(No Model.) 2 Sheets—Sheet 1.

F. H. RICHARDS.

MAGNETIC SEPARATOR FOR PAPER PULP.

No. 438,897. Patented Oct. 21, 1890.

Fig. 1

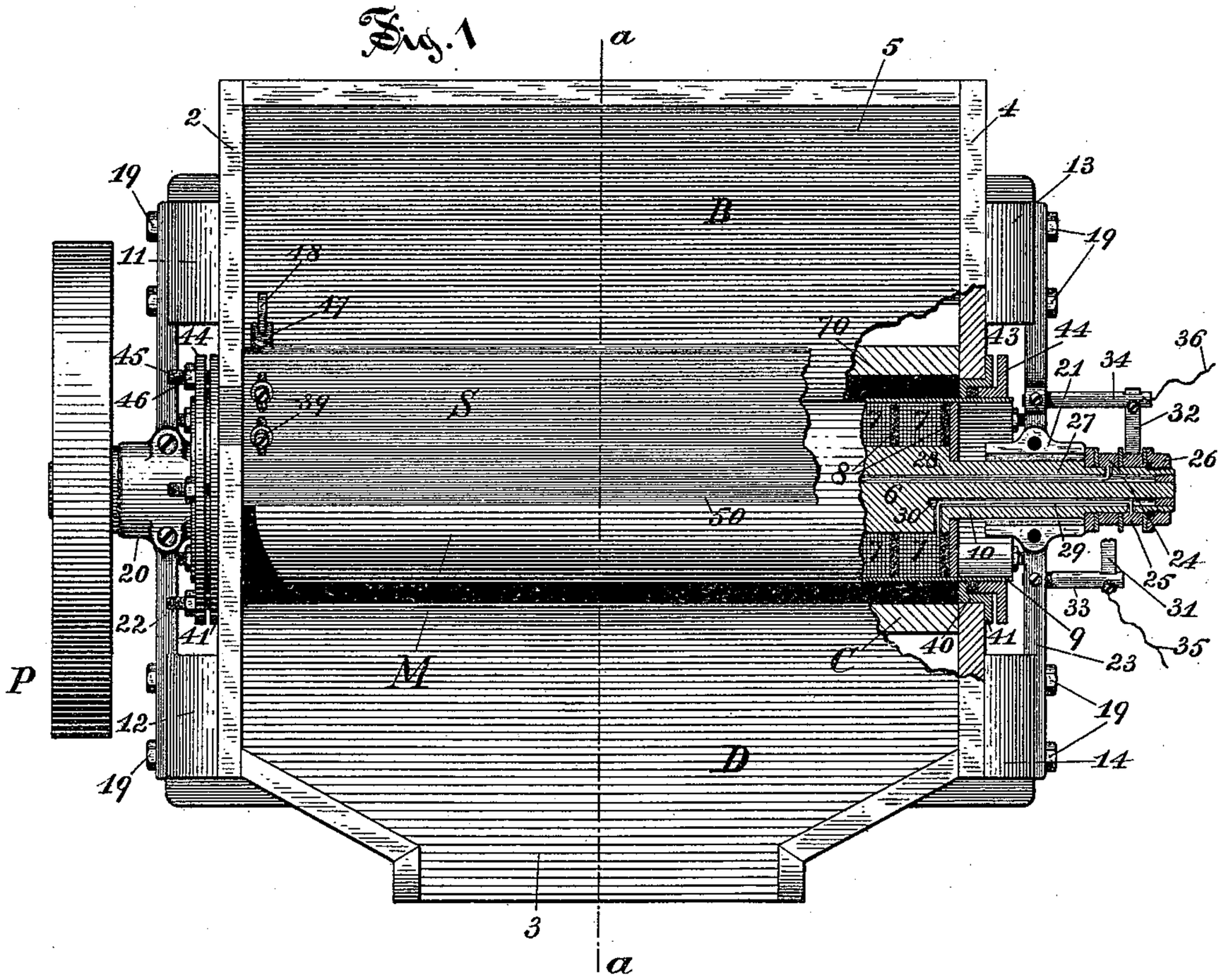
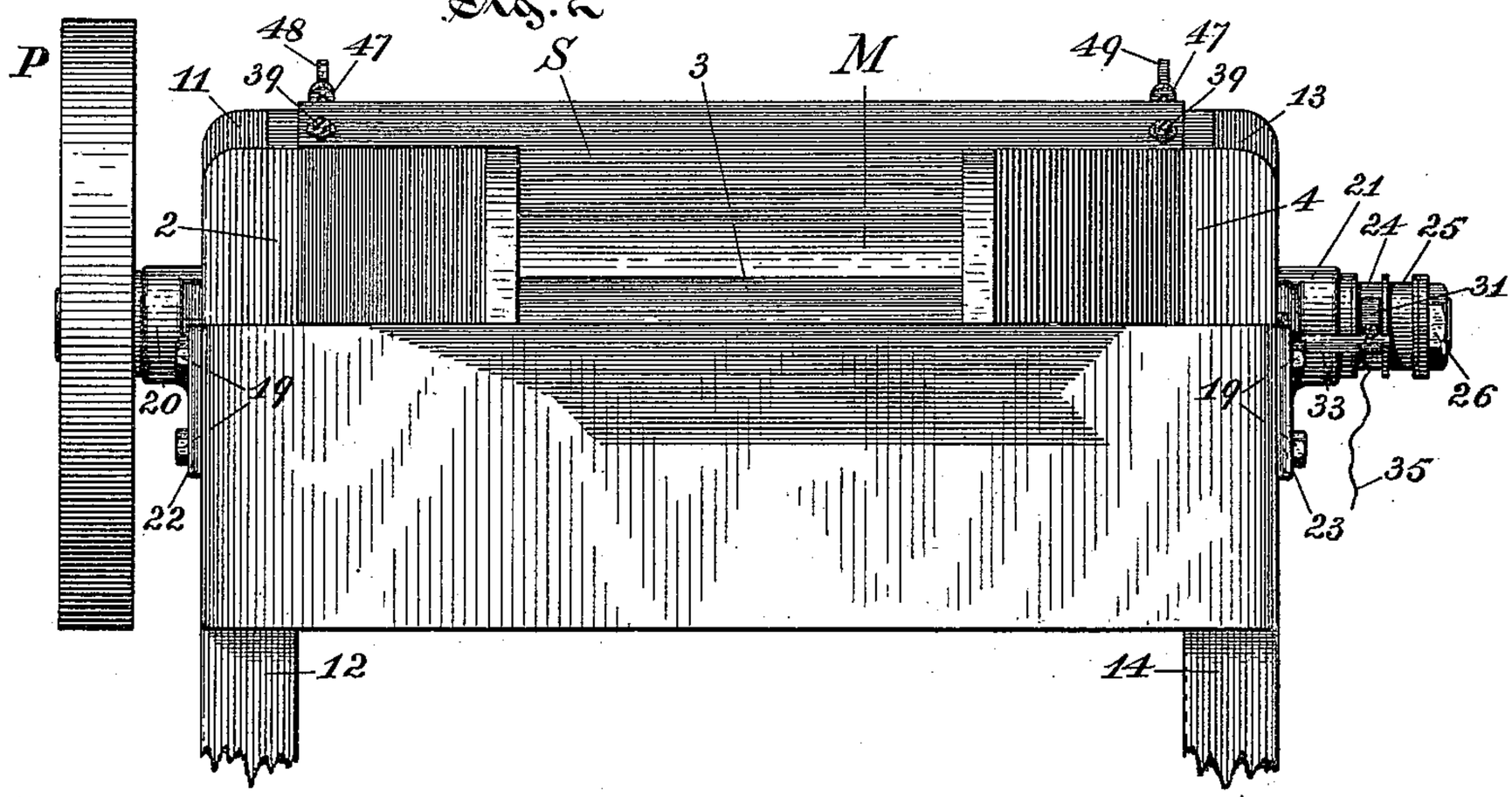


Fig. 2



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(No Model.) 2 Sheets—Sheet 2.

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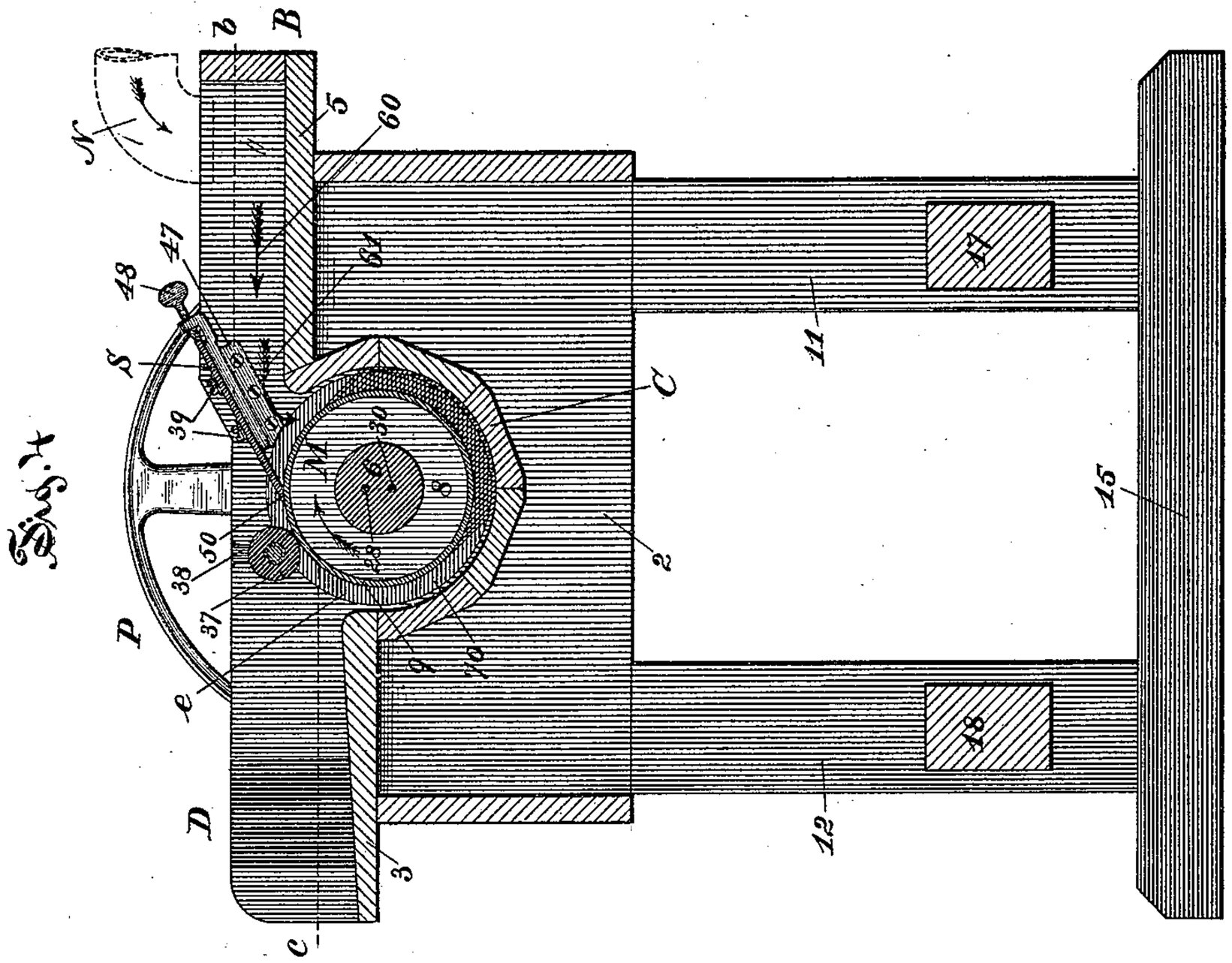
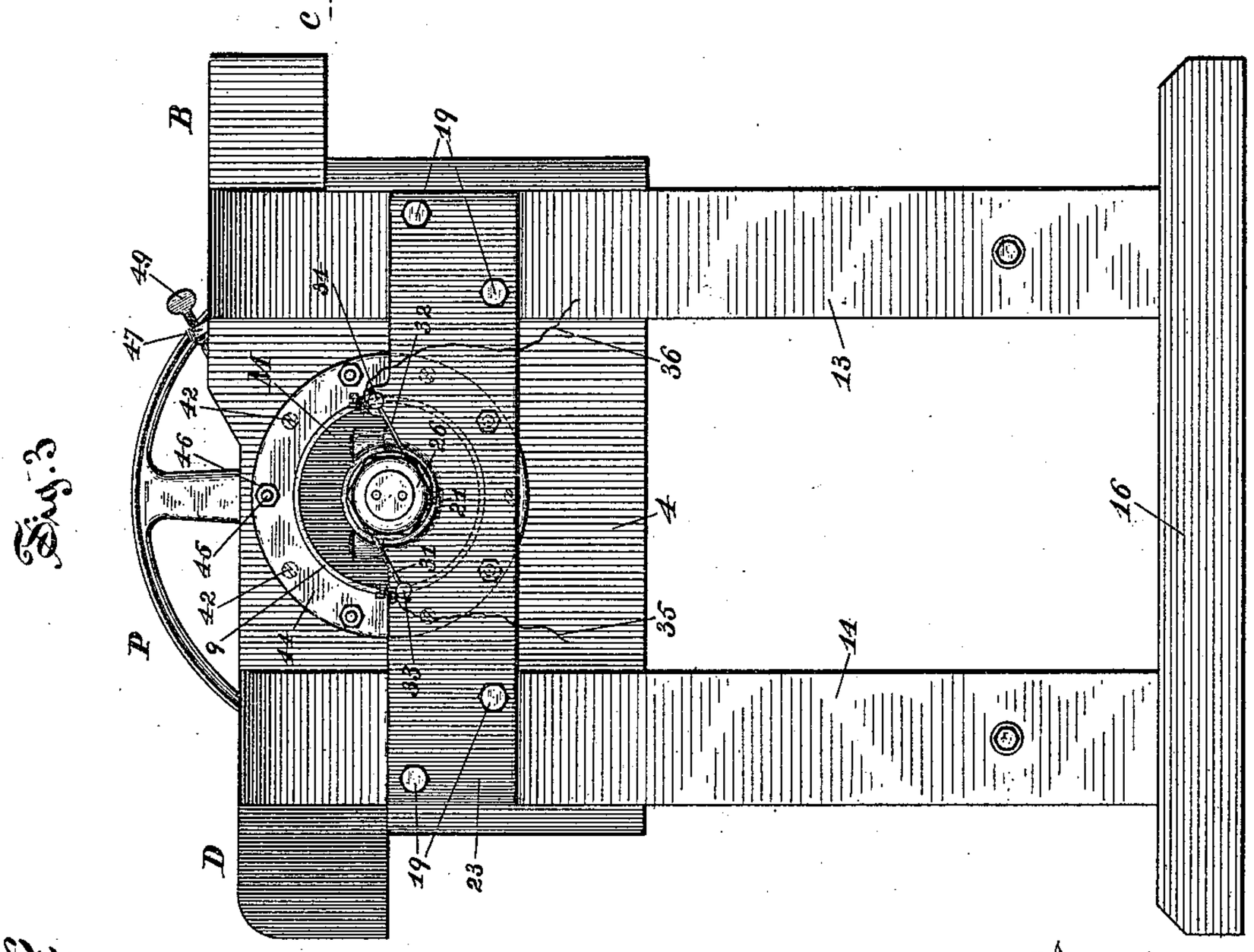


Fig. 3.



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UNITED STATES PATENT OFFICE.

FRANCIS H. RICHARDS, OF HARTFORD, CONNECTICUT.

MAGNETIC SEPARATOR FOR PAPER-PULP.

SPECIFICATION forming part of Letters Patent No. 438,897, dated October 21, 1890.

Application filed August 29, 1890. Serial No. 363,394. (No model.)

To all whom it may concern:

Be it known that I, FRANCIS H. RICHARDS, a citizen of the United States, residing at Hartford, in the county of Hartford and State of Connecticut, have invented certain new and useful Improvements in Magnetic Pulp-Separators, of which the following is a specification.

This invention relates to that class of magnetic separators in which the magnet is arranged to revolve while more or less submerged in the material to be separated.

The purpose for which my improvements are more especially intended is the separation of iron fragments and particles from paper-pulp. For this purpose I use a single cylindrical revolving magnet, to which the paper-pulp is directed by a suitable trough, is then conducted contiguous to the surface of the magnet throughout a considerable part of the circumference of the magnet, and is finally conducted away, being usually delivered directly from the separator to the paper-making machine.

In the drawings accompanying and forming a part of this specification, Figure 1 is a plan view, partly in section, of a pulp-separator embodying my present invention. Fig. 2 is a front elevation of the separator. Fig. 3 is an end elevation of the same as seen from the right hand in Figs. 1 and 2. Fig. 4 is a sectional elevation in the line *a a*, Fig. 1, and as seen from the right hand in Figs. 1 and 2.

Similar characters designate like parts in all the figures.

The apparatus consists of a suitable frame-work and tank, which may be constructed of metal, or, as supposed to be shown in the drawings, of wood, which in practice may be lined with sheet metal, after the manner of lining tanks and troughs used in the paper manufacture.

A suitable form of separator-tank may consist of the supply-box B, the receiving-box D, and the magnet-case C, all supported by suitable frame-work. Said tank may be suitably constructed as follows: The end walls 2 and 4 are fixed to the posts of the frame-work and form the ends of said supply and receiving boxes. The sides 2 and 4 are connected by the floor 5 of the supply-box B, the floor or apron 3 of the receiving-box D, and the magnet-case C. These several parts are all to be firmly united by screws or other fastenings in a manner well known to millwrights. As shown in the drawings, said tank is mounted on a frame-work consisting of the four posts 11, 12, 13, and 14, which rest on the two sills 15 and 16 and are connected together longitudinally of the machine by two beams 17 and 18, all being held together by suitable bolts or other fastenings. The side walls 2 and 4 are perforated concentrically of the magnet-case C for the passage through said walls of the shell or case of the revolving magnet, which magnet is designated in a general way by the letter M.

The magnet M consists or may consist of a central core 6, having thereon coils of wire 7, interposed between iron rings, as 8, the whole being incased in a non-magnetic shell or tube 9, extending over the entire length of the magnet proper. Said shell has the effect of holding the particles of iron at a slight distance from the face of the actual magnet, and thus overcomes the sticking or adhesion with which the particles usually are held when these lie directly against the magnet. The magnet M, being in practice of high power, so as to draw the particles through a considerable distance, of course said surface adhesion would be correspondingly great, except for the magnet-incasing tube. Said shell or tube may be made of suitable metal, as brass or copper, or of other non-magnetic material, as hard rubber or the like. Incidentally said tube 9 has also the advantage, when made of brass or copper, of being substantially non-corrosive by the action of the pulp. For supporting said magnet the aforesaid core 6 is extended on either end thereof to form journals, as 10, whereby the magnet is journaled in the bearings 20 and 21, which are formed on the bearing-beams 22 and 23, respectively, which beams are fixed, substantially as shown, to the frame-work of the apparatus, being secured in place by screws 19, or other suitable beam-holding devices.

On one end of the machine the magnet-core projects through the bearing 20 and has fixed thereon the driving-wheel P, by means of which and a suitable driving-belt (not shown) said magnet may be slowly revolved in the direction of the arrow thereon in Fig. 4. At

the other end of the apparatus said core is extended and has thereon two insulated rings 24 and 25, fixed between insulating-disks, all held in place by a nut 26, screwed on the projecting end of the core 6. One of said rings 24 is connected by a wire 27 through the passage 28 with one side of said coils, while the other ring 25 is connected by a wire 29 through the passage 30 with the other side of said coils. The connection between the energizing-dynamo and the magnet is made through said insulated rings and connecting-wires by means of the brushes 31 and 32, which are carried by insulated studs 33 and 34, that are fixed in a well-known manner to the bearing-beam 23 or to some other part of the machine, said brushes being electrically connected with the two wires, as 35 and 36, leading from the dynamo. By this means the magnet may be continuously energized while revolving.

For preventing leakage around the ends of the magnet a stuffing-box is provided in each of the end walls 2 and 4, which stuffing-boxes being substantially duplicates a description of one of them will suffice for a description of both.

In Fig. 1, at the left hand thereof, is shown a top view of said stuffing-box, while at the right hand of said figure is shown a horizontal section through the stuffing-box. Said box consists of an annular frame 40, which is fitted into the end wall and is affixed thereto by the projecting flange 41 by means of screws, as 42, Fig. 3, or other suitable fastening devices. On its inner side said stuffing-box frame 40 is shaped, substantially as shown, to receive the packing material 43, Fig. 1, and the gland 44 for compressing the packing material. For adjusting the gland the stuffing-box is provided with studs 45 and nuts 46, operating in the usual manner. The pressure or "head" of the paper-pulp being comparatively slight, (usually not over one foot in greatest depth in the tank,) of course the packing material need not be greatly compressed, and consequently will not cause much resistance to the rotation of the magnet.

For collecting the substances adhering to the magnet a scraper S is provided at the top of the magnet and is set inclined thereto, so that its forward edge 50 forms a knife-edge bearing upon the surface of the magnet-incasing shell. Said scraper should be adjustably fixed and also slightly elastic and preferably of magnetic material, such as iron or steel. It may properly be supported in the frame by brackets, as 47, fixed to the tank, and provided with thumb screws 48 and 49, for forcing down the scraper-blade, said blade being held in place by the binding-screws 39, which pass through slots in the blade in a well-known manner. When the scraper is made of magnetic material, as aforesaid, and is laterally elastic, (being of relatively small thickness,) it is attracted toward and by the magnet, and is thereby made to conform throughout its length to the slight inequalities of the surface of the incasing-tube 9, so as to prevent any of the collected metal from being carried under the knife-edge and into the paper-pulp back of the magnet.

In some cases I deem it useful to employ a rubber or other elastic roller 37, set forward of the scraper and bearing on the magnet, as shown in Fig. 4. This roll, which may be journaled in suitable bearings or slots, as 38, formed in the end walls of the tank, acts as a compress or guard to hold back the fluid pulp, while the particles of metal adhering to the magnet are, by reason of the elasticity of said roller, allowed to pass by and against the scraper. The use of this roller, in combination as set forth, is deemed especially advantageous in cases where the paper pulp, from its peculiar composition, is somewhat subject to foaming.

As will be seen from the foregoing description, and as shown best in Fig. 4, the pulp-tank consists of a supply-box, as B, (shown at the right hand in said figure,) a receiving-box D, set at a lower level than the supply-box, (shown at the left hand in said figure,) there being intermediate to said pulp-boxes a magnet-case C, between which and the magnet a communication is made from the supply-box B to the box D. Said supply-box has its floor 5 set at about the height of the top of the magnet, substantially as shown, so that the pulp flowing along said box, as indicated by the arrow 60, is turned downward by the inclined front end S (this being the scraper) of said box directly against the top of the magnetic roll M, as indicated by the arrow 61. By this means the pulp and the metallic particles floating therein are delivered to the magnet in the most effective manner for the purpose of separating the same, since by their superior momentum the metallic particles are carried toward the magnet beyond the normal line of the current of pulp. At the same time said particles, being directly over the magnet, are acted upon by gravity, as well as by the magnet itself, and thus are simultaneously subjected to the action of three forces—attraction, gravity, and momentum—all co-operating to carry the particles out of the curved current onto the magnet. The concentrically-formed magnet-case being located at a short distance (in practice usually from one-half inch to one inch) from the magnet-tube and the magnet being revolved in the direction of the pulp-current in said passage, the pulp in the concentric passage 70 is subjected to the frictional action between the outer surface of the shell 9 and the inner surface of the case C in such manner as to produce an intermixture of the different concentric portions of the stream of pulp, whereby the pulp is all brought at some time during its passage around the magnet into close proximity to the surface thereof. Said concentric passage-way 70 being of substantially the same thickness throughout the length thereof, the pulp-cur-

rent and the intermixture of the different portions thereof go on steadily and with relatively a minimum of agitation.

In using the apparatus, the magnet being revolved, as aforesaid, in the direction of the arrow in Fig. 4, the paper-pulp is delivered into the tank through a pipe or conduit, as N, Fig. 4, into the back side or supply-box of the apparatus, which it fills, for instance, up to the line *b*. Flowing forward, the pulp is stopped by the scraper, (which acts as a front end for the receiving part of the tank,) then passes down into the magnet-case and follows around the same contiguous to the magnet, all the time being subject to the powerful attraction of the magnet, which during said passage has ample time for attracting to itself any particles of iron or steel which may be floating in the pulp. Arriving at the point *e*, Fig. 4, the pulp flows out over the bottom 3 of the discharge-spout D, coming in practice to about the height of the line *c*. The difference in height between the lines *c* and *b* indicates the head or pressure, acting to force the pulp through the circular passage around the magnet. This passage is made of small thickness, substantially as shown, so as to bring all of the pulp into sufficiently close proximity to the magnet. The movement of the magnet being in the same direction as the flow of pulp around the same, the current of pulp does not so strongly tend to dislodge any material adhering thereto. It will be remembered that much of the metal floating in the paper-pulp is entangled with many times its volume of fiber, whereby the hold of the magnet on the entangled mass is relatively slight, so that strong currents might dislodge the mass and thus carry the entangled metal into the paper.

Having thus described my invention, I claim—

1. In a magnetic separator, the combination, with the pulp-tank, substantially as described, of the revolving magnet and the scraper bearing on said magnet, said tank having a magnet-case extending below the floor thereof and forming a passage-way concentric to the magnet and of substantially uniform thickness throughout the length thereof, whereby the pulp is guided around the magnet contiguous thereto and whereby the pulp is intermixed between the stationary and revolving surfaces of said passage-ways.

2. In a magnetic separator, the combination, with a pulp-tank, substantially as described, having the magnet-case, of the revolving cylindrical magnet having a non-magnetic casing, and a magnetic scraper bearing on said casing, whereby the scraper is held in contact with the magnet-casing.

3. In a magnetic separator, the combination, with the pulp-tank, of the revolving magnet having the non-magnetic casing and a flexible magnetic scraper bearing on said casing, whereby the scraper is held in contact and is by the attractive power of the magnet conformed to the surface of the casing during the revolution thereof.

4. In a magnetic separator, the combination, with a pulp-tank having the end walls perforated for the magnet, of the revolving magnet extending through the tank and said end walls, means for supporting and revolving the magnet, and packings between the end walls and the circumference of the magnet for preventing leakage from the pulp-tank.

5. In a magnetic separator, the combination, with the supply-box, of the magnet set forward of and below the level of said box, the magnet-case having between it and the magnet a passage-way, substantially as described, and means closing the end of the supply-box over the magnet, whereby the current of pulp is directed against the magnet on changing its course to enter said passage-way, thereby subjecting the floating metallic particles to the simultaneous action of attraction, gravity, and momentum.

6. In a magnetic separator, the combination, with the supply-box, of the revolving magnet set forward of and below said box, the magnet being revolved in a direction against the pulp-current in said box, whereby the pulp-current on reaching the magnet-case is abruptly and downwardly deflected by the magnet.

7. In a magnetic separator, the combination, with the supply-box and the receiving-box, of the magnet-case C, the revolving magnet in said case, and the inclined scraper above the magnet and forming the inclined forward side of the supply-box, whereby the metallic particles adhering to the magnet are collected and whereby the pulp on leaving the supply-box is directed against the magnet.

8. In a magnetic separator, the combination, substantially as described, with a pulp-tank, substantially as described, having its ends perforated for the magnet, of the stuffing-boxes inclosing the magnet and fixed to said tank-ends, the bearing-beams fixed to the frame-work and located outside of the stuffing-boxes, the magnet being journaled in the bearings on said beams, and means for revolving the magnet in its bearings.

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