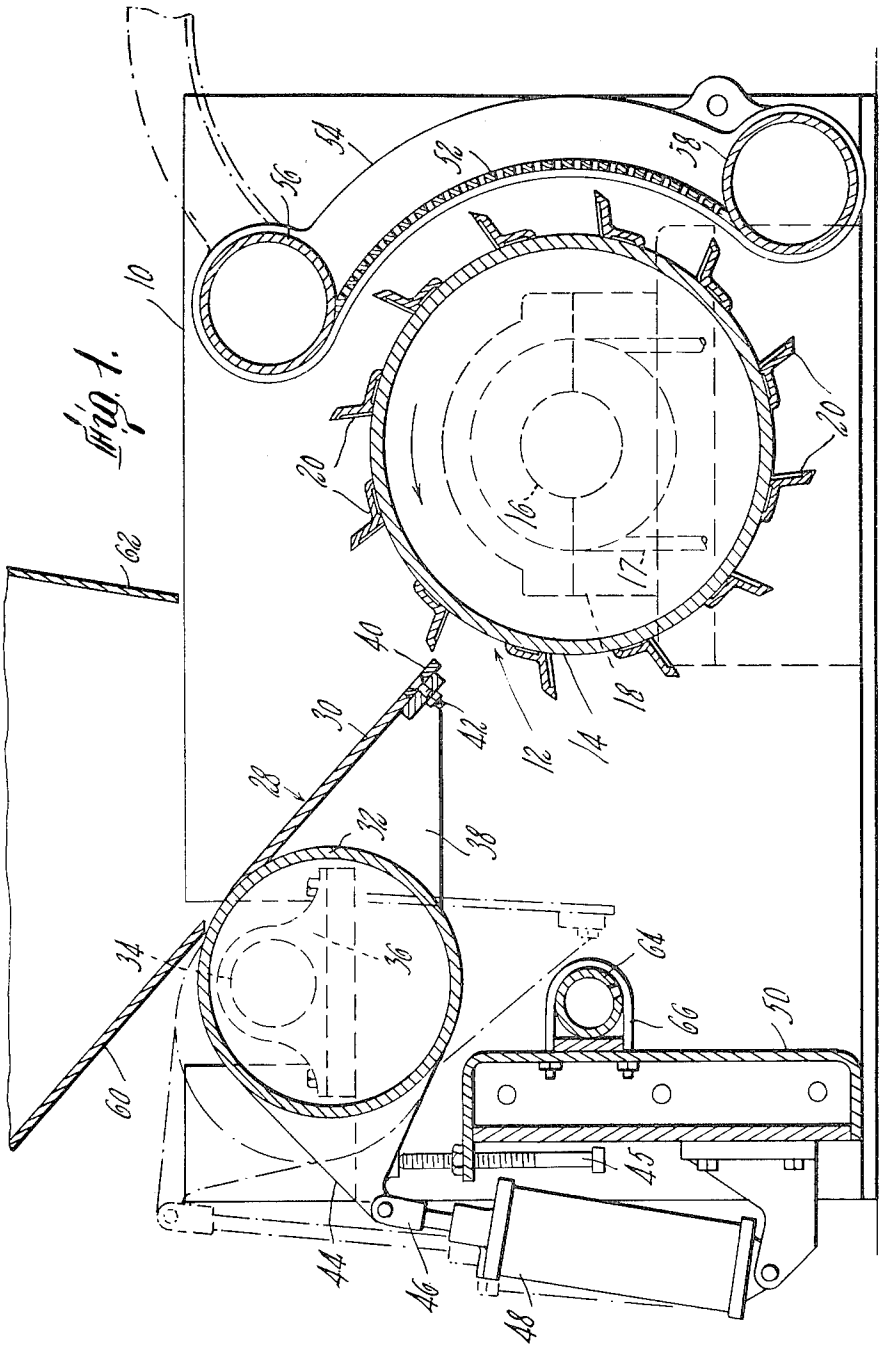
Feb. 22, 1966 A. L. WHITESIDE 3,236,723

SHEET MATERIAL REPROCESSING APPARATUS FOR PAPER BROKE

Filed May 7, 1963 4 Sheets-Sheet 1



Feb. 22, 1966 A. L. WHITESIDE 3,236,723

SHEET MATERIAL REPROCESSING APPARATUS FOR PAPER BROKE

Filed May 7, 1963 4 Sheets-Sheet 2

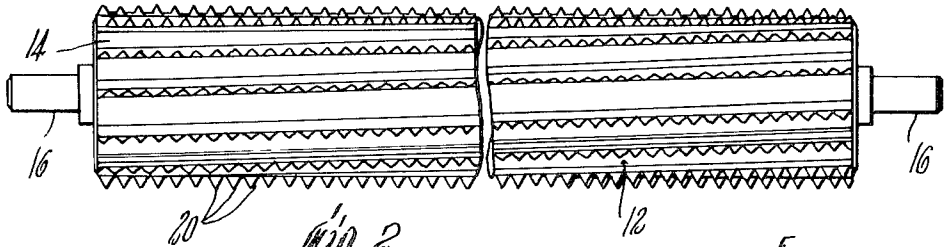


Fig. 2.

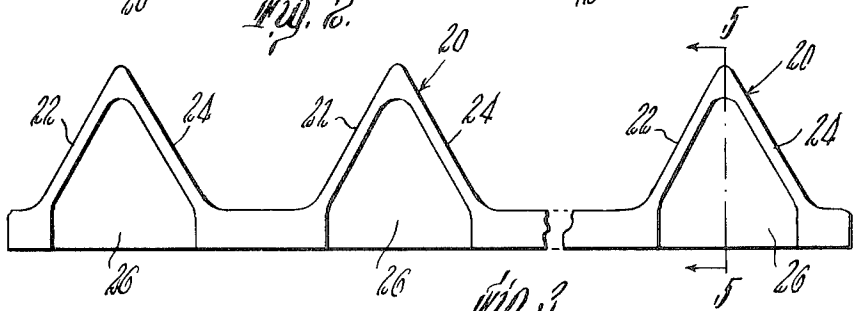


Fig. 3.

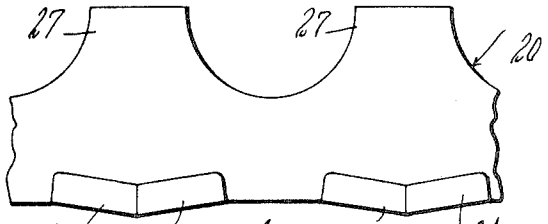


Fig. 4.

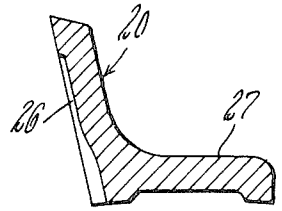


Fig. 5.

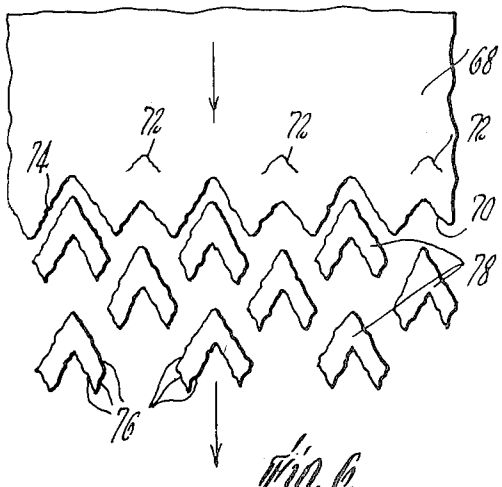


Fig. 6.

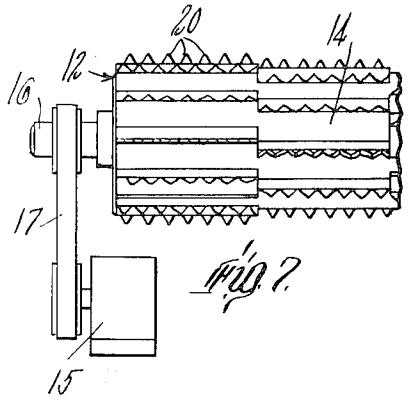


Fig. 7.

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SHEET MATERIAL REPROCESSING APPARATUS FOR PAPER BROKE

Filed May 7, 1963 4 Sheets-Sheet 3

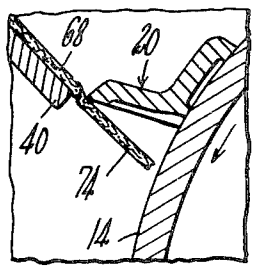


Fig. 8.

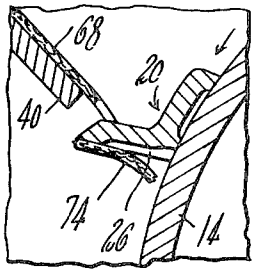


Fig. 9.

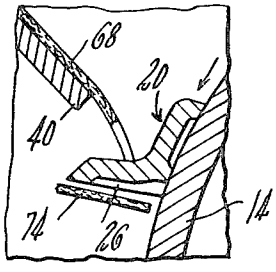


Fig. 10.

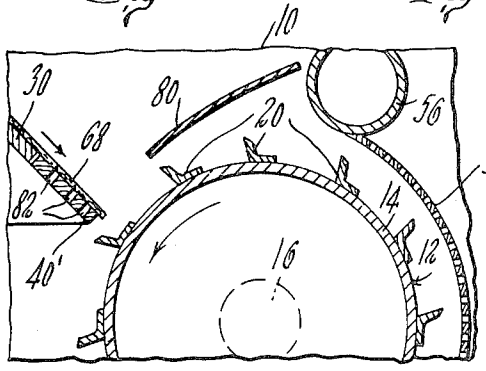


Fig. 13.

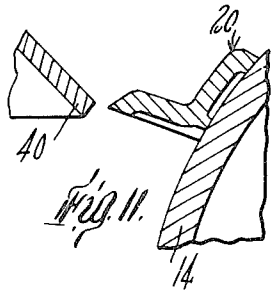


Fig. 11.

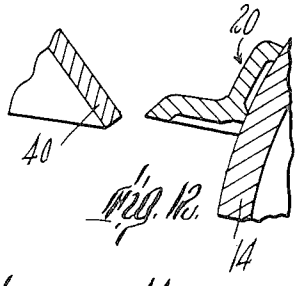


Fig. 12.

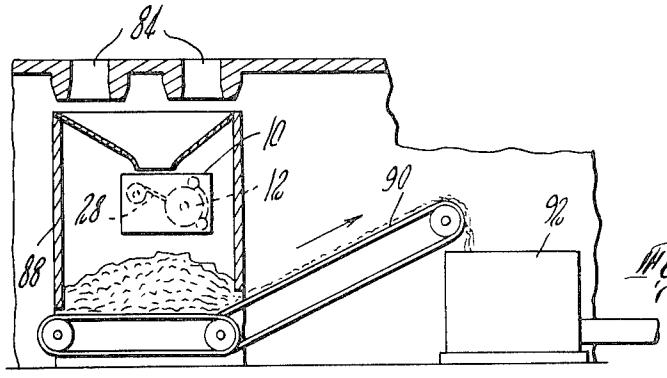


Fig. 14.

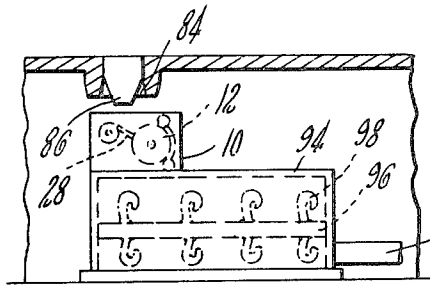


Fig. 15.

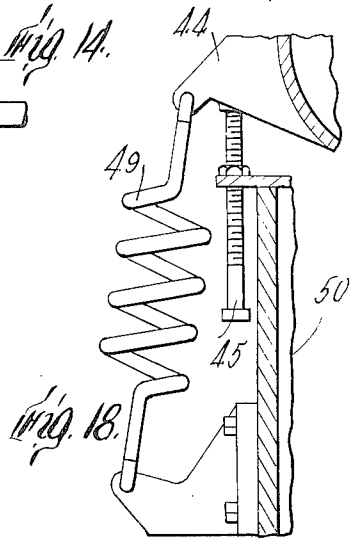


Fig. 18.

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SHEET MATERIAL REPROCESSING APPARATUS FOR PAPER BROKE

Filed May 7, 1963 4 Sheets-Sheet 4

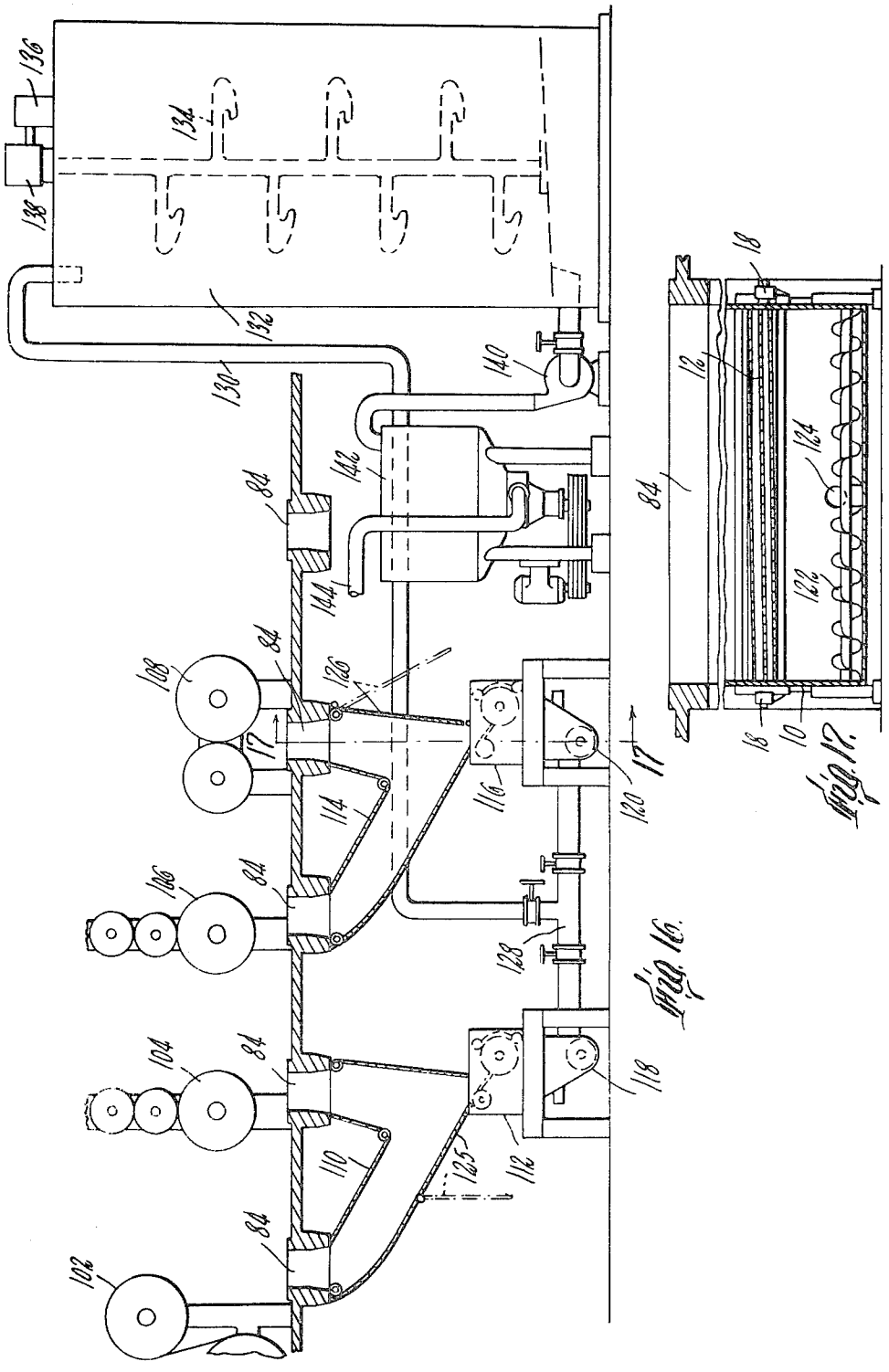


Fig. 16.

Fig. 17.

United States Patent Office 3,236,723 Patented Feb. 22, 1966

3,236,723

SHEET MATERIAL REPROCESSING APPARATUS FOR PAPER BROKE

Arthur L. Whiteside, Hamilton, Bermuda, assignor, by mesne assignments, to Improved Machinery Inc., Nashua, N.H., a corporation of Delaware

Filed May 7, 1963, Ser. No. 278,574
5 Claims. (Cl. 162—264)

This application is a continuation-in-part of Serial No. 8,158, filed February 11, 1960, and now abandoned. The invention relates generally to apparatus for reprocessing paper, paperboard and similar fibrous sheet materials, and more particularly to a system for reprocessing the defective material ("broke") produced by modern high speed paper and board machines, and to apparatus capable of continuously reducing such sheet material to a manageable and economically processable form.

Modern high speed paper making machines are capable of producing papers and similar fibrous sheet materials in sheets over twenty feet wide at rates in excess of 2,500 feet per minute. Ordinarily operation of these machines is continuous, once the speeds and adjustments of its several sections are synchronized for any specific grade and weight of paper or board. When the sheet breaks within the machine or is otherwise defective, and must be diverted from the finishing end, an expeditious means for disposal of this "broke" at full rate is imperative. There are usually three or four points ("broke holes") at the dry end of the machine, through one of which the sheet of paper is immediately diverted from the machine room to the machine room basement on the occurrence of a break until the trouble on the continuously running machine is cleared. Typically "broke holes" are located at the last dryer, at the calender stacks and at the reel. Conventionally disposal of the accumulated sheet broke is by manual transfer to a broke beater or by sheet conveyor transfer to a repulper after reduction of the sheet broke to manageable sizes. The several, commercially available types of such processing apparatus all operate in water submergence to break down the mechanical bonding agents used in sheet formation, thus recovering the individual fibers for reuse and are comparatively sped in operation.

The high speed, high production capacity of modern machines on heavy paper and board, is presently far beyond the physical design limitations of the conventional repulping methods and equipment. For example, during a ten minute adjustment or correction of formation trouble in some section of the continuously running machine operating at 2,500 feet per minute, a sheet nearly five miles in length and twenty feet in width, has to be diverted as "broke." Such an operation on a 900 ton per day machine would result in the accumulation of 500,000 square feet (on a weight basis, over six tons) of waste sheet to be handled manually at a later time, or the provision of repulping apparatus capable of reducing 1,250 pounds of waste sheet each minute. Present day dry sheet repulping devices of the largest size have ratings of less than half such a demand. In addition, such diverted wide, heavy sheet, travelling at the lineal speed of 30 miles per hour for example, is not in repulpable form as it is folded, lapped and crumpled so that it contains a substantial amount of entrained air and is substantially unwettable in conveyer transit; these conditions render the sheet non-submersible, except with manual manipulation, into the defibering zone of presently designed pulpers. The physical space available under modern paper making machines also precludes the design of present types of conveyer pulp disposal systems in much larger capacities than now considered maximum.

Accordingly, it is a principal object of this invention to provide improved apparatus for handling defective sheet materials such a "broke" at rates commensurate with the production capacity of a modern high speed paper making machine.

Another object of the invention is to provide a novel and improved apparatus for reducing "broke," in all commercial form, to a size suitably small for pneumatic, hydraulic or mechanical transfer from the machine area to defibering apparatus for final separation of the fibers into a condition suitable for reuse.

Still another object of the invention is to provide a sheet material reducing apparatus capable of expeditiously reducing "broke" into a form receptive to thorough wetting and rapid absorption of water for economical and efficient repulping.

A further object of the invention is to provide apparatus capable of rapidly reducing a sheet of broke moving at high speed to torn patches of a configuration such that they will readily absorb water for ease in defibering, and for handling such a sheet regardless of folds, thick places, or the like.

Still another object of the invention is to provide in a large high speed shredding apparatus adapted to reduce broke furnished by a modern paper making machine, a toothed rotatable shredding device having a tooth configuration such that a multiplicity of small torn patches are produced having peripheral surfaces which facilitate subsequent economical recovery of the fibers.

In accordance with the invention there is provided a system for handling diverted sheet broke which includes unique means for rapidly and concurrently reducing the diverted sheet to discrete patches of manageable size, which patches are transferred to bulk storage means and subsequently a small repulping device that is operated at a rate much slower than the production of broke for refining the patches to fibrous state suitable for reuse. The preferred system includes one or more shredding devices positioned adjacent broke holes, each of which is adapted to immediately tear broke diverted from the paper making machine into patches. The small torn patches, which have fluffy ragged edges of exposed fiber tips, are deposited in a wet repulper conveyer for immediate transport to wet patch accumulator chest. The broke is then refined by conventional repulping devices. Thus the invention provides a novel broke handling system for modern high speed paper making machines which accommodates, without requiring any manual intervention, the vast quantity of broke that is occasionally produced and utilizes conventional comparatively low capacity refining equipment.

In the shredding apparatus of the invention, a rotatable member, of a length in excess of the width of the sheet material produced, is positioned adjacent the broke hole with its axis perpendicular to the direction of travel of the sheet. This rotatable member has a multiplicity of dull generally triangularly shaped teeth spaced about its periphery. A flat guide plate, positioned parallel to the axis of the drum and adjacent the teeth but spaced therefrom is utilized to guide the sheet material into a position adjacent the teeth. The guide plate has a resiliently controlled positioning mechanism for automatically adjusting the position of the plate relatively to the rotor in accordance with the thickness of material to be shredded to control the space between the plate and the rotor teeth and to open more fully in case of a large bulk of material, to prevent jamming. The rotatable member is driven to provide a lineal tooth speed substantially in excess of the speed of the sheet material which is travelling across the guide plate. Typically the shredder is idling at no load but full speed and thus is always ready for incoming sheets which may

be travelling as fast as 50 feet per second from the point of break only a few feet away. Auxiliary equipment may be provided for the guidance of the sheet to the proper position on the guide plate. The apparatus is arranged so that the teeth hit the sheet material after it leaves the guide plate (at which point it is unsupported against bending and shear), burst through the material and tear it into a multiplicity of small patches.. These patches have torn fluffy edges which expose the fibrous interior structure of the material and thus facilitate water absorption and the subsequent mechanical refining of the patches into individual fibers in the repulping process. This apparatus requires less power than was required in prior attempts to solve this problem of handling massive quantities of broke by a cutting or shearing operation. Also this shredder apparatus does not require complex associated control equipment and is much less expensive to maintain. Further, as the patches are formed by tearing the fibers are exposed rather than sealed as occurs in a cutting operation and the material is refined much more readily. The shredder apparatus according to the preferred embodiment of the invention is capable of adjustment to receive varying quantities of material and to shred it into suitably small patches. The torn patches are then in suitable form for transfer to the next stages of the repulping operation which may either be storage, wet or dry, or directly to a repulping apparatus depending on the type of material being handled.

Thus the invention provides a comparatively simple but highly efficient system and apparatus which is capable of reducing "broke" and similar materials to a suitable form for transfer to repulping equipment at rates equal to the production speed of modern paper making machines. Other objects and advantages of the invention will be seen as the following description of the preferred embodiments thereof progresses in conjunction with the drawings, in which:

FIG. 1 is an end elevational view of the shredding apparatus according to a preferred embodiment of the invention;

FIG. 2 is a side view of the rotor element utilized in the embodiment of the invention shown in FIG. 1;

FIG. 3 is a front elevational view of tooth elements utilized on the rotor shown in FIG. 2;

FIG. 4 is a top plan view of the tooth elements shown in FIG. 3;

FIG. 5 is a sectional view of a tooth element taken along the line **5—5** of FIG. 3;

FIG. 6 is a diagrammatic illustration of a typical shredding operation;

FIG. 7 is a side view of a portion of a rotor element according to a second embodiment of the invention;

FIGS. 8 through 10 are a series of diagrammatic views showing the progressive action of a tooth in separating a patch of "broke" and the release of the patch from the tooth;

FIG. 11 is a semi-diagrammatic view of the spacing between a shredder tooth and the ductor plate when the apparatus is handling a single sheet of material with a relatively close nip setting;

FIG. 12 is a semi-diagrammatic view of the spacing between a shredder tooth and the ductor plate when the apparatus is handling thicker material;

FIG. 13 is an end elevational view of shredding apparatus according to another embodiment of the invention;

FIG. 14 is a diagrammatic view of a machine room basement showing a shredder associated with two "broke" holes and with subsequent dry storage, conveyer transport and repulping apparatus;

FIG. 15 is a diagrammatic view of a second installation in a machine room basement in which the shredder is associated with a continuously operating repulping apparatus;

FIG. 16 is a diagrammatic view of a complete continuous broke disposal system which employs two shredders and associated wet repulper conveyers, accumulator chest and pulper;

FIG. 17 is a sectional view of a shredder and associated conveyer taken along the line **17—17** of FIG. 16; and

FIG. 18 is a partial side view showing a modification of the structure of FIG. 1.

An end sectional view of one embodiment of the novel shredder apparatus of the invention is shown in FIG. 1 and a rotor utilized in that apparatus is shown in FIG. 2. The shredder includes a housing **10** which is mounted on a suitable support structure. The width of the housing is sufficient to accept without interference the width of the paper being produced on the associated paper machine, and in a constructed embodiment this dimension is in excess of twenty feet. Positioned within the housing is a rotor **12** comprising a cylindrical drum **14**, twenty inches in diameter, which has stub shafts **16** (FIG. 2) secured to either end thereof. Pedestal bearings **18**, of conventional design, are provided and associated with the housing **10** and the stub shafts **16** are supported thereon, such that the rotatable member is positioned with its axis parallel to the general direction of sheet flow through the paper machine. Provision for connection to an appropriate driving motor **15** is provided by belt and pulley drum **17** (FIG. 7) such that the rotor may be driven at a suitable speed so that the peripheral velocity is several times the speed of the paper. In the preferred embodiment this speed is up to seven times the paper speed depending on the characteristics thereof.

Mounted on the surface of the drum **14** are a multiplicity of teeth **20** that are not sharpened but rather are comparatively dull. These teeth are preferably precision cast in continuous bars of groups of ten for example, for the construction shown in FIG. 2 or groups of seven as shown in FIG. 7, so that dynamic balance may be more easily attained. These teeth are preferably secured to the drum by welding and are slightly spiraled or skewed relative to the drum axis as shown in FIG. 2 so that as the last tooth in one row is tearing the broke, the tooth at the opposite end of the next row is about to commence its tearing action.

Each tooth has a substantially triangular front surface having inclined sides **22** and **24** which terminate to form a blunt apex. In this embodiment the teeth are two inches in height and there is three inches between apices. The front surface is inclined forwardly at an angle of 5°. The front surface is slightly relieved at **26** to provide air cushion action as hereinafter described to assist release of the torn patch from the tooth. A base portion **27** extends rearwardly of the front surface of the tooth and provides means for securely and rigidly mounting the teeth on the drum **14**. The teeth are secured so that the alternate rows are staggered with the crests of the teeth in one row substantially aligned with the valleys between the teeth in the next row. This arrangement produces the preferred tear pattern shown in FIG. 6.

Secured within the housing **10** is a guide or ductor plate structure **28**. This structure includes a guide plate member **30** which is mounted on cylindrical drum structure **32** which in turn is mounted on shafts **34**. The shafts **34** are supported by suitable bearing assemblies **36** secured to the end walls of the bearing **10**. A plurality of ribs **38** secured perpendicular to the ductor plate lend reinforcement to the plate. At the outer end of the ductor plate **30** is a replaceable bar member **40** which forms the front edge of the guide plate. Its minimum distance from the rotor teeth **20** may be adjusted for best operation by means of adjusting screws **45** on side wall channel structure **50**. A pair of arms **44** associated with drum **32** of the ductor plate structure are connected by means of linkages **46** to air cylinders **48** with their minimum return defined by contact with screws **45**. The cylinders are

mounted on the side wall channel structure 50. Operation of the air cylinders pivots the ductor plate 30 about the axis of shaft 36 from the close nip position shown in solid lines in FIG. 1 defined by the adjustment of screws 51 to the wide open position shown in dotted lines. Other means, such as springs 49 (FIG. 18) may be used to provide a resilient operating force for plate 30, in which case screws 45 may be utilized to move the plate 30 to its open position, as well as to establish its minimum clearance from rotor teeth 20.

In the wide open position sheet material may flow directly through the shredding apparatus without interference if and when such operation may become necessary. The side wall 52, opposite the channel wall 50 is perforated to reduce windage effects due to the rapidly revolving rotor 12, and in the preferred embodiment is a sheet of expanded metal supported by ribs 54 and longitudinal members 56, 58. The assembly is secured with bolts and upon release of one of the members it may be pivoted as indicated by the dotted lines in FIG. 1, for example, to permit removal of the rotor 12. An entrance aperture, provided in the housing 10, is defined by walls 60 and 62. The broke material to be shredded is fed directly through the entrance aperture onto the ductor plate 30 and into the vicinity of the toothed rotor 12. Sheet directing means such as air jets or water showers may be provided adjacent the entrance aperture and the rotor and a "knockdown" water shower pipe 64 secured by U-bolts 66 is just beyond the shredding area.

The shredding operation may be understood with reference to FIGS. 6 and 8–10. The sheet 68 of material to be shredded moves across the resiliently supported guide plate 30 and into the vicinity of the rapidly moving shredder teeth 20. Shortly after the leading edge 70 of the sheet 68 slides over the edge of the end bar 40, it is contacted by the plurality of shredder teeth 20, one of which is shown in FIG. 8. It is to be noted that the sheet when it is first contacted by a shredder tooth is unsupported by the bar 40. The tooth tip, which is travelling at a speed that is more than twice as fast as the sheet, strikes the unsupported sheet and punctures it in a tearing operation as generally indicated in FIGS. 6 and 8 at point 72. The tearing that follows this initial puncture moves generally along the path indicated in FIGS. 6 and 9 at point 74 as the triangular shape of the tooth face determines the approximate shape of the torn patch. However, the actual parting lines of the patches are in the weaker areas of bonding materials so that minimum damage to the fibers results and the resulting patches have fluffy edges 76 which expose the fiber tips. This type of patch sharply contrasts with previous broke reduction techniques which utilize cutting or shearing operations to reduce it to manageable size. Such operations sever the fibers and thus shorten many of them to distinctly inferior lengths for reuse and the cut edge is substantially sealed against the absorption of water which is necessary in a wet repulping recovery operation. Further movement of the tooth relative to the sheet frees chevron shaped patches 78 from the broke sheet 76 as shown in FIGS. 6 and 10. Where the speed of the teeth relative to the broke is less, a plurality of generally diamond-shaped patches are detached from the main sheet. The general configuration of the patches thus is achieved through the combination of tooth face configuration, the relatively offset or staggered location of the teeth in subsequent rows and the speed to the teeth relative to the broke sheet. The chevron shaped patches have a long periphery and that entire length is characterized by fluffed, ragged edge 76 which exposes a substantial portion of the interior fiber structure of the patch. These edges have characteristics similar to that of blotting paper and readily absorb water to soften bonding agents, thus facilitating the saturated condition required for repulping.

The recessed faces of the teeth provide a positive patch detaching means. As shown in FIG. 9 the patch tends to flatten itself against the tooth as it is torn with air being trapped behind it. This air becomes compressed as the tooth drives further against the patch but when the patch is torn free this compressed air forces the patch away from the tooth surface thus freeing it. The detached patches then drop through the bottom of the shredder housing due to this inertia and under the influence of the knockdown shower 64 for subsequent handling as determined by the associated repulping equipment.

The pneumatic cylinder 48 or spring 49 enables an automatic adjustment of the nip between the rotor and the guide plate. The material to be shredded, whether it be a single thin sheet, a thick sheet or a number of sheets, is introduced through the entrance aperture and slides down the ductor plate 30. The guide is resiliently loaded so that it will automatically position itself relative to the rotor to vary the clearance in a manner dependent upon the thickness of the material to be shredded. Thus where the material is comparatively thin a close nip is provided between the bar 40 and the teeth 20 mounted on the rotor drum 14 as shown in FIG. 11. Where a thicker material is being handled, there is greater clearance between the bar and the teeth as shown in FIG. 12. If the material should not be capable of being shredded by the apparatus, the apparatus permits the ductor plate to be pivoted so that its free end moves in a direction generally along the cylindrical surface of the roller in the direction of movement thereof and with progressively increasing clearance between the free end of the plate and the tips of the teeth so that the material is permitted to pass through the shredder without damage to any of the operating parts.

While specific dimensions and configurations of the shredding apparatus have been given it will be understood that these are for illustrative purposes and various modifications thereof which do not depart from the inventive concept will be obvious. A somewhat modified construction is shown in FIG. 13. In this construction an additional confining plate 80 is provided as an extension on the rotor housing member 50. This plate 80 may be utilized to control and direct air movement so that the sheet material 68 is properly positioned on the ductor plate 30. The bar member 40′ is also provided with apertures 82 in it. In the vicinity below the guide plate there is an area of reduced pressure which is applied through the ports 82 to the under-surface of the sheet 68 and tends to maintain it in contact with the bar 40′. Thus the sheet of material to be shredded is properly positioned relative to the guide plate structure and slides across that bar into the path of the rapidly moving teeth to be shredded.

The shredder is perferable mounted adjacent the ceiling of the machine room basement as shown in FIGS. 14–16. This positioning of the shredding apparatus permits efficient utilization of the space typically existing in a machine room basement for associated auxiliary equipment. The shredder may be associated with two or more "broke" holes 84 as generally shown in FIGS. 14 and 16 or a single "broke" hole as shown in FIG. 15. These "broke" holes are in the floor of the machine room adjacent the finishing end of the machine and defective sheet material is diverted through them. A suitable chute 86 dependent on the position of the shredder relative to the broke holes may be provided to guide the material into the shredder entrance aperture. The patches resulting from the shredding operation may be collected in a suitable enclosure 88 as shown in FIG. 14 and held there in dry storage, to be conveyed by suitable means such as a conveyor 90 to a pulping device 92. This system permits the storage of a large amount of shredded "broke" in suitable form for transfer to a conventional pulping apparatus at a rate commensurate with the capacity of that apparatus. Thus the "broke" from the machine is produced periodically at a rate much greater than the capacity of the pulper, shredded and placed in intermediate

storage and gradually is removed therefrom and treated by the pulping apparatus to reduce the material to its fibrous state for reuse in paper making. Intermediate wet storage may be utilized if desired, of course. Alternatively, the shredder may be positioned immediately adjacent a repulping apparatus **94** as shown in FIG. 15. That repulper may be of the type disclosed in my co-pending application Serial No. 746,844 entitled "Repulper" filed July 7, 1958 and now abandoned. That device includes a shaft **96** on which a plurality of uniquely shaped propeller devices **98** are mounted. Action of the revolving propellers on the shredded material reduces that material to individual fibers for discharge through the conduit **100** at the bottom of the repulper. Such a system however would require approximately four repulpers of conventional size to be associated with a single shredder in order to be able to continuously process the amount of defective sheet material that modern high speed sized paper or heavyboard machines are capable of producing during a single break.

There is shown in FIGS. 16 and 17 a continuous broke disposal system associated with a high speed, high capacity (300 to 900 tons per day) paper making machine. The system is capable of handling broke from the last dryer **102**, the first calendar rolls **104**, the second calender rolls **106**, the reel **108**, and continuous winder trim from a machine which is producing sized heavyboard. Broke from the dryer or from the first calender rolls is directed through holes **84** and a chute structure **110** to a first shredder unit **112**. Broke from the second calender stack on the reel is directed through holes **84** and a second chute structure **114** to a second shredder apparatus **116**. Mounted beneath each shredder unit is a wet repulper conveyer **118**, **120** respectively. Dilution water, supplied to said repulper units, wets the patches as they are deposited therein and places them in suitable form for transport. FIG. 17 is a sectional view showing the broke hole **84** associated with the reel element **108**, the rotor **12** of the shredder **116** and the notched screw conveyer **122** of the wet repulper **120** which has a center discharge **124**.

The shredder rotors are idling between breaks of the full speed so that they are ready for instantaneous service. However the wet repulper conveyers operate only during actual breaks. It will be noted that there is provision for diverting the broke directly to the machine room basement, when necessary, by pivoting a wall portion **125** of the chute **110** or wall portion **126** of the chute **114** outwardly.

When a break occurs the repulper conveyer associated with the active shredder is started and the shredded wet pulp patches are transferred through conduits **128** and **130** to a wet patch accumulator chest **132**. Vertically positioned in the accumulator chest **132** is a repulping agitator having corrugated propeller members similar to the type disclosed in my aforementioned co-pending patent application, Serial No. 746,844. This agitator is driven in rotation by a motor **136** and through gear box **138** and maintains the patches stored in the chest in proper agitated state with top to bottom turnover and in addition produces partial defibering of the wet patches. The continuous winder trim may also be introduced into the accumulator chest for fiber recovery.

The mixture stored in the accumulator chest is continuously transferred therefrom in small quantities by a type disclosed in U.S. Patent No. 2,674,927 issued April 13, 1954 to Wicksell and entitled "Disintegrator for Fibrous Materials." Upon completion of the refining process by the pulper the fibers recovered are transferred via conduit **144**, for the reuse as desired. Finishing broke may be manually introduced into the pulper **142** through the broke hole **84** positioned directly above that device. The system enables the processing of all broke that may be encountered in operation of modern high speed paper making machines and permits utilization of repulping devices that can handle the material only at a much slower rate than that at which the material is produced during a break.

Thus the invention provides novel apparatus for the expeditious and economical reconditioning of defective fibrous materials for reuse. The apparatus includes means for shredding the sheet material prior to a repulping operation and the preferred apparatus for this shredding operation includes a toothed rotor structure which is adapted to tear an unsupported sheet into small fluffy edged Chevron shaped patches. The sheet is guided to a position adjacent the toothed rotor by a ductor plate structure which may be adjustably positioned and is responsive to the type of material being shredded. The shredding operation involves a tearing of the sheet material which exposes the fibrous interior of the material and does not shorten fiber length or seal that interior, as is the result in a cutting or shearing operation. Instrumentation is commercially available for any degree of continual or automatic control of this process and equipment, such as electric eye detection of breaks, valve operation, start and stop of drives and pumps and for consistence regulation. This shredder may be incorporated as an integral part of a comprehensive fiber recovery system. While preferred embodiments of this invention have been shown and described it is not intended that the invention be limited thereto or to details thereof and departures mav be made therefrom within the spirit and scope of the invention as defined in the claims.

I claim:

1. Fibrous sheet reducing apparatus for use in combination with a continuously running sheet-forming machine comprising a housing, a rotatable member mounted within said housing and having a multiplicity of dull teeth spaced about its periphery, a guide plate having a portion operatively positioned adjacent said rotatable member, means to adjust the position of said guide plate relative to said rotatable member to control the space between said guide plate and said rotatable member, said guide plate being mounted on a shaft positioned generally parallel to the axis of said rotatable member, said adjusting means including a pneumatically controlled guide plate positioning mechanism, means to guide a sheet of dry fibrous material of indeterminate length from said machine into said housing, and onto said guide plate into the vicinity of said rotatable member, and means to drive said rotatable member so that the lineal speed of said teeth is substantially higher than the feed speed of said material, said plate operatively being spaced from said teeth so that said teeth hit said material when it is unsupported by said plate and tear said material into a multiplicity of small patches such that said patches will easily absorb water during a subsequent fiber recovery process.

2. Fibrous sheet reducing apparatus for use in combination with a continuously running sheet-forming machine comprising a housing, a rotatable member mounted within said housing and having a multiplicity of dull teeth spaced about its periphery, guide means having a free end portion positioned adjacent said rotatable member, means for resiliently mounting said guide means for movement of its free end portion from a position having a minimum clearance with respect to said rotatable member in a direction generally along the surface of said rotatable member in the direction of movement thereof and with progressively increasing clearance between said free end portion and said surface for automatic adjustment of said clearance in accordance with the thickness of material to be shredded passing into said clearance, adjusting means to adjust the minimum clearance of said guide means relative to said rotatable member, means to guide a sheet of dry fibrous material of indeterminate length from said machine into said housing, and onto said guide means into the vicinity of said rotatable member, and means to drive said rotatable member so that the lineal speed of said teeth is substantially higher than the feed speed of said material, said guide means operatively being spaced from said teeth so that said teeth hit

said material when it is unsupported by said guide means and tear said material into a multiplicity of small patches such that said patches will easily absorb water during a subsequent fiber recovery process.

3. Fibrous sheet reducing apparatus as claimed in claim 2 wherein said guide means includes a plate mounted for pivotal movement about an axis positioned generally parallel to the axis of said rotatable member.

4. Apparatus for use in combination with a high speed paper making machine having calender rolls arranged so that broke in sheet form may be diverted through a hole in the machine room floor comprising a rotor mounted beneath the machine room floor with its axis parallel to the axis of the calender rolls, said rotor having an axial length at least equal to the width of the broke produced by said machine, and having a cylindrical surface, a plurality of rows of dull teeth mounted on the cylindrical surface of said rotor, each said row being positioned at a skew angle with respect to the rotor axis, and each row having a plurality of teeth therein, each said tooth having a front surface of generally triangular configuration and inclined forwardly at an angle of less than 90° to a tangent of said cylindrical surface, the teeth in alternate rows being aligned with one another and the teeth in intervening rows being positioned half way between the teeth in the adjacent rows to provide a zig-zag pattern of teeth in the circumferential direction about the rotor surface, guide means having a guiding edge parallel to the axis of said rotor for guiding broke into the path of said teeth, said guide means includes a ductor plate mounted for pivoting movement about an axis parallel to said rotor axis and a pneumatic ductor plate positioning mechanism for adjusting the position of said ductor plate relative to said rotor to control the space between said ductor plate and the tips of said teeth, and means to drive said rotor to provide a tooth tip speed at least twice the speed of the broke so that the teeth tear the broke into Chevron shaped patches of uniform size having fluffy, ragged edges which expose the fibers of said broke so that absorption of water by said fibers is facilitated during a subsequent fiber recovery process.

5. Apparatus for use in combination with a high speed paper making machine having calender rolls arranged so that broke in sheet from may be diverted through a hole in the machine room floor comprising a rotor mounted beneath the machine room floor with its axis parallel to the axis of the calender rolls, said rotor having an axial length at least equal to the width of the broke produced by said machine, and having a cylindrical surface, a plurality of rows of dull teeth mounted on the cylindrical surface of said rotor, each said row being positioned at a skew angle with respect to the rotor axis, and each row having a plurality of teeth therein, each said tooth having a front surface of generally triangular configuration and inclined forwardly at an angle of less than 90° to a tangent of said cylindrical surface, the teeth in alternate rows being aligned with one another and the teeth in intervening rows being positioned half way between the teeth in the adjacent rows to provide a zig-zag pattern of teeth in the circumferential direction about the rotor surface, guide means having a guiding edge parallel to the axis of said rotor for guiding broke into the path of said teeth, said guide means includes a ductor plate having a free end portion, said plate being mounted for pivoting movement about an axis parallel to said rotor axis, means for resiliently mounting said guide means for movement of said free end portion from a position having a minimum clearance between said free end portion and the tips of said teeth in a direction generally along said cylindrical surface in the direction of movement thereof and with progressively increasing clearance between said free end portion and said tips for automatic adjustment of said clearance in accordance with the thickness of material to be shredded passing into said clearance, adjusting means to adjust the minimum clearance between said ductor plate and the tips of said teeth, and means to drive said rotor to provide a tooth tip speed at least twice the speed of the broke so that the teeth tear the broke into Chevron shaped patches of uniform size having fluffy, ragged edges which expose the fibers of said broke so that absorption of water by said fibers is facilitated during a subsequent fiber recovery process.

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