D. L. BELLINGER.

REFINING ENGINE FOR PAPER STOCK.

APPLICATION FILED OCT. 25, 1915. RENEWED APR. 3, 1920.

1,358,354. **Patented Nov. 9, 1920.**

3 SHEETS—SHEET 1.

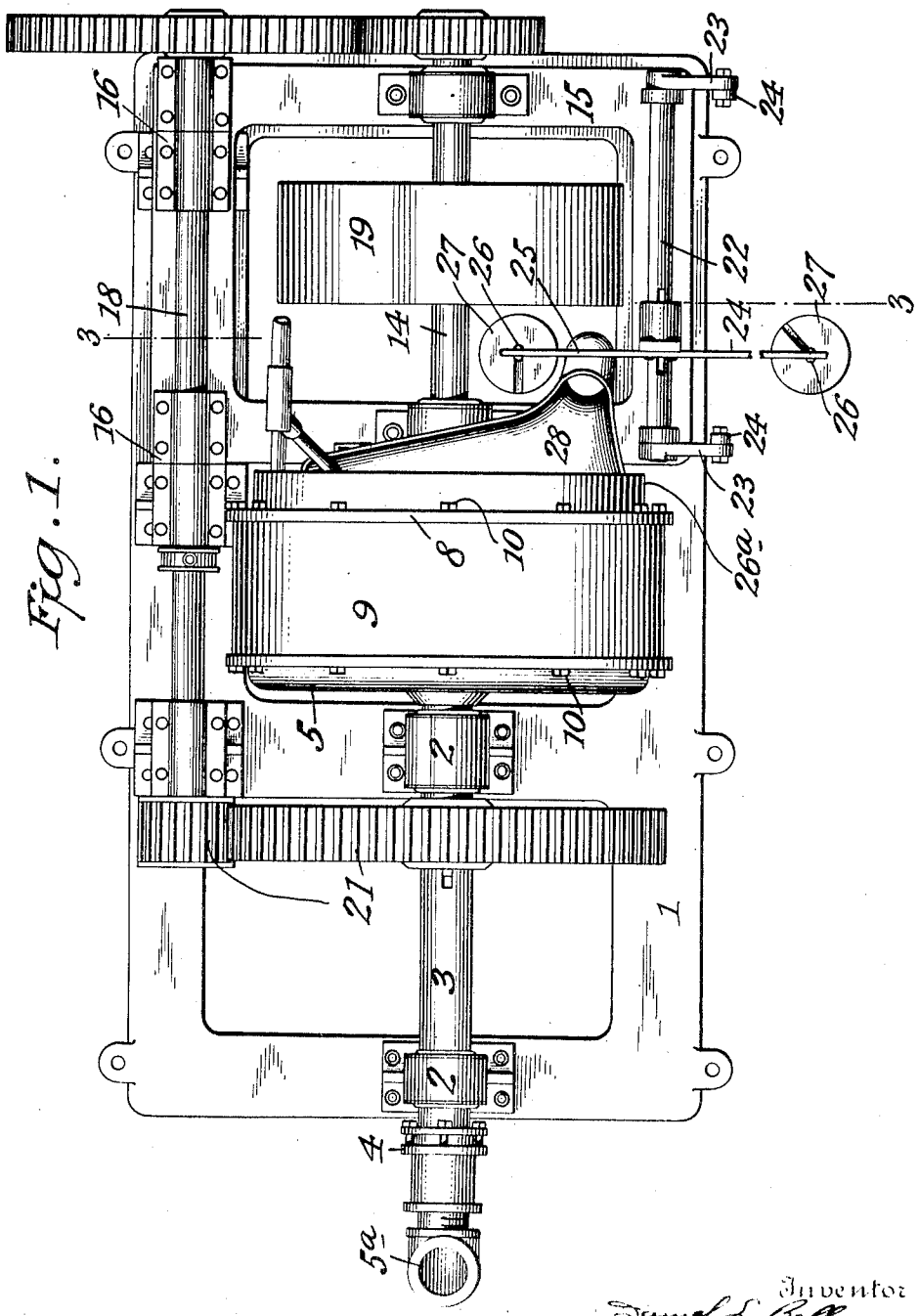


Fig. 1.

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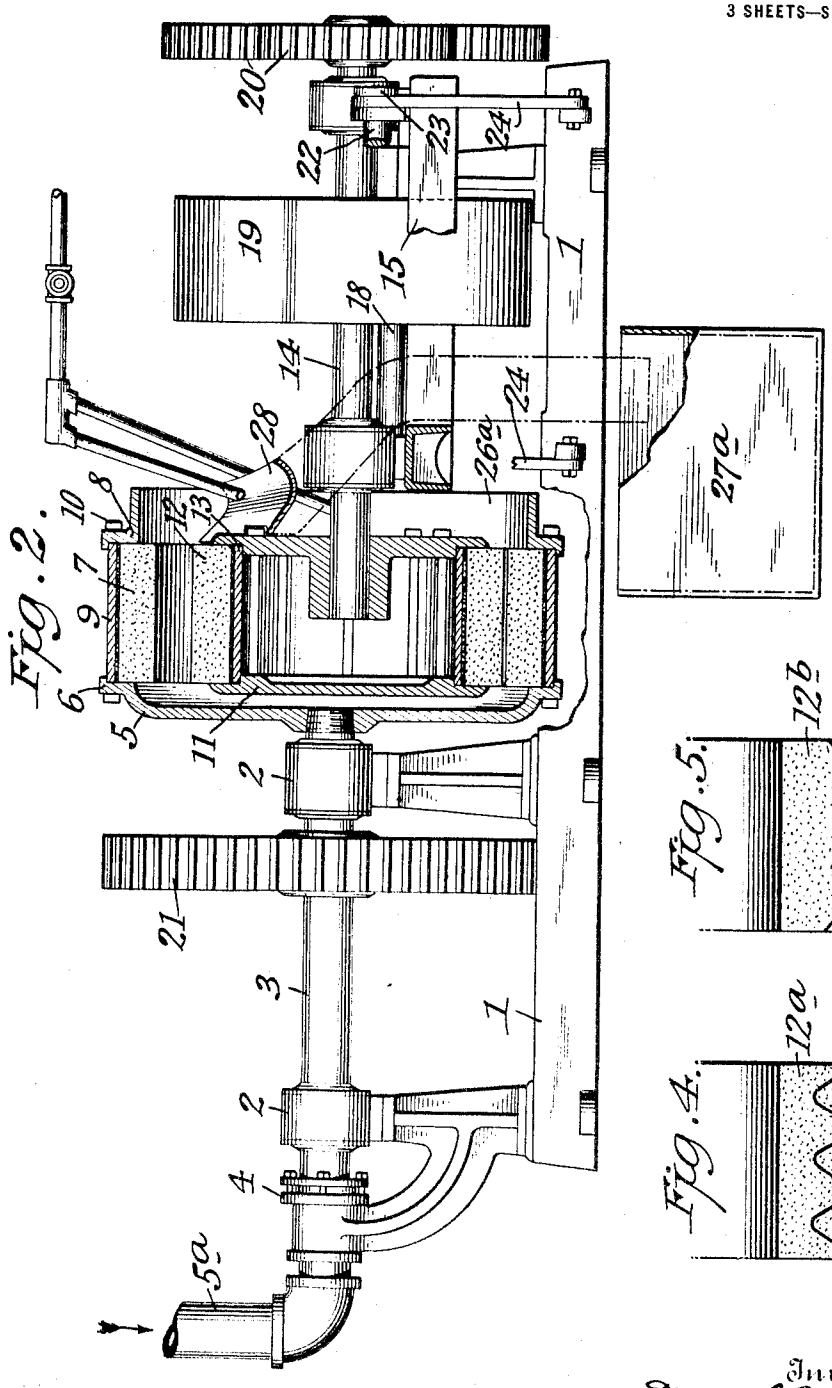


Fig. 2.

Fig. 5.

Fig. 4.

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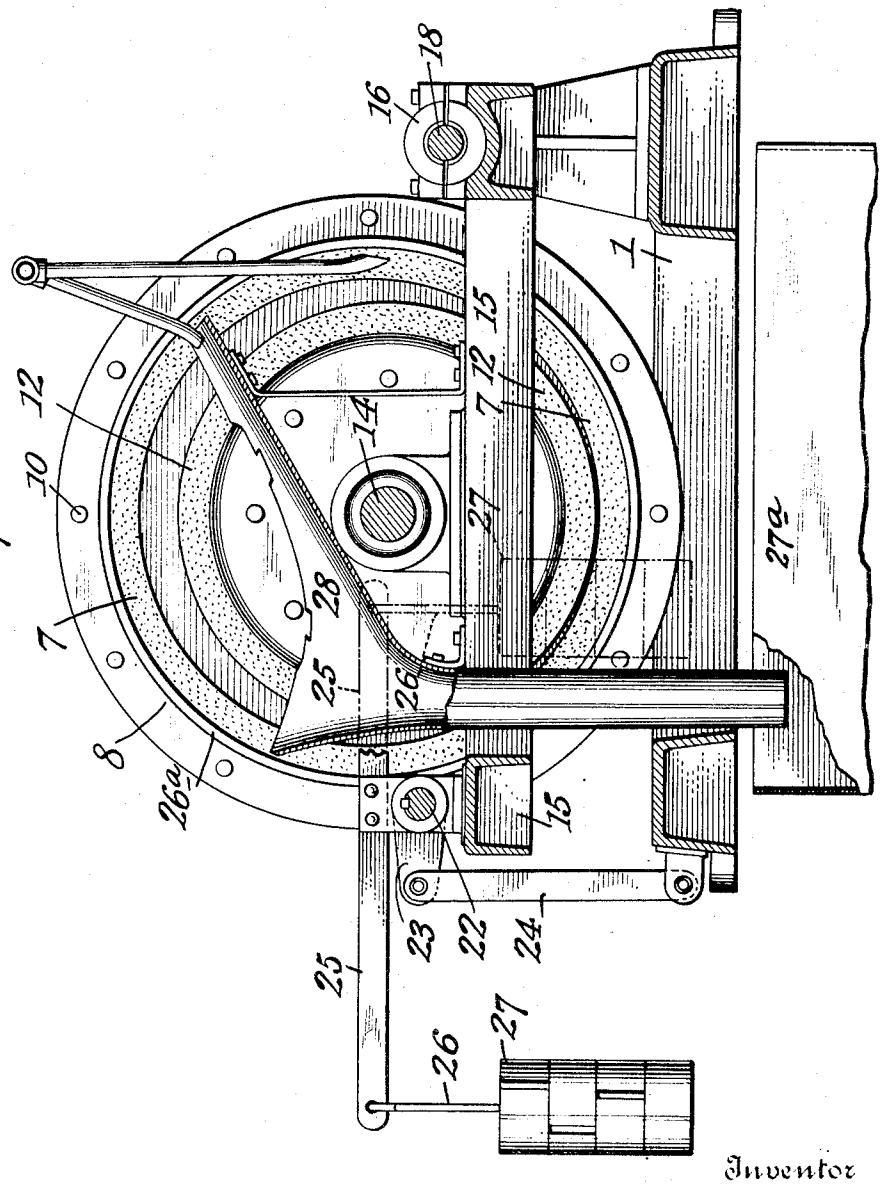
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3 SHEETS—SHEET 3.

Fig. 3.



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UNITED STATES PATENT OFFICE.

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REFINING-ENGINE FOR PAPER-STOCK.

1,358,354. Specification of Letters Patent. Patented Nov. 9, 1920.

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To all whom it may concern:

Be it known that I, DANIEL L. BELLINGER, a citizen of the United States, and a resident of Glens Falls, Warren county, State of New York, have invented certain new and useful Improvements in Refining-Engines for Paper-Stock; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

This invention relates to improvements in refining engines for reducing the coarse fiber, slivers, knots and other material rejected by the screens of paper pulp machines.

In the production of paper pulp the material from the digesters, or mechanical reducers, is subjected to a screening process to divide the fiber which has been reduced to the proper condition from the insufficiently reduced stock. The rejections from the screen or "tailings" must then be subjected to a further reducing action to obtain all the fiber possible from the stock. Several different types of machines for this purpose are now on the market, but, so far as I am aware, none of them is entirely satisfactory. The machines which produce good fiber are slow in operation, subject to rapid wear, and incapable of continuous operation, or else very complicated and requiring a large and expensive installation out of proportion to the output. On the other hand, the types of machines which are designed to better avoid the above objections produce a poor grade of short chopped fiber not equal in quality to the fiber passed by the screens from the material taken directly from the digesters.

The objects of my invention are to provide a refining engine of this type which will produce a fiber of the best grade and will also be capable of continuous operation with large output.

A further object of my invention is to provide a machine of this class capable of handling the stock when it is thick and heavy, without requiring a high pressure feed or the expenditure of excessive power in reducing the stock.

A further object of the invention is to provide a refining engine of simple mechanical design which will operate automatically without special attention and without liability to clogging or otherwise getting out of order, which is not subject to rapid wear, and in which the actual grinding parts may be readily removed and resurfaced or renewed at small cost.

A further object of the invention is to provide a refining engine which requires but small space for the entire installation, including the engine itself and the tanks, pumps, etc. necessary to the system, with a correspondingly small investment per ton of acceptable output.

A further object of the invention is to provide a machine in which the character of the operating surfaces, their relative speed and operating pressure may all be altered within wide limits to adapt the machine to widely varied work, both as regards the character of the stock to be handled and the quality of fiber desired.

Further objects of the invention will appear from the following description, taken in connection with the accompanying drawings, wherein I have illustrated a preferred embodiment of the invention as well as certain modifications.

In the said drawings,

Figure 1 is a plan view of my improved refining engine;

Fig. 2 is a side elevation, partly in section, of the apparatus shown in Fig. 1;

Fig. 3 is a transverse section on line 3—3 of Fig. 1; and

Figs. 4 and 5 are detail views of different designs of stones.

In the drawings, reference character 1 indicates the frame of the machine which may be of any suitable design for adequately supporting the parts. At one end the frame is provided with suitable bearings 2, for a longitudinally extending hollow shaft 3, connected through a stuffing box 4 with a stationary feed pipe 5^a for the stock to be treated. Supported on the projecting end of the shaft 3 is the end web 5 of a drum 6 constituting the outer member of the reducing couple and provided at its periphery with an annular stone 7 having its active face concentric with the axis of rotation of the shaft 3.

The stone 7 is held in place by a clamping ring 8, which engages the outer edge of the radial face of the stone and clamps the stone against an annular seat formed at the periphery of the web 5. The stone is backed by an inclosing ring 9 in which the clamping bolts 10 are supported.

The inner member of the reducing couple comprises a drum 11 of smaller diameter

than the internal diameter of the outer drum, and with its outer circumferential portion consisting of an annular stone 12 clamped between the two heads of the drum by suitable bolts, the stone being backed by an inner metal ring 13 as shown in Fig. 2.

The inner drum 11 projects within the outer drum and is supported on the end of a shaft 14, which shaft is mounted on a hinged or "floating" frame 15, so that the inner drum is supported by the outer drum, and the unbalanced weight of the drum and frame, which may be regulated, as will be later described, produces the working pressure of the couple. The frame 15 is supported along one edge by bearings 16 swung on a shaft 18 extending along the edge of the main frame 1 and serving as the driving shaft of the hollow shaft 3 of the outer drum. The shaft 14 preferably constitutes the main driving shaft of the entire machine and may be driven in any suitable manner, as by means of the pulley 19 attached thereto. The shaft 18 is driven from the shaft 14 by a pair of reducing gears 20 and the shaft 3 is in turn driven from the shaft 18 through a pair of reducing gears 21, whereby the outer drum will be driven in the same direction as the inner drum, but at a greatly reduced speed, the ratio of the gearing shown in the drawing being about 10 to 1.

For regulating the pressure of the drum grinding surfaces there is provided a variable counterbalance mechanism for the frame consisting of a shaft 22 extending along the free edge of the frame 15, and having at each end outwardly projecting crank arms 23, pivotally connected to the upper ends of links 24 rising from the base of the main frame 1, whereby a torsional force applied to the shaft 22 will tend to raise or lower the free edge of the floating frame and thereby add to or reduce the working pressure. The shaft 22 has also attached to it a pair of oppositely extending weight-carrying crank arms 25, 25, each of which is provided at its end with a sling 26 for receiving the weights 27. When the preponderance of weight is on the outer arm 25, the weight of the drum will be partially counterbalanced but when the greater weight is on the inner arm the downward pressure of the drum will be correspondingly increased. By changing the weights from one sling to the other or removing some of the weights, the pressure may be varied as desired, within the limits of the design.

The stock to be reduced is fed into the pipe 5^a by gravity from an elevated tank or by a suitable pump, not shown, through the hollow shaft, and thence between the heads of the drums which are spaced apart as shown in Fig. 2, to permit a ready passage of the stock to the space between the stones of the drums. The reduced material is forced out of the opposite side of the apparatus by the incoming stock on to a laterally extending flange 26^a on the clamping ring 8, from which it drops into a tank 27^a set in the floor beneath the base of the machine or into any other suitable receptacle. To prevent the apparatus becoming unnecessarily spattered with the reduced stock, an inclined trough 28 is preferably arranged across the face of the drums within the flange 26^a to catch any stock that may be carried above the end of the trough and direct it into the tank. To further insure keeping the machine clear of the reduced material I may direct small streams of water, as shown in Fig. 3, into the trough 28 and against the rising side of the flange 26^a to flush the material into the tank.

In Figs. 4 and 5 I have illustrated certain modified designs of the stones of the machine which may be of advantage with some grades of stock. The grooved construction of the stones 7^a and 12^a of Fig. 4 increases the abrading surface of the stones, and also by obstructing the lateral passage of the stock through the machine, prolongs the action. The curved surfaces of the stones 7^b and 12^b of Fig. 5 give the same effect, but to a lesser degree.

In operation the stock is fed through the hollow shaft under sufficient pressure to maintain the desired rate of flow of the more or less viscous material through the feed passages of the apparatus. No pressure is required to force the stock between the stones, as there is no resistance to the passage of the stock into the free space at the upper side of the stone, and the rotation of the stones in the same direction carries the stock positively into and through the active portions of the stones. As the material is carried upward into the space between the diverging faces of the stones, it is free of pressure to be gradually pushed off the edges of the stones by the incoming stock onto the flange 26, whence it falls into the tank or the receiving trough 28.

It will be noted that the action of the machine may be varied in all particulars within wide limits to adapt it to stock of all kinds. By varying the relative speeds of the stones, which may be done by simply substituting gear couples of different ratios, the action may be varied from a rolling and crushing effect when the stones revolve at small difference in speed, to the true grinding action produced by the more rapid rotation of the smaller stone. Varying the pressure of the inner stone, which is accomplished by merely shifting the weights on the floating frame, also alters the character of the action and adapts the machine to stock of varying weight and consistency. By changing the rate of speed, the duration

of the action on the stock may be suited to the character of the stock to insure complete disintegration of the most refractory material, and finally the stones themselves may be removed and replaced by others of different character without taking down the machine. A feature of prime importance in my improved machine is its capacity for continuous operation without liability of clogging or the accumulation of the material in one spot to produce uneven wear of the stones. The positive feed carries the material through the stones; the inner stone simply rising to permit the passage of any matter not reduced by the action of the stones.

The machine is economical in its consumption of power. There are no thrust bearings, the stuffing box is under practically no pressure, and the power required to feed the stock is no more than necessary to keep the material in motion.

The machine shown and described constitutes a preferred embodiment of my invention, but it is obvious that the details of construction may be variously modified without sacrificing any of the advantages of the invention. For example, instead of allowing the reduced stock to fall into an open tank, the drums may be completely inclosed in a suitable housing supplied with a delivery pipe for the reduced stock.

I claim:

1. In a refining engine, the combination of an outer grinding drum having an internal abrasive surface, an inner drum having an external abrasive surface coöperating with the abrasive surface of the outer drum, a shaft having a fixed horizontal axis of rotation supporting said outer drum, an independent shaft for said second drum, said shaft being mounted for free vertical movement to permit said inner drum to rest with its lower face on the abrasive surface of the outer drum, and means for varying the pressure between the surfaces of the two drums.

2. In a refining engine, the combination of an outer drum having an internal annular abrasive surface, an inner drum having an external annular abrasive surface, independent shafts for supporting said drums in eccentric relation, means for driving said drums at different peripheral speeds and means for feeding the stock to be refined axially between said drums under a moderate pressure so that the stock will be carried circumferentially between the coöperating faces of the drums before it is discharged from the side of the drums.

3. In a refining engine, the combination of an outer drum having an internal annular abrasive surface and an imperforate disk forming one end of said drum, a hollow driving shaft for said drum, said disk being mounted centrally on said shaft supporting said drum, an inner drum having an external annular abrasive surface, means for supporting said drum, a second drum within the first mentioned drum in eccentric relation thereto, means for rotating said drums at different peripheral speeds, and means for feeding the stock to be refined through said hollow shaft and axially between said abrasive surfaces.

4. In a refining engine, the combination of an outer member consisting of a drum closed at one end, a hollow shaft supporting said drum with its bore communicating with the interior of said drum, said drum having at its periphery an internal, annular abrasive surface, an inner drum having an outer cylindrical abrasive surface eccentrically mounted within said outer drum with its end wall spaced from the wall of said outer drum to provide a passage for the stock from said hollow shaft to the space between said abrasive surfaces, and means for effecting relative rotation of said drums.

5. In a refining engine, the combination of relatively rotatable members comprising an outer drum having an internal annular abrasive surface, an inner drum having an external cylindrical abrasive surface, of a diameter more than three fourths the internal diameter of said outer drum, one of said drums being supported for separating movement to allow a variance in the degree of separation of the active surfaces of said members, and means for feeding the stock to be refined axially between said members under moderate pressure whereby the stock will be carried circumferentially between the grinding surfaces of said drums before reaching the discharge side of the drum.

6. In a refining engine, the combination of relatively rotatable members comprising an outer drum having an internal annular abrasive surface, and an inner drum having an external cylindrical abrasive surface of a diameter more than three fourths the internal diameter of said outer drum, one of said drums being freely supported for separating movement, and means for yieldingly pressing said movable member toward the active face of said other member.

7. In a refining engine, the combination of relatively rotatable members comprising an outer drum having an internal annular abrasive surface, an inner drum having an external cylindrical abrasive surface of a diameter more than three fourths the internal diameter of said outer drum, said inner drum being supported for vertical movement with its lowermost portion resting on the adjacent surface of the outer drum, means for rotating said drums at different peripheral speeds and

means for feeding the stock to be ground axially between said members under moderate pressure whereby the stock will be carried circumferentially between the grinding surfaces of said drums before reaching the discharge side of the drum.

8. In a refining engine, the combination of relatively rotatable members comprising an outer drum having an internal annular abrasive surface, and an inner drum having an external cylindrical abrasive surface of a diameter more than three fourths the internal diameter of said outer drum, one of said drums being freely supported for separating movement, means for yieldingly pressing said movable member toward the active face of said other member, and means for varying the degree of pressure.

In testimony whereof I affix my signature.

DANIEL L. BELLINGER.