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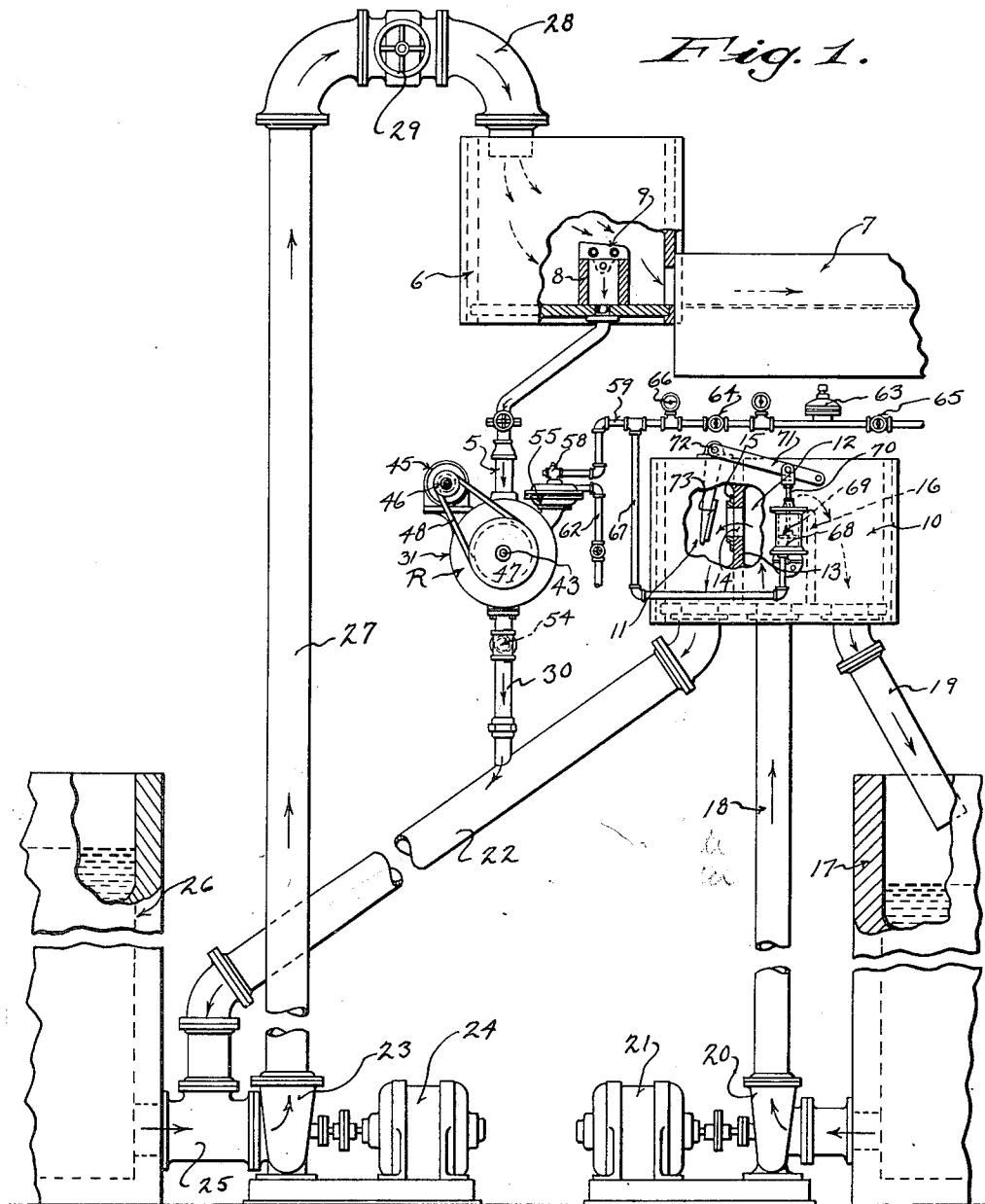
H. G. CRAM

2,392,026

CONSISTENCY REGULATOR

Filed Oct. 14, 1944

3 Sheets-Sheet 1



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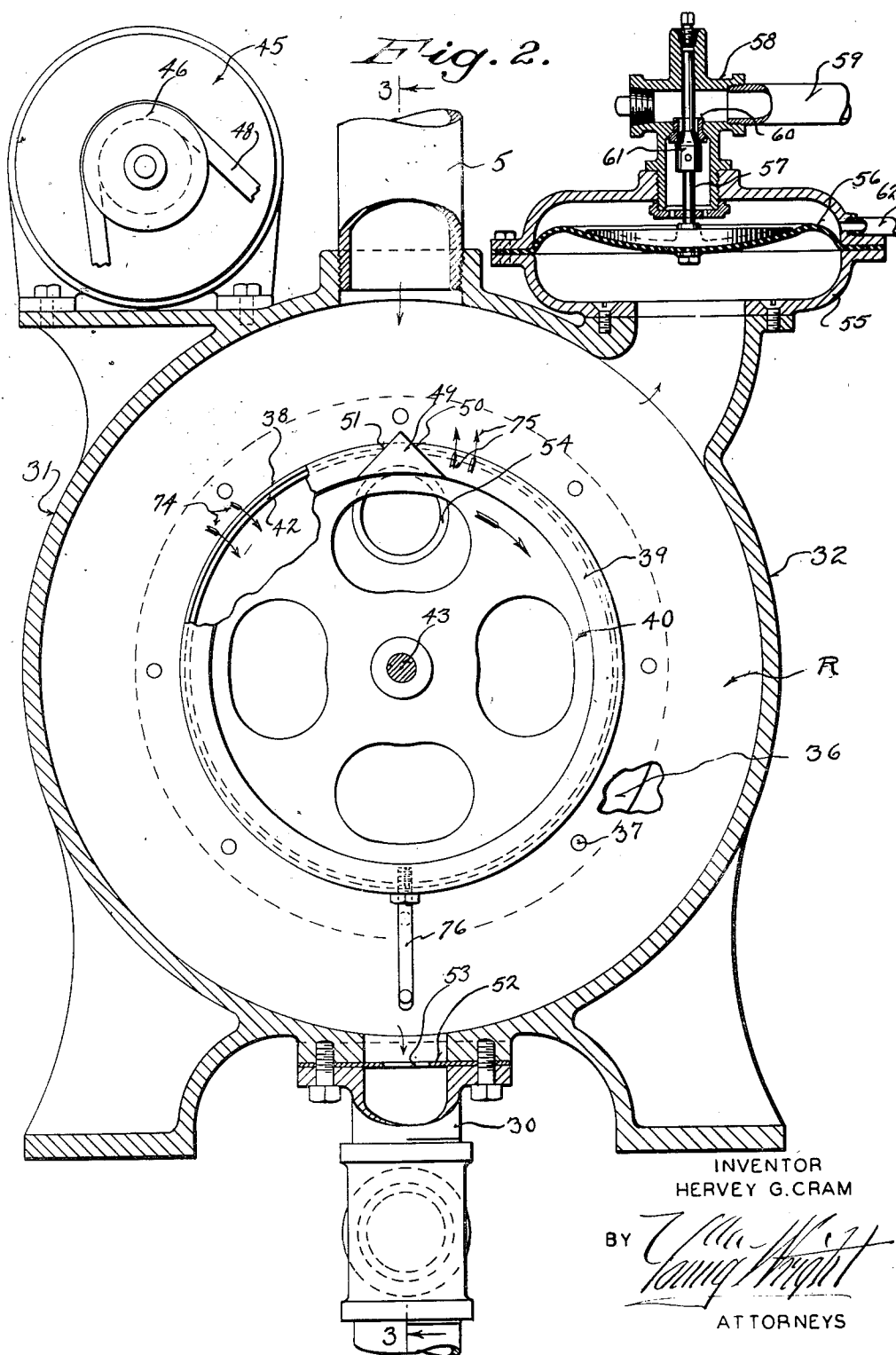
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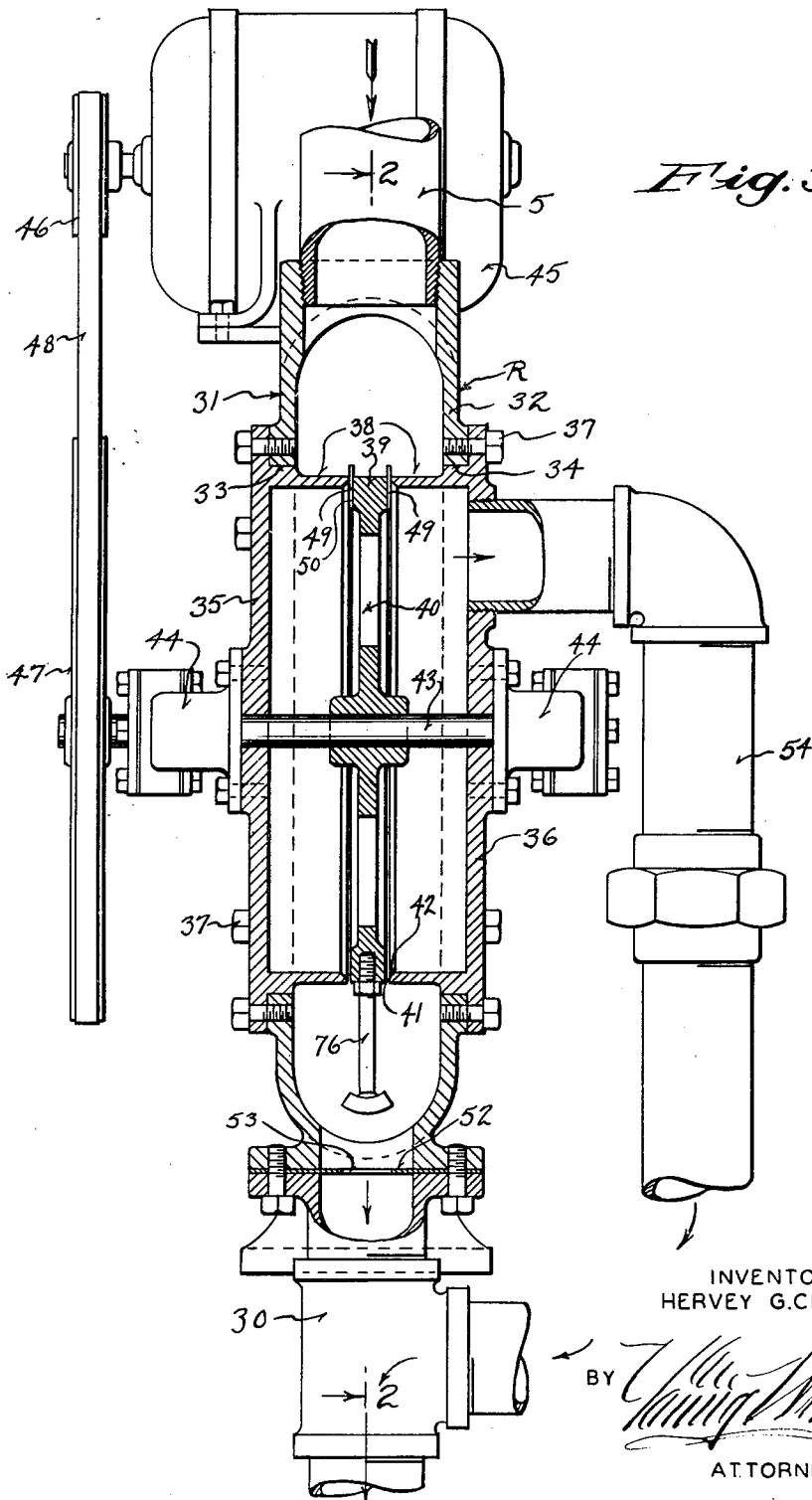
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**2,392,026**

CONSISTENCY REGULATOR

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## UNITED STATES PATENT OFFICE

2,392,026

## CONSISTENCY REGULATOR

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Application October 14, 1944, Serial No. 558,770

5 Claims. (Cl. 137—78)

This invention appertains to means for regulating the consistency of pulp or stock for use in the making of paper or similar fibrous products, and more particularly to an apparatus for accurately controlling low consistency pulp or paper stock in liquid suspension and is a further step forward in this art over my pending application Serial No. 528,670, filed March 30, 1944.

My present invention relates to the provision of a novel regulator arranged in a sample line leading from the screen head box so that any variation in the desired consistency of pulp or stock will be immediately reflected on the control gate for the unregulated stock to permit more or less stock as the case may be to be delivered to the white water pump.

One of the primary objects of my invention is to improve the construction of the regulator itself, whereby the desired accurate control of the consistency of the stock will be had in a quick and efficient manner.

Another salient object of my invention is to provide a regulator embodying a casing for receiving the sample stock from the head box having inwardly directed annular flanges between which rotates, at a desired constant rate of speed, the rim of a driven wheel, the rim and the facing edges of the annular flanges defining restricted peripheral slots for the passage of the filtrate, the flow of the filtrate depending on the consistency of the stock, whereby any variation in said consistency will be immediately reflected on a control diaphragm for actuating (through suitable instrumentalities) the control gate of the unregulated stock.

A further important object of my invention is to provide novel runners or blades on the rim of the wheel for constant movement in said peripheral slots for preventing the clogging of said slots by slivers, knots, etc.

A further object of my invention is the provision of a beater or agitator carried by the rim of the wheel for maintaining a perfect mixture of the pulp on the exterior of the slots or slits and to prevent any chance of interference with the rate of flow through the discharge orifice in the casing or discharge pipe.

A still further object of my invention is to provide a novel regulator of the above character, which will be durable and efficient in use, one that will be simple and easy to manufacture and to maintain in working condition and one which can be placed upon the market at a reasonable cost.

With these and other objects in view the invention consists in the novel construction, ar-

rangement and formation of parts, as will be hereinafter more specifically described, claimed and illustrated in the accompanying drawings, in which drawings:

5 Figure 1 is a diagrammatical view partly in elevation and partly in section showing my novel regulator in use.

Figure 2 is a vertical sectional view through the regulator taken on the line 2—2 of Figure 3 looking in the direction of the arrows.

10 Figure 3 is a sectional view through the regulator taken at right angles to Figure 3 and substantially on the line 3—3 of Figure 2.

Referring to the drawings in detail wherein 15 similar reference characters designate corresponding parts throughout the several views, the letter "R" generally indicates my novel regulator located in a sample line 5 leading from the screen head box 6. The head box 6 supplies consistency regulated pulp to the screens 7 of a paper or other machine.

20 In the present illustration, the sample line 5 leads from the bottom of the head box 6 and the inlet for the sample line is enclosed in an ended housing 8. Knot screen 9 covers the open end of the housing so that knots and the like will be excluded from the sample line.

Regulator box 10 is provided for the pulp and this box is divided into compartments 11 and 12 25 by a transverse partition 13. The partition is provided with an opening 14 to permit the flow of pulp or stock from the compartment 12 to the compartment 11. A valve or gate seat 15 can be fitted around the opening 14. Arranged within 30 the compartment 12 is a transversely extending dam 16 and unregulated pulp is delivered from the unregulated stock chest 17 to the compartment 12, by means of a supply pipe 18. Pulp or stock overflowing the dam 16 is returned to the 35 stock chest 17, by means of a return pipe 19.

A pump 20 driven by an electric motor 21 is employed for delivering the pulp from the chest 17 to the pipe 18.

40 The dam 16 insures the proper constant flow of the pulp or stock into the compartment 11 and to a feed pipe 22 which leads to the inlet side of the white water pump 23. An electric motor 24 can be utilized for operating the pump. Also communicating with the inlet side of the pump 23 45 through a T pipe 25 is the white water chest 26. The pulp feed pipe 22 communicates with the T 25 between the white water chest 26 and the pump 23 and consequently, the pulp tends to flow directly into the pump and the pulp and the 50 white water will be mixed by the pump and de-

livered to an upright delivery pipe 27. The upper end of the upright pipe 27 is provided with a gooseneck 28 which extends into the screen box 6. A manually operated valve 29 is arranged in the gooseneck and by opening and closing the valve, the rate of volume flow of consistency regulated stock to the screen head box 6 can be controlled.

Communicating with the lower end of the regulator R, at a point diametrically opposite the sample pipe 5, is a sample discharge line pipe 30. This pipe leads into and communicates with the pipe 22, as is clearly shown in Figure 1 of the drawings.

My novel regulator R includes a casing 31 embodying a substantially annular shell 32. The opposite sides of the shell 32 are provided with openings 33 and 34, respectively, and these openings are closed by front and rear side plates 35 and 36. Machine screws 37 can be employed for holding the plates tight against the shell. Each of the plates 35 and 36 has an inwardly extending annular flange 38 and the flanges define in conjunction with one another a peripheral or annular partition wall within the casing. Arranged snugly between the flanges 38 is the rim 39 of a constantly driven runner or wheel 40. The rim of the wheel 40 defines in conjunction with the facing edges of the flanges 38 restricted slits 41, the purpose of which will be later set forth. If preferred, the inner corners of the facing edges of the flanges 38 can be bevelled as at 42. The hub of the wheel is keyed or otherwise fastened to the wheel or runner shaft 43 and this shaft is mounted for free rotation in bearings 44 carried by the plates 35 and 36. The shaft 43 is driven at the desired constant rate of speed from an electric motor 45. This motor can be mounted directly on the casing 31, if so desired. Any suitable means can be employed for driving the shaft 43 from the motor, and as illustrated, the armature shaft of the motor and the runner shaft 43 are provided respectively with the desired sized pulley wheels 46 and 47. A pulley belt 48 operatively connects the wheels.

Formed on or secured to the opposite sides of the rim 39 are narrow runner plates 49 and these plates are adapted to travel through the slits 41, for a purpose which will also be more fully set forth. It is to be noted that the runner plates are of a triangular shape in side elevation and are provided respectively with a leading inclined edge 50 and a trailing inclined edge 51.

The discharge sample line pipe 30 at its point of connection with the lower end of the casing 31 is provided with a plate 52 having a discharge orifice 53 of a pre-determined size, and the purpose of this fixed orifice will also more fully appear.

Communicating with the interior of the casing 31 through the plate 36 is a filtrate discharge pipe 54 and this pipe can communicate with the discharge line pipe 30 as is shown in Figure 3. By referring to Figures 2 and 3 it can be seen that this filtrate discharge pipe 54 communicates with the casing inward of the flanges 38.

Communicating with the casing adjacent to the upper end thereof and at one side of the sample line pipe 5 is the diaphragm chamber or housing 55 and this chamber carries intermediate its ends a diaphragm 56. Connected with the diaphragm for movement therewith is the connecting rod or valve stem 57. The upper end of the diaphragm chamber or housing 55 carries a coupling fitting 58 and communicating with one arm of the fitting is a water pressure pipe 59. The

fitting below the pipe 59 carries a valve seat 60 and the valve 61 carried by the valve stem 57 is adapted to be moved on and off the seat by the diaphragm and obviously when the valve is unseated, pressure will be released in the pipe 59. An exhaust tube 62 can communicate with the diaphragm chamber above the diaphragm 56.

The pressure pipe 59 leads from any suitable source of water supply and is provided in its length with a pressure regulator 63, which maintains the water pressure, from the source of supply in the pipe 59 at a constant pre-determined degree (say 15 lb.). Hand valves 64 and 65 can also be arranged in the pressure line pipe and suitable gages 66 can also be employed to determine the pressure in said line. Thus it can be seen that when the valve body 61 is moved to a closed position on its seat by the upward movement of the diaphragm there will be 15 lb. water pressure in said line. When the valve body 61 moves away from its seat and water flows through the pipe 59 into the diaphragm chamber, pressure will be relieved or decreased in said line.

Leading off from the pressure line pipe 59, between the diaphragm chamber 55 and the pressure regulator 63, is a water conduit pipe 67 and this pipe leads to the lower end of a regulator cylinder 68. This cylinder can be supported by the regulator box 10. Mounted in the regulator cylinder 68 is a piston 69 and connected with this piston is the outwardly extending piston rod 70. The upper end of the piston rod is pivotally connected to a crank arm 71, which is keyed or otherwise secured to a rock shaft 72. As is clearly shown in Figure 1, the rock shaft is mounted for oscillating movement on the regulator box 10. Also fixed to the rock shaft is the control gate 73 for the unregulated pulp and this gate opens and closes the opening 14 and controls the amount of pulp flowing through the opening. Normally, the flow of pulp through the opening tends to move the gate 73 to an open position and as pressure increases in the cylinder 68 below the piston, the piston will be moved upwardly to move the gate toward the opening 14.

In operation of my regulator, a continuous sample of pulp or paper stock is delivered through the stand pipe 5 against the fixed discharge orifice 53 in the casing 31.

The rate of discharge of filtrate through the peripheral slots 41 is determined by the consistency of the stock in the passing sample.

With a constant rate of volume flow to the regulator, through stand pipe 5 and a practically constant rate of volume discharge through discharge orifice 53, the head in the stand pipe 5 will be determined, and is inverse ratio to the rate of flow by-passed through the peripheral slots 41. The hydrostatic head of stock in the stand pipe 5 reflected on the diaphragm 56 determines the vertical position of the valve 61.

As stated, the opening of the valve 61, by a decreasing head will release pressure in the water pressure line 59. This in turn will permit the lowering of the piston and the opening of the gate 73. Obviously the decrease of the head of stock in the regulator indicates that the consistency of the stock is thin in that there is a freer flow of stock through the peripheral slots 41. If the stock thickens, the head of stock in the regulator will rise and operate the diaphragm 56 and move the valve 61 on its seat. This will maintain the normal pressure of the water in the line 59 and this pressure will operate the piston to close the gate. Obviously when the gate is

open unregulated stock will flow at a greater rate to be mixed with the white water through the medium of the pump 23 to increase the consistency of the stock.

Attention is again directed to the cleaner plates 49 and it is obvious that the peripheral slots or slits 41 must be continuously clear of plugging or filling by materials such as slivers, shives, knots, etc., which would tend to vary the active area of the slots and invalidate true regulation.

The runner or rim 39 of the wheel 40 is rotated at such a speed as to create a centrifugal force on a liquid (traveling at an equivalent speed as the periphery of the runner or rim 39) somewhat greater than that established by the hydrostatic head on the exterior of the peripheral slots or slits 41.

Owing to slippage, the liquid adjacent the slots is not maintained at the peripheral speed of the runner or rim except in the immediate vicinity of the leading edges 50 of the cleaner plates 49, with the result that the head pressure on the exterior of the slots is greater than the opposing internal pressure created by centrifugal force.

In the immediate vicinity of the leading edges of the cleaner plates 49 the liquid is forced to rotate at the speed of the periphery of the runner or rim 39 with the result that the pressure created by centrifugal force from interior to exterior of the slots is greater than the external pressure established by the hydrostatic head.

Therefore, the flow indicated by the arrows 74 is inward, while the flow in the immediate vicinity of the leading edges of the cleaner plates 49 is outward as indicated by the arrows marked by the numeral 75.

Also: the outward flow in proximity to the leading edges of the cleaner plates 49 is accelerated by the shape of the leading edges 50 of the cleaner plates 49.

At the required constant speed of rotation of the runner or rim 39, it is apparent that only a very small proportion of the matter to be rejected from the slots or its vicinity actually reaches contact with the cleaner plates 49, but rather is washed out by the action of the liquid just in advance of the leading edges of the cleaner plates.

It is to be noted that the pipe 54 carries the liquid from the interior of the casing back to the discharge sample line 30 below the fixed orifice 53.

By again referring to Figures 2 and 3 it will be noted that the runner or rim 39 of the wheel carries a radially extending T-shaped agitator arm 76. Consequently, this arm rotates in the pulp or stock which is beyond the peripheral slots 41. The agitator arm 76 is preferably located at a point diametrically opposite the cleaner plates 49.

The purpose of the agitator arm 76 is to maintain a perfect mixture of the stock or pulp on the exterior of the slots 41 and also to avoid any chance of interference with the rate of flow through the fixed discharge orifice 53.

Changes in details may be made without departing from the spirit or the scope of my invention, but what I claim as new is:

1. In an apparatus for regulating the consistency of fibrous stock in liquid suspension, a casing having an inner chamber and an outer chamber, said chambers having communication with each other by means of an annular slot, means for maintaining a head of stock in the casing which is proportional to its consistency including means for supplying a constant quan-

tity of stock to the outer chamber a discharge for the outer chamber having a fixed orifice and a runner operated at a constant rate of speed in said slot defining in conjunction with the walls of the slot restricted slits, and a discharge for the inner chamber.

2. In an apparatus for regulating the consistency of fibrous stock in liquid suspension, a casing, means for delivering a continuous sample of the stock to the casing at a constant rate, said casing having an inner chamber and an outer chamber, a discharge for the stock communicating with the outer chamber, said discharge having an orifice of a fixed size, the chambers having communication with each other by means of an annular slot, a wheel rotatably mounted in the inner chamber having a runner rim in said slot defining in conjunction with the walls thereof restricted annular slits for the passage of filtrate, means for driving the wheel at a constant rate of speed, and a discharge for the inner chamber whereby the head of stock in the casing constitutes an indication of consistency.

3. In an apparatus for regulating the consistency of fibrous stock in liquid suspension, a casing having an inner chamber and an outer chamber, said chambers having communication with each other by means of an annular slot, means for maintaining a head of stock in the casing which is proportional to its consistency including means for supplying a constant quantity of stock to the outer chamber a discharge for the outer chamber having a fixed orifice and a runner operated at a constant rate of speed in said slot defining in conjunction with the walls of the slot restricted slits, and a discharge for the inner chamber, and cleaner plates fixed to said runner traveling in said slits.

4. In an apparatus for regulating the consistency of fibrous stock in liquid suspension, a casing having an inner chamber and an outer chamber, said chambers having communication with each other by means of an annular slot, means for maintaining a head of stock in the casing which is proportional to its consistency including means for supplying a constant quantity of stock to the outer chamber a discharge for the outer chamber having a fixed orifice and a runner operated at a constant rate of speed in said slot defining in conjunction with the walls of the slot restricted slits, and a discharge for the inner chamber, and cleaner plates fixed to said runner traveling in said slits, each cleaner plate having an inclined leading edge and an inclined trailing edge, said edges inclining inwardly toward the center axis of its cleaning plate.

5. In an apparatus for regulating the consistency of fibrous stock in liquid suspension, a casing having an inner chamber and an outer chamber, said chambers having communication with each other by means of an annular slot, means for maintaining a head of stock in the casing which is proportional to its consistency including means for supplying a constant quantity of stock to the outer chamber a discharge for the outer chamber having a fixed orifice and a runner operated at a constant rate of speed in said slot defining in conjunction with the walls of the slot restricted slits, and a discharge for the inner chamber, and cleaner plates fixed to said runner traveling in said slits, and an agitator arm carried by the periphery of the runner movable in the outer chamber and past said discharge orifice.

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