

It will be seen that while our separator is simple of construction the form of magnet is such as to give a highly-concentrated magnetic field, and as no belts or similar appliances are used between the poles of the magnets or between the magnets and the material the magnets can be brought very close to the material and their efficiency thus greatly increased.

We are aware that many changes may be made in the form and construction of our separator without departing from the spirit of our invention, and therefore do not wish to limit ourselves to the form shown and described except where specifically stated in the claims.

Having fully described our invention, what we claim as new, and desire to secure by Letters Patent of the United States, is—

1. In a magnetic separator, the combination with an electromagnet consisting of a core and a shell forming the poles and between which the exciting-coil is wound, of means of presenting the material to be separated directly to the end of said magnet.

2. In a magnetic separator, the combination with an electromagnet consisting of a core and a shell forming the poles and between which the exciting-coil is wound, of means for conveying the material to be separated beneath said magnet and presenting it to the end thereof, and means for rotating said magnet.

3. In a magnetic separator, the combination with an electromagnet consisting of a core and a shell forming the poles and between

which the exciting-coil is wound, of means for rotating said magnet in a substantially horizontal plane, and means for presenting the material to be separated directly to the poles of said magnet.

4. In a magnetic separator, the combination with an electromagnet consisting of a core and a shell forming the poles and between which the exciting-coil is wound, of means for rotating said magnet in a substantially horizontal plane, means for conveying the material to be separated beneath said magnet and presenting it directly to the end of the same, and means for removing the material adhering to said magnet.

5. In a magnetic separator, the combination with an electromagnet consisting of a core and a shell forming the poles and between which the exciting-coil is wound, one of said parts being provided with a flange projecting toward the other part and forming a pole-piece, of means for presenting the material to said magnet.

6. In a magnetic separator, the combination with an electromagnet consisting of a core and a shell forming the poles and between which the exciting-coil is wound, each of said parts being provided with a flange forming a pole-piece, of means for presenting the material to said magnet.

7. In a magnetic separator, the combination with a magnet having the magnetic gap between its pole-pieces in the form of an endless line, of a conveyer arranged below said magnet so as to leave a portion of said magnetic gap exposed, and means arranged adjacent to the exposed part of said gap for removing the material adhering to said magnet.

8. In a magnetic separator, the combination with a magnet having an annular magnetic gap between its pole-pieces, of a conveyer for the material arranged beneath said magnet so as to leave a portion of said magnetic gap exposed, and means arranged adjacent to the exposed part of said gap for removing the material adhering to said magnet.

9. In a magnetic separator, the combination with a magnet rotating in a substantially horizontal plane, of a conveyer of flexible material passing beneath said magnet, an agitating device acting on the under side of said conveyer, and a rotating brush for removing the material adhering to said magnet.

10. In a magnetic separator, the combination with an electromagnet mounted on a substantially vertical axis and composed of a core and a shell between which the exciting-coil is wound, of an annular magnetic gap in the under face of said magnet, a traveling conveyer for carrying the material across said gap, and means for removing the material adhering to said magnet.

11. In a magnetic separator, the combination with an electromagnet mounted on a substantially vertical axis and composed of a core and a shell between which the exciting-coil is wound, of an annular magnetic gap in the un-

der face of said magnet, a traveling conveyer for carrying the material across said gap, and a rotating brush for removing the material adhering to said magnet.

5 12. In a magnetic separator, the combination with an electromagnet mounted on a substantially vertical axis and composed of a core and a shell between which the exciting-coil is wound, of an annular magnetic gap in the under face of said magnet, a traveling conveyer for carrying the material across said gap but arranged to leave a portion of said gap exposed, and means arranged adjacent to said exposed portion for removing the material adhering to said magnet.

10 13. In a magnetic separator, the combination with an electromagnet mounted on a substantially vertical axis and composed of a core and a shell between which the exciting-coil is wound, of an annular magnetic gap in the under face of said magnet, a traveling conveyer for carrying the material across said gap but arranged to leave a portion of said gap exposed, and a rotating brush arranged adjacent to said exposed portion for removing the material adhering to said magnet.

25 material adhering to said magnet.

14. In a magnetic separator, the combination with an electromagnet mounted on a substantially vertical axis and composed of a core and a shell between which the exciting-coil is wound, of an annular magnetic gap in the under face of said magnet, a traveling conveyer of flexible material for carrying the material across said gap but arranged to leave a portion of said gap exposed, a rotating brush arranged adjacent to said exposed portion for removing the material adhering to said magnet, and an agitating device acting on said conveyer.

40 In testimony whereof we have hereunto set our hands and affixed our seals in the presence of the two subscribing witnesses.

W. P. CLEVELAND. [L. S.]
C. E. KNOWLES. [L. S.]

Witnesses:

W. P. BUELL,
E. O. BARTLETT.