Nov. 15, 1960 H. J. KNAPP 2,960,245

MATERIAL HANDLING VALVE

Filed Jan. 6, 1958 3 Sheets-Sheet 1

Fig. 1

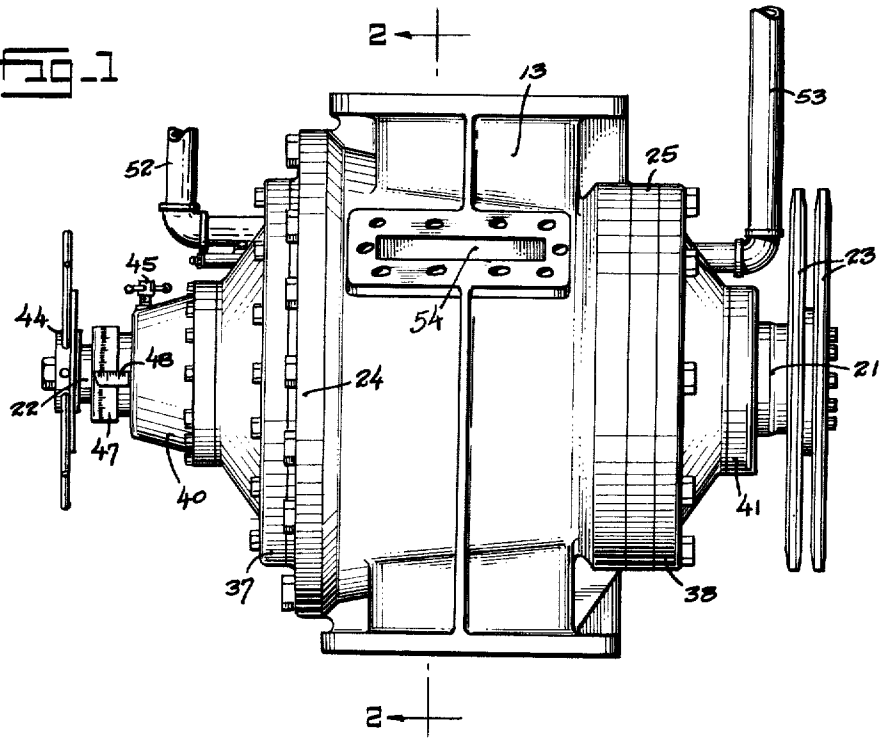
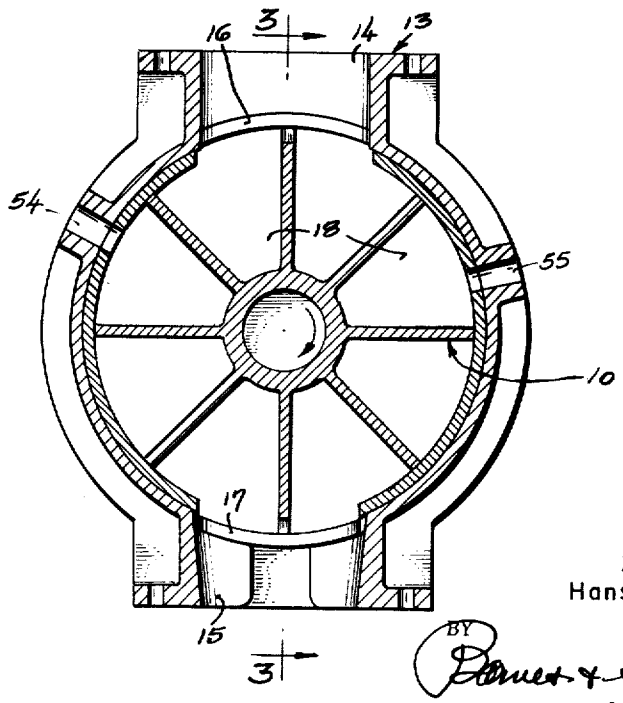


Fig. 2



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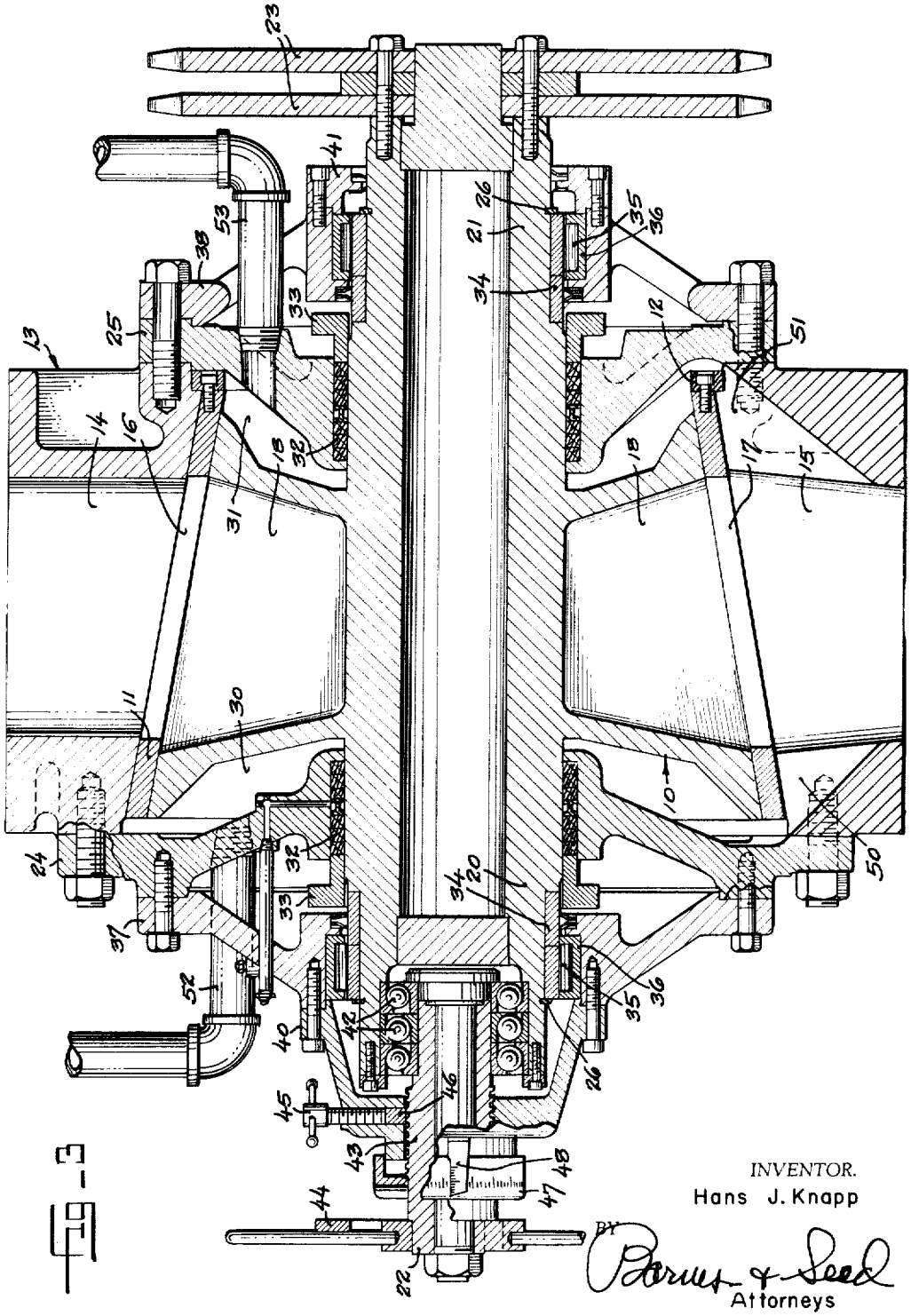

Fig. 3

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MATERIAL HANDLING VALVE

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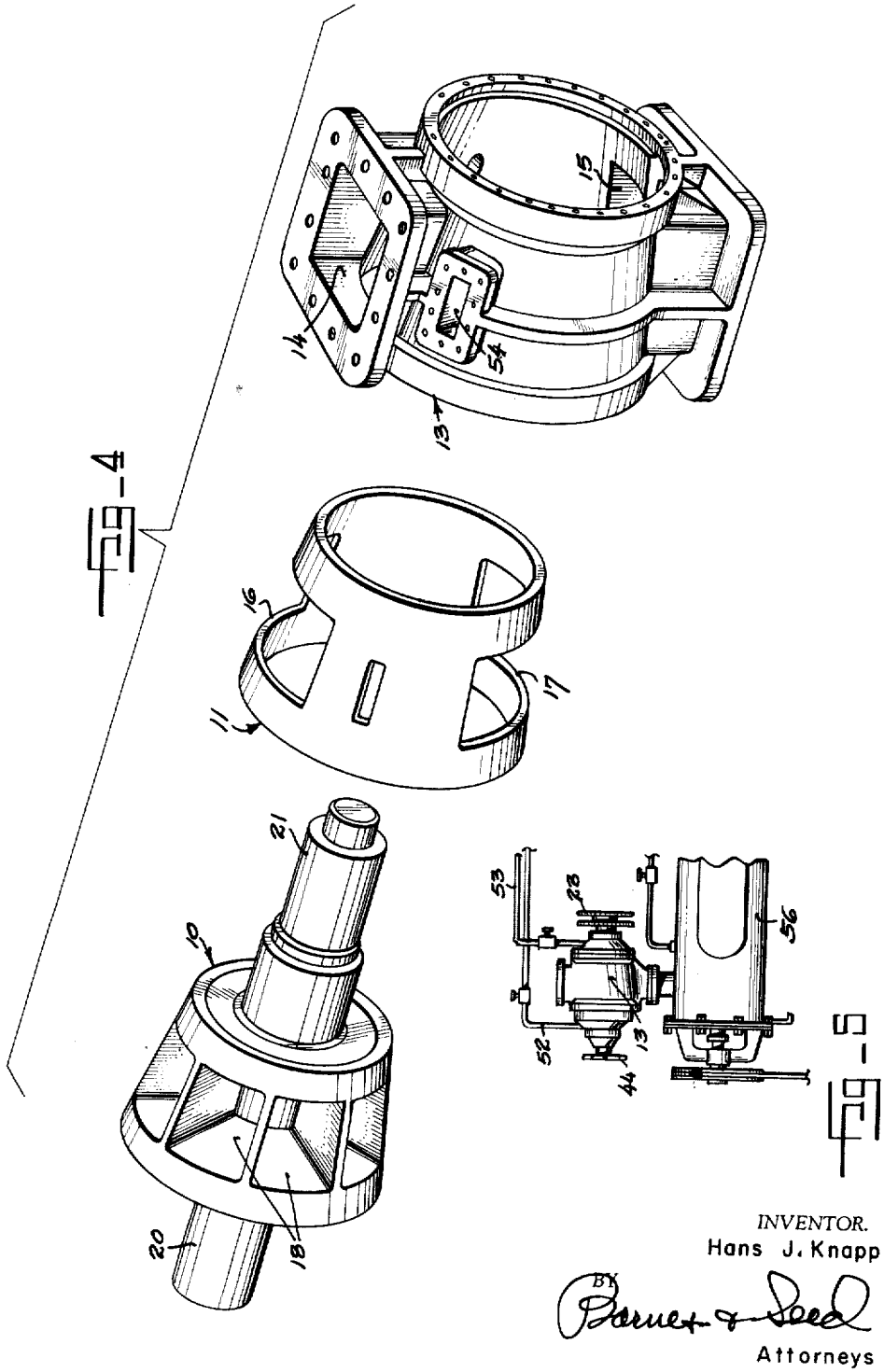

FIG-4

FIG-5

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MATERIAL HANDLING VALVE

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21 Claims. (Cl. 214—17)

This invention relates to material-handling valves, and one which finds especial usefulness in the continuous feeding of wood chips to a digester.

Comprised essentially of a rotor having circumferentially spaced pockets in the perimeter and received for rotation in the mating bore of a valve body so as to move the chips from an inflow to an outflow side with no loss of pressure from the latter, the invention has as its principal object the provision of a perfected valve in which means are provided for continuously flushing the end faces of the rotor to remove therefrom fines which have worked along the seat in which the rotor turns.

As a further object, the invention aims to provide a system in which these flushed fines are reintroduced to the moving body of chips as the latter is charged from the valve to the cooker.

As a yet further object, the invention purposes to provide a system in which the flushing agent comprises steam and/or digesting liquor required in the digesting process, and wherein this steam and liquor is given constant and controlled flow and is blended with the moving body of chips at the outflow side of the valve.

The invention further aims to provide a valve employing a tapered rotor, and having positive-acting means for shifting the rotor in a direction endwise to its axis for both (1) setting the rotor upon its seat and (2) backing off the rotor to give free clearance for periodic steam flushing of the wear surfaces.

With the foregoing objects and advantages in view and otherwise looking to the provision of a valve of generally perfected design and function, all of which will appear and be understood in the course of the following description and claims, the invention consists in the novel construction and in the adaptation and combination of parts hereinafter described and claimed.

In the accompanying drawings:

Figure 1 is an elevational view illustrating a material-handling valve constructed to embody the preferred teachings of the present invention.

Fig. 2 is a transverse vertical sectional view on line 2—2 of Fig. 1.

Fig. 3 is a longitudinal vertical sectional view drawn to an enlarged scale on line 3—3 of Fig. 2.

Fig. 4 is a perspective exploded view of the valve body, the rotor, and a liner which forms the seat for the rotor; and

Fig. 5 is a reduced-scale fragmentary view illustrating the relationship as between the valve and an associated cooking vessel through which material supplied by the valve is moved by a power driven worm or other suitable conveyor.

In its illustrated preferred embodiment, the valve of the present invention provides a frustro-conical pocketed rotor, designated generally by the numeral **10**, journaled for rotation by a liner **11** which is secured by a clamping ring **12** within the tapered bore of a valve body **13**. The valve body and its liner are formed at diametrically opposite sides with inlet and outlet openings, denoted by **14** and **15** in the instance of the body and by **16** and **17** in the instance of the liner. The successive pockets **18** of the rotor register with these openings by rotation of the rotor.

A hub for the rotor is extended fore and aft in the form of cylindrical prolongations **20** and **21**. The prolongation **20** lies at the large end of the rotor and is subjected to endwise force, so as to seat the rotor, by pressure transmitted from a thrust stem **23** hereinafter to be described. The other prolongation **21** has a drive sprocket **23** bolted or otherwise secured thereto. To distinguish the two ends but with no intent to imply any limitation as to placement of the responsible element which performs the function, the end of the valve on which said sprocket wheels are carried will be hereinafter termed the drive end and the other end will be termed the thrust end.

Each such prolongation of the rotor hub is stepped so as to provide an intermediate shoulder separating the extension into an inner and an outer neck with the latter reduced in point of diameter. A respective header, as **24** and **25**, is bolted to the opposite ends of the valve body with its hub portion fitting the concerned inner neck of the rotor prolongations. Each header is so formed that an annular cavity, as **30** and **31**, is provided between such header and the adjacent end of the rotor. The cavity **31** which lies at the small end of the rotor has a diameter at least as large as said small end of the rotor. The other cavity **30** has a diameter moderately larger than the large end of the rotor. Each cavity is sealed along the surface of the inner neck of the rotor's hub prolongation by packing rings **32** and a complementing gland **33**.

Fitted on each outer neck of the hub prolongation and held by a split retaining ring **26** against the shoulder which defines the inner limit of such neck is a respective inner race **34** for a roller bearing. The rollers therefor are denoted by **35** and the outer races by **36**, such bearings being contained by end housings, as **37** and **38**, bolted to the related headers **24** and **25**. Bearing closures **40** and **41** complement these roller bearing housings.

The referred-to thrust stem **22** receives a thrust and journal mounting at the outer end of the hub prolongation **20** from ball bearings **42**, and there is presented on this stem, beyond the prolongation, a threaded portion **43** working in internal threads provided by the closure member **40**. The stem is turned within said threads by an adjusting wheel **44**, and is set in adjusted positions by a lock screw **45** acting upon a locking slug **46**. A vernier dial **47** screwed or otherwise fixed to the thrust stem provides a visual reading by recourse to a scale plate **48** which is carried by the closure member **40**.

Reverting to the cavities **30** and **31**, the same are characterized in that while each is isolated from the inlet opening of the valve body the same communicate by escape passages **50** and **51** with the outlet opening or throat **15**. Pipes **52** and **53** connect one with one and the other with the other cavity, entering at a point therein distal from the escape passages. At opposite sides of the valve body (see Fig. 2) passages **54** and **55** extend to the inside or rotor-seating face of the liner **11**. Passage **54**, this being the passage traversed by the pockets of the rotor as the pockets move from the outlet to the inlet throat of the valve body, is vented to the atmosphere. The other passage **55**, which perforce is traversed by the rotor pockets in course of moving from the inlet to the outlet throat, is fed with steam at a regulated pressure from a high pressure source of steam supply. Steam at the same controlled pressure is also supplied from this source to one of the two pipes **52—53**. The other pipe receives a pumped

volume of digesting liquor flowing at a controlled rate constituting a given fraction of the rate at which chips are supplied to the inlet throat of the valve body to be fed by the rotor through the outlet throat into the associated cooking vessel **56** (Fig. 5). This digesting liquor may be either fresh or it may be comprised of spent liquor supplemented by fresh chemical. It is self-evident that the steam and liquor may, if desired, be merged in advance of their introduction to the valve body and fed to the latter through both pipes **52** and **53**. It is furthermore apparent that liquor and/or steam could, if desired, be charged directly to the head end of the cooking vessel, either as a supplement to or to the exclusion of any liquor charged to the valve body, although it is desirable to the end of insuring uniform impregnation and cooking that liquor as well as steam be fed into the valve body and both blended with chips in the outlet neck of the valve. Either as a supplement to or to the exclusion of liquor charged to one or both pipes **52** and **53** and/or directly to the vessel, such liquor may be charged with or without steam through the port **55** so as to impregnate the chips in course of the latter's travel with the valve as the pockets move between the inlet and the outlet throats. This may, if desired, be accomplished at a pressure higher than the pressure which prevails within such outlet throat. Submerging the chips in high pressure impregnating liquor as they progress toward the outlet throat has several advantages. It tends to insure uniform impregnation, and acts to agitate the chips and improve the discharge in that each successive pocket, having a pressure condition superior to that of the outlet throat, is subjected to an instantaneous pressure drop upon the initiation of communication between such pocket and the throat. This rapid pressure drop also de-aerates the wood cells to produce better liquor penetration.

The vernier dial is desirably so fixed to the thrust stem as to show a zero reading when the rotor is seated for proper bearing on cold contact. Tests under "run" conditions at known pressures and temperatures provide a "table" to which recourse is thereafter had by the operator in accurately ascertaining the proper vernier reading at which the adjusting wheel should be set in order to progressively back off the rotor at the onset of a chip-feeding operation as the pressure and temperature rise to a working norm. Changing this setting progressively in compensation of expansion differentials as the pressure and temperature build up maintains at all times substantially the exact seating condition which will preclude the rotor from either binding or leaking. A suitable test gauge is an ammeter placed on the motor drive to reflect the load placed on the motor. From time to time the vernier dial is or may be relocated on the thrust stem in compensation of gradual wear which takes place on the rotor surface and its seat.

As an operation progresses, fines perforce work along the rotor seat and enter the cavities. Steam and/or pressure liquor projected from the pipes **52** and **53** into these cavities picks up the fines, and the cavities are thus continuously flushed, "blown down" so to speak, to preclude the overloading and consequent plugging which has heretofore taken place at the outer ends of seats in which chip-feeding rotors have turned. It is feasible, albeit less desirable, to design the system so that the end cavities are steam-flushed only at intervals, normally passing the steam and liquor directly to the outlet throat or to the cooking vessel.

It is generally recognized that fines are responsible for the greater part of the wear on the bearing surfaces of a rotor and its seat. This wear may be magnified very considerably should fines become localized in their travel along the length of the seat. So localized, the fines carbonize under temperature conditions at or above the carbonization point of wood, and these carbonized particles can badly score the surfaces. The present invention permits the rotor, at periodic intervals, to be easily and quickly backed off sufficiently to provide a degree of clearance which will give free access of steam for a thorough flushing of the wear surfaces. In installations where steam is introduced normally through only one of the two pipes **52** and **53**, a normally closed valved connection is provided from the steam supply to the other pipe so that, for flushing the wear surfaces, both cavities may be charged with a head of steam.

It will be understood that the purpose of the port **54** is to automatically vent the pockets **18** after the same have delivered their charge of chips so that the empty pocket will not be under pressure when it again registers with the inlet passages **14** and **16** for the reception of a fresh charge of chips. The port **55**, conversely, acts to place the filled pockets under pressure.

An advantage inherent to the present invention is that of lubricating the rotor for easier rotation.

The advantages of the invention will, it is thought, have been clearly understood from the foregoing detailed description of the illustrated preferred embodiment. Minor changes will suggest themselves and may be resorted to without departing from the spirit of the invention, wherefore it is my intention that no limitations be implied and that the hereto annexed claims be given a scope fully commensurate with the broadest interpretation to which the employed language admits.

What I claim is:

1. In a continuous feeder, a housing assembly presenting a tapered seat and circumferentially spaced and externally exposed ingress and egress ports in the tapered working face of the seat, a tapered valve mounted in said seat for rotary movement and having a plurality of circumferentially spaced pockets spaced from the ends of the valve and exposed to the tapered working face of the valve, said pockets being arranged to successively communicate with said ingress and egress ports, end cavities formed between the ends of said valve and the ends of said housing assembly and internally sealed from said ingress port by said valve, said end cavities each having an externally exposed fluid input opening thereto through said housing assembly and each internally communicating with said egress port for fluid output, and sealing means externally sealing said end cavities other than for said fluid input openings.

2. In a continuous feeder, a housing assembly presenting a tapered seat and circumferentially spaced ingress and egress ports in the tapered working face of the seat, a tapered valve assembly journal-mounted on said valve assembly and having a valve mounted in said seat for rotary movement, said valve having a plurality of circumferentially spaced pockets spaced from the ends of the valve and exposed to the tapered working face of the valve, said pockets being arranged to successively communicate with said ingress and egress ports, end cavities formed between the ends of said valve and the ends of said housing assembly and sealed from said ingress port by said valve, said end cavities each having a fluid input opening thereto through said housing assembly and each communicating with said egress port for fluid output, and sealing means operatively associated with said housing and valve assemblies and spaced toward said valve from the journal mounting for the valve assembly for externally sealing said end cavities other than for said fluid input openings.

3. In a continuous feeder, a housing assembly presenting a tapered seat and circumferentially spaced and externally exposed ingress and egress ports in the tapered working face of the seat, a tapered valve mounted in said seat for rotary movement and having a plurality of circumferentially spaced pockets spaced from the ends of the valve and exposed to the tapered working face of the valve, said pockets being arranged to successively communicate with said ingress and agress ports, aligned stub shafts projecting endwise from said valve and journal-mounted at the ends of said housing assembly, annular end cavities formed between the ends of said valve and

the ends of said housing assembly and surrounding said stub shafts, said end cavities each having an externally exposed fluid input opening thereto through said housing assembly and each internally communicating with said egress port for fluid output, and sealing means between said stub shafts and said housing assembly for externally sealing said end cavities other than for said fluid input openings, said valve internally sealing said end cavities from said ingress port.

4. In a continuous feeder, a housing assembly presenting a tapered seat and circumferentially spaced ingress and egress ports in the tapered working face of the seat, a tapered valve mounted in said seat for both rotary movement and endwise adjustment and having a plurality of circumferentially spaced pockets spaced from the ends of the valve and exposed to the tapered working face of the valve, said pockets being arranged to successively communicate with said ingress and egress ports, end cavities formed between the ends of said valve and the ends of said housing assembly and sealed from said ingress port by said valve, said end cavities each having a fluid input opening thereto through said housing assembly and each communicating with said egress port for fluid output, adjusting means external of said end cavities and operatively associated with said valve for adjusting the valve endwise relative to said seat, and sealing means toward the valve from said adjusting means for externally sealing said end cavities other than for said fluid input openings.

5. In a continuous feeder, a housing assembly presenting a tapered seat, a valve assembly journal-mounted for both rotary movement and endwise adjustment in said housing assembly relative to a rotary axis and providing a tapered valve for said seat, adjusting means threadably associated with said housing assembly for turning adjustment along said rotary axis, thrust bearing means held against endwise movement relative to said valve assembly and said adjusting means, and lock means for selectively locking said adjusting means relative to said valve assembly.

6. In a continuous feeder, a housing assembly presenting a tapered seat, a tapered valve for said seat and having stub shafts at its opposite ends as integral prolongations, said shafts being journal-mounted in said housing assembly for both rotary movement and endwise adjustment with respect to a rotary axis, adjusting means threadably associated with said housing assembly at one end thereof for turning adjustment along said rotary axis, thrust bearing means held against endwise movement relative to said adjusting means and the stub shaft at the respective end of the valve, and lock means for selectively locking said adjusting means relative to said valve assembly.

7. In a continuous feeder, a housing assembly presenting a tapered seat having a center axis, a tapered valve for said seat, stub shafts projecting rigidly from the ends of said valve along said axis and held against both endwise and turning movements relative to the valve, said shafts being journal-mounted in said housing assembly for both rotary movement and endwise adjustment with respect to said axis, adjusting means threadably asociated with said housing assembly at the end thereof corresponding to the larger end of said seat for turning adjustment along said axis, thrust bearing means seated within the free end of the stub shaft at the larger end of said valve and seated on the inner end of said adjusting means, said thrust bearing means being held against endwise movement relative to said thrust adjusting means and the last-mentioned stub shaft, lock means for selectively locking said adjusting means relative to said valve assembly, and drive means on the stub shaft at the smaller end of said valve for turning the valve.

8. In a continuous feeder, a housing assembly presenting a tapered seat with circumferentially spaced ingress and egress ports, a tapered valve for said seat having a plurality of circumferentially spaced pockets spaced from the ends of the valve and arranged to successively communicate with said ports in response to rotary movement about a longitudinal axis, stub shafts projecting rigidly from the ends of said valve along said axis and journal-mounted in said housing assembly for both rotary movement and endwise adjustment relative thereto, end cavities surrounding said stub shafts and formed between the ends of said valve and the ends of said housing assembly, said cavities being sealed from said ingress port by said valve and each having a fluid input opening thereto through said housing assembly and having a fluid output opening communicating with said egress port, sealing means working between said shafts and said housing assembly and spaced toward said valve from the shaft journals for sealing off said end cavities, adjusting means threadably associated with said housing assembly at the end thereof corresponding to the larger end of said seat for turning adjustment along said axis, thrust bearing means seated within the free end of the stub shaft at the larger end of said valve and seated on the inner end of said adjusting means, said thrust bearing means being held against endwise movement relative to said thrust adjusting means and the last-mentioned stub shaft, lock means for selectively locking said adjusting means relative to said valve assembly, and drive means on the stub-shaft at the smaller end of said valve for turning the valve.

9. In combination, a pressure vessel having an inlet, and a continuous feeder comprising a housing assembly presenting a tapered seat with circumferentially spaced ingress and egress ports, said egress port being connected with said inlet of the pressure vessel, a tapered rotary valve for said seat having a plurality of circumferentially spaced pockets spaced from the ends of the valve and arranged to successively communicate with said ports in response to rotary movement about a longitudinal axis, stub shafts projecting rigidly from the ends of said valve along said axis and journal-mounted in said housing assembly, end cavities surrounding said stub shafts and formed between the ends of said valve and the ends of said housing assembly, said cavities being sealed from said ingress port by said valve and each having a fluid input opening thereto through said housing assembly and having a fluid output opening communicating with said egress port, sealing means working between said shafts and said housing assembly and spaced toward said valve from the shaft journals for sealing off said end cavities, and means for supplying fluid to said input openings of the end cavities at a pressure at least as great as the working pressure of said pressure vessel.

10. The combination of claim 9 in which steam is supplied to one of said end cavities and cooking liquor to the other.

11. The combination of claim 9 in which steam is supplied to at least one of said end cavities through its said fluid input opening.

12. The combination of claim 9 in which the fluid pressure in the end cavity at the smaller end of said valve exceeds the fluid pressure in the other end cavity.

13. The combination of claim 9 in which both steam and cooking liquor are supplied to at least one of said end cavities through its said fluid input opening.

14. The combination of claim 9 in which cooking liquor is supplied to at least one of said end cavities through its said fluid input opening.

15. Mechanism for feeding material from a charging to a discharging station comprising a rotor having material-receiving pockets located at circumferentially spaced intervals about the perimeter, said pockets being exposed at the outside of said rotor and being closed at the inside thereof, and a body structure formed with a bore providing a rotary journal for said rotor, said body structure providing said stations at points circumferentially spaced apart in positions traversed by the pockets

of the rotor as the latter turns in the bore and having at each of its two ends a respective closed cavity exposed to a related end of the bore and communicating with the discharge station, said cavities each circumscribing the axis of said bore and means for supplying fluid under pressure to said cavities.

16. Mechanism for feeding material from a charging to a discharging station comprising a frustro-conical rotor having material-receiving pockets located at circumferentially spaced intervals about the perimeter, said pockets being exposed at the outside of said rotor and being closed at the inside thereof, and a body structure formed with a tapered bore providing a rotary journal for said rotor, said body structure providing said stations at points circumferentially spaced apart in positions traversed by the pockets of the rotor as the latter turns in the bore and having at each of its two ends a respective closed cavity exposed to a related end of the bore and communicating with the discharge station, said cavities each circumscribing the axis of said bore and means for supplying fluid under pressure to said cavities.

17. Mechanism for feeding material from a charging to a discharging station comprising a rotor having material-receiving pockets located at circumferentially spaced intervals about the perimeter, said pockets being exposed at the outside of said rotor and being closed at the inside thereof, and a body structure formed with a bore providing a rotary journal for said rotor, said body structure providing said stations at points circumferentially spaced apart in positions traversed by the pockets of the rotor as the latter turns in the bore and having at each of its two ends a respective closed cavity exposed to a related end of the bore and communicating with the discharge station, said cavities each circumscribing the axis of said bore and means for passing through said cavities a constant flow of fluid under pressure and composed at least in part of steam.

18. Mechanism for feeding material from a charging to a discharging station comprising a frustro-conical rotor having material-receiving pockets located at circumferentially spaced intervals about the perimeter, and a body structure formed with a tapered bore providing a rotary journal for said rotor, said body structure providing said stations at points circumferentially spaced

apart in positions traversed by the pockets of the rotor as the latter turns in the bore and having at each of its two ends a respective closed cavity exposed to a related end of the bore, and means for passing a fluid composed at least in part of high pressure steam through said end cavities for flushing the same, positive-acting means being provided for imparting controlled endwise motion to the rotor for either adjusting the journal clearance of the rotor within the bore or backing off the rotor in a degree sufficient to unseat the rotor and permit said fluid to flush the seat by passing from the cavities along the journal surface of the rotor into the pockets of the latter.

19. Structure according to claim 18 having means acting upon the charged material in course of its travel between said charging and discharging stations for placing the material within the pockets under a pressure condition higher than the pressure which obtains at the discharging station.

20. The mechanism recited in claim 18, means being provided for charging digesting liquor at high pressure to the material in said pockets as the pockets move between the charging and discharging stations.

21. Mechanism for feeding material from a charging to a discharging station comprising a rotor having material-receiving pockets located at circumferentially spaced intervals about the perimeter, and a body structure formed with a bore providing a rotary journal for said rotor, said body structure providing said stations at points circumferentially spaced apart in positions traversed by the rotor as the latter turns in the bore and having at each of its two ends a respective closed cavity exposed to a related end of the bore and communicating with the discharge station, means for passing through said cavities a constant flow of fluid under pressure and composed at least in part of steam, and positive-acting means for imparting controlled end-wise motion to the rotor for adjusting the journal clearance of the rotor within the bore.

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