No. 635,563. Patented Oct. 24, 1899.

E. R. MARSHALL.

REFINING ENGINE FOR PAPER PULP.

(Application filed Aug. 5, 1898.)

(No Model.) 5 Sheets—Sheet 1.

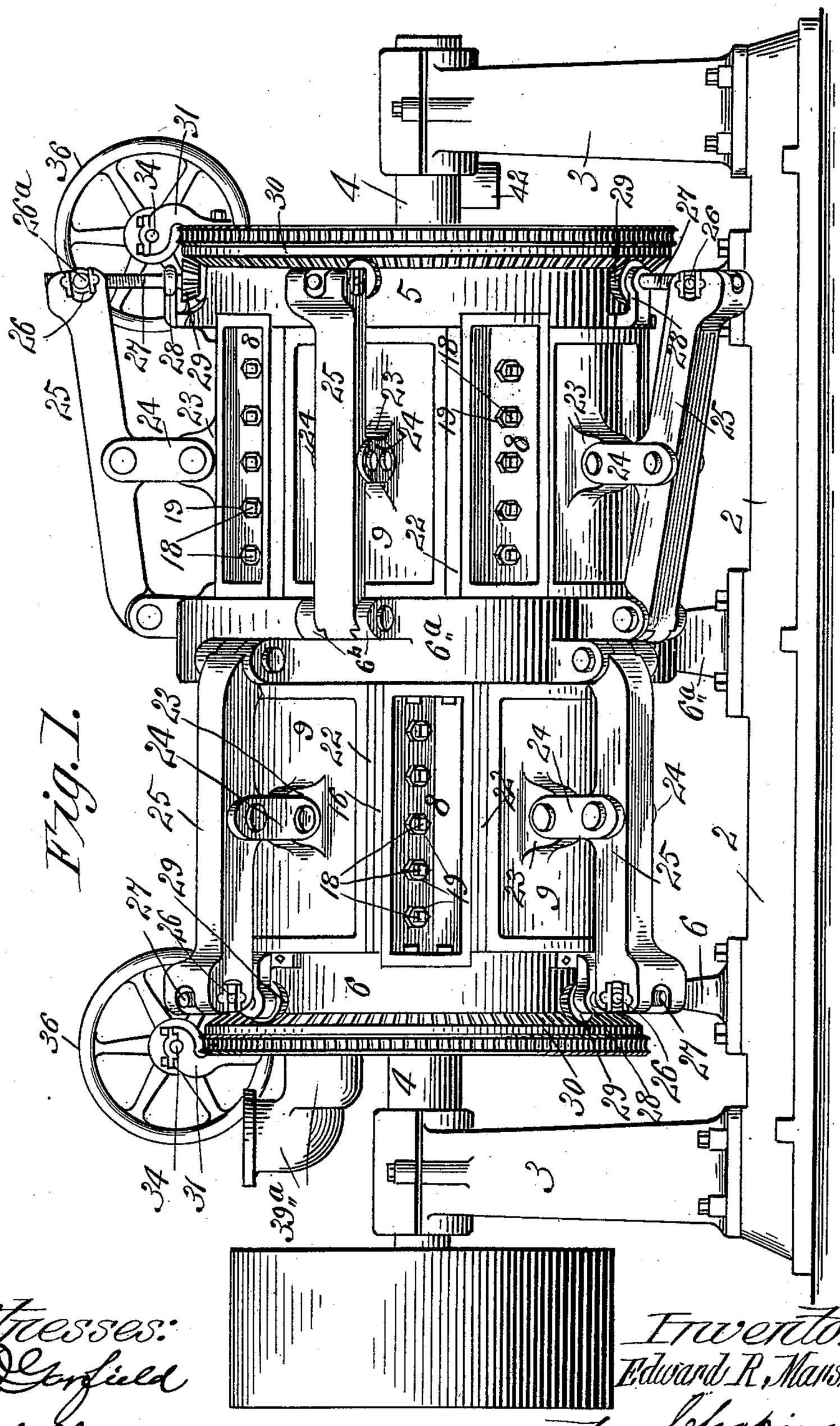

Fig. 1.

Witnesses:
J. L. Longfield
H. S. Clemons

Inventor,
Edward R. Marshall
by Chapin & Co
Attorneys.

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E. R. MARSHALL.

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(No Model.) 5 Sheets—Sheet 2.

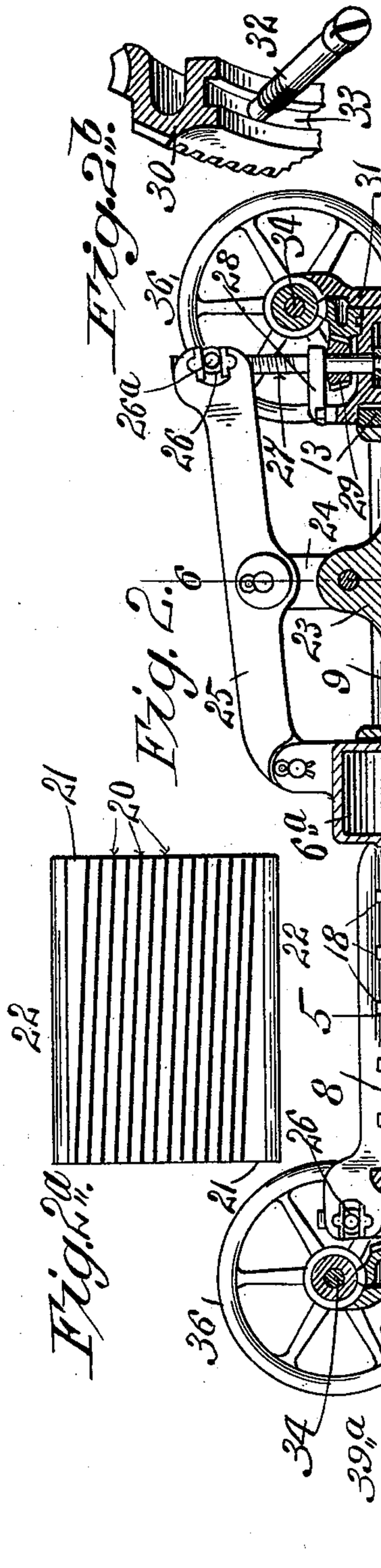

Fig. 2.

Fig. 2a.

Fig. 2b.

Fig. 2c.

Witnesses:
J. W. Garfield
K. D. Clemons

Inventor,
Edward R. Marshall,
by Chapin & Co
Attorneys

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E. R. MARSHALL.

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(No Model.) 5 Sheets—Sheet 3.

Fig. 4.

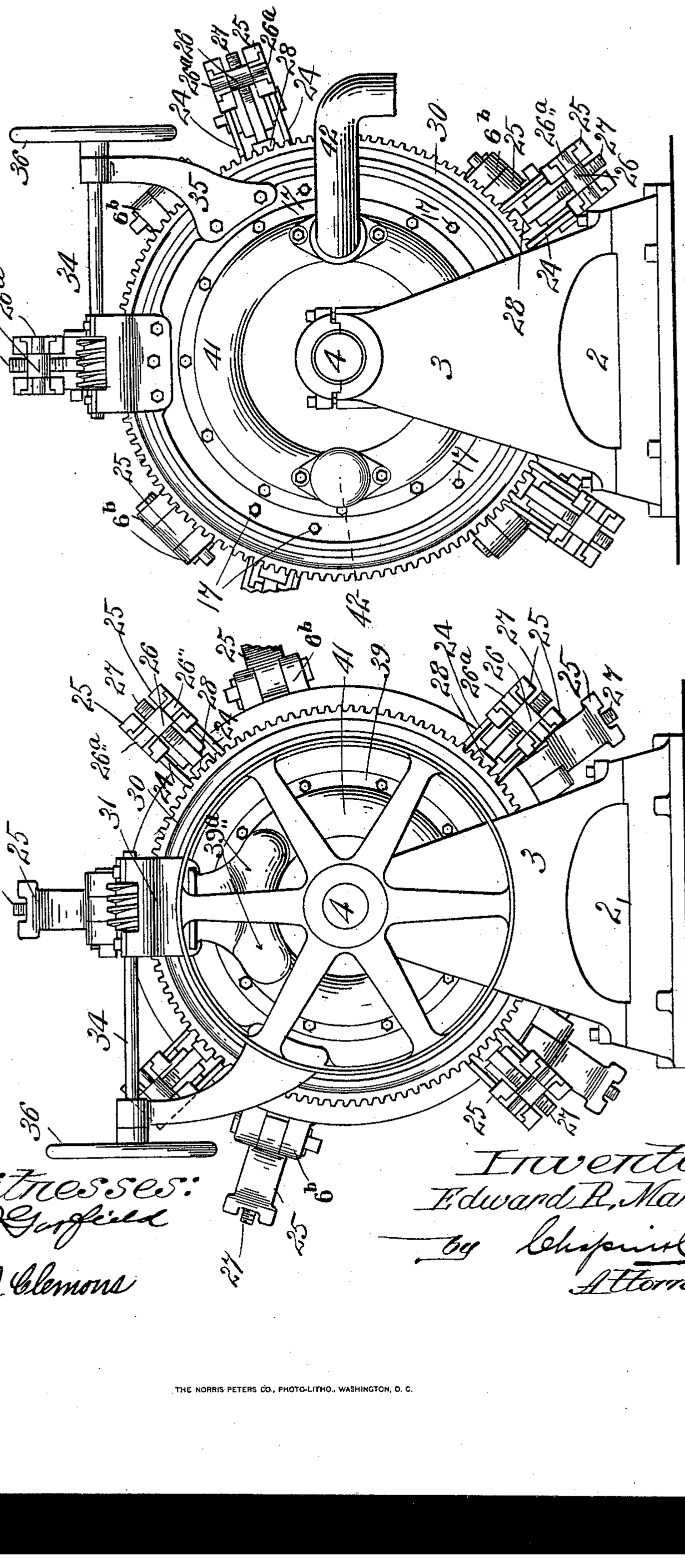

Fig. 3.

Witnesses:
J. D. Garfield
K. D. Clemons

Inventor:
Edward R. Marshall,
by Chapin & Co
Attorneys.

No. 635,563. Patented Oct. 24, 1899.

E. R. MARSHALL.

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(Application filed Aug. 5, 1898.)

(No Model.) 5 Sheets—Sheet 4.

Fig. 6.

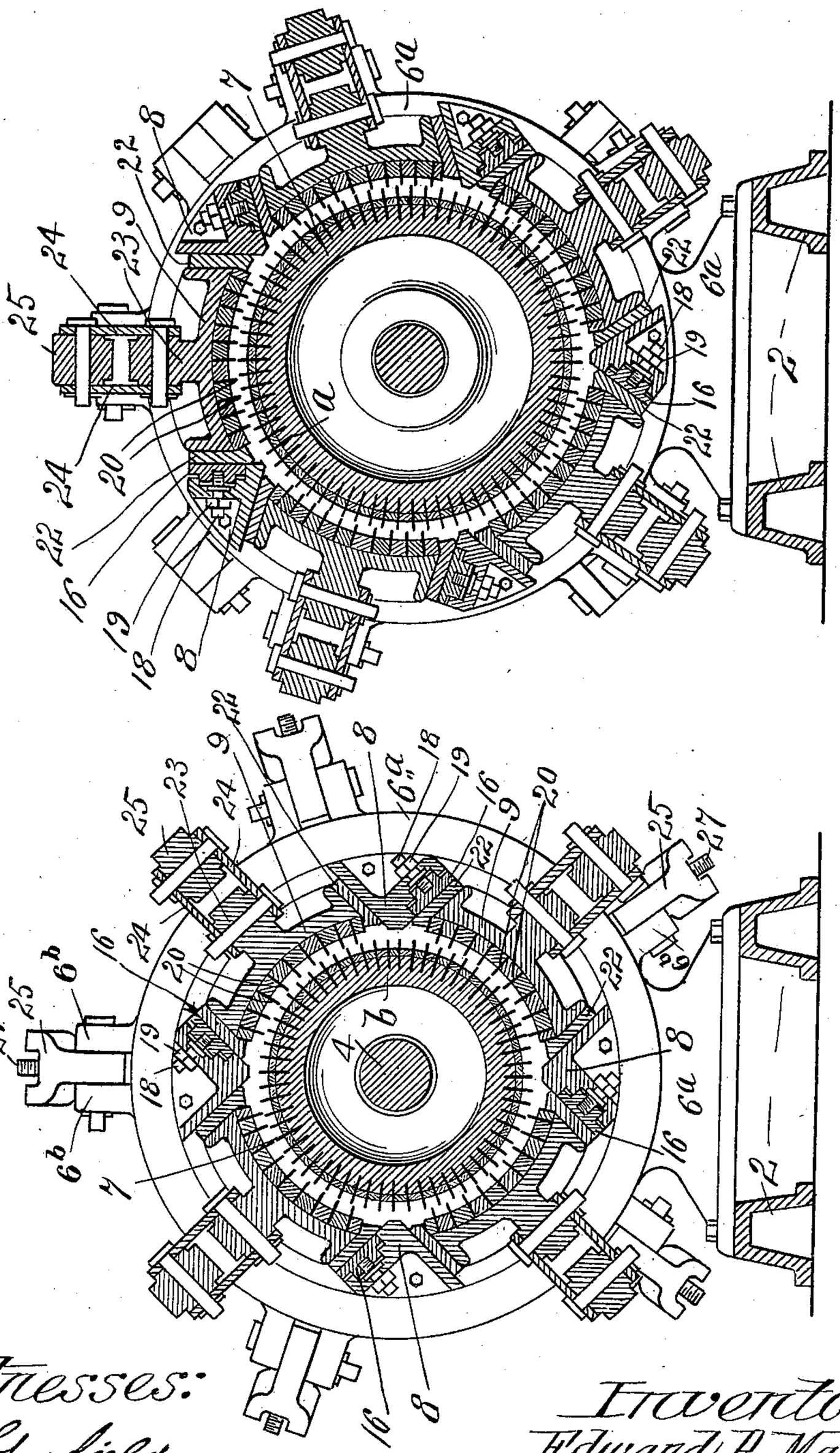

Fig. 5.

Witnesses:
J. H. Garfield
H. D. Clemons

Inventor,
Edward R. Marshall,
by Chapin & Co.
Attorneys.

No. 635,563. Patented Oct. 24, 1899.

E. R. MARSHALL.

REFINING ENGINE FOR PAPER PULP.

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(No Model.) 5 Sheets—Sheet 5.

Fig. 10.

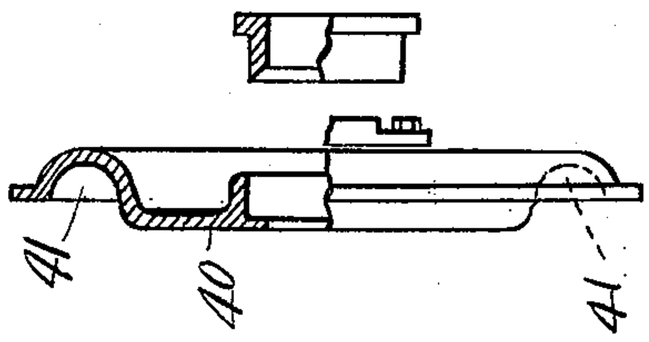


Fig. 13.

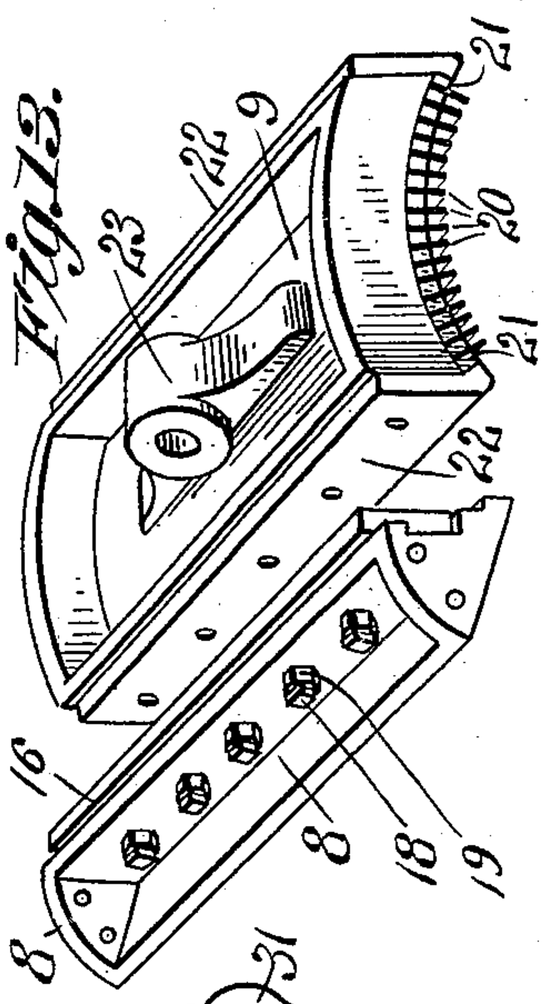


Fig. 9.

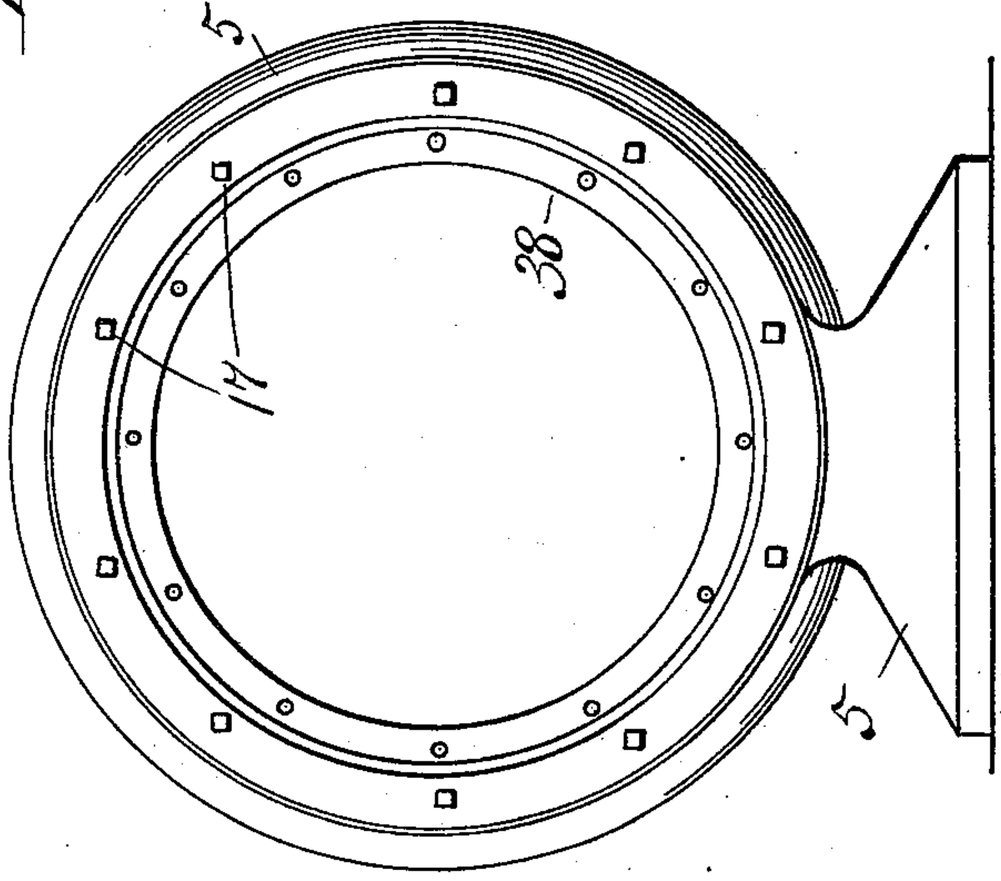


Fig. 8.

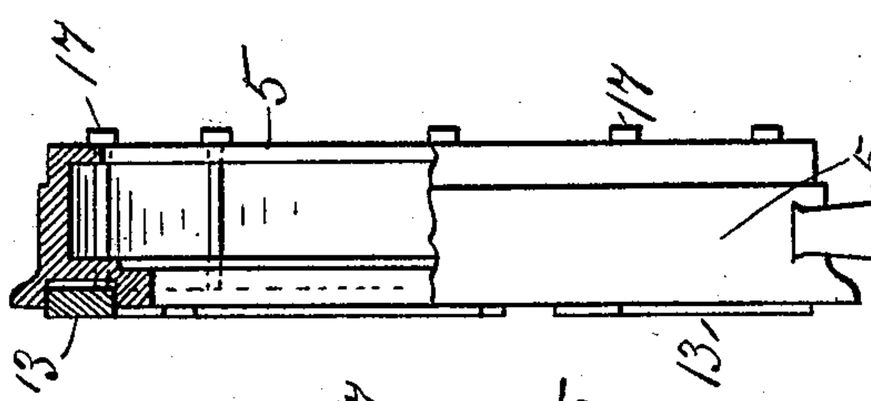


Fig. 12.

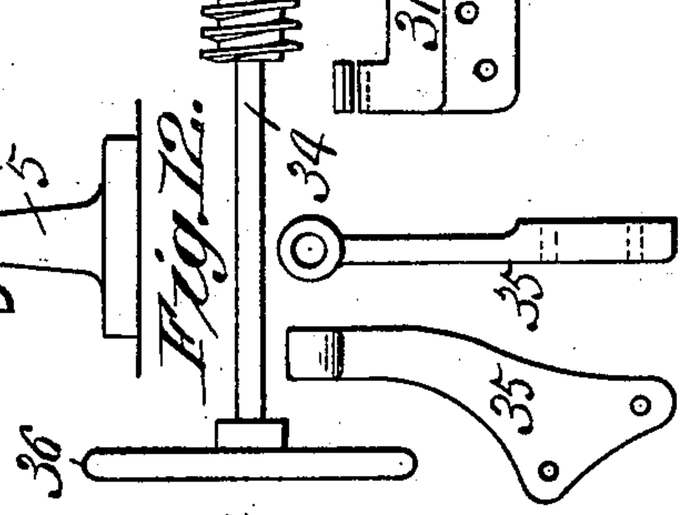


Fig. 7.

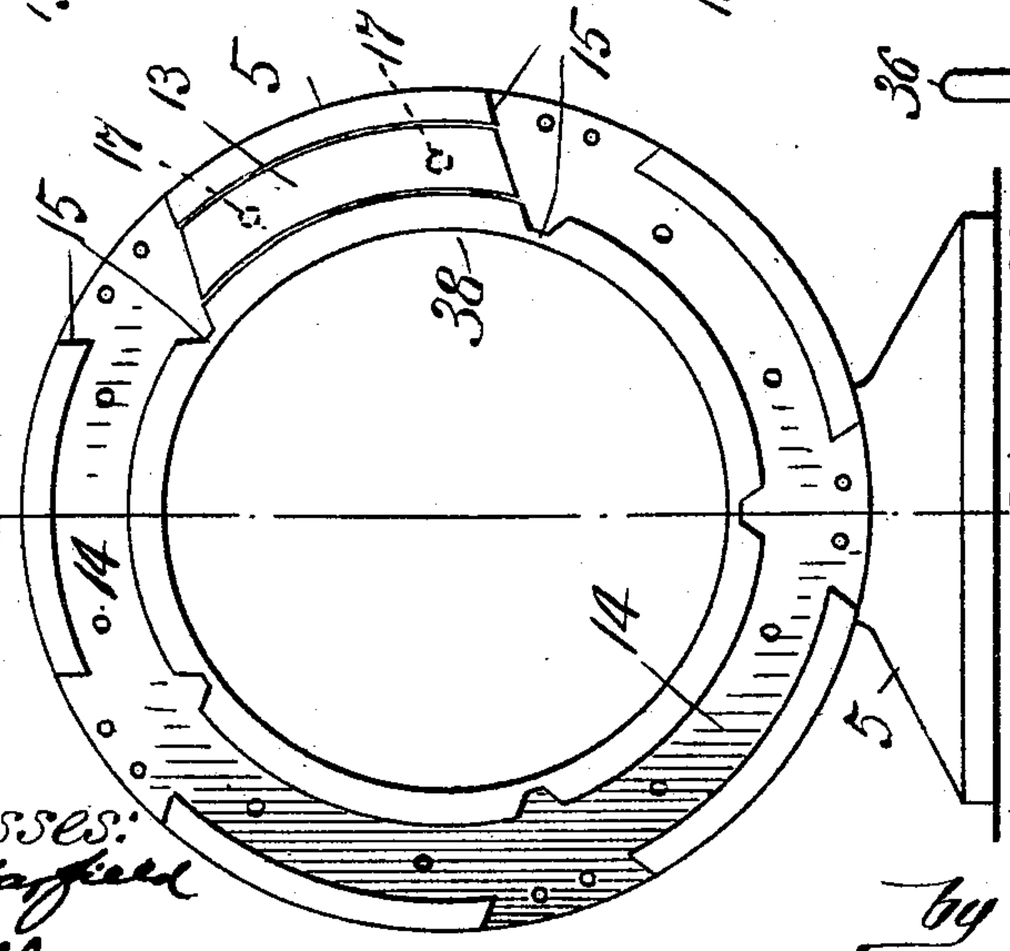
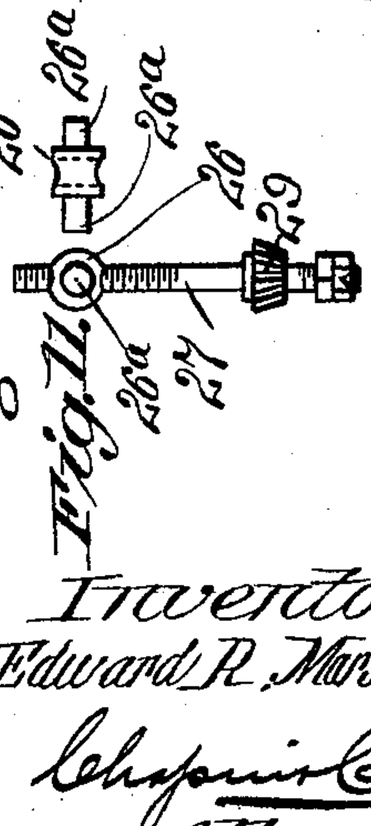


Fig. 11.



Witnesses:
J. D. Canfield
H. D. Clemons

Inventor:
Edward R. Marshall,
by Chapin & Co
Attorneys.

UNITED STATES PATENT OFFICE.

EDWARD R. MARSHALL, OF TURNER'S FALLS, MASSACHUSETTS.

REFINING-ENGINE FOR PAPER-PULP.

SPECIFICATION forming part of Letters Patent No. 635,563, dated October 24, 1899.

Application filed August 5, 1898. Serial No. 687,846. (No model.)

To all whom it may concern:

Be it known that I, EDWARD R. MARSHALL, a citizen of the United States, residing at Turner's Falls, in the county of Franklin and State of Massachusetts, have invented new and useful Improvements in Refining-Engines for Paper-Pulp, of which the following is a specification.

This invention relates to paper manufacturing, and particularly to the construction of refining-engines for paper-pulp, and has for its object the production of a machine of this class wherein a beater-roll revolves within a casing composed of suitable frame parts and a series of bed-plates radially movable in said frame parts toward and from the surface of the said beater-roll for adapting the machine to the production of pulp of any degree of fineness.

A further object of the invention is the construction of a beater-roll consisting of two cylinders mounted upon a common shaft, one of said cylinders having a larger diameter than the other, whereby greater circumferential speed is attained by one end of said roll than the other, which causes a movement of the stock on which the roll is operating from that part of the roll having the smaller diameter to that part having the larger diameter.

Another object of the invention is the construction of means whereby all of the bed-plates surrounding the larger or smaller part of said roll may be moved simultaneously toward or away from said roll and in the provision of suitable means for packing the ends and sides of the bed-plates forming part of the casing of the machine, whereby the latter is rendered water-tight.

The invention consists in the construction of the machine, as fully pointed out in the following specification and claims.

In the drawings, Figure 1 is a side elevation of a machine embodying this invention. Fig. 2 is a longitudinal section of Fig. 1, except that the beater-roll is shown in half-elevation and half-section. Fig. 2^a is a plan view of the face of one of the bed-plates. Fig. 2^b is a perspective view of a part of the circular rack for operating the bed-plates and shows means for holding said rack in operative position on the frame part of the casing. Figs. 3 and 4 are elevations of opposite ends of the machine. Figs. 5 and 6 are cross-sections on lines 5 5 and 6 6, Fig. 2. Figs. 7 and 8 are views of the inner face and side of one of the end frame parts. Fig. 9 is an elevation of the outer face of said end frame part. Fig. 10 is an edge view, partly in section, of a plate for closing the central opening in said frame part. Figs. 11 and 12 are views of detail parts of the operating mechanism of said circular rack. Fig. 13 is a perspective view of one of the movable bed-plates and one of the bars between which the said plates are supported.

The usual type of refining-engines of this class is one having a cone-shaped case and a cone-shaped beater-roll therein and longitudinally adjustable in its bearings, whereby the edges of the knives on said roll and on the interior of said case may be brought into a proper degree of proximity for producing the required fineness of pulp. Certain disadvantages have been found to exist in the use of this machine, chief among which is the uneven wear of parts of the knives of the roll and the knives on the interior of the case, owing mainly to the shape of said roll and its case. This uneven wear is a cause of serious inconvenience, for it necessitates a truing up of the edges of the knives in the case and of those on the roll, whereby their edges will lie in parallel relation to each other when in operative position in the case; otherwise the product of the machine would be of uneven fineness and would be reduced in quantity. Furthermore, this uneven wearing away of the cutting edges of the said knives, necessitating more frequent grinding, shortens the life of the knives very considerably. To obviate this uneven wear of the knives due to the difference in circumferential speed between their opposite ends, the machine forming the subject of this application is constructed with a beater-roll having the form of two cylinders placed end to end on a shaft, one having a larger diameter than the other and preferably made in one piece. By means of this construction the stock is kept moving through the machine in the same manner as in the machine having a cone-shaped roll, for as that part of the cylindical roll located at the delivery end has a greater circumferential speed than the part having the smaller diameter, located at the inlet end thereof,

the stock will leave said delivery end, if permitted to do so, faster than it enters the opposite end of the machine. The tendency, therefore, is for the stock to move through the machine in the same manner as in the cone type referred to above. This roll revolves on a fixed axis, and a series of properly-supported bed-plates constitute the cylindrical case in which said roll revolves, which plates are simultaneously adjustable concentrically to that part of the roll which is inclosed by them. This construction obviates another disadvantage of the cone type of engine in that it does away entirely with the end thrust of the roll-shaft against its bearings and permits the easy and quick removal of the sections of bed-plates for repair or for the examination of the beater-roll.

Referring to the drawings, the base of the machine is indicated by 2, and bolted thereto are the standards 3, in which are suitable bearings for the roll-shaft 4. The annular end frames 5 and 6, one of which is shown in detail in Figs. 7, 8, and 9, and the center frame 6^a are bolted to the frame 2 in proper positions, as shown, to receive the beater-roll 7. When the end frames and center frames are properly placed, they are rigidly secured together by bars 8, which are bolted to said end and center frames in positions parallel with the axis of the roll-shaft 4 and so spaced as to receive between them the bed-plates 9.

The number of the plates constituting the casing for the beater-roll may vary according to the diameter of the roll they inclose. In the machine shown herein the number of plates forming the case inclosing that part of the roll having the smaller diameter is four, and for the case inclosing the larger diameter thereof the number is five.

To provide for the location of a packing-plate 13 in the inner surface of the end frames 5 and 6 for bearing against the end of the bed-plates 9, an annular groove 14 is turned therein, as shown in Figs. 2, 7, and 8, and the segment-shaped plates 13, preferably of brass, are inserted in said groove, filling the space between the adjoining sides of two of the bars 8. Suitable cuts 15 (see Fig. 7) are made through the outer wall of said groove 14 and into the inner wall thereof for the reception of the ends of the bars 8, which are V-shaped in cross-section. This construction permits the packing-plate 13, bearing against the end of the bed-plates, to overlap the end of the packing-plate 16, which is located in one side of the bar 8 and which bears against the side of said bed-plate.

The packing-plates for one end and one side of the bed-plates 9 are identical in the casing for both the large and small portions of the beater-roll and in each case are applied only to the outer ends and to one side of the plates. Adjusting-screws 17, (shown in Figs. 8 and 9,) passing through the end frames, force said bed-plates endwise against the opposite faces of the center frame. The ends of the bed-plates and the surfaces of the frame and packing-plates against which they bear are faced off smooth, and when held firmly in contact, as with the screws 17, are practically water-tight. The sides of the bed-plates 9 are packed in a similar manner, viz: The said bars 8 are provided on one side thereof with the before-mentioned plate 16, let into said side, which is made thick enough to receive it, (see Figs. 5 and 6,) and by means of the adjusting-screws 18, which enter suitably-threaded holes in said packing-plates and have a bearing in the side of said bars, serve to move said packing-plates toward or away from one side of said bed-plate and force the latter against the side of the adjoining bar 8. These bars are made of such shape as will permit easy access to the heads of the screws 18 for manipulating the same, and each screw is provided with a check-nut 19 for locking it in place. It is thus readily apparent that by loosening slightly the screws 17 and 18 of the bed-plates the latter may be moved to occupy any desired position relative to the surface of the beater-roll, and the screws then set up will rigidly secure said plate in that position and at the same time pack the edges of said plate against the egress of water when the machine is in operation. The bed-plates are guided in their radial movements by the accurately-finished surfaces of the packing-plates on three sides thereof and by the accurately-finished surface of the center frame on the remaining side of said plate, and as the lug 23, by which the plates are supported, is located as nearly as possible at the center of gravity of said plate the movement of both ends is practically uniform; but should it not be precisely so the packing-plates, when again screwed up to a bearing, will bring said plate to its proper position. It will be observed that the said bed-plates are forced both sidewise and endwise against fixed abutments, whereby whatever may be the degree of separation between the operative surfaces of the bed-plates and roll those surfaces will always be in parallelism.

The bed-plates are of the usual construction as far as their operative surface is concerned, and consist of a suitable number of knives radially located relative to the axis of the roll-shaft 4. One of the plates is shown in face plan in Fig. 2^a and in perspective looking at the outside of the plate in Fig. 13. It is seen that the body of the plate consists in a metal rectangular-shaped open box having a concave lower surface concentric with the beater-roll, on which surface the knives 20 are secured between wood strips in the usual manner, wedges 21 being employed to lock the knives and strips 20 between the edges of the side plates 22, which project beyond the inner surface of the body of the bed-plate, the inner edges of that part of said side plates which project beyond the bottom of the said body being radially formed relative to the center of the roll-shaft. Said side plates are

secured to the sides of the body part of the bed-plate by screws, as shown in Fig. 13.

As hereinbefore stated, the roll 7 is made up of two cylinders having different diameters, and a series of bed-plates incloses each of said cylinders, the center frame 6^a being located between said two series of bed-plates. Separate adjusting devices for each of said series are provided and located at opposite ends of the machine, by means of which each series of bed-plates may be adjusted at will toward and away from the surface of the roll which they inclose. Said adjusting devices are constructed as follows: Each of the bed-plates 9 has a lug 23 cast on the upper surface of the body part thereof at about the center thereof, and said lug is perforated to receive pivotally one end of a pair of links 24, with which said plate is connected to a lever 25. The latter is pivotally supported by one end on the center frame 6^a between the lugs 6^b, cast on said frame, and its opposite end is forked to receive therein the swiveled nut 26, which is applied to a screw-threaded shaft 27, supported at one end in the end frame and passing through a suitable bracket 28, bolted to the end frame. (See Fig. 2.) Trunnions 26^a on said nut 26 engage with the end of said lever, as will hereinafter appear. On said shaft is fixed a pinion 29, located between said bracket and the surface of the frame. Said shaft 27 is revoluble and is rotated by the engagement of the said pinion with the teeth on the side of the circular rack 30, which is also provided with gear-teeth on its periphery. This rack fits over the circular frames 5 and 6, as shown, and is revoluble on said frames and is held thereon for rotation in a fixed plane by a bracket-arm 31, Figs. 1, 2, 3, and 4, bolted to the end frame and bearing against the edge of the rack, and by screws 32, (see Figs. 2 and 2^a,) radially located in said frame and the ends of which enter loosely a groove 33, located in the inner surface of said rack. Said bracket-arm 31 supports a worm-shaft 34, having a worm-gear thereon engaging with the row of teeth on the periphery of said rack 30. A second bracket 35, bolted to the frame, Figs. 3 and 4, supports the outer end of said worm-shaft 34, and on the end of the latter is a hand-wheel 36, whereby said shaft is rotated. Said nut 26 is provided with trunnions 26^a, which have a bearing in suitable slots in the forked end of said levers 25, whereby the latter may be operated by said nut 26 without springing said shaft 27 and causing any binding thereof in the said nut.

The foregoing description of the manner of supporting one of the bed-plates 9 applies to all of them forming the casing for both ends of the beater-roll 7.

As shown in the drawings, the levers 25, which support the bed-plates, are all supported by one end on the center frame 6^a and extend toward opposite ends of the machine. The other ends of said levers are all connected by the gearing above described with the circular racks located on the end frames 5 and 6, each of which racks is provided with the worm-gear devices described, whereby they may be rotated and all of the bed-plates 9 simultaneously operated for adjustment relative to the surface of the beater-roll 7.

The roll 7 is of the usual construction so far as the application of the knives to the surface is concerned. The roll may be made, as shown in the drawings, having a cylindrical body of two diameters, made preferably in one piece of any suitable metal and secured to the roll-shaft 4 by keys or otherwise and having knives applied thereto in the usual manner. The novelty in the construction lies in placing two cylinders, one of larger diameter than the other, on a common shaft, whereby the same effect is obtained as by the use of a cone-shaped cylinder of the type in common use in machines of this class without the attendant disadvantages of the latter, to which allusion has been made. By making the delivery end *a* of the roll 7 of a larger diameter than the inlet end *b* thereof a greater circumferential speed at said delivery end of the roll is attained, and consequently a more rapid movement of the stock through the machine takes place after said stock has passed through the annular passage 37, between the inside surface of the center frame 6^a and the periphery of the body part of the roll 7, between the adjacent ends of larger and smaller portions of the beater-roll. This accelerated movement of the stock in the delivery end of the machine causes a uniform flow of the stock through the inlet end thereof, and the bed-plates which inclose the two parts *a* and *b* of the roll may be set to give to the stock in one end of the machine a different treatment from that to which it is subjected in the other end thereof. This characteristic is very important, as machines of this class are used chiefly as refiners—viz., they are employed to reduce stock taken from the beating-engine to a proper condition to run on to the paper-machine, and by reason of the separate adjustment of the bed-plates to the two sections *a* and *b* of the roll both sets of plates may be adjusted to give the stock a uniform treatment or the inlet end of the machine may be adjusted to give the stock a quick reduction and the exit end of the machine adjusted to give it a very light brushing effect only. Every requirement of the paper-manufacturer can be met by reason of the wide range of adaptability of the machine to the rapid reduction of fibers requiring different modes of treatment.

The center frame 6^a is constructed with the annular openings 37, having a diameter slightly exceeding that of the inlet end *b* of the roll 7, and the end frame 5 is constructed with a similar opening 38, slightly larger than the diameter of the end *a* of the roll. The purpose of this is to permit the easy removal of the roll from the casing without disturbing

the adjustment of the bed-plates surrounding either section of the roll. The opening 38 and a similar opening in the frame 6 are closed by circular plates, 39 indicating the plate for end frame 6, and 40 for the end frame 5. On the said plates a channel 41 (see Figs. 2 and 10) is formed concentric therewith and located opposite the ends of the knives in said plates and beater-roll for the easy entrance and exit of the pulp, and a pipe connection 42 is made with the channel of the plate 40, means being provided for making said connection at either side of the machine. The inlet connection 39ª on plate 39, however, is preferably made permanently thereon and centrally over the shaft 4, and suitable pipes extend from said connections to a source of supply of stock for the machine and to a suitable sheet or receptacle for the finished product. The central apertures in the plates 39 and 40, through which the shaft 4 passes, are provided with suitable stuffing-boxes for making them tight.

Having thus described my invention, what I claim is—

1. In a pulp-refining engine, a beater-roll comprising two cylinders, one of greater diameter than the other, the one having the smaller diameter being located at the inlet end of the engine, a shaft for said roll, and a plurality of concentrically-supported, radially-movable bed-plates forming a casing surrounding said roll, substantially as described.

2. In a pulp-refining engine, a beater-roll comprising two cylinders, one of larger diameter than the other, the one having the smaller diameter being located at the inlet end of the engine, a shaft therefor, a bed-plate for each of said cylinders, and a suitable case for said roll, substantially as described.

3. In a pulp-refining engine, a beater-roll comprising two cylinders, one of greater diameter than the other, the one having the smaller diameter being located at the inlet end of the engine, a shaft for said roll, a series of concentrically-supported, radially-movable bed-plates forming, with the frame parts of the engine, a casing for each of said cylinders, and means for simultaneously and uniformly moving each of said series of bed-plates toward and from said roll, independently of the other, substantially as described.

4. In a pulp-refining engine, a beater-roll comprising two cylinders, one of greater diameter than the other, the one having the smaller diameter being located at the inlet end of the engine, a shaft therefor, a frame, a plurality of concentrically-supported radially-movable bed-plates forming, with said frame, a casing surrounding said roll, and means for suitably packing said bed-plates and securing them in said frame, substantially as set forth.

5. In a pulp-refining engine, a suitable frame, a beater-roll comprising two cylinders, one of which is of greater diameter than the other, supported in said frame; a series of bed-plates forming with said frame a casing for each of said cylinders, a passage between the casing of one cylinder to that of the other, levers supported on said frame and connected with said bed-plates, screw-threaded shafts engaging said levers, suitable gear connections between said shafts whereby the bed-plates coöperating with each cylinder may be simultaneously adjusted toward and from said cylinder by the actuation of said shafts, suitable packing between said frame and bed-plates, and means for securing the latter to the frame, substantially as set forth.

6. In a pulp-refining engine, two suitably-supported end frames and a center frame, bars extending between said end and center frames and fixed thereto, a beater-roll centrally supported in said end frames, bed-plates supported between said frames and constituting with said bars a roll-inclosing case; packing devices for the two sides and one end of said bed-plates, means for uniformly moving all of the latter radially and for rotating said roll, substantially as described.

7. In a pulp-refining engine, a beater-roll comprising two cylindrical portions having different diameters and having the same axis of rotation, an inclosing case for said roll comprising a series of radially-adjustable bed-plates for each of said cylindrical portions, means for adjusting each of said series independently, and all of the plates of each series at one time, and a suitable frame for supporting said roll and said plates, substantially as described.

8. In a pulp-refining engine, two suitably-supported end frames and a center frame, a beater-roll comprising two cylindrical portions, one of which is disposed on each side of said center frame and supported on a common shaft having bearings in said end frames, bars between each of the latter and said center frame, bed-plates adjustably supported between said frames and said bars and constituting, with said parts, separate inclosures for each of the cylindrical portions of said roll, a suitable passage through said center frame, packing for the edges of said bed-plates, and means for rotating said roll, substantially as described.

9. In a pulp-refining engine, a beater-roll comprising two cylinders, one of larger diameter than the other, the one having the larger diameter being located at the delivery end of said engine, a shaft for said rolls, a bed-plate for each of said cylinders, a suitable case for said roll, and a passage in said case located between the adjoining ends of said cylinders and inclined to the axis of the roll, substantially as described.

EDWARD R. MARSHALL.

Witnesses:
WM. H. CHAPIN,
I. H. BARTLETT.