

Description

This invention relates to an apparatus for treating material in a sealed pressure chamber with a processing fluid under pressure, said apparatus comprising a cylindrical tubular shell forming part of said pressure chamber and means for introducing and removing said processing fluid to and from said pressure chamber and movable means forming another part of said pressure chamber and being mounted for reciprocating between a first position for opening said pressure chamber and a treating position for closing said pressure chamber and means for moving said movable means between said first position and said treating position and sealing means associated with said movable means and said shell for sealingly closing said pressure chamber with said movable means being in said treating position.

More particularly, this invention relates to a unique pressure vessel which can be used in processes utilizing high pressure and, in particular, processes for increasing the filling capacity for tobacco, extraction processes or any other processes where treating materials at high or supercritical pressure is required.

Although the apparatus disclosed can be used for various types of processes mentioned above, this disclosure will be directed primarily to one high pressure use of the apparatus—namely a process for increasing the filling capacity of tobacco.

Some examples of the type of extraction processes which are adaptable to this system are nicotine extraction from tobacco, caffeine extraction for coffee, essential oils from plants and petroleum extraction from coal or shale.

In the presently known processes for expanding tobacco which use high pressure, for example from about 138 N/cm² (200 psig) and above, and in most extraction processes, the pressure vessel required is quite bulky having heavy pivotable lids to withstand the pressure. The seal mechanism for the lids are also specially designed to withstand the high pressures. These types of pressure vessels, which are generally referred to as autoclaves, normally have a cylindrical body portion with convex ends, one or both ends being removable to permit loading and unloading.

Further, US-A-2 627 221 discloses an apparatus of the general type indicated above and comprising separate charging and expansion chambers, respectively. This apparatus is operating in an intermittent manner, and is rather bulky and complicated.

One of the primary goals in developing any system is to provide a continuous flow or throughput of material through the system. The only method now known to carry out a high pressure process continuously is to carry out the entire process under pressure. This is not practical, however, because most processes have steps which cannot be carried out at high pressure, therefore, the pressure must be released at some point and the material removed from the pressure

vessel. The infeed and outfeed to the pressure treatment step is a principal reason that makes it difficult, if not impossible, to develop a continuous high pressure process. Most of the high pressure processes are limited by the equipment used, particularly the pressure vessel. Nevertheless, attempts have been made and will continue to be made to develop equipment which will provide for a continuous throughput system for high pressure processes.

The only presently-known arrangement for obtaining a continuous output from a high pressure system where some of the steps are carried out in low pressure is to provide a plurality of pressure vessels which are operated at different time intervals so that a continuous stream of the treated material can be maintained at the outfeed of the pressure step, thus, causing the overall system to have a continuous output. Of course, such a system is not a true continuous system even though it does provide a somewhat continuous flow. Even though no system having high and low pressure steps can be fully continuous, the apparatus used can dramatically decrease the time required to load, seal, pressurize, unseal and unload the pressure vessel, producing a process operating on a generally continuous basis.

In all the presently used tobacco expansion processes, a volatile compound is introduced into the cellular structure of the tobacco which has collapsed due to the curing process. Generally, this step is referred to as impregnation. The impregnated tobacco is then heated to rapidly volatilize the compound causing the tobacco cell to expand as the compound is driven out of the cell in a gaseous or vaporous state. There are a number of processes which utilize this basic concept, some of which are disclosed in US-A-30,693 RE, 3,524,452 and 3,771,533, in GB-A-1,484,536 and in CA-A-1,013,640. The only difference between the processes described in the above patents is the volatile compound used to impregnate the tobacco cells.

It has been found that pressure can be used to reduce the time required to impregnate the tobacco with certain compounds, and the amount of pressure normally used depends on the particular compound used. US-A-3,524,452 discloses a process in which a relatively low pressure can be used because the impregnant is normally in a condensed state at these pressures, while according to CA-A-1,013,640 and GB-A-1,484,536, which disclose processes which use carbon dioxide as the impregnating compound, a much higher pressure is required to insure that a sufficient quantity of carbon dioxide is introduced into the tobacco cells to cause expansion of the cells when the impregnated tobacco is heated.

Even though the process and apparatus of the present invention can be used at relatively low pressures, it is more adaptable to the high pressure impregnation such as that disclosed in GB-A-1,484,536.

Some of the drawbacks of using any of the presently known high pressure systems are the

bulkness of the autoclave and lids, the difficulties with sealing the system, the special basket or container required to hold the material, and, in particular, problems associated with loading and unloading of the pressure vessel.

It is, therefore, important in designing a pressure vessel for use in high pressure materials treatment, particularly tobacco, to have a system which permits easy loading and unloading and eliminates the problems associated with the sealing and locking mechanisms.

Is is, therefore, an object of this invention to provide an apparatus which can be used to treat materials under pressure, especially at high pressures, and which can be conveniently loaded and unloaded.

This object according to the invention is accomplished with an apparatus of the type indicated at the outset and being characterized in that said movable means comprises a spool means including first and second cylindrical end members and a connecting rod for spacing and securing said end members so that an annular longitudinal space is created between the two cylindrical end members of said spool means about the connecting rod for receiving the material to be processed that this annular space is accessible for loading and unloading said material in said first position of said spool means wherein at least a portion thereof is outside said shell and that said annular space forms said pressure chamber in combination with the cylindrical tubular shell in said treating position in which said spool means is within said shell.

Thus, according to the present invention, there is provided a spool assembly having two sealable end members and a connecting member which is positionable in a cylindrical tubular shell. The spool reciprocates between a loading and unloading zone where material to be processed is placed about the spool and a pressurizing or treating zone within the tubular shell. Sealing elements on the end members cooperate with the shell to seal and form the sealed pressure vessel. A series of conduits through the shell and/or within the spool assembly permits a fluid to be introduced into and withdrawn from the pressure zone in a uniform manner without permitting material being processed to pass from the pressurized zone with the fluid. Furthermore, when utilized as a system for expanding tobacco, a loading mechanism is provided which permits tobacco to be placed about the spool assembly and an unloading system which removes the tobacco when the spool is in an unloading position.

Preferred embodiments of the invention are the subject matter of various dependent claims.

The invention will be further explained by reference to the accompanying drawings, in which

FIG. 1 is a side section view of a spool pressure vessel apparatus according to the present invention with the spool assembly in the retracted or loading position and only portions of the spool assembly cut away;

FIG. 2 is a side section view of the spool pressure vessel apparatus with the spool assembly inserted to the pressure vessel shell;

FIG. 3 is a detailed section view of the spool pressure vessel within the pressure zone and illustrating one sealing mechanism and one processing fluid introduction means for the system;

FIG. 4 is a cross section view taken along Line 4—4 of FIG. 3.;

FIG. 5 is a side view of a spool pressure vessel including a fluid manifold which permits the introduction or withdrawal of fluids from the pressure zone;

FIG. 6 is a sectional side elevational view of a system which utilizes the spool pressure vessel according to the present invention illustrating one embodiment of a loading and unloading mechanism;

FIG. 7 is a section view taken along Line 7—7 of FIG. 6;

FIG. 8A is a section view taken along Line 8—8 of FIG. 6 with the semi-cylindrical enclosure members in the retracted position and the spool assembly in the loading position; and

FIG. 8B is a section view taken along Line 8—8 of FIG. 6 with the semi-cylindrical enclosure members in the closed position and the spool assembly in the loading position.

Although the spool pressure vessel system as described herein can be used in other types of processes, it is primarily for use in processes for increasing the filling capacity of tobacco; therefore, the description herein shall be directed to the use of the system and method in such processes. It should be understood, however, that the scope of the invention is not so limited. Other types of processes which can utilize the disclosed system are extraction processes, dying processes, or any process requiring pressurized treatment of the material, in particular high or supercritical pressure treatment.

Referring more particularly to the drawings, in FIGS. 1, 2 and 3, the numeral 10 indicates a pressure vessel including a cylindrical tubular shell or enclosure member 12 and a spool assembly 14. The cylindrical shell 12 and the spool assembly 14 can be made of any suitable material, such as stainless steel or the like, but the material selected should be compatible with the materials and procedures used in a specific process.

The spool assembly 14 includes circular or cylindrical shaped end members 16 and 18, corresponding generally in diameter to the inside diameter of the cylindrical tubular shell 12, which are connected together by a connecting rod 20. The spool assembly in the embodiment illustrated has two positions—a loading and unloading position 22, in which the spool assembly 14 is positioned to the left of the shell 12 (see FIG. 1), and a pressurizing or treating position 24, in which the spool assembly 14 is inserted within the shell 12 (see FIG. 2) to form a sealed pressure chamber. A receiving container 23 includes a pair of enclosure members 26 and 28, generally semi-

circular in cross sections and secured together by hinges 30, positioned about spool assembly 14 in the loading position 22 contiguous to the shell 12. The enclosure members 26 and 28 when pivoted together form the container to receive tobacco that is distributed in the annular space between the spool connecting rod 20 and enclosure members 26 and 28 (see FIG. 1). The nonhinged edges of the enclosure members located at the top in FIG. 1 do not contact one another, thus, leaving a gap through which the tobacco can be introduced into the annular space. To permit unloading at position 22, the enclosure members are pivoted downwardly so that the treated tobacco can fall away from the spool assembly 14. If desired, the spool assembly can be so constructed and positioned that it can be rotated by an external motor and a scraper or brush assembly (not shown) can be pivoted into position adjacent the connector rod 20 to clean the tobacco particles from the spool assembly. It should be understood that there are numerous other mechanisms and systems which can be used to load and unload the spool assembly.

The spool end members 16 and 18 mentioned above have sealing members which contact the inside surface of the shell 12, thus sealing the pressure chamber when the spool assembly is in the pressurizing position 24 (see FIG. 2) to form an annular cavity. The sealing members maintain pressure integrity within the system during operation. In the illustrated embodiment, there is a single seal member 32 on end 16 and spaced dual seal members 34 and 36 on end 18. Seal member 34 is used primarily to direct processing fluid in a desired manner as will be explained hereinafter. The seal members can function in a number of ways, for example, sealing member can be formed of a generally non-compressible, deformable material which can be squeezed mechanically outward and pressed against the inside surface of the cylindrical shell 12. The sealing member may also be pneumatically or hydraulically inflatable. When inflated, the seals press against the inside surface of the shell member. If a fluid is used to inflate the seals, it should be compatible with the substance being processed in the event a seal leaks.

The sealing system illustrated in FIG. 3 is used when the processing fluid is introduced into the pressure chamber in the manner described herein. However, there are other sealing systems and other methods of introducing the processing fluid into the chamber. For example, only a single seal may be used on end 18 and the processing fluid can be introduced into the pressure chamber via a flexible hose connected to the spool or through the shell 12 by the manifold 98, as shown in FIG. 5 and as described hereinafter. Also, mechanically squeezed seals may be operated by force from processing fluid pressure when evacuation of the chamber is not required during processing.

The sealing system and the processing fluid introduction system of the preferred embodiment

are illustrated in detail in FIG. 3. In this particular embodiment, the sealing system is hydraulic. Although the end members 16 and 18 can be secured to the connecting rod 20 in several ways, for example welding, in the illustrated embodiment, the end members 16 and 18 are carried on the connecting rod 20 which has threaded portions 21 and 23 at each end thereof that extends through bores 25 and 27 in the center of end members 16 and 18, respectively. Nuts 48 and 50 hold and secure the end members against annular shoulders on the connecting rod. Such an arrangement permits the spool assembly 14 to be disassembled more easily for maintenance and cleaning.

A central bore 52 extends the length of the connecting rod 20 and is plugged at one end by a set screw 54. End members 16 and 18 have radially extending bores 56 and 58 which connect with the central bore 52 and permit communication between the central bore and annular seal grooves 60 and 62. Elastic seal rings 32 and 36 are carried in the seal grooves 60 and 62, respectively. A right angle bore 68 extends from radial bore 58 in end member 18 to annular groove 70 which carries a seal ring 34.

Fitting 72 is threaded into the central bore 52 at the unplugged end of connecting rod 20 and is connected to a high pressure flexible hose 74, permitting the introduction of fluid under pressure into the sealing system from a fluid source (not shown). A tubular shaft 75 is secured by bolt 77 to opposite end of connecting rod 20. The shaft 77 is connected to a mechanism which moves the spool assembly between loading position 22 and treating position 24.

Around the periphery of the outer face of each end 16 and 18 are annular grooves 74 and 79, respectively, which carry rings 76 and 78. These rings are used to scrape the inside surface of shell 12 as the spool assembly is shifted from one position to another. Of course, only one end will require a scraper ring if the spool is used in a two-position system while both ends will require a scraper ring if a three-position system, as described hereinafter, is used. A bolt 82 and clip 84 are used to hold the ring 76 in position while bolt 86 holds ring 78 in position.

Turning now to the processing fluid system, it has been found that, when utilizing certain types of processing fluids, impregnation of the tobacco can be enhanced if the pressure chamber is maintained at a specific temperature; therefore, the shell 12 can be surrounded by an insulated cover, a fluid bath or the like 40, which can be heated or cooled as desired. In the illustrated embodiment in FIG. 1, the processing fluid or impregnant is introduced into the pressure chamber by a line 42 connecting cylindrical shell 12 and a supply line 43 and inlet valve 44. Recovery line 45 having outlet valve 46 allows the processing fluid to be withdrawn from the system. Supply line 43 is connected to a source of impregnant supply (not shown) while recovery line 45 is connected to a recovery system (not

shown) which allows the processing fluid to be recovered and reused. The processing fluid can be in any flowable state such as liquid, vapor, gaseous, etc., when introduced into the system.

The processing fluid is introduced into the pressure chamber through line 43 which is connected by line 42 to the chamber shell 12. Cylindrical end member 18 has an annular outer groove 88 (see FIG. 3) around its peripheral surface and located between the seal members 34 and 36. A plurality of radial bores 90 (only one shown in drawings) extend inwardly from outer groove 88 to an inner groove 92 within bore 27, through which connecting rod 20 is inserted, thus, producing an annular space or passage defined by the inner groove 92 and the connecting rod 20. The connecting rod has a plurality of longitudinal grooves 96 formed in its outer surface which extend from the annular inner groove 92 in end 18 to a point contiguous to the inner face of end member 16. In the illustrated embodiment, four grooves are shown spaced at 90° intervals (see FIG. 4).

Covering the connecting rod between the ends 16 and 18, is a screen or filtering system which utilizes screens of varying meshes from coarse (contacting the connecting rod) to fine (on the outside). The purpose of utilizing the screen system is to prevent product loss and to eliminate expensive separating procedures by preventing any particulate matter entrained in the processing fluid during processing from exiting the chamber into the fluid recovery system, thereby facilitating processing fluid recovery.

It is important to vary the size of the layered screen meshes to prevent clogging; however, the critical layer is the outer layer which must have a very fine mesh that will prevent fluid from passing through unless under pressure. An example of such a layered screen system would range from a coarse mesh of about 3 openings per cm (8 openings per inch) to a fine mesh of about 200 openings per cm (500 openings per inch). The outer screen is preferably a 1400 x 250 mesh screen.

The illustrated apparatus is primarily used for a process to expand tobacco, but by a simple modification, the apparatus can be used for a variety of processes, for example, extraction. This simple modification is the addition of a fluid entrance system or manifold 98 connected directly to the chamber shell 12 (see FIG. 5). By having such a manifold, fluid such as a hot gas, solvent, etc., can be introduced and removed from the chamber in a desired sequence or in combination with the process fluid system for heating, cooling or extracting. If fluid is removed through the manifold system 98, a screen or filtering system similar to the one discussed above may be required to prevent particulate matter from exiting the system.

When using flammable processing fluids in the chamber, the manifold 98 may be used to deliver a purge of inert fluid before or after the

processing fluid is introduced or removed, respectively, from the chamber.

One of the primary reasons for utilizing this type of spool assembly arrangement is that the process fluid can be introduced into the material being processed over a shorter distance, thus, requiring less time to complete the process than is normally required in most presently known autoclave systems. For example, the fluid must only travel from the connecting rod 20 or the cylindrical shell 12 through one half of the diameter of the cylindrical shell 12 to contact all of the material in the chamber. Although the spool assembly and chamber can be of any size depending upon the amount of material one desires to process, the spool size is not unlimited in that the advantage of having a short distance for the fluid to travel can be lost if the distance between the connecting rod and shell becomes too great. To obtain quantities greater than one spool can effectively process, a plurality of spools can be used and operated in sequence so that a continuous stream of material is processed and discharged from the overall system.

FIGS. 1 — 5 illustrate a simple version of the spool pressure chamber, however, in order to be commercially practical, an effective system for loading and unloading the spool assembly is required as is illustrated in FIGS. 6, 7, 8A and 8B. In FIG. 6, the spool pressure chamber 100 is arranged so that the axes of the tubular shell 101 and the spool assembly 102 coincide and the spool reciprocates vertically between a lower loading position 104, an intermediate processing position 106 and an upper unloading position 108. The embodiment of the spool assembly 102 is similar to the assembly illustrated in FIGS. 1 — 5 in that the sealing system and process fluid system can be the same. An insulating covering and fluid manifold described above can be used, if desired.

The spool assembly 102 is carried on a shaft 110 of a lift mechanism (not shown) which can be hydraulically or mechanically operated. In operation, the spool 102 initially begins in the lower loading position where a loading mechanism 112 forms and positions the material 114 around the spool 102. The loading mechanism includes a lower platform or plate 116 which is used to support a portion of the material 114. The plate has a central opening corresponding in size and shape to the end member 118 of the spool 102. When in the loading position, the upper surface 120 of the end 118 is aligned with the upper surface 122 of the plate 116.

Positioned above the plate 116 and adjacent the shaft 110 on opposite sides thereof are vertical line assemblies 124 and 126 each forming one end of a containment area or accumulating chamber 128 and 128' for the material. The other ends of the containment areas are formed by upper and lower closure shells or semi-cylindrical enclosure members 130, 130' and

132, 132', respectively. The closure shells are semicircular in cross sections and, when closed, their configuration conforms to that of the pressure vessel shell 134. The closure shells 130, 130' and 132, 132' are carried by reciprocating piston assemblies 136, 136' and 138, 138', respectively. The piston assemblies move the closure shells from a retracted position as shown in FIGS. 6 and 7 to a closed position adjacent the spool 102 as can be seen in FIG. 8B.

Interposed between the closure shells 130 and 132 and 130' and 132' are intermediate support members or horizontal tine assemblies 140 and 140'. These tine assemblies are used to separate or divide the tobacco in the containment areas 128 and 128' and, thus, prevent compaction. The tine assemblies 140 and 140' is carried by a reciprocating piston 142 and 142', respectively.

When in the retracted position as illustrated in FIG. 7, material 114 from each of the loading conveyors 144 positioned on opposite sides of the spool assembly will deposit material 114 on the base plate 116 until a specified volume or a particular height has been reached. At this event, the horizontal tine assemblies 140 and 140' are reciprocated inwardly as shown in FIG. 8A to an accumulating position and the upper portion of the containment area is filled with a specified amount of material 114. This loading operation can be carried out during the time the spool 112 is in the processing position 106 or the unloading position 108.

When the spool assembly 102 returns to the loading position 104, the horizontal tine assemblies 140 and 140' are reciprocated inwardly until they contact one another contiguous to the spool assembly as can be seen in FIG. 8B. As has been previously mentioned, the upper surface 120 of spool end 118 aligns with the upper surface 122 of plate 116. After the horizontal tines 140 and 140' are in position, vertical tine assemblies 124 and 126 are retracted, thus, permitting shell assemblies 130, 130', 132 and 132' to be reciprocated inwardly, moving the material to a position around the spool connecting rod or shaft. The horizontal tine assemblies 140 and 140' are then extracted and the spool assembly is raised vertically from the loading position 104 to the processing position 106 with the closure shells remaining in the closed position as shown in FIG. 8B. As the spool reaches the processing position, the closure shells 130, 130', 132 and 132' are withdrawn to their retracted position. The vertical tine assemblies 124 and 126 are repositioned or reset so that the containment area 128 is formed to receive a subsequent load of material. It should be understood that the disclosed tine assemblies and closure shells are only illustrative of the various types of mechanical mechanisms which can be used. For example, a single closure shell on each side can be used or a plurality of horizontal tine assemblies may be required if the equipment is extremely large. Furthermore, the closure shells can be solid pieces with openings through which the tine assemblies 140 are

inserted. It should also be understood that side plate assemblies 146 and 148, as can be seen in FIGS. 7 and 8A and 8B, are used to contain the material 114 when the shell is in the retracted position. The side members 146 and 148 are spaced sufficiently that the shell members 130, etc., will contact their inside surface and a resilient sealing member can be used which will permit the closure shells to be moved easily within the side members.

If necessary, two clamp collars with outwardly extending tine arrays may be placed on the connecting rod at desirable elevation to hold the tobacco in position in the spool as it is moved into the shell.

After the processing has been completed, the spool assembly is moved from the processing position 106 to the unloading position 108 which includes a housing 150 having a fluid introduction conduit 152 and an exit conduit 154 formed integrally therewith. A fluid such as a gas either heated or cooled as the process dictates is directed by a blower 153 through the housing 150 when the spool assembly 102 is in the unload position. The gas should have a controllable moisture content. The material 114 is blown or forced from the spool assembly through the exit or outlet conduit 154 onto a conveyor 156 for transport to other processing areas. The conveyor can be carried within a closed housing if it is desirable to recover any impregnated vapor which may be escaping from the material or it can be opened to the atmosphere, if desired. The fluid introduced through the housing 150 can be gas, air at room temperature, or it can be steam if heat is required to treat the material 114 after it has been removed from the processing section 106. Furthermore, if heat is required instead of heating the fluid passing through the housing 150, heat can be applied to the material 114 at a later stage (not shown) in the process. For example, an expansion tower as known in the art can be used to receive material from conveyor 156. The shaft 160 of the spool assembly may be spindled and mated with a pinion of gear motor assembly 162, which will permit the shaft to be rotated when it is in the unloading position. If desired, retractable brushes or scrapers (not shown) within the housing 150 can be adapted to brush or scrape the spool assembly clean as the spool is rotated and fluid is forced through the housing. Again, it should be understood that other methods might possibly be used to remove material from the spool depending upon the material being processed and any subsequent processing steps required.

As has been previously mentioned, the primary purpose of the spool assembly and loading and unloading system described and illustrated thus far is to be utilized with a process for increasing the filling capacity of tobacco. In such processes, the tobacco must be impregnated with a material which will become dense or can be condensed sufficiently at the appropriate temperatures and pressures to permit the impregnant to enter into

the tobacco cells. A number of impregnants can be utilized, for example, light hydrocarbons, such as ethane, propane, n-butane, halogenated hydrocarbons, such as trichlorofluoromethane, dichlorodifluorethane, argon, carbon dioxide, nitrogen and many other compounds. The primary feature in most tobacco expansion processes is that the impregnating compound be chemically inert to the tobacco. It should, however, be understood that most presently known impregnants will function with this system and operation as described and illustrated herein. Of primary importance in utilizing some of these impregnants, however, is the recovery of such impregnants which will reduce the cost of operation, thereby making the process more economical. Therefore, it is sometimes important to provide a method of returning the impregnant from the spool assembly for recovery and reuse as is known in the art.

Examples of methods which can be used to increase the filling capacity of tobacco, with the above described apparatus, include methods where the tobacco cells are impregnated with a compound which is then removed from the tobacco cells, thus causing expansion in the cells. In such a process the quantity of tobacco to be treated would be placed around the spool assembly and thereafter inserted into the tubular shell. The seals would be expanded to form the pressure vessel. Impregnated compound would be introduced into the pressure chamber in a fluid state under pressure whereby the compound would impregnate the tobacco cells. After impregnation the pressure within the chamber is released and the tobacco is removed from the vessel.

A heating step could also be utilized after the tobacco is removed from the pressure vessel to rapidly remove the impregnating compound from the tobacco cells.

The pressure levels used in the process will depend upon the specific compound used as the impregnate; however, it is anticipated that pressure levels at or above the critical point of the impregnating compound would be used. The pressure used will also have an effect on the time required for impregnation. For example, if the impregnating compound is pressurized above its critical point or higher, the period for maintaining the pressure can be quite short, for example, one second. However, as the pressure is decreased from the critical point, the time period for impregnation can increase in the range of a few minutes to hours.

The above described embodiments can be modified in accordance with the subject invention in numerous ways, such as the sealing system, the processing fluid introduction system, etc., Furthermore, the system can be positioned horizontally and utilized in a different material handling system, however, these and other variations and changes can be made in the invention without departing from the true spirit and scope thereof as defined in the following claims.

Claims

1. An apparatus for treating material (114) in a sealed pressure chamber (10, 100) with a processing fluid under pressure, said apparatus comprising

a cylindrical tubular shell (12, 101) forming part of said pressure chamber (10, 100) and

means for introducing and removing said processing fluid to and from said pressure chamber (10, 100) and

movable means (14, 102) forming another part of said pressure chamber and being mounted for reciprocating between a first position for opening said pressure chamber and a treating position for closing said pressure chamber and

means (77, 162) for moving said movable means (14, 102) between said first position and said treating position and

sealing means (32, 34, 36) associated with said movable means (14, 102) and said shell (12, 101) for sealingly closing said pressure chamber (10, 100) with said movable means being in said treating position,

said apparatus being characterized in that said movable means comprises a spool means (14, 102) including first and second cylindrical end members (16, 18) and a connecting rod (20) for spacing and securing said end members so that an annular longitudinal space is created between the two cylindrical end members (16, 18) of said spool means (14, 102) about the connecting rod (20) for receiving the material (114) to be processed, that this annular space is accessible for loading and unloading said material (114) in said first position of said spool means (14, 102) wherein at least a portion thereof is outside said shell (12, 101) and that said annular space forms said pressure chamber (10, 100) in combination with the cylindrical tubular shell (12, 101) in said treating position in which said spool means (14, 102) is within said shell (12, 101).

2. The apparatus of claim 1, wherein said processing fluid introducing and removing means includes a conduit means (42, 88, 90, 92, 96) within said spool means to permit the introduction of processing fluid within the center of said material (114).

3. The apparatus of claim 2, wherein said conduit means includes grooves (96) on the outer surface of said connecting rod (20) and means for introducing processing fluid into said grooves.

4. The apparatus of claim 3, further including a screen assembly covering said connecting rod (20) for preventing any material particles from passing into said groove (96) when said processing fluid is removed from said pressure chamber (10) while permitting said processing fluid to pass through under pressure.

5. The apparatus of claim 4, wherein said screen assembly includes a plurality of layers of mesh coverings ranging from an inner layer adjacent said connecting rod (20) to an outer layer, said inner layer mesh being about 3.15

the tobacco cells. A number of impregnants can be utilized, for example, light hydrocarbons, such as ethane, propane, n-butane, halogenated hydrocarbons, such as trichlorofluoromethane, dichlorodifluorethane, argon, carbon dioxide, nitrogen and many other compounds. The primary feature in most tobacco expansion processes is that the impregnating compound be chemically inert to the tobacco. It should, however, be understood that most presently known impregnants will function with this system and operation as described and illustrated herein. Of primary importance in utilizing some of these impregnants, however, is the recovery of such impregnants which will reduce the cost of operation, thereby making the process more economical. Therefore, it is sometimes important to provide a method of returning the impregnant from the spool assembly for recovery and reuse as is known in the art.

Examples of methods which can be used to increase the filling capacity of tobacco, with the above described apparatus, include methods where the tobacco cells are impregnated with a compound which is then removed from the tobacco cells, thus causing expansion in the cells. In such a process the quantity of tobacco to be treated would be placed around the spool assembly and thereafter inserted into the tubular shell. The seals would be expanded to form the pressure vessel. Impregnated compound would be introduced into the pressure chamber in a fluid state under pressure whereby the compound would impregnate the tobacco cells. After impregnation the pressure within the chamber is released and the tobacco is removed from the vessel.

A heating step could also be utilized after the tobacco is removed from the pressure vessel to rapidly remove the impregnating compound from the tobacco cells.

The pressure levels used in the process will depend upon the specific compound used as the impregnate; however, it is anticipated that pressure levels at or above the critical point of the impregnating compound would be used. The pressure used will also have an effect on the time required for impregnation. For example, if the impregnating compound is pressurized above its critical point or higher, the period for maintaining the pressure can be quite short, for example, one second. However, as the pressure is decreased from the critical point, the time period for impregnation can increase in the range of a few minutes to hours.

The above described embodiments can be modified in accordance with the subject invention in numerous ways, such as the sealing system, the processing fluid introduction system, etc., Furthermore, the system can be positioned horizontally and utilized in a different material handling system, however, these and other variations and changes can be made in the invention without departing from the true spirit and scope thereof as defined in the following claims.

Claims

1. An apparatus for treating material (114) in a sealed pressure chamber (10, 100) with a processing fluid under pressure, said apparatus comprising

a cylindrical tubular shell (12, 101) forming part of said pressure chamber (10, 100) and means for introducing and removing said processing fluid to and from said pressure chamber (10, 100) and

movable means (14, 102) forming another part of said pressure chamber and being mounted for reciprocating between a first position for opening said pressure chamber and a treating position for closing said pressure chamber and

means (77, 162) for moving said movable means (14, 102) between said first position and said treating position and

sealing means (32, 34, 36) associated with said movable means (14, 102) and said shell (12, 101) for sealingly closing said pressure chamber (10, 100) with said movable means being in said treating position,

said apparatus being characterized in that said movable means comprises a spool means (14, 102) including first and second cylindrical end members (16, 18) and a connecting rod (20) for spacing and securing said end members so that an annular longitudinal space is created between the two cylindrical end members (16, 18) of said spool means (14, 102) about the connecting rod (20) for receiving the material (114) to be processed, that this annular space is accessible for loading and unloading said material (114) in said first position of said spool means (14, 102) wherein at least a portion thereof is outside said shell (12, 101) and that said annular space forms said pressure chamber (10, 100) in combination with the cylindrical tubular shell (12, 101) in said treating position in which said spool means (14, 102) is within said shell (12, 101).

2. The apparatus of claim 1, wherein said processing fluid introducing and removing means includes a conduit means (42, 88, 90, 92, 96) within said spool means to permit the introduction of processing fluid within the center of said material (114).

3. The apparatus of claim 2, wherein said conduit means includes grooves (96) on the outer surface of said connecting rod (20) and means for introducing processing fluid into said grooves.

4. The apparatus of claim 3, further including a screen assembly covering said connecting rod (20) for preventing any material particles from passing into said groove (96) when said processing fluid is removed from said pressure chamber (10) while permitting said processing fluid to pass through under pressure.

5. The apparatus of claim 4, wherein said screen assembly includes a plurality of layers of mesh coverings ranging from an inner layer adjacent said connecting rod (20) to an outer layer, said inner layer mesh being about 3.15



openings per cm and said outer layer being about 1400 x 250 mesh.

6. The apparatus of claim 1, wherein said sealing means (32, 34, 36) includes at least one seal member (32, 34, 36) on said cylindrical end members (16, 18) which can be expanded into engagement with the inner wall of said shell (12) to from the sealed pressure chamber (10) and means (52, 56, 58, 60, 62, 68, 70, 72, 74) to deform said seal members (32, 34, 36).

7. The apparatus of claim 6, wherein said means to deform said seal members (32, 34, 36) includes conduit means (52, 56, 58, 60, 62, 68, 70, 72, 74) in the spool means (14) to transmit a fluid to the seal members to cause the seal members to expand and engage the inner surface of the cylindrical tubular shell (12).

8. The apparatus of claim 6, wherein said means to deform said members (32, 34, 36) includes a means to squeeze the seal members, causing them to deform and engage the inner wall of the cylindrical tubular shell (12).

9. The apparatus of claim 1, further including a second fluid introduction means (98) associated with the cylindrical shell (12) for introducing processing fluid into or extracting processing fluid from the pressure chamber (10).

10. The apparatus of claim 1, further including means for maintaining the temperature of said sealed pressure chamber at a selected level.

11. The apparatus of claim 1, wherein said first position of said spool means (102) is a loading position (104) and further including a second position (108) outside said shell (101) for unloading.

12. The apparatus of claim 11, further including:

(a) means (112) for loading said spool means (102) with a material (114) for treatment at said first position (104) and

(b) means (150, 152, 153, 154, 156) for unloading said spool means (102) at said second position (108).

13. The apparatus of claim 12, wherein said loading means (112) includes:

(a) a movable shell (130, 130', 132, 132') which encloses said spool means (102) in the loading position (104) to confine the material (114) to be treated prior to said spool (102) being moved into the cylindrical tubular shell (101); and

(b) conveying means (144) for depositing the material within the movable shell.

14. The apparatus of claim 12, wherein said spool (102) is mounted for reciprocation on a vertical axis and said tubular shell (101) is located intermediate to said loading and unloading means.

15. The apparatus of claim 14, wherein said loading means (112) includes:

(a) a support member (116) positioned adjacent the upper surface (120) of the lower cylindrical end member (118) when the spool means (102) is in loading position (104);

(b) spaced side walls (146, 148) on opposite sides of the spool means (102), defining the sides of a pair of accumulating chambers (128, 128')

located on opposite sides of the spool means (102);

(c) a pair of removable vertical end walls (124, 126) transverse to said side walls (146, 148), said vertical end walls being located on opposite sides of said spool means (102) and adjacent thereto forming a first end of each of said accumulating chambers (128, 128');

(d) shell members (130, 130', 132, 132') on opposite sides of said spool means (102) and located outwardly from said vertical end walls (124, 126) and forming the second end of said accumulating chambers (128, 128'), said shell members (130, 130', 132, 132') being positioned between said spaced side walls (146, 148);

(e) means (144) for depositing said material (114) into said accumulating chambers (128, 128');

(f) means for removing and inserting said vertical end walls from and into the space between said side walls (146, 148); and

(g) means (136, 142) for reciprocating said shell members (130, 130', 132, 132') inwardly toward said spool means (102) to form and enclose the material (114) around said spool means (102) prior to movement of said spool means (102) from the loading position (104) to the treating position (106).

16. The apparatus of claim 14, wherein said unloading means includes:

(a) a housing (150) to enclose said spool means, said housing having an outlet opening (154);

(b) means (153) for removing said treated material from said spool means (102).

17. The apparatus of claim 16, wherein said housing (150) further includes an inlet opening (152) and said means for removing said treated material includes means (153) for passing a fluid through said housing (150) and through said outlet opening (154) to remove said treated material from said spool means (102).

18. The apparatus of claim 16, wherein said means for removing said treated material includes:

(a) means (160, 162) for rotating said spool means (102) while it is in said unloading housing (150); and

(b) scraper means for engaging said treated material as said spool means is rotated, whereby said treated material is removed from said spool means.

19. The apparatus of claim 16, further including means (156) for conveying said treated material (114) received from the outlet opening (154) of said housing (150).

20. The apparatus of claim 19, wherein said means (156) for conveying is enclosed and further including means for heating said material while in said conveying means.

21. Apparatus of claim 17, further including means for heating said fluid passing through said housing.

22. The apparatus of claim 1, wherein said processing fluid is recovered and reused.

23. The apparatus of claim 1, wherein said



processing fluid is used to extract constituents from material (114) being treated.

24. The apparatus of claim 1, wherein the material (114) treated is tobacco and the fluid is used to impregnate the tobacco in the process for increasing its filling capacity.

25. The apparatus of claim 24, further including means for applying heat to the impregnated material (114) upon removal of said material from the pressure chamber (10).

26. The apparatus of claim 24, further including means for heating said pressure chamber (10).

27. The apparatus of claim 7, wherein said conduit means for expanding said seal members includes:

(a) grooves (60, 62, 70) on the outer surface of said end members (16, 18) which carry said expandable seal members (32, 34, 36);

(b) a bore (52) within said connecting rod (20);

(c) passageways (56, 58, 68) extending between said seal member grooves (60, 62, 70) and said bore (52); and

(d) means for introducing and removing an inflating fluid into said seal member grooves through said bore (52) and passageways (56, 58, 68) to expand and deflate said expandable seal members (32, 34, 36).

28. The apparatus of claim 27, wherein said inflating fluid is substantially noncompressible and compatible with tobacco.

29. The apparatus of claim 1 and 24, wherein the means for introducing processing fluid in said pressure chamber (10) includes:

(a) a supply line (44) connected to said tubular shell (12) located at one (18) of said end members (16, 18) when said spool means (14) is in the treating position;

(b) an annular groove (88) in said end member (18) located on the outer surface thereof;

(c) at least one longitudinal groove (96) extending along the surface of the connecting rod (20) from the inside face of one (18) of said end members (16, 18) to the other (16);

(d) a passageway (90) extending between the annular groove (88) and said longitudinal groove (96); and

(e) screen assembly carried on said connecting rod (20), said screen assembly permitting the processing fluid to pass therethrough under pressure while preventing the tobacco being treated from passing into the longitudinal grooves upon removal of the processing fluid from the pressure vessel.

30. The apparatus of claim 24, wherein the axes of said cylindrical tubular shell (101) and said spool means (102) coincide and are vertically positioned.

31. The apparatus of claim 15, further including an intermediate support means (140) which divides said accumulating chambers (128, 128') into sections, said intermediate support means (140) being reciprocated between a retracted position which permits the material (114), especially tobacco, to be deposited on said bottom, an accumulating position which permits

the material (114) to be deposited therein and a loading position contiguous to said spool means (102) to permit said inwardly moving enclosure means to form the material (114) about the spool means (102).

Patentansprüche

1. Vorrichtung zum Behandeln von Material (114) in einer dichtend verschlossenen Druckkammer (10, 100) mit einem unter Druck stehenden Behandlungsfluid,

wobei diese Vorrichtung umfaßt:

Einen zylindrischen, rohrförmigen Mantel (12, 101), der einen Teil der Druckkammer (10, 100) bildet, und

Einrichtungen zum Einführen und zum Entfernen des Behandlungsfluids in die bzw. aus der Druckkammer (10, 100) und

bewegliche Einrichtungen (14, 102), welche einen weiteren Teil der Druckkammer bilden und zwischen einer ersten Position zum Öffnen der Druckkammer und einer Behandlungsposition zum Schließen der Druckkammer hin- und herbeweglich montiert sind, und

Einrichtungen (70, 162) zum Bewegen der beweglichen Einrichtungen (14, 102) zwischen der ersten Position und der Behandlungsposition und

Dichtungseinrichtungen (32, 34, 36), die mit den beweglichen Einrichtungen (14, 102) und dem Mantel (12, 101) verbunden sind, um die Druckkammer (10, 100) dichtend zu verschließen, wenn sich die beweglichen Einrichtungen in der Behandlungsposition befinden,

wobei die Vorrichtung dadurch gekennzeichnet ist, daß die beweglichen Einrichtungen eine spulenförmige Einrichtung (14, 102) umfassen, welche ein erstes und ein zweites zylindrisches Endelement (16, 18) und eine Verbindungsstange (20) umfaßt, um die Endelemente im Abstand voneinander zu halten und festzulegen, derart, daß zwischen den beiden zylindrischen Endelementen (16, 18) und der spulenförmigen Einrichtung (14, 102) rings um die Verbindungsstange (20) ein ringförmiger longitudinaler Raum zur Aufnahme des zu behandelnden Materials (114) geschaffen wird, daß dieser ringförmige Raum zum Einfüllen und Entladen des Materials (114) in der ersten Position der spulenförmigen Einrichtung (14, 102) zugänglich ist, in der mindestens ein Teil derselben (der spulenförmigen Einrichtung) sich außerhalb des Mantels (12, 101) befindet, und daß der ringförmige Raum in der Behandlungsposition, in der sich die spulenförmige Einrichtung (14, 102) innerhalb des Mantels (12, 101) befindet, in Verbindung mit dem zylindrischen, rohrförmigen Mantel (12, 101) die Druckkammer bildet.

2. Vorrichtung nach Anspruch 1, bei der die Einrichtungen zum Zuführen und Entfernen des Behandlungsfluids Leitungseinrichtungen (42, 88, 90, 92, 96) in den spulenförmigen Einrichtungen umfassen, um das Einführen des Behandlungsfluids in der Mitte des Materials (114) zu ermöglichen.



3. Vorrichtung nach Anspruch 2, bei der die Leitungseinrichtungen Nuten (96) an der Außenfläche der Verbindungsstange (20) und Einrichtungen zum Einführen des Behandlungsfluids in diese Nuten umfassen.

4. Vorrichtung nach Anspruch 3, welche ferner eine Siebanordnung umfaßt, die die Verbindungsstange (20) bedeckt, um zu verhindern, daß irgendwelche Materialpartikel in die Nuten (96) passieren, wenn das Behandlungsfluid aus der Druckkammer (10) entfernt wird, während sie das Hindurchgehen des Behandlungsfluids unter Druck gestatten.

5. Vorrichtung nach Anspruch 4, bei der die Siebanordnung mehrere Lagen von Siebabdeckungen umfaßt, die von einer inneren Lage, angrenzend an die Verbindungsstange (20), bis zu einer äußeren Lage reichen, wobei die Maschenweite der inneren Lage etwa 3,15 Öffnungen pro cm ist und die äußere Lage etwa 1400 x 250 Maschen aufweist.

6. Vorrichtung nach Anspruch 1, bei der die Dichtungseinrichtungen (32, 34, 36) mindestens ein Dichtungselement (32, 34, 36) an den zylindrischen Endelementen (16, 18) umfassen, welches derart expandiert werden kann, daß es in Eingriff mit der Innenwand des Mantels (12) steht, um die abgedichtete Druckkammer (10) zu bilden, sowie Einrichtungen (52, 56, 58, 60, 62, 68, 70, 72, 74) zum Verformen der Dichtungselemente (32, 34, 36).

7. Vorrichtung nach Anspruch 6, bei der die Einrichtungen zum Verformen der Dichtungselemente (32, 34, 36) Leitungseinrichtungen (52, 56, 58, 60, 62, 68, 70, 72, 74) in der spulenförmigen Einrichtung (14) umfassen, um ein Fluid zu den Dichtungselementen zu übertragen, um zu bewirken, daß sich die Dichtungselemente ausdehnen und in Eingriff der Innenfläche des zylindrischen, rohrförmigen Mantels (12) gelangen.

8. Vorrichtung nach Anspruch 6, bei der die Einrichtungen zum Verformen dieser (Dichtungs-) Elemente (32, 34, 36) Einrichtungen zum Zusammendrücken der Dichtungselemente umfassen, welche letztere veranlassen, sich zu deformieren und in Eingriff mit der Innenwand des zylindrischen, rohrförmigen Mantels (12) zu gelangen.

9. Vorrichtung nach Anspruch 1, welche ferner zweite Fluidzuführeinrichtungen (98) umfaßt, welche dem zylindrischen Mantel zugeordnet sind, um das Behandlungsfluid in die Druckkammer (10) einzuleiten oder aus dieser abzuziehen.

10. Vorrichtung nach Anspruch 1, welche ferner Einrichtungen umfaßt, um die Temperatur der abgedichteten Druckkammer auf einem ausgewählten Niveau zu halten.

11. Vorrichtung nach Anspruch 1, bei der die erste Position der spulenförmigen Einrichtung (102) eine Beschickungsposition (104) ist, und welche ferner eine zweite Position (108) außerhalb des Mantels (101) zum Entladen umfaßt.

12. Vorrichtung nach Anspruch 11, ferner umfassend:

a) Einrichtungen (112) zum Beschicken der spulenförmigen Einrichtung (102) mit einem zu

behandelnden Material (114) in der ersten Position (104) und

b) Einrichtungen (150, 152, 153, 154, 156) zum Entladen der spulenförmigen Einrichtung (102) in der zweiten Position (108).

13. Vorrichtung nach Anspruch 12, bei der die Entladeeinrichtungen (112) umfassen:

a) eine bewegliche Schale (130, 130', 132, 132'), welche die spulenförmige Einrichtung (102) in der Beschickungsposition (104) umschließt, um das zu behandelnde Material einzuschließen, ehe die Spule (102) in den zylindrischen, rohrförmigen Mantel (101) bewegt wird; und

b) Transporteinrichtungen (144) zum Ablegen des Materials innerhalb der beweglichen Schale.

14. Vorrichtung nach Anspruch 12, bei der die Spule (102) zur Hin- und Herbewegung auf einer vertikalen Achse montiert ist und bei der die rohrförmige Schale (101) zwischen den Beschickungs- und den Entladeeinrichtungen angeordnet ist.

15. Vorrichtung nach Anspruch 14, bei der die Beschickungseinrichtungen (112) umfassen:

a) ein Stützelement (116), welches angrenzend an die obere Oberfläche (120) des unteren zylindrischen Endelements (118) angeordnet ist, wenn sich die spulenförmige Einrichtung (102) in der Beschickungsposition (104) befindet;

b) im Abstand voneinander angeordnete Seitenwände (146, 148) auf gegenüberliegenden Seiten der spulenförmigen Einrichtung (102), welche die Seiten eines Paares von Sammelkammern (128, 128') definieren, die sich auf gegenüberliegenden Seiten der spulenförmigen Einrichtung (102) befinden;

c) ein Paar von entfernbaren, vertikalen Stirnwänden (124, 126), welche quer zu den Seitenwänden (146, 148) verlaufen, wobei die vertikalen Stirnwände auf gegenüberliegenden Seiten der spulenförmigen Einrichtung (102) angeordnet sind und, angrenzend an dieselbe, ein erstes Ende jeder der Sammelkammern (128, 128') bilden;

d) Schalenelemente (130, 130', 132, 132') auf gegenüberliegenden Seiten der spulenförmigen Einrichtung (102), die auf der Außenseite der vertikalen Stirnwände angeordnet sind und das zweite Ende der Sammelkammern (128, 128') bilden, wobei die Schalenelemente (130, 130', 132, 132') zwischen den im Abstand voneinander angeordneten Seitenwänden (146, 148) angeordnet sind;

e) Einrichtungen (144) zum Ablegen des Materials (114) in die Sammelkammern (128, 128');

f) Einrichtungen zum Entfernen und Einsetzen der vertikalen Stirnwände aus dem und in den Raum zwischen den Seitenwänden (146, 148); und

g) Einrichtungen (136, 142) zum Hin- und Herbewegen der Schalenelemente (130, 130', 132, 132') nach innen auf die spulenförmige Einrichtung (102) zu zum Formen und Einschließen des Materials (114) rings um die spulenförmige Einrichtung (102) vor der Bewegung dieser spulenförmigen Einrichtung (102) aus der Beschickungsposi-



tion (104) in die Behandlungsposition (106).

16. Vorrichtung nach Anspruch 14, bei der die Entladeeinrichtungen umfassen:

a) ein Gehäuse (150) zum Umschließen der spulenförmigen Einrichtung, wobei das Gehäuse eine Auslaßöffnung (154) besitzt;

b) Einrichtungen (153) zum Entfernen des behandelten Materials aus der spulenförmigen Einrichtung (102).

17. Vorrichtung nach Anspruch 16, bei der das Gehäuse (150) ferner eine Einlaßöffnung (152) umfaßt und bei der die Einrichtungen zum Entfernen des behandelten Materials Einrichtungen (153) zum Hindurchleiten eines Fluids durch das Gehäuse (150) und durch die Auslaßöffnungen (154) umfassen, um das behandelte Material von der spulenförmigen Einrichtung (102) zu entfernen.

18. Vorrichtung nach Anspruch 16, bei der die Einrichtungen zum Entfernen des behandelten Materials umfassen:

a) Einrichtungen (160, 162) zum Drehen der spulenförmigen Einrichtung (102), während sie sich in dem Entladegehäuse befindet; und

b) Abstreifeinrichtungen zum Erfassen des behandelten Materials, während die spulenförmige Einrichtung gedreht wird, wodurch das behandelte Material von der spulenförmigen Einrichtung entfernt wird.

19. Vorrichtung nach Anspruch 16, welche ferner Einrichtungen (156) umfaßt, um das behandelte Material (114), welches von der Auslaßöffnung (154) des Gehäuses (150) empfangen wurde, zu transportieren.

20. Vorrichtung nach Anspruch 19, bei der die Einrichtungen (156) zum Transportieren eingeschlossen sind und ferner Einrichtungen umfassen, um das Material zu erhitzen, während es sich in den Transporteinrichtungen befindet.

21. Vorrichtung nach Anspruch 17, welche ferner Einrichtungen zum Heizen des das Gehäuse passierenden Fluids umfassen.

22. Vorrichtung nach Anspruch 1, bei der das Behandlungsfluid zurückgewonnen und erneut verwendet wird.

23. Vorrichtung nach Anspruch 1, bei der das Behandlungsfluid verwendet wird, um Bestandteile des Materials (114), welches behandelt wird, zu extrahieren.

24. Vorrichtung nach Anspruch 1, bei der das Material (114), welches behandelt wird, Tabak ist und bei der das Fluid verwendet wird, um dem Tabak im Verlauf des Prozesses zum Erhöhen der Füllkapazität desselben zu imprägnieren.

25. Vorrichtung nach Anspruch 24, welche ferner Einrichtungen zum Erhitzen des imprägnierten Materials (114) beim Entfernen dieses Materials aus der Druckkammer (10) umfaßt.

26. Vorrichtung nach Anspruch 24, welche ferner Einrichtungen zum Beheizen der Druckkammer (10) umfaßt.

27. Vorrichtung nach Anspruch 7, bei der die Leitungseinrichtungen zum Expandieren der Dichtungselemente umfassen:

a) Nuten (60, 62, 70) an der Außenfläche der

Endelemente (16, 18), welche die expandierbaren Dichtungselemente (32, 34, 36) tragen;

b) eine Bohrung (52) in der Verbindungsstange (20);

c) Kanäle (56, 58, 68), die sich zwischen den Dichtelement-Nuten (60, 62, 70) und der Bohrung (52) erstrecken; und

d) Einrichtungen zum Einführen und Entfernen eines Aufblasfluids in die Dichtelement-Nuten durch die Bohrung (52) und Kanäle (56, 58, 68) zum Expandieren und Entlüften der expandierbaren Dichtelemente (32, 34, 36).

28. Vorrichtung nach Anspruch 27, bei der das Aufblasfluid im wesentlichen inkompressibel und mit Tabak kompatibel ist.

29. Vorrichtung nach Anspruch 1 und 24, bei der die Einrichtungen zum Einführen des Behandlungsfluids in die Druckkammer (10) umfassen:

a) eine Versorgungsleitung (44), die mit dem rohrförmigen Mantel (12) an einem (18) der Endelemente (16, 18) verbunden ist, wenn die spulenförmige Einrichtung (14) sich in der Behandlungsposition befindet;

b) eine ringförmige Nut (88) in dem Endelement (18), die an der äußeren Oberfläche desselben angeordnet ist;

c) mindestens eine Längsnut (96), welche sich längs der Oberfläche der Verbindungsstange (20) von der Innenfläche eines (18) der Endelemente (16, 18) zu dem anderen (16) erstreckt;

d) einen Kanal (90), der sich zwischen der ringförmigen Nut (88) und der Längsnut (96) erstreckt; und

e) eine Gitteranordnung, welche von der Verbindungsstange (20) getragen wird, wobei die Gitteranordnung das Passieren des Behandlungsfluids unter Druck durch sie hindurch ermöglicht, während sie verhindert, daß der Tabak, welcher behandelt wird, beim Entfernen des Behandlungsfluids aus dem Druckgefäß in die Längsnuten passiert.

30. Vorrichtung nach Anspruch 24, bei der die Achsen des zylindrischen, rohrförmigen Mantels (101) und der spulenförmigen Einrichtung (102) zusammenfallen und vertikal positioniert sind.

31. Vorrichtung nach Anspruch 15, welche ferner eine Zwischenstützeinrichtung (140) umfaßt, die die Sammelkammern (128, 128') in Abschnitte unterteilt, wobei die Zwischenstützeinrichtung (140) zwischen einer zurückgezogenen Position, in der sie das Ablegen des Materials (114), insbesondere des Tabaks, auf dem Boden gestattet, einer Sammelposition, die es gestattet, das Material (114) darin abzulegen, und einer Beschickungsposition hin- und herbeweglich ist, die an die spulenförmige Einrichtung (102) angrenzt, um die Einwärtsbewegung der Einschließeinrichtungen zum Formen des Materials (114) um die spulenförmige Einrichtung (102) zu gestatten.

Revendications

1. Appareil pour traiter une matière (114) dans une chambre à pression scellée de manière



étanche (10, 100) au moyen d'un fluide de traitement sous pression,

cet appareil comprenant:

une enveloppe tubulaire cylindrique (12, 101) faisant partie de la chambre à pression (10, 100);
un moyen pour introduire le fluide de traitement dans la chambre à pression (10, 100) et pour l'évacuer;

un moyen mobile (14, 102) formant une autre partie de la chambre à pression et monté de manière à se déplacer en va-et-vient entre une première position pour ouvrir la chambre à pression et une position de traitement pour fermer la chambre à pression;

un moyen (77, 162) pour déplacer le moyen mobile (14, 102) entre la première position et la position de traitement, et

des moyens d'étanchéité (32, 34, 36) associés au moyen mobile (14, 102) et à l'enveloppe (12, 101) pour fermer la chambre à pression (10, 100) de manière étanche lorsque le moyen mobile se trouve dans la position de traitement,

cet appareil étant caractérisé en ce que le moyen mobile comprend un tiroir (14, 102) comprenant un premier et un second organe d'about cylindrique (16, 18) et une tige de raccordement (20) pour espacer et fixer les organes d'about de telle sorte qu'un espace longitudinal annulaire soit créé entre les deux organes d'about cylindriques (16, 18) du tiroir (14, 102) autour de la tige de raccordement (20) pour recevoir la matière (114) à traiter, que cet espace annulaire est accessible pour le chargement et le déchargement de la matière (114) dans la première position du tiroir (14, 102) dans laquelle au moins une partie se trouve à l'extérieur de l'enveloppe (12, 101) et que l'espace annulaire forme la chambre à pression (10, 100) en combinaison avec l'enveloppe tubulaire cylindrique (12, 101) dans la position de traitement dans laquelle le tiroir (14, 102) se trouve dans l'enveloppe (12, 101).

2. Appareil suivant la revendication 1, dans lequel le moyen destiné à introduire et à évacuer le fluide de traitement comprend des conduits (12, 88, 90, 92, 96) dans le tiroir pour permettre l'introduction de fluide de traitement dans le centre de la matière (114).

3. Appareil suivant la revendication 2, caractérisé en ce que les conduits comprennent des cannelures (96) dans la surface extérieure de la tige de raccordement (20) et des moyens pour introduire du fluide de traitement dans ces cannelures.

4. Appareil suivant la revendication 3, comprenant, en outre, un fourreau en treillis qui couvre la tige de raccordement (20) pour empêcher des particules de matière de pénétrer dans les cannelures (96) lorsque le fluide de traitement est évacué de la chambre à pression (10), tout en laissant passer le fluide de traitement sous pression.

5. Appareil suivant la revendication 4, dans lequel le fourreau en treillis comprend plusieurs épaisseurs de treillis allant d'une épaisseur intérieure adjacente à la tige de raccordement (20)

jusqu'à une épaisseur extérieure, les mailles de l'épaisseur intérieure étant d'environ 3,15 ouvertures par cm et l'épaisseur extérieure étant un treillis d'environ 1400 x 250 mailles.

6. Appareil suivant la revendication 1, dans lequel les moyens d'étanchéité (32, 34, 36) comprennent au moins un organe d'étanchéité (32, 34, 36) sur les organes d'about cylindriques (16, 18) qui peut être dilaté en contact avec la paroi intérieure de l'enveloppe (12) pour former la chambre à pression étanche (10) et des moyens (52, 56, 58, 60, 62, 68, 70, 72, 74) pour déformer les organes d'étanchéité (32, 34, 36).

7. Appareil suivant la revendication 6, dans lequel les moyens destinés à déformer les organes d'étanchéité (32, 34, 36) comprennent des conduits (52, 56, 58, 60, 62, 68, 70, 72, 74) dans le tiroir (14) pour transmettre un fluide aux organes d'étanchéité en vue de les amener à se dilater et à attaquer la surface interne de l'enveloppe tubulaire cylindrique (12).

8. Appareil suivant la revendication 6, dans lequel les moyens destinés à déformer les organes d'étanchéité (32, 34, 36) comprennent un moyen pour écraser les organes d'étanchéité afin de les amener à se déformer et à attaquer la paroi interne de l'enveloppe tubulaire cylindrique (12).

9. Appareil suivant la revendication 1, comprenant, en outre, un second moyen d'introduction de fluide (98) associé à l'enveloppe cylindrique (12) pour introduire du fluide de traitement dans la chambre à pression (10) ou pour évacuer du fluide de traitement de celle-ci.

10. Appareil suivant la revendication 1, comprenant, en outre, un moyen pour maintenir la température de la chambre à pression étanche à un niveau choisi.

11. Appareil suivant la revendication 1, dans lequel la première position du tiroir (102) est une position de chargement (104) et qui comprend, en outre, une seconde position (108) à l'extérieur de l'enveloppe (101) pour le déchargement.

12. Appareil suivant la revendication 11, comprenant, en outre:

(a) un moyen (112) pour charger le tiroir (102) dans la première position (104) au moyen d'une matière (114) à traiter, et

(b) des moyens (150, 152, 153, 154, 156) pour décharger le tiroir (102) dans la seconde position (108).

13. Appareil suivant la revendication 12, dans lequel le moyen de chargement (112) comprend:

(a) une enveloppe mobile (130, 130', 132, 132') qui enferme le tiroir (102) dans la position de chargement (104) pour confiner la matière (114) à traiter avant d'introduire le tiroir (102) dans l'enveloppe tubulaire cylindrique (101), et

(b) un moyen de transport (114) pour déposer la matière dans l'enveloppe cylindrique.

14. Appareil suivant la revendication 12, dans lequel le tiroir (102) est monté de manière à se déplacer en va-et-vient suivant un axe vertical et l'enveloppe tubulaire (101) est disposée entre le moyen de chargement et le moyen de déchargement.



15. Appareil suivant la revendication 14, dans lequel le moyen de chargement (112) comprend:

(a) un support (116) positionné près de la surface supérieure (120) de l'organe d'about cylindrique inférieur (118) lorsque le tiroir (102) se trouve dans la position de chargement (104);

(b) des parois latérales espacées (146, 148) de part et d'autre du tiroir (102), définissant les côtés de deux chambres accumulatrices (128, 128') disposées de part et d'autre du tiroir (102);

(c) deux parois d'extrémité verticales amovibles (124, 126) transversales aux parois latérales (146, 148), ces parois d'extrémité verticales étant disposées de part et d'autre du tiroir (102) et formant, à proximité de celui-ci, une première extrémité de chacune des chambres accumulatrices (128, 128');

(d) des éléments d'enveloppe (130, 130', 132, 132') de part et d'autre du tiroir (102), disposés à l'extérieur des parois d'extrémité verticales (124, 126) et formant la seconde extrémité des chambres accumulatrices (128, 128'), les éléments d'enveloppe (130, 130', 132, 132') étant situés entre les parois latérales espacées (146, 148);

(e) un moyen (144) pour déposer la matière (114) dans les chambres accumulatrices (128, 128');

(f) un moyen pour retirer les parois d'extrémité verticales d'entre les parois latérales (146, 148) et pour les insérer en place, et

(g) un moyen (136, 142) pour déplacer en va-et-vient les éléments d'enveloppe (130, 130', 132, 132') vers l'intérieur vers le tiroir (102) en vue de façonner et de confiner la matière (114) autour du tiroir (102) avant de faire passer ce tiroir (102) de la position de chargement (104) à la position de traitement (106).

16. Appareil suivant la revendication 14, dans lequel le moyen de déchargement comprend:

(a) une enceinte (150) pour enfermer le tiroir, l'enceinte comportant une ouverture de sortie (154), et

(b) un moyen (153) pour évacuer la matière traitée du tiroir (102).

17. Appareil suivant la revendication 16, dans lequel l'enceinte (150) comprend, en outre, une ouverture d'entrée (152) et le moyen pour évacuer la matière traitée comprend un moyen (153) pour faire passer un fluide à travers l'enceinte (150) et à travers l'ouverture de sortie (154) en vue d'évacuer la matière traitée du tiroir (102).

18. Appareil suivant la revendication 16, dans lequel le moyen destiné à évacuer la matière traitée comprend:

(a) un moyen (160, 162) pour faire tourner le tiroir (102) tandis qu'il se trouve dans l'enceinte de déchargement (150), et

(b) un moyen de raclage pour attaquer la matière traitée lorsque le tiroir est tourné, de telle sorte que la matière traitée soit évacuée du tiroir.

19. Appareil suivant la revendication 16, comprenant, en outre, un moyen (156) pour transporter la matière traitée (114) reçue de l'ouverture de sortie (154) de l'enceinte (150).

20. Appareil suivant la revendication 19, dans

lequel le moyen (156) pour le transfert est enfermé et qui comprend, en outre, un moyen pour chauffer la matière tandis qu'elle se trouve dans le dispositif de transport.

21. Appareil suivant la revendication 17, comprenant, en outre, un moyen pour chauffer le fluide traversant l'enceinte.

22. Appareil suivant la revendication 1, dans lequel le fluide de traitement est récupéré et réutilisé.

23. Appareil suivant la revendication 1, dans lequel le fluide de traitement est utilisé pour extraire des constituants de la matière (114) en cours de traitement.

24. Appareil suivant la revendication 1, dans lequel la matière (114) traitée est du tabac et le fluide est utilisé pour imprégner le tabac au cours du processus visant à augmenter sa capacité de remplissage.

25. Appareil suivant la revendication 24, comprenant, en outre, un moyen pour appliquer de la chaleur à la matière imprégnée (114) lors de l'évacuation de cette matière de la chambre à pression (10).

26. Appareil suivant la revendication 24, comprenant, en outre, un moyen pour chauffer la chambre à pression (10).

27. Appareil suivant la revendication 7, dans lequel les conduits pour dilater les organes d'étanchéité comprennent:

(a) des gorges (60, 62, 70) dans la surface extérieure des organes d'about (16, 18) qui portent les organes d'étanchéité dilatables (32, 34, 36);

(b) un canal (52) dans la tige de raccordement (20);

(c) des passages (56, 58, 68) qui s'étendent entre les gorges à organes d'étanchéité (60, 62, 70) et le canal (52), et

(d) un moyen pour introduire un fluide de gonflage dans les gorges à organes d'étanchéité par le canal (52) et les passages (56, 58, 68) et pour l'évacuer afin de dilater et de contracter les organes d'étanchéité dilatables (32, 34, 36).

28. Appareil suivant la revendication 27, dans lequel le fluide de gonflage est en substance incompressible et est compatible avec le tabac.

29. Appareil suivant les revendications 1 et 24, dans lequel le moyen pour introduire du fluide de traitement dans la chambre à pression (10) comprend:

(a) une conduite d'alimentation (44) raccordée à l'enveloppe tubulaire (12) au niveau d'un (18) des organes d'about (16, 18) lorsque le tiroir (14) se trouve dans la position de traitement;

(b) une gorge annulaire (88) dans l'organe d'about (18), dans la surface extérieure de celui-ci;

(c) au moins une cannelure longitudinale (96) qui s'étend le long de la surface de la tige de raccordement (20) depuis la face interne (18) d'un des organes d'about (16, 18) jusqu'à l'autre face (16);

(d) un passage (90) qui s'étend entre la gorge annulaire (88) et la cannelure longitudinale (96), et



(e) un fourreau en treillis monté sur la tige de raccordement (20), ce fourreau livrant passage au fluide de traitement sous pression, mais empêchant le tabac traité de pénétrer dans les cannelures longitudinales lorsque le fluide de traitement est évacué de la cuve à pression.

30. Appareil suivant la revendication 24, dans lequel les axes de l'enveloppe tubulaire cylindrique (101) et du tiroir (102) coïncident et sont disposés verticalement.

31. Appareil suivant la revendication 15, comprenant, en outre, un support intermédiaire (140)

qui divise les chambres accumulatrices (128, 128') en sections, le support intermédiaire (140) étant déplacé en va-et-vient entre une position rétractée dans laquelle la matière (114), en particulier du tabac, peut être déposée sur le fond, une position d'accumulation dans laquelle la matière (114) peut être déposée dans l'appareil et une position de chargement contiguë au tiroir (102) pour permettre aux éléments d'enceinte qui se déplacent vers l'intérieur de façonner la matière (114) autour du tiroir (102).

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