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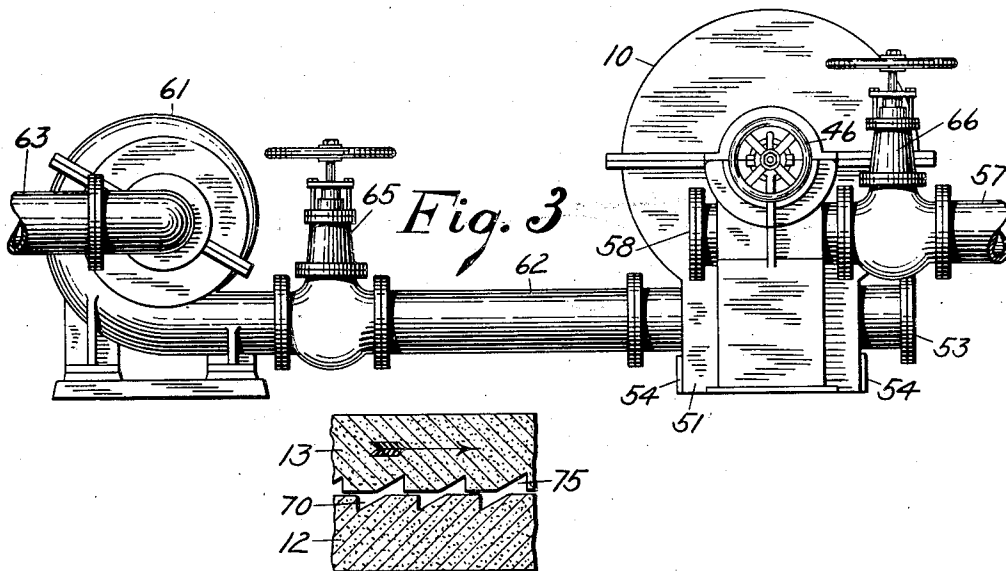
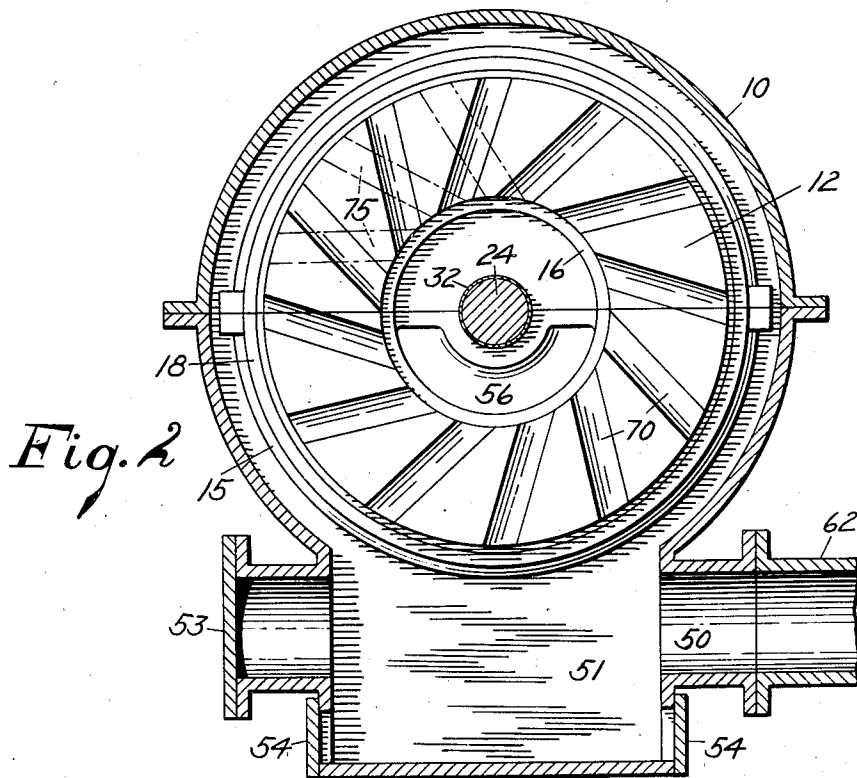
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PULP REFINING APPARATUS

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2 Sheets-Sheet 2



WITNESS
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Fig. 4

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PULP REFINING APPARATUS

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This invention relates to pulp refining apparatus as used in the manufacture of paper and more particularly to a machine of this type which utilizes cooperating abrasive stones.

It has been proposed to utilize a stationary abrasive stone and a cooperating rotatable stone for the refining of paper pulp. In these prior constructions, however, the pulp and water have been introduced near the axis of the machine and passed outwardly in the direction of centrifugal force towards the periphery thereof. With such a construction the pulp passes but once between the stones and if it has not been sufficiently refined during this single passage, it has no further opportunity.

It is accordingly one object of my invention to provide an apparatus of this general type in which the pulp may be caused to recirculate within the machine and pass again and again between the stones.

Further objects of my invention are to provide a pulp refining apparatus which will produce the results desired with a minimum expenditure of power, which will be inexpensive to manufacture, and which will require a small amount of floor space.

With these and other objects in view as will be apparent to those skilled in the art, my invention resides in the combination of parts set forth in the specification and covered by the claims appended hereto.

In accordance with my invention I provide a pulp refining apparatus having a pair of relatively rotatable abrasive stones, and I provide suitable means, such as a pump, to cause the pulp to flow inwardly from the periphery towards the axis of the stones against the centrifugal force set up by the rotation. One of the stones is preferably stationary and in order to aid in the recirculation of the pulp between the stones, I provide grooves in the operative face of the stationary stone so that the pulp may flow along these grooves towards the center of the machine and a part of it be returned outwardly again to the periphery by the centrifugal action of the rotating stone.

Referring to the drawings illustrating one

embodiment of my invention and in which like reference numerals indicate like parts:

Fig. 1 is a vertical section through the center of my apparatus;

Fig. 2 is a cross section through the machine, the section being taken on the line 2—2 of Fig. 1;

Fig. 3 is an end elevation of the apparatus on a smaller scale showing it connected to a centrifugal pump;

Fig. 4 is a partial section through the abrasive stones shown in Fig. 1, showing the shape of the grooves therein; and

Fig. 5 is a fragmentary view similar to a portion of Fig. 1 illustrating a modified form of the invention.

The embodiment of my invention illustrated in the drawings comprises a substantially cylindrical hollow casing 10 arranged with its axis horizontal. This casing is preferably divided along a horizontal plane as shown in Fig. 2 for convenience in manufacture and assembly and in order to permit easy access to the interior of the apparatus.

Within the casing I provide a pair of abrasive wheels 12 and 13 of suitable material, such as grains of crystalline alumina or silicon carbide bonded by vitrified ceramic materials or other bonds, well-known in the grinding wheel art. While both wheels may rotate I prefer that the wheel 12 shall be stationary, as shown in the drawings. This stationary stone is preferably annular in shape and may be mounted in any suitable manner in the casing. As illustrated, I may provide a supporting member 15 having an inner annular flange 16 and an outer annular flange 18. The flange 18 is turned in as shown and the wheel may be held in place upon the supporting member by pouring molten sulphur or other suitable material between the turned-in flange 18 and the wheel itself. The wheel is slightly enlarged in diameter at its supporting portion so that the sulphur will hold it more firmly in place and prevent it from being accidentally withdrawn. The supporting member 15 is attached to the casing 10 in any suitable manner. For convenience in assembly, both the supporting member 15 and the sta-

tionary wheel 12 may be divided along a horizontal plane as illustrated in Fig. 2.

The wheel 13 is preferably annular in shape and is supported upon a suitable rotatable member, such as the vertical disk 19 which may be provided with an inner flange 21 and an outer flange 22 corresponding to the flanges 16 and 18 on the supporting member 15. The wheel 13 may be held in place by the use of molten sulphur in the same way as the wheel 12.

In order to drive the disk 19 it is keyed to a substantially horizontal rotatable shaft 24 which preferably extends entirely through the casing 10 and is mounted in suitable ball bearings 26 and 27. These bearings are of a type well-known in the art, and are entirely enclosed by housings constructed to retain the grease and keep out all grit and water. The bearing 26 is preferably so constructed that it may take thrust in either direction without an appreciable amount of end play. Stuffing boxes 29 and 30 are provided to prevent the leakage of water and pulp along the shaft, and the shaft may be provided with sleeves 32 and 33 of bronze or other non-corrosive material which may be replaced in case of wear. A pulley 35 may be mounted on one end of the shaft 24 in order that it may be driven by a suitable source of power.

The bearings 26 and 27 are mounted for axial sliding movement in hollow cylindrical supports 37 and 38 so that the shaft may be moved lengthwise of itself and the clearance between the abrasive wheels thereby varied. In order to effect this adjustment conveniently a horizontal screw 40 is provided in line with the axis of the shaft and this screw 40 has an enlarged head 41 which is rotatably mounted within the housing 43 of the bearing 26. The screw 40 passes through a stationary nut 45 and may be turned by means of a hand wheel 46. A lock nut 47 is provided to hold the screw in any given adjusted position.

The casing 10 is provided with an inlet opening 50 which preferably leads into an enlarged chamber 51 in the bottom portion of the casing. There may be two of these inlet openings on opposite sides of the chamber 51 as shown in Fig. 2. By means of this construction it is possible to connect up the machine from whichever side is most convenient and the inlet not used may be closed by means of a blank flange 53. The chamber 51 serves as a receptacle for the collection of sand or other heavy foreign material which may enter the machine with the pulp and water. Any accumulation of such material in the chamber may be cleaned out by first removing either of the small cover plates 54.

An outlet passage 56 is provided from the casing near the central portion thereof

and adjacent to the shaft 24. The passage 56 may lead to a discharge pipe 57 of which there may be one on each side of the machine, as shown in Fig. 3. The discharge opening not used may be closed by a blank flange 58.

The rotating wheel 13 sets up a centrifugal force which tends to prevent the passage of material from the inlet towards the outlet and in order to transport pulp through the machine means must be provided to counteract this tendency. Various devices may be used within the scope of my invention to produce this flow, such as a suction pump connected to the discharge of the machine, or a static head of water and pulp connected to the inlet of the machine; but in my preferred embodiment which I have illustrated I have utilized a pressure pump 61, which may be of the centrifugal type, and this is connected by means of a pipe 62 to the inlet 50 of the refining apparatus. The pulp is brought to the pump 61 from any suitable source of supply by means of a pipe 63. The rate at which the pulp flows through the machine and the pressure in the interior of the machine may be controlled by means of gate valves 65 and 66 on the discharge of the pump and the discharge of the refining machine respectively.

In order to assist the flow of material inwardly between the grind stones I prefer to provide a series of grooves 70 in the stationary stone 12 extending from its outer to its inner periphery. As shown in Fig. 4, these grooves may be formed with one side substantially perpendicular to the face of the stone and with the other arranged at a suitable angle thereto. With this construction, if the rotating stone is driven in the direction of the arrow in Fig. 4, there is a constant tendency to drag the material out of the grooves. As shown in Fig. 2 these grooves 70 may each be arranged at an angle to a radial line.

If desired the rotatable stone 13 may also be provided with grooves 75 which may be similar to the grooves 70 in the stationary stone. If the two wheels are made exactly alike, when they are assembled the two sets of grooves will cross each other as shown by the broken lines in Fig. 2 and thereby produce a sort of a scissors action on the material. For clearness of illustration, only three of the grooves 75 are shown in Fig. 2, but it will be understood that these grooves are provided all the way around the wheel 13 the same as on the wheel 12.

The construction shown in Fig. 5 is the same as that in Fig. 1, except that a rotating wheel 80 is provided which has an operative surface free from grooves. For some purposes this construction may be preferable.

The operation of my invention will now be apparent from the above disclosure. The

shaft 24 and the rotatable abrasive wheel are rotated at a suitable speed by any desired source of power connected to the pulley 35. This rotation may be in either direction desired but is preferably in the direction indicated by the arrow 85 in Fig. 1. The pulp and water are forced into the machine through the inlet 50 by means of the centrifugal pump 61. Any sand or other foreign material contained in the pulp is deposited in the chamber 51 and the pulp then flows inwardly along the grooves 70 in the stationary wheel 12. If the rotating wheel is provided with the grooves 75, as shown in Fig. 1, there will be a continual flow of material outwardly along these grooves. If, as shown in Fig. 5, the rotating wheel is made without grooves, there will still be a flow of material outwardly along its surface due to centrifugal force. The general course of the material as it flows through the machine is shown by the small arrows in Figs. 1 and 5. The pulp as it flows through the various grooves is being continually dragged laterally therefrom and refined by the cooperating surfaces of the abrasive wheels. After recirculating a number of times between the wheels the refined pulp passes outwardly through the passage 56 to the discharge pipe of the machine.

By manipulating the valves 65 and 66 the rate of flow of the pulp through the machine can be controlled as desired. The pulp can be forced rapidly through with a minimum amount of refining action by the stones, or it may be retained in the casing and recirculated again and again when this is considered desirable. The speed of the rotating wheel and the distance between the stones can be varied as found best for the particular pulp at hand.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent is:

1. A pulp refining apparatus comprising an annular grinding wheel having a centrally located fluid outlet, a second grinding wheel laterally opposed to and in operative grinding relation with the other wheel, the operative side of each wheel being plane faced and one wheel having spaced grooves in its side face which extend from the outer periphery to the inner outlet for transporting pulp therethrough, means for rotating one of the wheels, and means for causing a part of the pulp to circulate inwardly through the grooves from the periphery towards the center of the wheel, while some of the material is being ground between the plane faces.

2. A pulp refining apparatus comprising a casing having an inlet and a centrally located outlet, two laterally opposed abrasive stones within the casing, one stone being annular in shape and having its central space

connected with said outlet, the stones having plane faced grinding portions juxtaposed for grinding the pulp, and one having grooves in its operative side extending from the periphery to the inner outlet space for the circulation of the fluid material, means for relatively rotating the stones, and means for causing the material to move from the inlet to the outlet of the casing and part of the pulp to pass freely inwardly through the grooves while part is being ground between the stones and moving outwardly, so that recirculation and repeated grinding of the material is effected.

3. A pulp refining apparatus comprising a casing having an inlet and an outlet in its walls and a large free space adjacent to the inlet for the reception of foreign material, means whereby said material may be readily removed from the casing, two laterally opposed grinding wheels within the casing, one of which is annular and has an inner space connected with said outlet, each wheel being plane faced and one having spaced grooves in its side which extend from the outer periphery of the wheel to said inner space and freely transport fluid there-through, means for rotating one of the wheels and means to cause the pulp to move through the casing from the inlet towards the outlet and to circulate through said grooves from the periphery towards the inner space while some of the material is being ground between the plane faces of the wheels.

Signed at Worcester, Massachusetts, this 28th day of March, 1928.

FRED H. DANIELS.