Sept. 22, 1931. W. H. MASON 1,824,221

PROCESS AND APPARATUS FOR DISINTEGRATION OF FIBROUS MATERIAL

Filed Oct. 24, 1928 2 Sheets-Sheet 1

Fig. 1

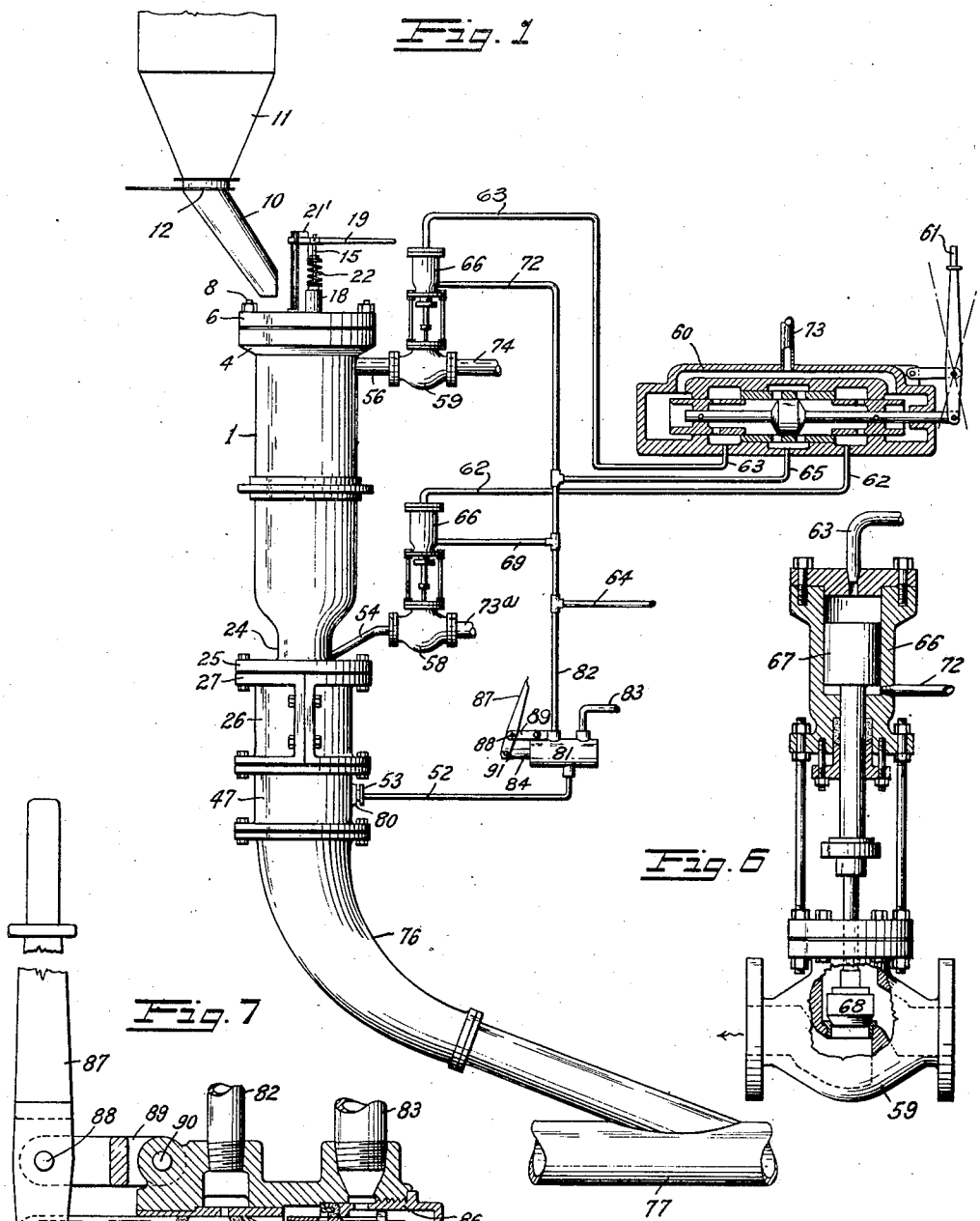

Fig. 6

Fig. 7

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Fig. 2

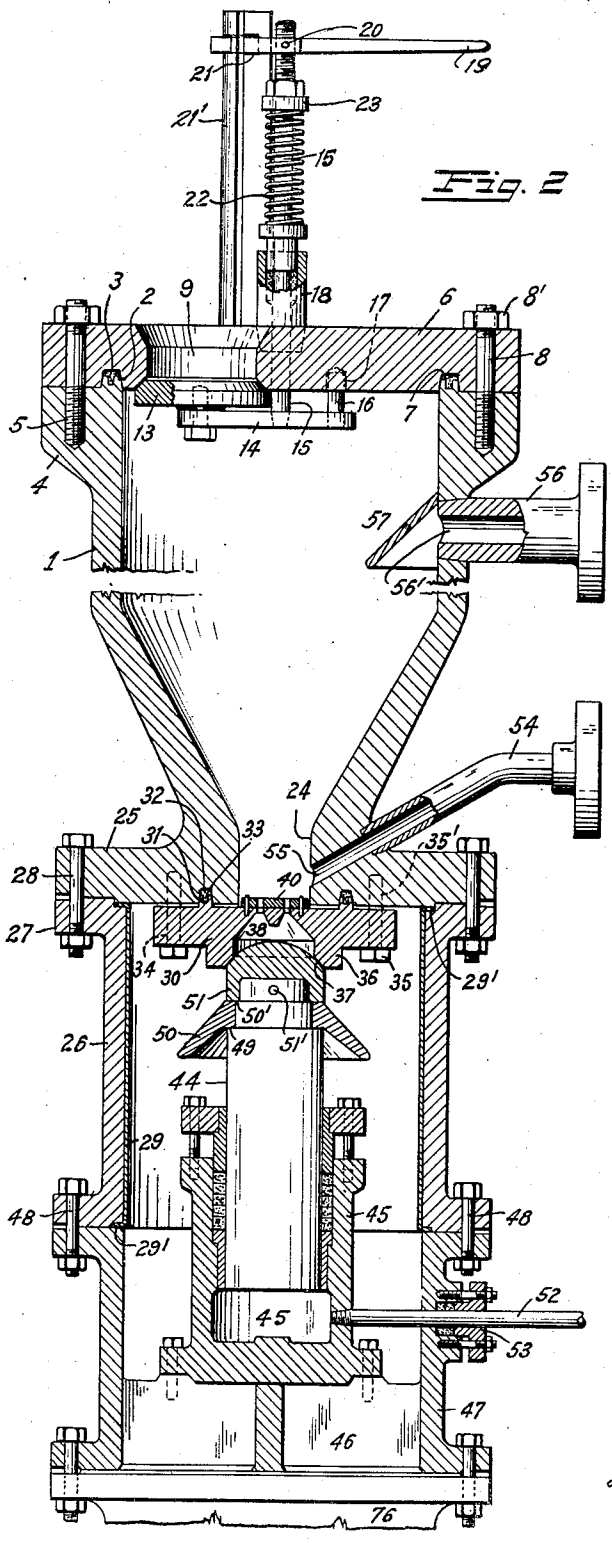


Fig. 5

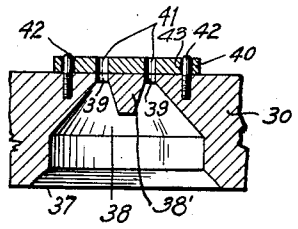


Fig. 4

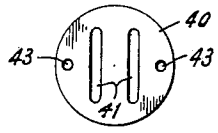
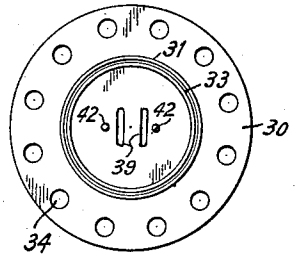


Fig. 3



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UNITED STATES PATENT OFFICE

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PROCESS AND APPARATUS FOR DISINTEGRATION OF FIBROUS MATERIAL

Application filed October 24, 1928. Serial No. 314,812.

My invention relates to a process and apparatus for the disintegration of fibrous material, for example, wood chips, in which the material in a closed chamber or gun is subjected to penetration by an elastic fluid such as steam or other gas or vapor at very high pressure and is thereupon progressively discharged therefrom through a constricted opening into a region at low pressure, for example, atmospheric pressure, whereupon the elastic fluid within the pores and interstices of the material by expansion quickly and thoroughly disintegrates the material into a mass of loose fibre.

Such a process and apparatus are disclosed and broadly claimed in U. S. Letters Patent No. 1,578,609, granted to me on March 30, 1926. The present process relates to improvements thereon in the manner of controlling and applying the steam or other fluid to the material in the pressure chamber, and in the manner of controlling the discharge therefrom. The present apparatus relates to special valve means for controlling the discharge of material and fluid from the pressure chamber, and hydraulic means for controlling such valve means. The improved apparatus also includes hydraulic means for controlling the admission of steam or other elastic fluid to the pressure chamber and various details of construction as hereinafter set forth and claimed.

Reference is hereby made to the accompanying drawings of which Figure 1 is a side elevation of an apparatus constructed in accordance with my invention.

Fig. 2 is a vertical sectional view, partly broken away, showing the pressure chamber and its discharge valve and means for controlling the same.

Fig. 3 is a plan view of the discharge valve plate.

Fig. 4 is a plan view on a larger scale of the wear plate which is associated with the discharge valve plate.

Fig. 5 is an enlarged detail section of a portion of the valve plate with wear plate mounted thereon.

Fig. 6 is a side elevation, partly in section, of one of the steam valves with hydraulic means for operating same.

Fig. 7 is a vertical section of the hydraulic valve for operating the ram which closes the discharge opening of the gun.

In the apparatus shown the pressure chamber is within a vertical cylinder or gun 1 of a strength suitable for resisting very high internal pressure, for example pressure in excess of twelve hundred pounds per square inch. This cylinder is preferably formed of a single piece. Its upper end is provided with an annular rib 2 of tapered cross section and having a groove 3 in its face or upper surface for insertion of compressible packing material. The cylinder also has a flange 4 provided with a large number of threaded bores 5.

The upper end of the cylinder 1 is sealed by the cap plate 6 which is provided with an annular groove 7 of tapered cross section and adapted to receive the rib 2. Vertical threaded studs 8 having nuts 8′ are provided for firmly uniting the cap 6 to the cylinder 1. There is a feed opening 9 formed in cap 6 by which the raw material, as for example wood chips, may be fed into the cylinder at any desired time from the chute 10 which is supplied from the hopper 11, the supply being controlled by a sliding gate 12. The opening 9 may be closed by the valve 13 which is mounted on an arm 14 carried on the lower end of a vertical operating rod 15. The arm 14 is provided with a positioning pin 16 which engages a bore 17 formed in the lower surface of the plate 6, whereby upon depressing the rod 15 the arm 14 and valve 13 will be correspondingly depressed, and upon rotating the rod 15 the valve 13 will be moved to one side so as to fully uncover the feed opening.

A suitable stuffing box 18 is provided to permit the rotation and sliding movement of the rod 15 without escape of steam from the cylinder. The means for operating the rod 15 comprises a hand lever 19 pivoted at 20 to said rod. A coil spring 22 surrounds the rod 15, and normally holds the same in an elevated position, the lower end of the spring pressing against the movable member

or stuffing box 18 and the upper end against the collar 23 adjustable upon said rod. The short end of lever 19 engages a slotted opening 21 formed in a standard 21′ secured to the cap 6, said opening 21 permitting horizontal movement of said lever through an angle of approximately 90°.

The lower end of the cylinder 1 is tapered to form a hopper having a portion 24 of reduced cross sectional area. At this point the cylinder 1 is provided with a horizontal flange 25 to the lower surface of which is secured a cylinder 26. The upper end of the cylinder 26 is provided with a flange 27 which is united to the flange 25 of cylinder 1 by bolts 28.

In order to facilitate access to the interior of the cylinder 26 the same is preferably made of semi-cylindrical parts one of which may be removed without affecting the other, or the parts above and below to which it is united.

A bushing 29, preferably of bronze, is provided to protect the interior of the cylinder 26 against wear due to the discharge of steam and fibrous material from the cylinder 1. This bushing is also made of a pair of semi-cylindrical parts, one of which may be removed along with the corresponding portion of cylinder 26. Each half of bushing 29 is provided with upper and lower integral flanges 29′, which occupy recesses in the ends of the cylinder 26 and are clamped in such position by the action of the holding bolts 28 and 48.

On account of the fact that elastic fluid at very high pressure must be retained for an interval within the cylinder 1 and thereupon discharged therefrom, a problem is involved in the designing of valve means for controlling the retention and discharge of the elastic fluid.

In my earlier apparatus, as shown in Patent No. 1,578,609 previously mentioned, the valve means comprises a constricted outlet or port in the form of a slot and a balanced valve piston is movable transversely across the slot to close and open it, and in Patent No. 1,655,618 granted to me on January 10, 1928, another form of valve is shown which however depends upon the closing of slot shaped ports by a movable member, in this case an oscillatory hollow cylinder, by which means pressures are substantially balanced.

The present structure is a wide departure in principle from the valve means referred to, in that although ports of small cross section, preferably in the form of slots are used, no closing means are applied directly to the slots and the pressure of escaping fluid is not balanced with respect to the movable part of the valve.

According to the present invention, the discharge valve includes a fixed member or body having a chamber which communicates with the pressure chamber of cylinder 1 through small ports, preferably formed as slots, said chamber also having a valve seat of much greater area than the area of the ports and adapted to be closed by a movable member, which in its preferred form is an axially movable hydraulic ram which can be held in contact with the valve seat by hydraulic pressure which can readily be sufficient to overcome the pressure of the elastic fluid within the cylinder 1 and valve body, or released to permit its discharge.

In the structure shown, a fixed valve member or body 30, preferably of manganese bronze, is provided. The upper surface of this member is flat, except for an annular rib 31 of tapered cross section which engages a similarly shaped groove 32 in the lower surface of the end of the cylinder 1. There is a groove 33 formed in the face or upper surface of the rib 31 for insertion of compressible packing material to insure a tight joint. The valve body 30 is provided with a large number of drill holes 34 to receive the holding bolts 35 and said bolts engage threaded bores in the cylinder 1 whereby the valve body is firmly united thereto.

The lower surface of the valve body 30 is formed with an annular rib 36, the interior lower edge of which is spherically ground to form a valve seat 37. Within the valve body above said seat is a chamber or recess 38, the lower portion of which is of circular cross-section, and the upper portion tapered as shown. There are a pair of narrow ports in the form of slots 39 forming constricted openings through which the chamber 38 communicates with the lower end 24 of the pressure chamber of cylinder 1, and between said slots the wall of the valve body is formed as a web 38′ of substantial depth, and of tapered cross section, so that the cross section of the chamber 38 increases in the direction of discharge from a point immediately below the ports 39. The valve seat 37 is at a substantial distance from the ports 39, and its diameter, as shown, is much greater than the width of the ports.

In order to protect the ports 39 of the valve body 30 against excessive wear, a wear plate 40 of suitable material, for example manganese bronze, is provided. This plate, preferably circular in form, is provided with slotted ports 41, which are adapted to register with the ports 39 when the plate 40 is in operative position and such plate is normally retained in such position by a pair of dowel pins 42 which are threaded in and rigid with body 30 and engage suitable openings 43 formed in the wear plate 40. The plate 40 may be removed from its operative position for purposes of replacement, etc., by means of a rod having a hook at its lower end which may be inserted through the feed opening 9 and the hook caused to engage plate 40 by one of the slots 41, or otherwise, whereupon the plate 40 may be lifted from its position and removed from the cylinder 1.

A new wear plate exactly similar thereto may then be lowered through the opening 9 and by suitable manipulation seated upon the valve body 30 with the dowel pins 42 passing through the openings 43.

In order to close the lower end of the chamber 38 of the valve plate 30, I provide a hydraulic ram or plunger 44 suitably mounted in an operating cylinder 45 which is bolted to a spider 46 integral with the cylinder 47, the latter being secured by bolts 48 to the lower end of cylinder 26. The cylinder 47 is also secured to the upper end of the discharge pipe 76.

The upper end of the ram 44 is provided with a shoulder 49 upon which is removably seated a conical deflector 50, and above the same is a removable valve cap 51 which is ground to fit the valve seat 37. This cap is seated upon a shoulder 50′ formed on the ram and upon the upper surface of the deflector 50 and is pinned to the end of the ram by a pin 51′. The parts 50 and 51 may be made of manganese bronze.

A pipe 52 is threaded within the cylinder 45 to control by hydraulic means the position of the ram 44 so as to either hold the same against the fluid pressure within the cylinder 1 or permit said pressure and gravity to move the ram downward to open the discharge valve and permit escape of steam and fibrous material from the cylinder 1. This pipe 52 passes through a suitable gland 53 mounted on the cylinder 47 and thence to a hydraulic 3-way valve 81. This valve may be of any desired construction. As shown, the valve body 81 is provided with openings within which are respectively threaded a pressure pipe 82, an exhaust pipe 83 and one end of pipe 52. A piston or plunger 84 is slidable within bushings 85, 86 rigid with said body and an operating lever 87 is pivoted at 88 to a link 89 which is pivoted at 90 to the body 81.

The lower end of lever 87 is pivotally connected at 91 to the outer end of the piston 84 and the parts are so arranged that when the lever 87 is in the position shown in Fig. 7 no water can flow into the valve 81 from pipes 82 and 52.

When the lever is moved to the right the piston moves to the left sufficiently to cause water from pressure pipe 82 to flow through pipe 52 to cylinder 45 thereby elevating the ram until it contacts with valve seat 37 to close the valve, the hydraulic pressure being sufficient to hold the ram against the maximum steam pressure which will be used in the cylinder 1.

When the lever 87 is moved to its extreme left hand position, the piston 84 first acts to shut off the connection between pipes 82 and 52, and thereafter establishes a connection between pipes 52 and 83, whereby the weight of the ram and the pressure of steam within cylinder 1 will cause the ram to descend and open the discharge valve of said cylinder.

Means are provided for permitting the entrance of steam into the cylinder 1 at its lower and also at its upper end. The said means comprise a pipe 54 threaded in the wall of cylinder 1 at or near its lower end so that the bore thereof registers with the inlet 55 formed in the wall of the cylinder, and another pipe 56 which is threaded in the wall of the cylinder at or near its upper end to thereby form an inlet 56′. A deflector 57 is preferably provided within the cylinder so that the wall thereof opposite the inlet 56′ will be protected against wear caused by inrushing steam or other gaseous fluid. The flow of steam through the inlet pipes 54 and 56 is controlled by valves 58 and 59, Fig. 1, said valves being preferably operated by hydraulic means of any desired form. The particular hydraulic means for operating said valves is not important, as any well known control may be used. I have therefore shown in Fig. 1 in somewhat diagrammatic or simplified form a 4-way hydraulic valve 60 by which the steam valves are operated, as follows:

The hydraulic valve 60 is provided with a controlling lever 61. This lever has three positions.

When the lever 61 is in central or neutral position, the pressure pipe 65 which is supplied from the main pressure line 64 is connected to pipes 62 and 63 and through such pipes with the hydraulic cylinders 66 of both of the steam valves 58 and 59. The pipes 62 and 63 enter their respective cylinders above the pistons 67 which are united to the movable valve heads 68 of said valves. The lower surfaces of pistons 67 are continuously subjected to pressure of fluid from pressure pipe 64 through the pipes 69 and 72 respectively. However, since the upper surface of the piston is of greater area than the lower, the pressure thereon overcomes that from below and holds each of the steam valves tightly closed, in which action it is aided by the pressure of the steam itself.

When the lever 61 is moved to the left the upper steam valve 59 is unaffected and remains closed, and the pipe 62 is connected to the exhaust 73. This relieves the pressure above the piston 67 of valve 58 and the pressure upon the lower surface of the piston derived from the pressure pipe 69 causes upward movement of the piston which opens the steam valve 58.

As the lever 61 is moved from its left hand to neutral position, the connection between pipe 62 and exhaust 73 is broken, and pipe 62 is connected to pressure pipe 65 whereupon the excess of pressure above the piston 67 with respect to that below causes its descent and closes the steam valve 58. As the lever 61 is moved from neutral to its right hand

position the pressure in pipe 62 is unaffected so that valve 58 remains closed and pipe 63 is connected to exhaust 73 whereupon the pressure below the piston 67 of valve 59 due to the fluid from pipe 72 causes the piston to rise and open the steam valve 59. Movement of lever 61 from right hand to neutral position brakes the connection of pipe 63 with the exhaust 73 and restores the connection of pipe 63 with pressure pipe 65, thereby causing the descent of the piston 67 and the closing of the steam valve 59.

In the operation of the apparatus to carry out my improved process and assuming the control lever 61 to be in neutral position, the control lever 87 in right hand position and the parts in position shown in Fig. 2, the operator depresses the lever 19 thereby opening the feed inlet 9 and by a horizontal movement of the lever swings the valve 13 to one side of the inlet opening. The gate 12 is opened to permit the discharge of chips through the chute 10 through said inlet into the pressure chamber of the gun or cylinder 1, practically filling the same, whereupon the gate 12 is closed and by reverse movement of the lever 19, the valve 13 is seated in position shown to tightly close the inlet 9.

The hydraulic controlling lever 61 is thereupon moved to its left hand position, thereby opening the steam valve 58. This causes a flow of steam at a comparatively low pressure from the steam pipe 73ª through the valve 58 and pipe 54 into the pressure chamber at a point adjacent its discharge ports The steam so admitted is preferably at a comparatively low pressure, for example one hundred pounds per square inch, although lower or higher pressures may be used, and if desired such pressure may be obtained by suitably throttling the high pressure steam which supplies the upper steam valve as will be hereinafter described. The low pressure steam referred to may be supplied through valve 58 for a period of fifteen seconds, although this time is also subject to variation depending to some extent on the pressure of the low pressure steam. The lever 61 is then moved to neutral position thereby causing the closing of the steam valve 58 and it is then immediately shifted to its right hand position. This causes the opening of the upper steam valve 59 by which steam at very high pressure is admitted from supply pipe 74 through valve 59 to pipe 56.

The high pressure steam may be at a pressure of one thousand pounds per square inch, although obviously somewhat lower or higher values may be used. Within one or two seconds the operator begins discharging material and steam through the discharge valve of cylinder 1 by shifting the lever 87 from its right hand to left hand position thereby causing the descent of the hydraulic ram 44 from the position shown and opening the discharge valve of cylinder 1. The chips forced by high pressure steam thereupon escape rapidly through the ports 41 and 39 of the wear plate and discharge valve member into a region at substantially atmospheric pressure, whereupon the expansion of the steam which has filled the pores and interstices of the material while in the pressure chamber causes the chips to be instantly disintegrated into loose fibres which by the rapidly moving steam are carried through the discharge pipe 76 into the manifold 77.

The supply of high pressure steam to the pressure chamber is continued until substantially all of the material has been discharged from the chamber, at which time the whistling sound of steam escaping through the ports of the discharge valve becomes audible to the operator who immediately shifts the lever 61 from the right hand to neutral position thereby closing the steam valve 59. He thereupon operates the hydraulic valve lever 87 from its left to its right hand position thereby causing a flow of fluid through the pressure pipe 52 into the cylinder 45 and elevating the ram 44 into the position shown, whereby the discharge valve of the gun 1 is closed.

The period of discharge may be from 3 to 5 seconds, or more or less, being dependent upon the pressure of the steam, the size of the chips, the size of the gun, the amount of moisture in the chips and the size and number of the valve ports. After the normal time of discharge with a given apparatus and material has been determined, it is possible to conserve high pressure steam by shutting it off just before its escape through the valve ports would become audible by a whistling sound, as above described.

The process described is very advantageous in that the preheating of the material with low pressure steam causes a softening thereof without subjecting it to an excessive temperature, by which the character of the product might be unfavorably affected.

Furthermore, the application of low pressure steam to the material at a point adjacent the discharge ports of the pressure chamber softens first the material which will be first discharged and the stem progressively acts upon and softens the material at points more and more remote from the discharge opening and which will be later discharged. Such application of steam provides for a more uniform heating of the raw material than where the steam is applied at a point remote from the discharge opening, since in the latter case the material first contacted by the low pressure steam would be heated longer than material between it and the discharge opening. Another advantage of introducing steam at the bottom of the gun is to prevent the chips at such point from becoming submerged by condensed steam which would interfere with

the thoroughness of their disintegration when discharged from the gun. At the time the high pressure steam is admitted to the pressure chamber the material has been so softened by the low pressure steam that not more than one or two seconds are required for penetration of its pores and interstices by the high pressure steam, and the discharge valve can then be opened for the purpose of forcing the material through the ports of the discharge valve, whereby overheating or charring of the material is avoided. The high pressure steam is preferably admitted at a point near the upper end of the pressure chamber although it might be admitted at some other point so long as it did not interfere with the descent of the material by gravity to the bottom of the pressure chamber and its substantially continuous discharge therefrom.

It will be understood that the values of steam pressure which have been mentioned and the lengths of time during which the pressure is applied are subject to variation, and my invention is not limited thereto but includes all such apparatus and methods as come within the scope of the claims.

Having now disclosed my invention, what I claim is:

1. In an apparatus of the class described, a discharge valve member having a circular valve seat, a recess interior thereto, and an aperture extending from said recess through said member, the cross-section of said aperture increasing in the direction of discharge, and being substantially less than that of the valve seat.

2. In an apparatus of the class described, a discharge valve comprising a member having a circular valve seat, a recess interior thereto, and an aperture extending from said recess through said member and so formed that its cross sectional area increases in the direction of discharge, the minimum diameter of the circular valve seat being much greater than the minimum width of said aperture.

3. In an apparatus of the class described, an elongated vertically disposed body having a pressure chamber, means for closing the lower end of said pressure chamber, said means having one or more ports, movable valve means for closing said port or ports, and a wear plate above said pressure chamber closing means and having a port or ports in registry with the port or ports thereof.

4. In an apparatus of the class described, an elongated vertically disposed body having a pressure chamber, means for closing the lower end of said chamber, said means having one or more ports, movable valve means for closing said port or ports, a wear plate having a port or ports in registry with the first named port or ports, said wear plate resting upon the pressure chamber closing means within the pressure chamber and being removable therefrom in a vertical direction, and means for securing said wear plate against movement in a horizontal plane.

5. In an apparatus of the class described, an elongated vertically disposed body having a pressure chamber, means for closing the lower end thereof, said means having one or more ports, movable valve means for closing said port or ports, a wear plate having a port or ports in registry with the first named port or ports, said wear plate resting upon the pressure chamber closing means within the pressure chamber and being removable therefrom in a vertical direction, and means carried by said pressure chamber closing means to secure the wear plate against movement in a horizontal plane.

6. In an apparatus of the class described, an elongated vertically disposed body having a pressure chamber, a discharge valve member at the bottom of said chamber, having a recess and a valve seat on its lower surface, said recess communicating with said pressure chamber through one or more ports of small area as compared with the passage through said valve seat, and a wear plate having a port or ports in registry with the port or ports of said valve member, said wear plate resting upon said valve member within the pressure chamber and being removable in a vertical direction.

7. In an apparatus of the class described, the combination of a valve member having one or more narrow slots extending therethrough, one or more upwardly extending projections and a wear plate having a slot or slots extending therethrough to register with the slot or slots of the valve plate and an opening or openings to receive the projection or projections of the valve plate.

8. In an apparatus of the class described, a cylinder having an open end with an outwardly extending flange, a circular groove of tapered cross section in said flange surrounding said opening, a plate having a circular rib of tapered cross section, means for retaining said rib in engagement with said groove, a port or ports extending through said plate, and valve means for controlling discharge through said port or ports.

9. In an apparatus of the class described, a cylinder member having an open end and a member for closing said end, one of said members having a circular groove of tapered cross-section, and the other a circular rib of tapered cross section, and means for retaining said rib in engagement with said groove, said rib having a groove formed in its face.

10. A valve member having a circular rib of tapered cross section, a port or ports extending through said member within the outline of said rib, and a valve seat surrounding said port or ports.

11. A valve member having a circular rib

of tapered cross section, said rib having a groove formed in its face, a port or ports extending through said member within the outline of said rib, and a valve seat surrounding said port or ports.

12. In an apparatus of the class described, an elongated pressure chamber having a charging inlet adjacent one end and a discharge portion of reduced area adjacent the other end, separate steam connections adjacent the two ends of said chamber, said discharge portion having a port or ports opening directly into a recess of much greater cross-section than the area of the port or ports, and valve means for closing the outlet of said recess.

13. In an apparatus of the class described, an elongated pressure chamber having a charging inlet adjacent one end and a discharge portion of reduced area adjacent the other end, separate steam connections adjacent the two ends of said chamber, means within said chamber for deflecting steam entering the chamber from the connection at the charging end thereof, said discharge portion comprising a port or ports opening directly into a recess of much greater cross-section than the area of the port or ports, and valve means for closing said recess.

14. In an apparatus of the class described, a body having a pressure chamber adapted to hold high pressure steam, a charging inlet, a steam inlet, and a discharge valve seat, a valve to engage said seat, and a hydraulic ram to support said valve against steam pressure within the pressure chamber.

15. In an apparatus of the class described, a body having a pressure chamber adapted to hold high pressure steam, a charging inlet, a steam inlet, an outwardly opening outlet valve, and a hydraulic ram for holding said valve in closed position against the action of high pressure steam within the chamber.

16. In an apparatus of the class described, a cylinder having an end rib of gradually diminishing thickness, a groove formed in the face of said rib, an end plate having a tapered groove fitted upon said rib, and means for securing said plate to said cylinder.

17. In an apparatus of the class described, a body having a pressure chamber adapted to hold high pressure steam, a charging inlet, a discharge outlet, a steam inlet adjacent the discharge outlet, a second steam inlet remote therefrom, and unitary means for admitting steam, first through the first steam inlet alone and thereafter through the second steam inlet.

18. In an apparatus for disintegrating wood or woody material by subjecting same to penetration by elastic fluid, the combination of a pressure cylinder and means for admitting low and high pressure elastic fluid thereto comprising unitary hydraulic means for admitting low pressure fluid only, high pressure fluid only and for shutting off both the low and high pressure fluid.

19. A process for reducing vegetable fibre by disintegration of wood or woody material, which consists in substantially filling a pressure chamber with such material in small pieces unsubmerged in liquid, said chamber having a charging inlet and a constricted discharge opening, admitting steam at a pressure of the order of 100 lbs. per square inch to the chamber only at a point adjacent the discharge opening for a time sufficient to soften the material adjacent said opening and thereafter admitting steam at a pressure upward of 500 lbs. per square inch to the chamber only at a point remote from the discharge opening, opening the discharge opening and progressively discharging the material therethrough while substantially maintaining the high steam pressure.

20. In an apparatus of the class described, a body having a pressure chamber, a constricted discharge port, a chamber exterior to said port, and having a valve seat, and a hydraulic ram movable axially into and out of engagement with said valve seat.

21. In an apparatus of the class described, a body having a pressure chamber, a constricted discharge port, a chamber exterior to said port and having a valve seat and an axially movable piston having at one end a removable valve cap to engage said valve seat.

22. In an apparatus of the class described, a cylinder having a pressure chamber, a body secured to the lower end of said cylinder and having a valve seat, a piston movable into and out of engagement with said valve seat, a second cylinder secured to the lower end of the first cylinder to enclose said body and a discharge trunk secured to said second cylinder, the second cylinder comprising independent sections, removably secured to each other and to said first cylinder and said trunk.

23. In an apparatus of the class described, a cylinder having a pressure chamber, means for closing the lower end of said cylinder and having a valve seat, a piston movable axially into and out of engagement with said valve seat, a deflector on said piston, a cylinder enclosing said valve seat and receiving the discharge therefrom, and a bushing removably secured to the interior of said cylinder.

24. A chambered gun member open at one end, a separate closure member secured thereto, said closure member having on the gun side constricted outlet means for the gun chamber with an enlarged passage therebeyond, an outlet for said passage and means for valving said outlet.

25. In an apparatus of the class described, a body having a pressure chamber, a valve member having a recess communicating with the pressure chamber through a constricted aperture, and a valve seat for the seating of a valve to control flow of material through

said aperture and recess, the area of the aperture being substantially less than that of the passage through the valve seat.

26. In an apparatus of the class described, a body having a pressure chamber, a valve member having a recess communicating with the pressure chamber through a constricted aperature, and a spherical valve seat for the seating of a valve to control flow of material through said aperture and recess, the area of the aperture being substantially less than that of the passage through the valve seat.

27. In an apparatus of the class described, a body having a pressure chamber, a member having a chamber communicating with the pressure chamber through a constricted port and having a valve seat situated at a substantial distance from said port in an outward direction, and a valve member movable into and out of engagement with said valve seat.

28. In an apparatus of the class described, a body having a pressure chamber, a member having a chamber communicating with the pressure chamber through a constricted port and having a valve seat situated at a substantial distance from said port in an outward direction, a valve member movable into and out of engagement with said valve seat, and hydraulic means for operating said movable member.

29. A valve comprising a hydraulic cylinder and piston ram, said ram having at one end a valve cap removably seated thereon, and a member having a valve seat with a passage therethrough, said valve cap seating upon said valve seat.

30. A valve comprising a hydrulic cylinder and piston ram, said ram having at one end a valve surface, a flaring deflector surrounding said ram adjacent said valve surface, and a member having a valve seat with a passage therethrough, said valve surface seating upon said valve seat.

31. A valve comprising a hydraulic cylinder and piston ram, said ram having at one end a valve surface, a shoulder and a flaring deflector surrounding said ram adjacent said valve surface and removably seated on said shoulder, and a member having a valve seat with a passage therethrough, said valve surface seating upon said valve seat.

32. A valve comprising a hydraulic cylinder and piston ram, said ram having at one end a shoulder, a deflector seated thereon, a valve cap seated on said deflector, and a member having a valve seat with a passage therethrough, said valve cap seating upon said valve seat.

In testimony whereof, I have signed my name hereto.

WILLIAM H. MASON.