

Dec. 8, 1942.

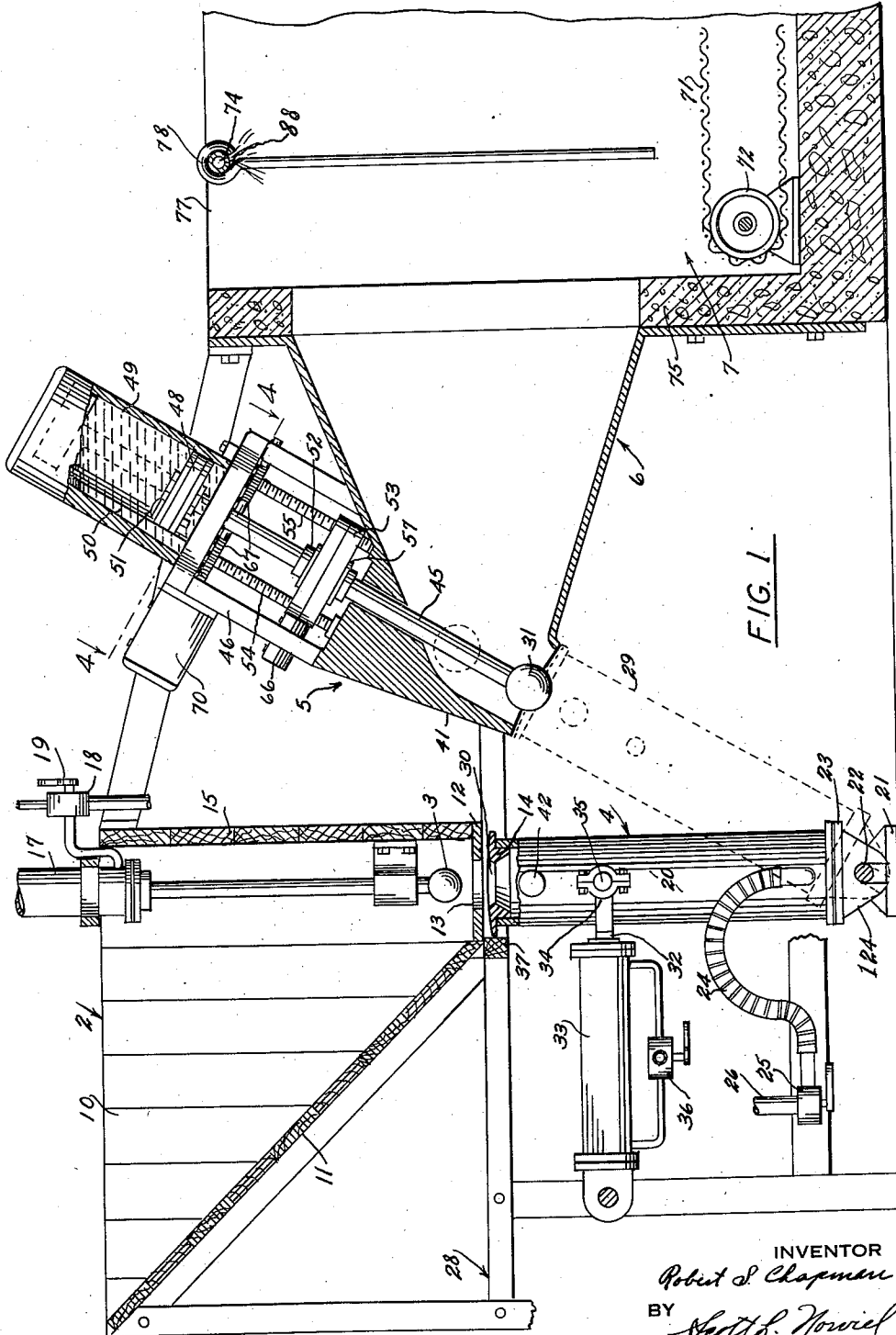
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2,304,543

FIBER SEPARATING APPARATUS

Filed June 2, 1941

2 Sheets-Sheet 1



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2 Sheets-Sheet 2

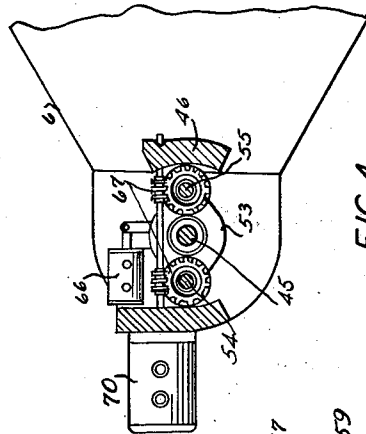
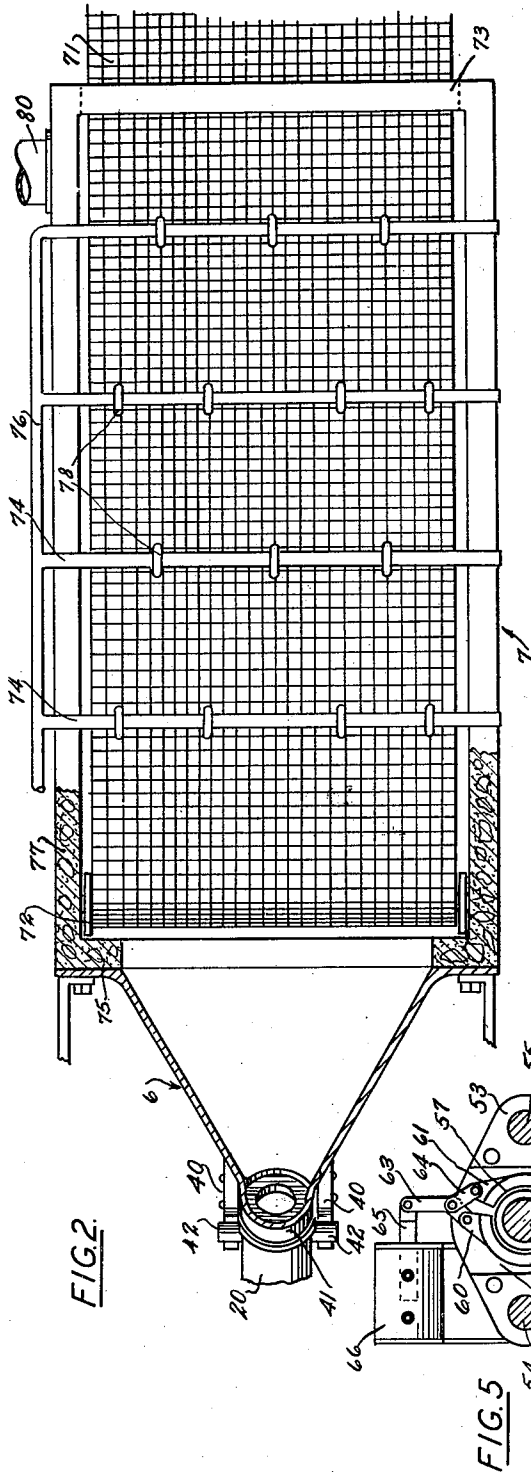


FIG. 4

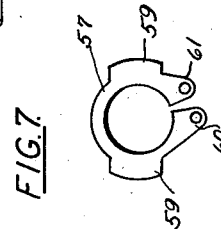


FIG. 7

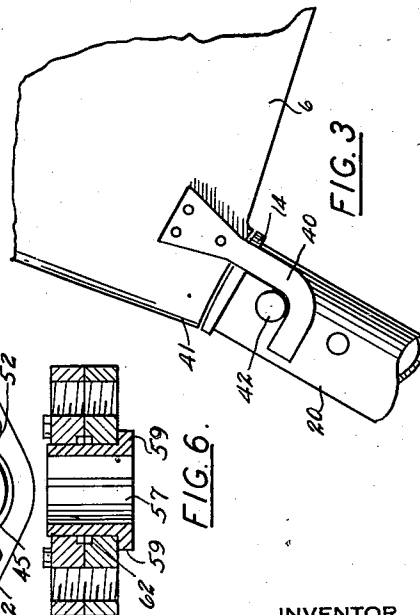


FIG. 3

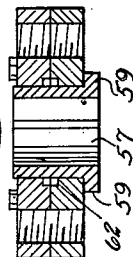


FIG. 6

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FIBER SEPARATING APPARATUS

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7 Claims. (Cl. 19—5)

This invention concerns apparatus and mechanism for separating fiber from leaves of various types of yucca plants native of the Southwest United States, by the explosion process.

It has for its objects:

First, the provision of mechanism for rapidly handling and loading leaves of this nature, taking into account the peculiar structure of the leaves;

Second, mechanism for subjecting successive charge of leaves to steam of a predetermined pressure for a desired time and then rapidly expanding or exploding the charge to produce a disruption of the leaf envelope and a separation of leaf pulp from fibers, and

Third, mechanism for receiving and washing the separated fiber with a minimum of breaking of the long fibers.

It is known that there are a number of devices for pulping wood, cane and the like, but the apparatus, here concerned, is to be distinguished from these in that it is peculiarly adapted to handling of long, narrow or spear shaped leaves, and in securing a separation of the fiber in long strands with a minimum of breakage. Fiber so produced is for use in weaving of coarse textiles, for cordage, oakum packing and the like, and is, therefore, entirely distinguished from the product of exploded wood and cane pulp used for paper and press board manufacture.

I attain the foregoing objects by means of the devices, mechanism and construction shown in the accompanying drawings, in which:

Figure 1 is a side elevation of the hopper exploding cylinder closing mechanism, expansion chamber and a portion of the fiber receiving chamber; portions being shown in section as indicated to show the interior of the several parts;

Figure 2 is a plan view of the fiber receiver drawn on a somewhat smaller scale; also showing the expansion chamber in horizontal section;

Figure 3 is a fragmentary side elevational view of the neck of the expansion chamber together with an upper portion of the gun showing particularly the means of securing the gun to the expansion chamber;

Figure 4 is a section taken substantially on lines 4—4, Figure 1, showing the means for actuating the jack screws used in closing the gun cylinder;

Figure 5 is a plan view of the ram plug releasing mechanism, showing the lower portion of the closing yoke in plan;

Figure 6 is a vertical section of the closing yoke, and

Figure 7 is a bottom plan view of the yoke gripping band.

Similar numerals designate similar parts in the several views.

5 The main parts of my device consist of a hopper 2 provided with a loading ram 3, a pressure treatment cylinder or gun 4, closing mechanism for the gun 5, an expansion chamber 6, and a fiber receiving chamber 7.

10 Considering these parts in detail it is to be noted that the sides 10 and one end 11 of the hopper converge toward the bottom which consists of a plate 12 having a circular opening 13 positioned to register with the center of the head 14 of gun 4 when it is in loading position, shown in solid lines in Figure 1. The end 15 is vertical and supports a vertically operating loading ram 3 positioned directly over the mouth of gun 4. This ram is operated by a piston in steam cylinder 17 connected through a reversing operative valve 18, which may be manually operated by handle 19. This constitutes a mechanism for forcing ram 3 upward and downward through a mass of leaves in the body of hopper 2 to effectively load and pack the gun 4. Cut leaves of the yucca plants do not bunch. They slide endwise relative to each other but cannot be rapidly loaded through the comparatively small port of the gun without applying considerable force. The ram may therefore be termed a means for forcefully loading the gun.

30 Gun 4 has a cylinder 20 pivotally mounted and supported at the bottom on a bearing block 21 having a spindle 22. The bottom closing head 23 is provided with an open or notch bearing 24 to allow a slight amount of end play when the cylinder is moved to angular expansion position indicated by the dotted outline 29. Steam is admitted into the bottom of cylinder 20 through a flexible high pressure steam hose 24. Admission of steam is controlled by a valve 25 connecting to a supply of live steam through pipe 26. Its top is closed by a head 14 welded in place and provided with a centrally positioned port 30 having a beveled outer edge ground to receive plug 31 to form a steam tight joint.

45 The gun is tilted from the vertical loading position to the exploding or expanding position 29 by means of a piston rod 32 working in cylinder 33, connected by a crosshead 34 to bosses 35 on the cylinder body.

50 The movement of a piston in cylinder 33 is best effected by steam and this is controlled by manually operated valve 36. When in vertical position the gun rests against a cross bar 37 of

the hopper frame 28. When moved to the angular expanding position the cylinder 20 of the gun is caught and held by hooks 40 attached to each side of the neck 41 of expander body 6. These hooks engage trunnions 42 on each side of gun cylinder 20.

When in expanding position the gun cylinder 20 is aligned with neck 41 of the expander 6. This latter is preferably made of metal and may be a single casting or may be fabricated from sheets and sections of heavy sheet metal bolted or welded together. The neck 41 is shaped to constitute an open angle L to give the expanding fiber a resultant general horizontal direction. The body of the expansion chamber is generally trumpet shaped extending from its small end at the neck to wide flanges at its outer end which are bolted to the adjacent near wall of expansion chamber 7.

Built integral with the expander body and above neck 41 is the gun cylinder closing mechanism 5. A ram shaft 45 operates in guides in the frame cage 46 and is positioned so that its axis coincides with that of cylinder 20 when in the angularly tilted expansion position. In this position the port 30 is in register with a ball plug 31 on the lower end of this shaft.

Ball plug 31 is sized, shaped and ground to fit the beveled edge of port 30. The upper end of the ram shaft carries a piston 48 which operates in a dash pot cylinder 49. This is filled with oil which flows from above the piston to its under side when the shaft moves upward. Oil escapes through the varying depth slotted port 50, which is cut and proportioned to reduce the speed of opening movement of the ball plug to the desired degree. The angular upwardly decreasing depth of this port slows the plug shaft and piston assembly progressively. On the downward motion of the piston movement of oil to its top side is facilitated by check valve 51.

Attached to that portion of ram shaft 45 which moves within the frame cage 46 is a drum or thimble 52 firmly pinned and keyed on. This thimble is faced with friction resistant material such as brake lining.

A yoke 53, made of two superimposed parts, is supported on and driven longitudinally relative to the ram shaft by two jack screws 54 and 55 within the frame cage. In the central portion of the yoke there is an opening which contains a contracting band clamp 57. The circular inner face of this clamp is proportioned to grip the periphery of drum 52 when it is closed. Two lugs 59 extend outward from its bottom rim to prevent upward movement of the clamp relative to yoke 53. The clamp is otherwise retained in the yoke by brackets 60 and 61 which are positioned within a slot 62 between the upper and lower halves of the yoke. A lever 63 and link 64 connect and clamp brackets respectively to effect constriction, and the outer end of lever 63 is connected to the armature 65 of a large and powerful solenoid 66.

Jack screws 54 and 55 are turned together through worm and sector gearing 67 by a high torque reversible electric motor 70, controlled manually by switches (not shown but readily understood to those familiar with motors).

When solenoid 66 is energized the drum 52 is gripped by band clamp 57 and ram shaft 45 locked to yoke 53. The ram shaft and plug may thus be made to move with the yoke and effect a closure of port 30 by plug 31 when the gun is in expanding position. As pressure is applied

to the port rim by the plug, cylinder 20 backs away slightly but is retained in position by hooks 40. This forms an effective mechanical means for closing or sealing the loading and discharge port 30 of the gun cylinder. Band clamp 57 may be instantly released by de-energizing solenoid 66. Band clamp is made of spring metal normally tending to open and to assume an interior diameter greater than that of the outside of drum 52. Upon breaking the circuit energizing the solenoid the clamp and the yoke 53 are immediately disengaged from drum 52 and ram shaft 45. This mechanism forms an effective mechanical means for instantly opening port 30, to allow expansion. When this is done with pressure in cylinder 20 piston 48 in dash pot 49 absorbs the shock of the sudden outward movement of the closing assembly including the plug 31, ram shaft 45 and drum 52.

The fiber receiving chamber 7 is preferably built of reinforced concrete and made in the shape of a rectangular trough. In the bottom of this structure there is a flexible conveyor belt 71 running over a roller 72. This belt runs through a slot in the lower portion of its far wall 73 and extends onto a second roller (not shown) positioned at a place where it is desired that the fiber be deposited. This belt may be driven by any conventional means and constitutes an efficient means for removing fiber from the bottom of the receiver. The forward end of this receiver is shown in this view with a portion broken away to illustrate the construction and means of attachment of the expansion chamber 6 to the fiber receiver. It is to be noted that the near wall of the receiver 75 is open to communicate directly with the mouth of the expansion chamber.

A number of water pipes 74 extend laterally across the top of the receiver structure resting in notches along the top edges of its sides 77. These pipes are spaced throughout the length of the trough, shown particularly in Figure 2. Pipes 74 are all interconnected by a header 76 connected to a source of water supply. The lower sides of these pipes are drilled along their lower sides as shown particularly at 88, Figure 1. When water is introduced into these pipes through the header 76 a downward spray is formed throughout the entire area of the fiber receiver. Water is removed through a drain pipe 80.

Spaced laterally on the cross pipe 74 there are a number of loosely suspended swinging fiber stops 78. These are made of heavy rod, bent and hooked over the cross pipes at the top, and they are spaced as shown in Figure 2, in alternate positions on the successive pipes. As fiber is ejected from the expansion chamber these stops catch it. In practice, the fiber comes out in strands or hanks usually wholly separated from fragments of the leaf envelope. These hanks of fiber engage these several rods and the force with which they are ejected is absorbed by the weight and the loose swinging motion of these rods. Some portions of the fiber may strike the walls or the far end of the receiving chamber or fall directly on belt 71. However, the spray is maintained in sufficient volume so that all fiber including those portions caught by the rods 78 as well as those portions striking the trough walls are quickly washed down and onto belt 71. This spray also tends to condense the steam

as it enters this chamber and thus reduce the force of the explosion.

In operation leaves are deposited into hopper 2, the expansion gun cylinder 20 is brought into vertical loading position as shown in solid lines in Figure 1. Loading ram 3 is then operated by manipulation of valve 18, until sufficient quantity of leaves are forced through the opening 13, port 30 of the gun, and cylinder 20 to practically fill it. Thereupon, the cylinder is moved to the position indicated by the dotted outline 29. This is done by manipulation of valve 36 causing the cylinder 33 to force the yoke 34 forward. This angular position is known as the loading position and the expansion gun cylinder is caught and retained in this position by the hooks 40, as above explained.

Motor 70 is then set in motion and the solenoid 66 energized so that yoke 53, ram shaft 45 and plug 31 move together to the closing position shown in the figure. In this position plug 31 closes port 30 of the gun cylinder. The motor 70 is stopped when this closure is effected but power is kept on solenoid 66.

Live steam is then introduced from pipe 26 into cylinder 20 by manipulation of valve 25. It has been determined that steam between 150 and 200 pounds pressure per square inch is sufficient to effectively permeate the envelopes of all ordinary fiber bearing leaves to be treated as herein contemplated. This pressure is maintained in cylinder 20 long enough to effect this purpose and so that all parts of the load are brought in contact with this steam pressure. Valve 25 is then closed and solenoid 66 de-energized by breaking the electrical circuit which energizes it. Clutch band 57 then immediately springs open and drum 52 is released. Pressure within the cylinder forces plug 31 upward to the position indicated by the dotted outline. Since this force is considerable the dash pot 49 must be used to absorb it and prevent disruption of the closing mechanism.

Immediately upon the opening of port 30 the contents of cylinder 20 forcefully expand and are directed by the neck portion 41 through the main body of the expansion chamber 6 into the fiber receiving chamber 7. This rapid expansion causes a disruption of the envelope of all the leaves packed within cylinder 20. Pulpaceous matter surrounding the fibers within the leaves is reduced by the temperature and moisture of the steam to a viscous fluid. This fluid is sprayed and deposited within the chamber 7 and quickly thinned and dissolved in spray water. The leaf envelope is, in all cases, completely disrupted and is collected and washed away along with this pulp through the bottom of the chamber 7 and into drain 80. Fiber contained within the leaves is ejected into the fiber receiving chamber in a haphazard fashion. Most of this fiber is in hanks or bunches, the strands retaining the same relative position they occupy within the leaf before disruption.

These bunches of fiber are deposited within the chamber 7, some upon the side and far end walls but principally upon the yieldable fiber catching elements or bars 78. These bars are made heavy enough so as not to be blown back too violently by the expansion and contact of fibers but light enough so that they will bend backward to some extent and absorb the shock of the impact of the fiber masses without excessive tearing of the fiber strands. The charge

of steam accompanying expansion is almost instantly condensed by the spray and the force of expansion thus greatly diminished. The spray from pipes 74 also washes fiber down from the sides of the chamber as well as from the rods 78 and these bunches of fiber are collected on the screen conveyor belt 71 and conveyed out of the chamber to a convenient place of deposit.

While I have indicated certain specific devices and mechanisms for attaining the results herein desired, I realize that to those familiar with the art various changes and modifications will suggest themselves, all of which, however, may well remain within the spirit of the invention and, therefore, I wish to be limited only by the following claims.

I claim:

1. Mechanism for separating fiber from the remaining portion of fiber bearing leaves, including, in combination, an expansion gun having a port at its upper end and being pivotally mounted at its lower end to swing from a loading position to an expanding position, means for introducing live steam into said gun and means for moving it from loading to expanding position, a loading hopper, a ram operative in said loading hopper adapted to forcefully load and compress leaves through said port into said gun when in loading position, mechanism for closing said gun port when in expanding position provided with a closure release to effect rapid opening of said closure mechanism, an expansion chamber adapted to surround said port when in expanding position constructed to direct the expanding contents of said gun into a fiber receiving chamber, and a fiber receiving chamber provided with a plurality of spaced yieldable stops to catch fiber contained within the expanded mass ejected from said gun.

2. Mechanism for recovering fiber from fiber bearing leaves including, in combination, an expansion gun having a port at its upper end, a pivotal mounting at its lower end and means, including a piston and cylinder adapted to move said gun from a vertical loading position to an inclined expanding position, means for introducing live steam into said cylinder when in expanding position to a pressure desired, mechanism for closing said gun port when in expanding position, including a plug mounted on a ram shaft adapted to be set into said port by pressure applied through a yoke mounted on jack screws and turned by gearing from a motive source, mechanism for quickly releasing said ram shaft from said yoke to effect instant opening of said port, a neck surrounding said gun port when in expanding position adapted to direct products of expansion from said gun port through a trumpet shaped body of progressively increased sectional area into a fiber receiving chamber, and a fiber receiving chamber of general rectangular shape having an open top and solid side and far end walls, with the near wall opened to communicate with said expansion chamber, a plurality of yieldable fiber stopping drop rods positioned in spaced relationships within said fiber receiving chamber, means for spraying said rods and the interior of said chamber, and mechanism for removal of fiber from the bottom of said chamber.

3. In mechanism, as herein described, for separating fiber from fiber bearing leaves, having an expansion gun, having a cylinder provided with a loading and expanding port and trunnions on said cylinder body, mechanism for closing said port to hold against steam pressure applied there- within and to provide for quick release from said

closure when desired, including a pair of hooks adapted to engage said trunnions and hold said cylinder body in alignment with a closing plug, a closing plug mounted on a ram shaft, adapted to move axially to effect seating of said plug in the port of said cylinder, screw mechanism for seating said plug on said port, mechanism for releasing said screw mechanism from said plug and ram shaft, and a piston and dash pot operative on said ram shaft to cushion and absorb the energy of opening when said ram shaft is released with pressure in said cylinder.

4. In mechanism, as herein described, for separating fiber from fiber bearing leaves, having an expansion gun having a cylinder provided with a loading and expanding port and trunnions on said cylinder body, mechanism for closing said port to hold against steam pressure applied therewithin and to provide for quick release from said closure when desired, including a pair of hooks adapted to engage said trunnions and hold said cylinder body in alignment with a closing plug, a closing plug mounted on a ram shaft adapted to move axially to effect seating of said plug in the port of said cylinder, screw closing mechanism for forcing said ram shaft and plug into closed position and quick release mechanism including a releasable axially operating band clutch operable intermediate said ram shaft and said screw closing mechanism, together with a piston mounted on said ram shaft and operative in a dash pot to absorb the opening movement energy of said ram shaft when said plug is quickly opened with steam pressure in said gun cylinder.

5. In mechanism, as herein disclosed, for separating fiber from fiber bearing leaves, said mechanism including an expansion gun having a cylinder provided with a loading and expanding port and trunnions on said cylinder body, loading mechanism adapted to forcefully pack leaves to be expended into said cylinder including a hydraulic piston adapted to maintain said cylinder in vertical loading position, a hopper positioned above said cylinder having a bottom plate with a feeding opening therein in register with the loading port in said cylinder when in said vertical position, and a pneumatically operated loading ram positioned above said feeding opening adapted to force leaves contained in said hopper through said loading port and to pack them into said cylinder.

6. In mechanism, as herein described, for separating fiber from fiber bearing leaves, having an expansion gun adapted to forcefully expand a mass of fiber bearing leaves loaded therein after these are subjected to steam pressure, a fiber receiving chamber adapted to receive and wash fiber ejected from said gun comprising a trough shaped body having a solid side and far end walls and an open top bridged by a plurality of water spray pipes, and a plurality of vertically positioned yieldably suspended fiber catching elements positioned in spaced relationship throughout the area of said chamber and means for removing fiber from the bottom of said chamber.

7. Mechanism for separating fiber from fiber bearing leaves, including in combination, a swingably mounted expansion gun, adapted to move from a vertical loading position to an expanding position, means for forcefully loading said gun when in loading position, mechanism for releasably closing said gun when in expanding position, means for injecting steam into said gun, an expansion chamber adapted to receive, expand and direct the contents of said gun to a fiber receiving chamber, and a fiber receiving chamber operatively attached to said expansion chamber.

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