Sept. 22, 1936. J. E. BOND 2,055,142

PAPER MAKING MACHINERY

Filed Nov. 9, 1933 3 Sheets-Sheet 1

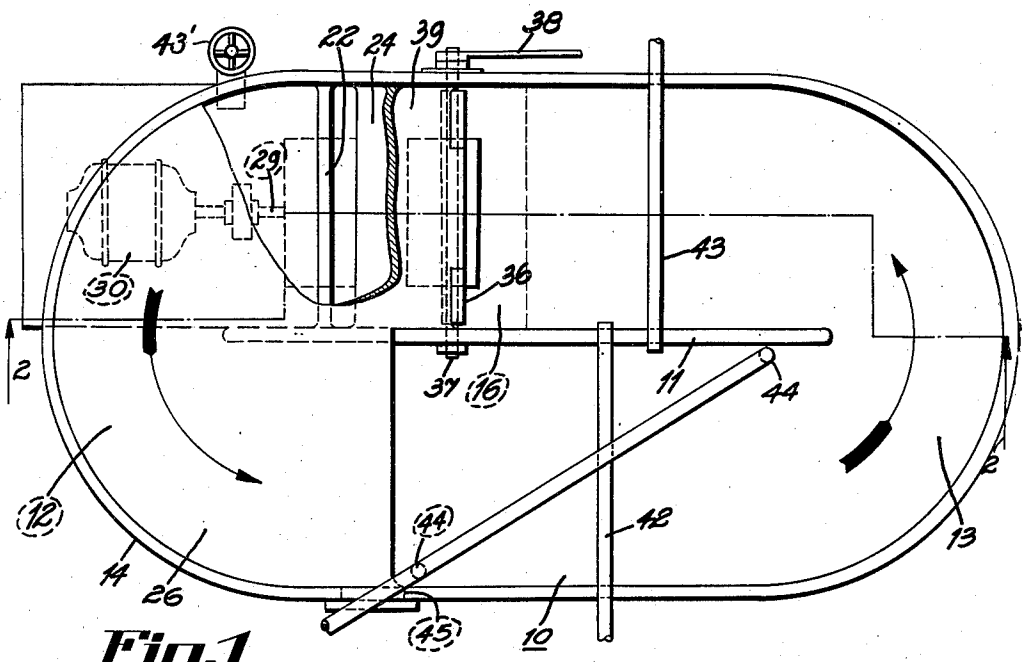

Fig. 1

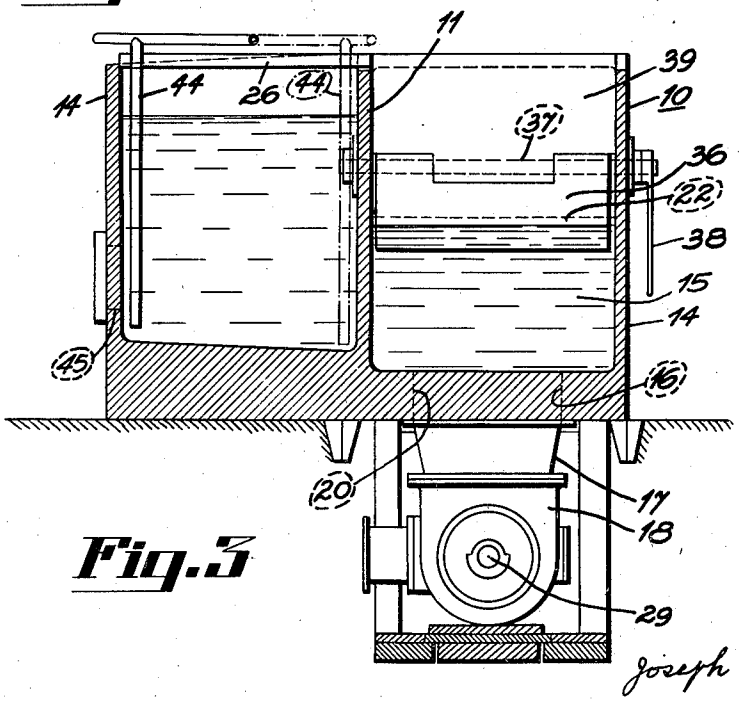

Fig. 3

Inventor

Joseph E. Bond

By Marechal & Nox

Attorney

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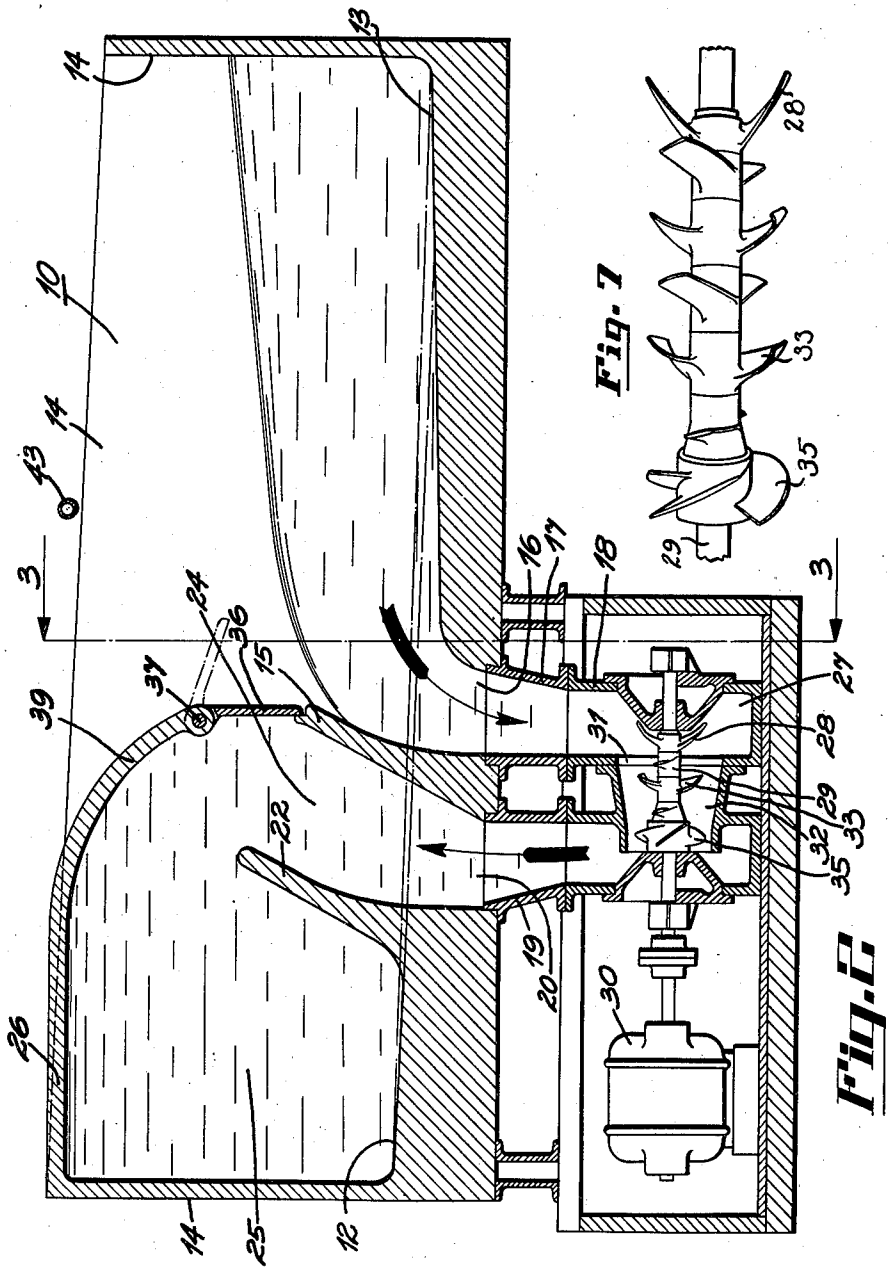

Fig. C

Fig. 7

Inventor

Joseph E. Bond

By Maréchal & Noz

Attorney

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Fig. 4

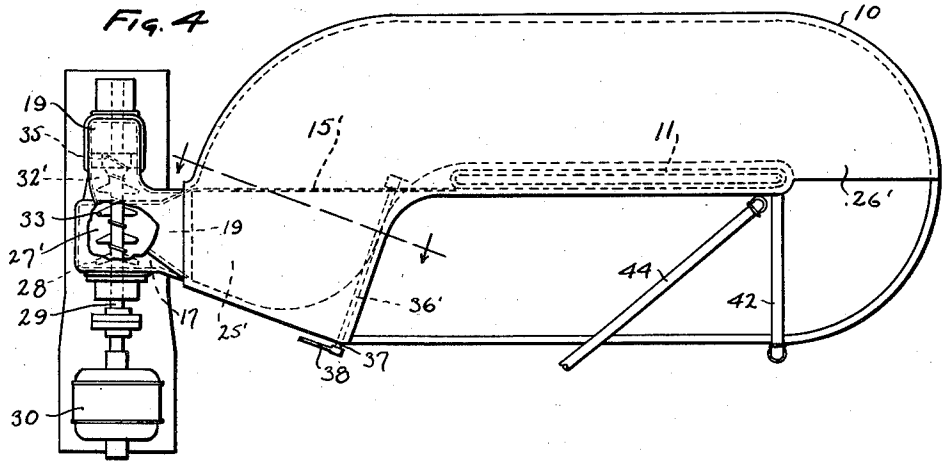


Fig. 5

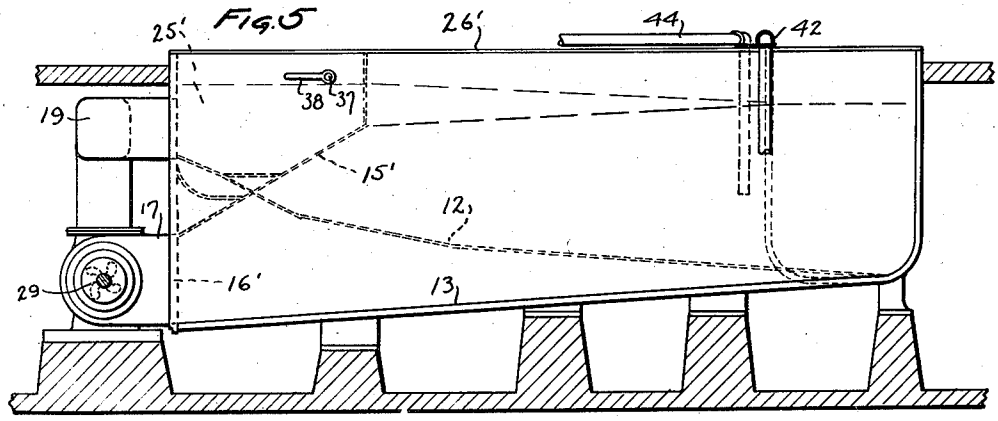
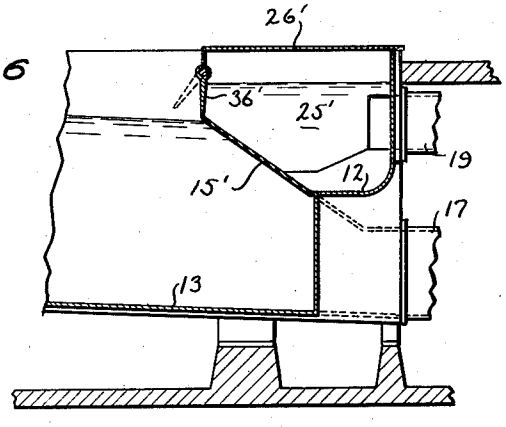


Fig. 6



Inventor

Joseph E. Bond

By Maréchal & Nox

Attorney

Patented Sept. 22, 1936

2,055,142

UNITED STATES PATENT OFFICE

2,055,142

PAPER MAKING MACHINERY

Joseph E. Bond, Middletown, Ohio

Application November 9, 1933, Serial No. 697,311

11 Claims. (Cl. 92—20)

This invention relates to the art of making paper and the like and more particularly to apparatus for disintegrating and breaking up paper pulp and the like.

One of the principal objects of the invention is to provide an efficient and effective method and means of pulping stock at very high consistencies heretofore not capable of attainment in operation.

Another object of the invention is the provision of a method of pulping or defibering paper pulp and the like by efficient apparatus of small power requirements adapted to process the pulp stock in a very dense or thick condition.

Still another object of the invention resides in the method of breaking up stock bundles in which the pulp flows at very high consistency through a passage in which it is shredded by the action of blades rotating at high speed and so arranged as to hold back a bundle of stock while playing upon it.

A further object of the invention is the provision of a method of breaking up bundles of stock in which the bundles are shredded or pulped by rotating blades, some of the processed stock being directed to fall upon the advancing ends of stock laps to turn or point the stock laps downwardly and facilitate their passage to the pulping or processing blades.

A further object of the invention is the provision of apparatus for breaking up or processing pulp laps adapted to carry out the method herein referred to.

Other objects and advantages of the invention will be apparent from the following description, the appended claims and the accompanying drawings, in which,—

Fig. 1 is a plan view of apparatus embodying and for practicing the present invention;

Fig. 2 is a vertical sectional view taken on the line 2—2 of Fig. 1;

Fig. 3 is a transverse sectional view taken on the line 3—3 of Fig. 2;

Fig. 4 is a plan view, with certain parts shown in dotted lines, of a modified form of apparatus embodying and for practicing the invention;

Fig. 5 is a side elevation of the apparatus shown in Fig. 4;

Fig. 6 is a fragmentary sectional view along the line 6—6 of Fig. 4; and

Fig. 7 is a detail view showing the shaft bearing the beater arms and pump impellers.

It is customary in the construction of beaters or breakers adapted to break up paper pulp and the like to rotate a beater roll within a vat or tank partly filled with water or thin pulp stock, the breaker bars of the roll co-acting with stationary bars to defiber the pulp supplied to the tank.

In accordance with the present invention, however, a shredding and defibering action is obtained by means of rotatable blades which revolve at high speed while acting upon stock or semi-dry pulp laps and which are so constructed that in operation they hold back a bundle or piece of pulp or the like as the body of pulp is forced past these blades, the blades thus playing upon it and shredding, whirling and breaking the bundles or laps of stock into pieces which are then forced along with the stock to a circulating vat or tank.

Referring more particularly to the drawings by reference numerals, 10 designates generally a vat or tank, having a midfeather 11 which is shown as extending vertically although it may be otherwise arranged. The vat is preferably of oval shape to provide for substantially unobstructed circulation of the stock around the midfeather and along the sides of the tank. The bottom of the tank is preferably sloped as shown in Fig. 2, one portion of the bottom or floor being substantially higher as indicated at 12 than the floor portion 13 so that the stock tends to flow by gravity from the floor portion 12 along to the portion 13 in a continuous manner.

Extending between the midfeather 11 and the wall 14 of the vat is a partition or dam 15, and at one side of the partition the floor of the vat has a large opening 16, preferably rectangular in shape and of sufficient size to admit a large pulp sheet, into which the pulp stock passes after completing a circuit of the vat. Communicating with the opening 16, as herein shown, is a pipe 17 which preferably although not necessarily extends to the exterior of the tank proper, projecting downwardly and being connected at its lower end to a casing 18 in which is arranged the stock processing or shredding apparatus including a suitable pump. The pump is driven by a motor of suitably large power output to force circulation or movement of the very high consistency stock to be acted on. This pump, in this invention, is effective to force the stock along suitably, at consistencies of 10% and even up to 14%. This can be done, despite long belief and practice to the contrary, means being provided whereby such thick stock actually feeds into the inlet of the pump and into the path of impellers driven with sufficient power to force the stock forward. Despite universal belief that stock of

such high consistency cannot be pumped and circulated, based on a long existing failure to succeed in handling stock anywhere approaching this high consistency I have found that it may be done in the manner of my invention. The pump forces the stock moving in through the inlet pipe 17 along through a pipe 19 extending from the casing up to an opening 20 provided in the vat floor on the opposite side of the partition 15. A second partition or wall 22 extends between the midfeather 11 and the vat wall 14, generally parallel to the partition 15 but spaced from it and preferably somewhat higher than partition 15. Both partitions preferably incline somewhat as shown in Fig. 2. The pulp stock which is pumped up through the passage 24 between the two partitions, overflows the wall 22 and moves in the direction of the arrows shown in the drawings, the pumping force applied to the stock being sufficient to maintain the pulp stock level in the end 25 of the vat well above the top of the wall 22 and preferably completely filling the vat end. A cover plate 26 is provided at this end of the vat to confine the stock so that the pressure applied to the stock by reason of the pumping action is extended and causes a continuous circulation of the stock around the midfeather and through the suction opening 16 in the tank. This gives, in effect, a high head forcing the stock into the inlet opening leading to the pump.

The pulp shredding or disintegrating means, as herein shown, comprises a plurality of blades, designated by the numeral 28 constructed to hold back bundles of stock being forced forward by the pumping action while playing upon them in the space 27 provided in the casing 18. The blades 28 are secured on a shaft 29 which is connected to a reversible electric motor 30 preferably arranged below the floor of the vat or in any other desired location. The passage in which the shaft 29, and the blades carried thereby, is mounted is preferably at such level that the stock tends to flow into the inlet thereof by gravity to facilitate and supplement the flow thereof in operation. The motor 30 rotates the blades 28 at high speed as compared with the usual speed of the conventional breaker roll. Very satisfactory and successful results in actual operation, using stuff of 12% consistency, have been attained where the peripheral speed of the blades 28 of about 19 inches in diameter is approximately a mile per minute. The breaker blades 28 are arranged adjacent an opening 31 leading to a passage 32 in which are additional blades 33 provided on the same shaft 29 and revolved at high speed by means of the motor 30. The end blades 28 are axially inclined in a rearward direction so as to prevent the laps from clogging or filling up adjacent the end of the shaft and the faces of the blades 28 and 33 are suitably inclined to the planes of rotation and to a certain extent have a propelling action on the pulp stock towards the left as shown in Fig. 2. There is a considerable distance between the ends of the blades 28 and the walls of the chamber 18 in which the blades are arranged so that there is little tendency for the comparatively large bundles supplied through the pipe 17 to clog. These bundles are held back by the blades which at the same time play upon the bundle and break it up by whirling and whipping it until it is so shredded and torn apart as to be in condition to go to the following blades. The end wall of the passage or compartment 27 is extended toward the left, as shown, in frusto-conical form, to divert or direct the incoming bundles or pieces of pulp or other fibrous material into the path of the blades 28 and to thus prevent bundles or pieces of stock from building up or collecting to dam or clog the inlet and thus interfere with operation. At the very high consistencies used it is important that every impediment to the movement of the stock be eliminated and that the apparatus be constructed to facilitate this movement.

The blades 33 are rather more confined in their action on the stock, the pipe 32 being preferably of circular cross-section and spaced some distance from the ends of the blades 33 although the adjacent walls of the chamber in which the blades 33 operate are considerably closer to the blade ends than is the case with respect to the blades 28. The space provided outwardly of the ends of the blades 33 gives room, however, for considerable whirling and whipping action as the pieces supplied to the blade 33 are smaller than those supplied to the blades 28. The blades 33 also tend to hold back the smaller bundles of stock passed by the blades 28, while playing upon them. Of course, the inclination of the blades 28 and 33 causes a forward movement of the stock, despite the holding back of the stock referred to. The very rapid rotation of these blades and the high consistency of the stock causes a high resistance to be set up so that the action of the blades is to hold back and also to quite severely tear and shred the stock bundles and separate them into the separate fibers. But when the stock is thus torn and shredded, the bundles thus acted on and moved within the circle of travel of these blades is urged forward thus supplementing the feeding of the stock into the inlet of the circulating impact type pump impeller 35 provided in the end of the passage 32. The blades 28 and 33 hold back the bundles of stock and play upon it, shredding, whirling, and breaking up the stock bundles and effectively hydrating the stock in a remarkably short time. As shown a plurality of successive blades are preferably used, the shredded stock being moved along through the path of the additional blades and to the impact impeller, and returned to the main supply of stock in the circulating vat or tank. The impeller 35 comprises a number of blades arranged in helical form, the edge adjacent the blades 33 being sloping so that the pieces of stock tend to be thrown outwardly. The space between the suction casing and the impeller blades 35 is rather small providing a reasonably close fit for the impeller blades of the pump, which being fixed on the shaft 29 likewise operate at high speed. As shown in the drawings the blades of the pump 35 are of steeper inclination and are also extended for a greater angular distance than the blades 28 and 33, thus serving much more effectively and efficiently as a pump unit. By the time the pulp stock has been passed by the several blades 28 and 33 it is fairly well defibered and torn apart, but it is further shredded by the impeller blades. After passing through the impact pump 35, the small pieces of pulp stock flow up through the passage 24. Several sets of blades may be used, for example six sets may be used as shown in Fig. 7, for an effective shredding and tearing of the stock bundles.

The amount of overflow over the partition 15 is variable so that some of the stock passing up through the channel or passage 24 can be bypassed, or returned directly to the suction opening 16 of

the vat. As shown, there is an adjustable valve board, or gate, 36 provided on a supporting shaft 37 which is suitably journaled in the vat wall 14 and in the midfeather 11, the end of the shaft 37 projecting through the vat wall and being provided with an operating lever 38 adapted for convenient manual operation. The board or gate 36 cooperates with the upper end of the partition 15 when the gate is in a vertical position as shown in full lines in Fig. 2 and in this position it closes the space between the upper end of the partition 15 and the down-turned end 39 of the top cover 26 in order that all of the stock flowing up through the passage 24 must flow over the dam or wall 22 and be circulated in the vat around the midfeather. However, when the board 36 is swung to the dotted line position shown, by means of the lever 38, some of the stock flowing up through the passage 24 is returned or by-passed over the partition 15, the return flow being directed downwardly by the inclined board 36 so that it flows onto the stock laps in the vat and which is passing or ready to pass into the suction pipe to the breakers. The opening 16 through which the stock flows from the vat is preferably quite large, being shown in Fig. 1 as commensurate in length with the distance between the midfeather and the vat wall 14. The bundles or stock laps are supplied to the vat, preferably on the side of the midfeather opposite the suction or inlet opening 16 and in approaching the opening 16 tend to float upon the surface of the stock, advancing bundles being overlapped by succeeding bundles. When bundles of stock are used they actually assist in the operation. As the bundles approach the opening 16 they are carried through the opening, which is large enough to take the stock bundles downwardly at a rate considerably in excess of the rate of motion of the stock in circulating around the tank. As shown the stock will circulate in the tank at about one foot per second, and the opening 16 can pass the same stock at the rate of four or five feet per second. With the flow in the chest toward the suction opening slower than the vertical downward descent into the suction opening the pulp bundles will tend to flow endwise into the down passage, but the flow of stock over the gate or board 36 very materially assists in pointing or submerging the advancing ends of the laps of stock, the fluid falling over the partition 15 onto the advancing ends of the laps forcing the front edge of the laps down. Since the laps are overlapped by succeeding laps they are held against tilting to a certain extent and submerged quite rapidly, the downward velocity being such as to carry the first lap away from the succeeding lap so that the first can move freely to the blades 28. While reference is made above to bundles or laps of pulp, other forms of fibrous material—such for example as printed papers, broke, etc.,—are to be included within the terms used herein.

When the pulp is supplied to the vat at the start of a pulping operation only sufficient water is provided in the vat to carry or float the stock laps. Thus the stock laps are supplied to the blades 28 in a semi-dry condition, the consistency being about 10% to 14% and this high consistency is maintained as additional pulp is supplied to the vat by governing the addition of water as the amount of material in the vat increases.

Figs. 4, 5 and 6 illustrate a somewhat modified form of apparatus. In this form the passage connecting the tank on opposite sides of the midfeather is not located underneath a part of the tank, as shown in Fig. 2, for example, but is at one end of the tank. In this form also, however, the passages 27' and 32' are located at a lower level so that the stock flows uninterruptedly, and under the gravity and pressure head thereinto through the opening 16'. The shape and proportions of the passages and their walls, and the size and relative location of the breaker blades and pump member are the same as described above. The partition 15' is formed as an extension of the midfeather, and is provided with a bypass opening and a valve 36' therein through which the bypassed stock falls on to the stock flowing beneath the partition 15' to the connecting passage. As shown in Figs. 4–6 the partly shredded stock from the pump is discharged into the space 25', the floor of the tank or vat being inclined downwardly from that point to the opening 16'. Also the hood or cover 26' extends over more than half of the tank, so that by feeding the stock into the space 26' under sufficient head or pressure its flow through the vat is more definitely forced and a greater head is available for forcing it into the opening 16' and so into the passage 27'. And when once in the passage 27' its flow past the defibering blades to feed into the blades of the pump is insured even with stock consistencies as high as 14%,—the pumping and handling of which has heretofore been unheard of and considered to be impossible; this being a consistency from two to three times that heretofore handled in beaters and by pumps in paper mills.

In both forms of the apparatus the partitions 15—15' provide large passages which are unobstructed and large enough to completely receive the column of very thick stock moving along through the tank, and the passages 27—27' are so shaped that stock entering thereinto will necessarily be acted on by the shredding blades. And so a forced flow of the thick stock to effect a definite and positive feeding thereof into the pump is produced. The pump is of sufficient power to force the stock through the discharge and under pressure back into the tank, so that circulation is enforced even of this very high consistency stock.

In starting operation, sufficient water is placed in the vat to start the process and provide for circulation of the stock. Until the latter will move freely a small quantity of the water is bypassed over the partition 15 to effectively submerge the laps or bundles of stock as they move to the suction opening 16. The bundles of stock may be of any size as may be conveniently handled. During the time the pulp or fibrous material is supplied to the tank, additional water is added through the water spray pipe 43 or main water supply pipe 43'. Also bleaching liquor or deinking liquor may be added through the pipe 42. Pipes 44 provide for the addition of steam as desired. During the time stock is being added the level of the fluid in the tank gradually rises, so that after the desired amount of stock has been added the pulp level in the end 25—25' of the tank will be up to a desired level, or even up to the cover 26—26' in which case the approximate stock level adjacent the outlet opening 16 would be about as indicated in Figs. 2 and 5. After stopping the supply of stock bundles to the vat the valve or partition board 36 may be moved to its closed position so that all of the stock

forced up through the passage 24 is circulated around the midfeather when the pieces of stock flowing to the suction passage 16 are sufficiently small so that no bypass overflow is required. After circulating the batch of stock through the beater a sufficient time for a thorough shredding and breaking action, or after the bleaching or deinking process is completed, the processed stock may be pumped or drawn through an opening 45 (see Fig. 1) to a suitable chest or the like, Using the apparatus only as a pulper, ten or fifteen minutes after the admission of the last of the pulp the stock is effectively shredded and pulped. Shortly after stopping the supply of stock bundles to the vat the motor 30 may be reversed momentarily to loosen up any dry stock that may be clinging along the walls, or if the passage to the breakers through opening 16 should become clogged by any unusual conditions the motor may be reversed to loosen up the clogged stock and permit effective circulation when the motor is again operated in the normal direction.

It has been found that in accordance with the present invention, and with stock of 11% consistency, 80% of the pulp is broken up into the ultimate fibers in 36 minutes and with a power requirement of only ninety horse power, as compared with the results obtained in an efficient breaker of a usual construction with the same amount of stock of 3½% consistency in which 65% of the pulp was broken up into fibers in 1½ hours with a power requirement of one hundred horse power. Stock at 3½% consistency however, contains less than one-third of the amount of fibers present in the same amount of stock at 11% consistency, so it will be apparent that a remarkably greater amount of pulp is defibered in a shorter time and with less power than in accordance with usual practice, and the pulping is accomplished more effectively since a greater proportion of the stock bundles is broken up into the ultimate fiber. It has also been found that a better grade of paper results from the use of stock pulped in accordance with this invention due in part to the more effective pulping action produced, which permits a more effective interlacing of the fibers.

Customary pulpers or breakers are of heavy construction and large power requirements, and often subject the stock to intense strains especially when dry or confined pulp is acted upon by the breaker rolls. In the present arrangement as herein set forth there is practically no chance of confining a large portion of dry pulp and then having it subjected all at once to the action of a breaker, since if the stock is too dry it will lodge in the decreasing passage beside the partition 15—15' leading to the opening 16 and will ordinarily bridge over the opening with resulting choking at this point. As the choked portion is not within reach of the rotatable blades no harmful effects are produced either on the machinery or on the pulp itself, the impellers merely continuing to rotate but with reduced power requirements. In case of such clogging somewhat more water is added and the motor reversed to dislodge the dry stock in the suction pipe, after which the motor is operated again in its normal direction so that the pulp is passed through in the normal way. Furthermore as the stock bundles are not closely confined when acted on by the blades 28 and 33 it will be impossible to subject the stock to great strains, and "fish eyes" and "shiners" that result when the fibers are bruised will be avoided, and by the time it moves into the path of the succeeding breakers the stock is broken into comparatively small pieces. An additional very material advantage of the present arrangement over the prior constructions is the fact that the device of the present invention being adapted to operate efficiently in producing a batch of pulp of such very high consistency a greater amount of pulp stock is broken in a comparatively small machine of comparatively small power requirements. Also the breaking up of the bundles is more rapidly accomplished and in a very thorough manner. The power requirements are also very much less than in an ordinary breaker beater due to the efficiency of the operation of the blades arranged as herein set forth and also due to the efficient pumping action of the impeller as compared with the inefficient pumping action produced in an ordinary breaker roll. Due to the efficient and rapid pumping action bleaching or deinking liquor and colors or dyes can be effectively and thoroughly mixed with the stock in a minimum of time.

While the method herein described, and the forms of apparatus for carrying this method into effect, constitute preferred embodiments of the invention, it is to be understood that the invention is not limited to this precise method and forms of apparatus, and that changes may be made in either without departing from the scope of the invention which is defined in the appended claims.

What is claimed is:

1. The method of breaking paper pulp of consistency as high as 10% or more which comprises circulating the pulp in a tank, subjecting the pulp to a breaking and pumping action to break up the fiber bundles and return it upwardly to a height sufficient to circulate the stock in the tank, and flowing some of the stock that is pumped upwardly to fall on the moving stock to direct the floating pieces of pulp to cause them to pass into the breaking and pumping zone.

2. A method of breaking up pulp of consistency as high as 10% or more, which comprises circulating the pulp in a tank, withdrawing the pulp from the tank and pumping and breaking the pulp so withdrawn, returning the pulp to the tank to be circulated again in the tank, and bypassing some of the returned pulp to fall upon the pulp approaching the point where the pulp is withdrawn to assist feeding of the pulp into the withdrawal opening.

3. The method of breaking paper pulp laps of consistency as high as 10% or more which comprises circulating the pulp laps in a tank, withdrawing the circulating pulp laps and forcing their circulation past shredding and breaking blades, subjecting the moving pulp to a plurality of successive shredding and breaking actions, returning the shredded pulp into the tank with a sufficient head to cause its circulation, and rapidly submerging the forward ends of flowing laps of stock to facilitate feeding of the circulating pulp laps into the path of the shredding and breaking blades.

4. Breaking apparatus of the character described for pulping fibrous material comprising a tank for receiving pulp, a passage extending from said tank and returning back to the tank, rotary bladed means in said passage for pumping and breaking the pulp, a partition in said tank between the inlet and outlet sides of said passage, and means providing for return of some pulp stock over the partition.

5. Breaking apparatus of the character de-

scribed for pulping high consistency pulp or fibrous material comprising a tank for receiving pulp, a passage extending from the tank and returning thereto, a high speed rotary blade member in said passage for breaking the pulp, a partition in said tank between the inlet and outlet sides of said passage, and means for controlling the effective height of said partition for bypassing a portion of the stock to flow downwardly upon the pulp flowing to said passage.

6. Breaking apparatus of the character described for pulping fibrous material comprising a tank for receiving pulp or fibrous material, a midfeather and a partition at one side of said midfeather, a passage connecting the portions of said tank at opposite sides of said partition, a rotary bladed member for shredding the pulp flowing through said passage, said tank being adapted for the circulation of the pulp around said midfeather from one side of said partition to the other, and means for controlling the return of some of the pulp over said partition.

7. Breaking apparatus of the character described for pulping high consistency pulp stock or fibrous material comprising a tank for receiving pulp stock, a midfeather and a partition at one side of said midfeather, a passage connecting the portions of said tank at opposite sides of said partition, a rotary bladed member for shredding the stock flowing through said passage, said tank being adapted for the circulation of the stock around said midfeather from one side of said partition to the other, and an adjustable blade over said partition providing for bypassing some of the stock over said partition to fall on the stock entering said passage.

8. Breaking apparatus of the character described for pulping high consistency pulp stock or fibrous material comprising a tank for receiving pulp stock, a midfeather and a partition at one side of said midfeather, a passage connecting portions of said tank at opposite sides of said partition, a rotary bladed member for shredding the pulp stock flowing through said passage, said tank being adapted for the circulation of the stock around said midfeather from one side of said partition to the other, a second partition substantially parallel to the first partition and arranged to provide a substantial head of stock between said partitions, and an adjustment means cooperating with said first partition for controlling overflow of stock over said first partition for return to said passage.

9. The method of breaking paper pulp which comprises circulating the pulp in a tank, subjecting the pulp to a breaking, whirling and pumping action to break up the paper pulp bundles while holding back the bundles and to return it upwardly to a height sufficient to circulate the stock in the tank, and flowing some of the stock that is pumped upwardly to fall on the moving stock to direct the floating pieces of pulp to cause them to pass into the breaking and pumping zone.

10. Breaking apparatus of the character described for pulping stock comprising a tank for receiving pulp or fibrous material, a midfeather and a partition at one side of said midfeather, a passage connecting the portions of the tank at opposite sides of said partition, said tank providing for substantially unobstructed flow from one end of said passage to the other, a shaft rotatable in said passage, blades on said shaft rotatable in a plane substantially coinciding with the direction of flow of the pulp stock thereto and spaced radially from the walls of said passage a considerable distance so as to whirl and shred the stock and additional blades in said passage rotatable in planes substantially transverse of the direction of flow of the pulp stock thereto and adapted to shred and whirl the stock while holding back bundles of stock.

11. In a device of the character described, a tank in which stock is circulated, a pump for circulating the stock in the tank and having its inlet connected to a low point of the tank, said tank having a division wall around which the stock circulates and having an inclined baffle wall at one side of the division wall extending angularly downwardly toward the pump inlet and confining the stock therebelow in its moving toward the pump inlet, said baffle wall separating a body of stock received from the pump outlet from the body of stock flowing to the pump inlet and having means for bypassing a portion of the stock from said first body on to the body of stock flowing to the pump.

JOSEPH E. BOND.