Nov. 15, 1966 J. D'A. CLARK 3,285,669

FEEDING AND EXTRACTING APPARATUS AND METHOD

Filed May 20, 1964 2 Sheets-Sheet 1

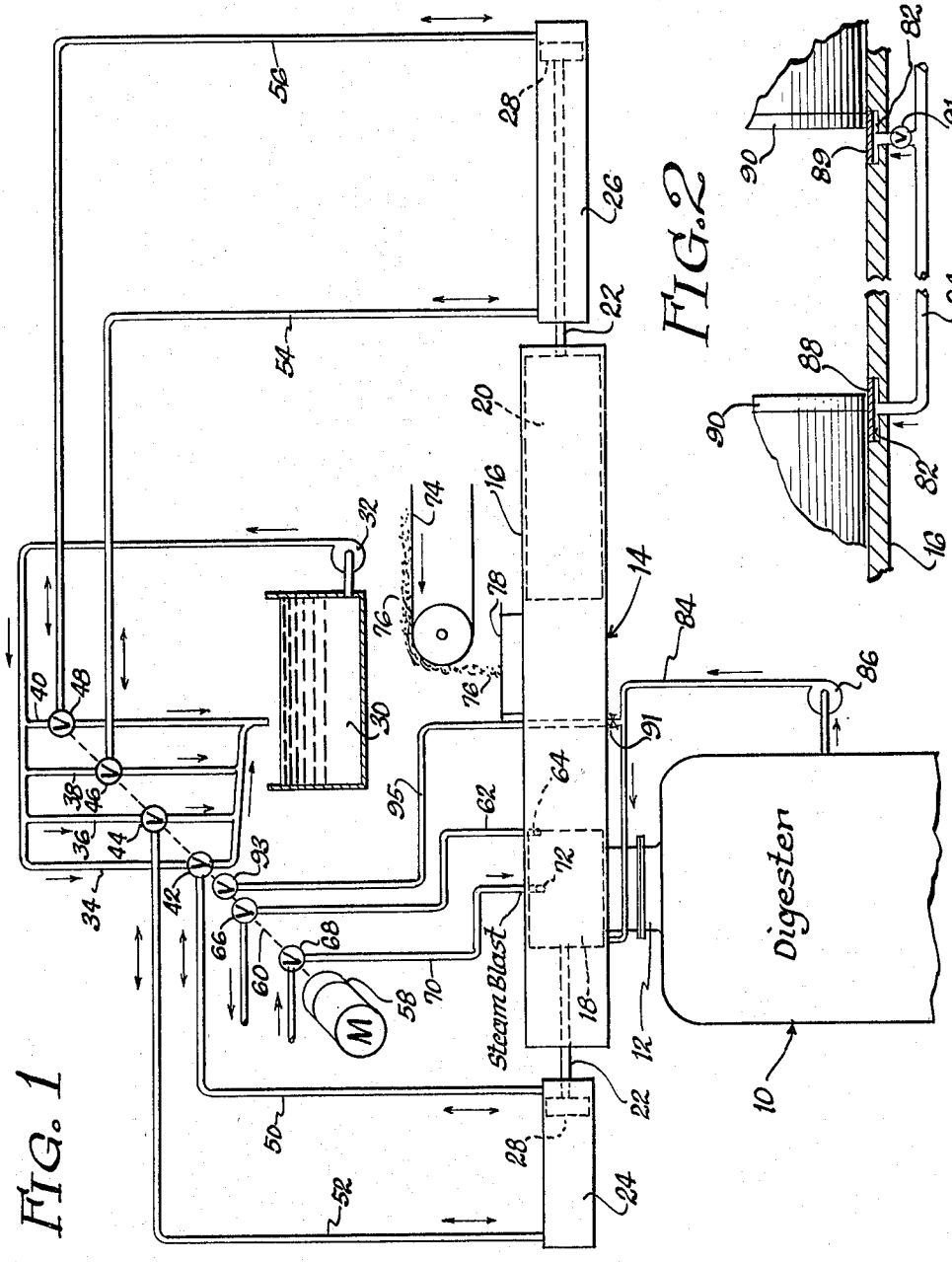


FIG. 1

FIG. 2

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FIG. 3

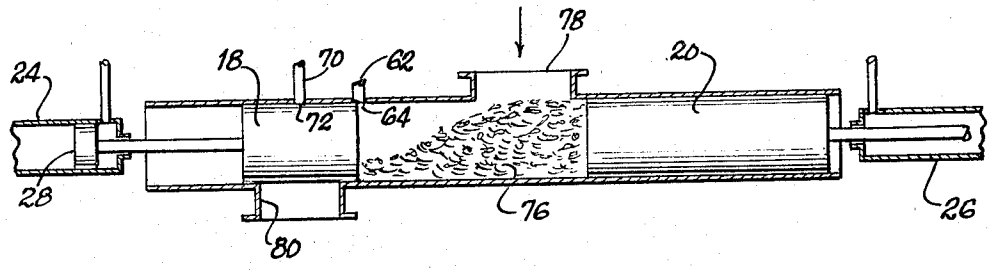


FIG. 4

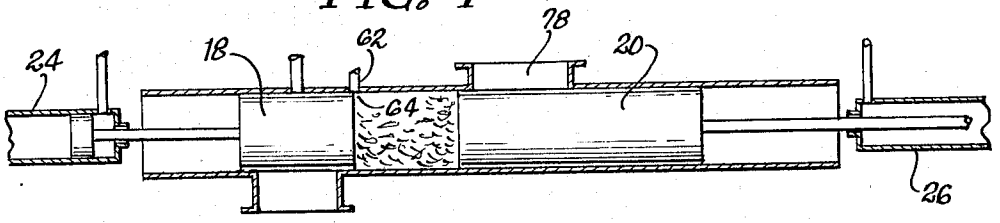


FIG. 5

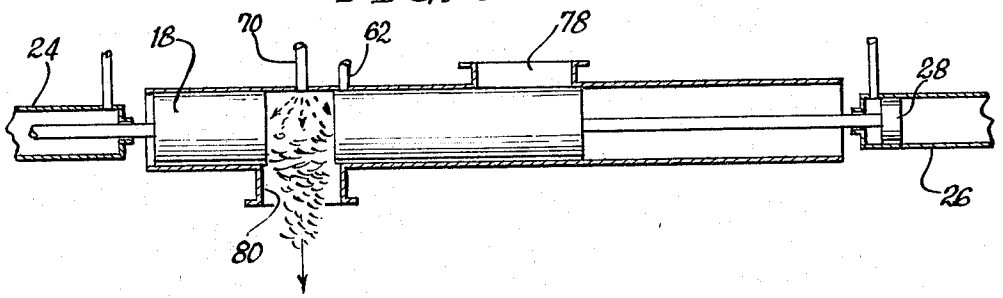
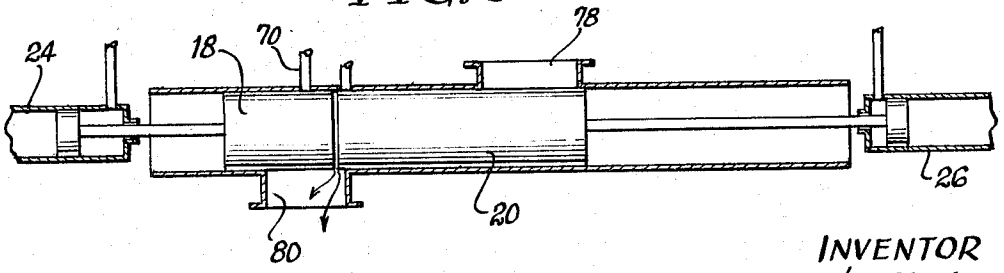


FIG. 6



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FEEDING AND EXTRACTING APPARATUS AND METHOD

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Filed May 20, 1964, Ser. No. 368,915
10 Claims. (Cl. 302—14)

This invention relates to an improved mechanism for the transferring of fibrous materials and the like. The invention also involves methods for undertaking such transfer of material, and the method and apparatus may be employed for feeding the material into an apparatus or for extracting the material from an apparatus.

In the handling of raw fibrous material such as discrete particles of wood, such materials are introduced into a pressure vessel for the purpose of digestion therein. In addition, precedures call for the removal of the digested material from such vessels. The instant invention will be described with reference to the wood pulp industry; however, other uses of the mechanisms and methods will also be obvious.

In the handling of fibrous material, certain difficulties have been recognized when employing conventional constructions. In pressure vessels, a substantial amount of steam and gas pressure is built-up and a great deal of pressure is lost during charging into such vessels and during extracting of material from the vessels. Thus, during every cycle of operation of the means for transferring the material, exposure to lower pressure conditions results, and loss of pressure cannot be avoided.

Known constructions also exhibit certain other limitations. For example, the quantity of liquor which is discharged with fibrous material is considered to be an important factor insofar as the quality of the material is concerned. Conventional constructions do not provide suitable means for controlling the amount of liquor whereby control of the pulp quality can be accomplished.

It is an object of this invention to provide an improved mechanism for feeding or extracting fibrous material and the like from various constructions.

It is a further object of this invention to provide improved methods for the transfer of fibrous material and the like whereby certain disadvantages of prior art constructions can be overcome.

It is a still further object of this invention to provide an apparatus and method characterized by the above features and also capable of feeding or extracting material to or from a pressure vessel with a minimum loss of gas or steam pressure.

It is a still further object of this invention to provide an apparatus and method characterized by the above features and also adapted for the transferring of digested material from a digester construction in a manner such that control of the amount of liquor discharged can be accomplished.

It is an additional object of this invention to provide an apparatus capable of achieving the foregoing objects and also adapted to be economically maufactured, simply operated, and having minimum maintenance problems.

These and other objects of this invention will appear hereinafter and for purposes of illustration, but not of limitation, specific embodiments of this invention are shown in the accompanying drawings in which:

FIGURE 1 is a diagrammatic view illustrating the use of the structure of this invention in combination with a digester construction;

FIGURE 2 is an enlarged fragmentary view illustrating characteristics of the piston means employed in the apparatus of this invention; and

FIGURES 3 through 6 comprise elevational views illustrating the cycle of operations which characterize a system incorporating the features of this invention.

The construction of this invention is generally suited for the transfer of fibrous materials and the like from one location to another. The apparatus comprises a cylindrical member which defines an inlet opening in one location and an outlet opening at a different position along the length of the cylindrical member. First and second pistons are adapted to reciprocate within the cylindrical member. These pistons operate to alternately open and close the inlet and outlet opening during each cycle of operation.

The described apparatus and the method of its use involve the provision of control means whereby the respective pistons can be operated in accordance with a suitable sequence. The sequence involves the introduction of fibrous material between the pistons through the inlet opening. This introduction of material takes place while one of the pistons is closing off the outlet opening whereby there will be no communication with the interior of the vessel or other means to which the apparatus is connected. On the other hand, if the apparatus is being employed for extracting fibrous material, the inlet opening will communicate with the interior of the vessel holding the material but the outlet opening will be closed off to avoid communication with the exterior atmosphere.

After a sufficient amount of material has been introduced between the pistons, the second piston operates to close off the inlet opening. The two pistons are then moved whereby the outlet opening is exposed, and the material is then passed through the outlet opening from between the pistons. The pistons are moved into engagement to assist in removal of the fibrous material and also to discharge any other substances from the space between the pistons. Accordingly, when a new cycle of operation is undertaken, there will be no foreign substances included between the pistons along with the fibrous material.

FIGURE 1 illustrates a digester **10** which may be of the type referred to in applicant's copending application Serial No. 368,917, filed May 20, 1964, and entitled, "Continuous Digester." Fibrous material is introduced into digesters of this type through the neck **12**. The apparatus of this invention generally designated by the numeral **14** can be employed for the introduction of the fibrous material.

The construction of this invention comprises a cylindrical member **16** and a pair of pistons **18** and **20** reciprocally movable within the cylindrical member. Each of the pistons is connected to a shaft **22**, and the respective shafts extend into cylinders **24** and **26**. Reciprocation of the pistons is effected through action of hydraulic fluid on the discs **28** which are connected to the shafts **22**, and which are slideable in the respective cylinders.

In the embodiment illustrated, the hydraulic fluid is delivered from a reservoir **30** by means of a pump **32**. The pump forces the liquid through lines **34**, **36**, **38** and **40** where the fluid encounters valves **42**, **44**, **46** and **48**, respectively. To move the piston **18** to the left, the valve **42** is operated to provide communication with line **50**. Movement of this piston to the right is effected through operation of valve **44** and transmission of fluid through line **52**. It will also be apparent that the piston **20** can be moved in either direction through operation of one of the valves **46** and **48**, these valves communicating with lines **54** and **56**, respectively.

A motor **58** is connected to a common shaft which extends along the line **60**. Accordingly, each of the valves can be sequentially operated in a desired fashion to achieve reciprocation of the pistons in accordance with a predetermined cycle. It will be apparent that the particular valve arrangement and the operation thereof provides an extremely efficient means for effecting the desired movements of the piston elements in the appa-

ratus of this invention. However, other drive means including non-hydraulic systems can be utilized.

The construction of this invention also may include a line **62** which extends to an opening **64** communicating with the interior of the cylindrical member **16**. A valve **66** is included in this line, and when the valve is opened, excess fluids can be removed from the interior of the cylindrical member. As will appear hereinafter, the removal of these fluids takes place at a specific time in the operating cycle. For this reason, the valve **66** can also be advantageously controlled through the operation of the motor **58**.

An additional valve **68** is also operatively connected to the motor **58**, this valve is provided in line **70** which also communicates with the interior of the cylindrical member through opening **72**. The line **70** is connected to a source of steam or high pressure fluid whereby the fluid can be employed for assisting in removal of fibrous material from the cylindrical member **16** for passage of the material into the digester **10**.

The illustrated apparatus can be employed in combination with a conveyor **74** which is adapted to deliver fibrous material **76** to the inlet **78** for the cylindrical member. It will be appreciated that the apparatus could also be employed in combination with other means capable of passing material into the inlet **78**. Thus, the inlet **78** could be connected to the outlet for the digester **10** to provide for removal of the contents of the digester in the advantageous manner provided by this invention.

FIGURES 3 through 6 illustrate a typical cycle of operation of the apparatus of this invention. The cycle illustrated begins with the piston **18** closing off the outlet opening **80** which is connected to the neck **12** in FIGURE 1. The fibrous material **76** is placed in the cylindrical member between the pistons **18** and **20**. The piston **20** is then operated to move toward the piston **18** whereby the fibrous material can be slightly compressed between these pistons. In the preferred operation, excess fluid is passed out through the opening **64** into conduit **62**. As shown in FIGURE 5, each of the pistons **18** and **20** are then displaced whereby the fibrous material is brought over outlet opening **80**. The material is then adapted to be removed from the space between the ends of the pistons. To assist in this removal, a steam blast can be provided by opening valve **68** for passage of the steam through conduit **70**. The combination of the blast of steam or other fluid as well as the position of the two pistons will provide for complete clearing of the space between the pistons. As shown in FIGURE 6, the pistons can be moved into substantial contact whereby all substances including excess gases and fluid will be displaced from between the pistons.

In order to insure proper sealing in the apparatus and to reduce friction, grooves **82** are formed in the side walls of the cylindrical member **16**. These grooves communicate with conduit **84** which is in turn connected to a source of pressurized fluid. In the instant embodiment, the line **84** is connected to the digester through pump **86**. Cylindrical sealing rings **88** and **89** (see FIGURE 2) are fitted into the grooves **82**, and these rings are caused to bear against the piston surfaces through action of the pressurized fluid in the grooves. A small quantity of liquid under pressure will issue from the periphery of the rings, and this will serve to lubricate the pistons and to wash back any debris which may be carried to the rings on the piston surfaces.

The connection to the ring **89** is preferably provided with a timing valve **91** operated by the motor **58** to cut off the fluid supply just prior to the time the ring is uncovered by the piston **20** and the valve remains closed when this ring is uncovered. A valve **93** is operatively connected to shaft **60** and a line **95** connects this valve to the valve **91**. Piston **18** could be provided with a conventional piston ring at its trailing end.

Also illustrated in FIGURE 2 is a preferred form to be taken by the end faces of the pistons. These faces preferably carry renewable collars **90** of a hard material such as high speed steel. The peripheral edges of the inlet and outlet openings **78** and **80** are also provided with such hard material whereby any particles caught between the leading edges of the pistons and the openings can be cut away. Where the collars are renewable, they can be replaced when worn. It is also contemplated that the entire inner surface of the cylinder may have a renewable liner, and the cylinder and liner may be formed in semicircular halves to facilitate replacement.

It will be apparent that the sequential operation described can be conducted in an extremely efficient manner with the control means of this invention. By providing a single motor for operating the respective valves, the various operations can be synchronized with each other whereby each portion of a cycle will take place at a prescribed time.

The control means is fixed in such a way that there will be no undue compression of the fibrous material during the stage of operation shown in FIGURE 4. The application of undue force to the fibrous material often damages this material and the described control means provide an effective means for avoiding this.

It will be obvious that the particular sequence of operations described effectively prevents loss of pressure during introduction of material into a digester. The inlet **80** is closed during the time that the outlet **78** is open, and the inlet is not brought into communication with the cylinder member until the outlet is closed by the piston **20**. This overcomes recognized defects in prior art constructions wherein substantial quantities of pressurized gases are released during additions of new material.

Where the apparatus is employed for removing digested material, other advantages are recognized. Specifically, it has been found that the provision of means such as the opening **64** in the cylindrical member permits control of the amount of liquor removed with the digested pulp irrespective of the liquor-pulp ratio in the digester.

It will be understood that various changes and modifications may be made in the above described method and apparatus which provide the characteristics of this invention without departing from the spirit thereof particularly as defined in the following claims.

That which is claimed is:

1. A method for transferring fibrous material and the like from one location to another, said method comprising the steps of providing a cylindrical member having an inlet opening and an outlet opening, said cylindrical member providing a passage for the movement of first and second separately operated pistons, moving said first piston to close off the passage from said outlet opening to said second piston and moving said second piston to open said inlet opening whereby said inlet openings is situated between said pistons introducing said material into said cylindrical member through said inlet opening, moving said second piston toward said first piston to close off said inlet opening with said material being disposed between said pistons, slightly compacting said material between said pistons and removing excess fluids from said material during said compacting operation, moving each of said pistons to open said outlet opening and to effect passage of said material from between said pistons through said outlet opening, and moving said first piston toward said second piston to displace substantially all substances from the space between said pistons.

2. A method in accordance with claim **1** including the step of using a liquid under pressure from the location connected to the outlet opening as an actuating liquid to seal the periphery of said second piston whereby any leakage of the liquid from the sealing ring is subsequently returned by said second piston to said location.

3. An apparatus for transferring fibrous material and the like from one location to another, said apparatus comprising a cylindrical member having an inlet opening and an outlet opening, first and second pistons, shafts connected to said pistons, said shafts extending to separate cylinders operative to reciprocate said pistons, and control means for said cylinders adapted to position said first piston for closing off said outlet opening while said inlet opening is situated between said pistons whereby said inlet opening communicates with said cylindrical member to permit introduction of said material into said cylinder, said control means operating to move said second piston toward said first piston to thereby close off said inlet opening with said material disposed between said pistons, said control means operating to move each of said pistons to open said outlet opening whereby the material between said pistons can be passed out of said cylindrical member, said control means operating to move said first piston toward said second piston to displace substantially all substances from the space between said pistons, valve means operatively associated with said control means, said valve means being opened and closed by a single motor means whereby movement of said pistons can be undertaken automatically in accordance with a predetermined pattern, and including fluid inlet means defined by said cylindrical member at a point adjacent said outlet whereby fluid can be forced into said cylindrical member to assist in removal of said material through said outlet, and wherein an additional valve means is associated with said fluid inlet means and is operated by said motor means.

4. An apparatus for transferring fibrous material and the like from one location to another, said apparatus comprising a cylindrical member having an inlet opening and an outlet opening, first and second pistons, shafts connected to said pistons, said shafts extending to operating means operative to reciprocate said pistons, and control means for said operating means adapted to position said first piston for closing off said outlet opening while said inlet opening is situated between said pistons whereby said inlet opening communicates with said cylindrical member to permit introduction of said material into said cylindrical member, said control means operating to move said second piston toward said first piston to thereby close off said inlet opening with said material disposed between said pistons, said control means operating to move each of said pistons to open said outlet opening whereby the material between said pistons can be passed out of said cylindrical member, and said control means operating to move said first piston toward said second piston to displace substantially all substances from the space between said pistons, and including an opening defined in said cylindrical member between said inlet and outlet openings whereby excess fluids in said material can be expelled when said second piston is moved toward said first piston.

5. An apparatus for transferring fibrous material and the like from one location to another, said apparatus comprising a cylindrical member having an inlet opening and an outlet opening, first and second pistons, shafts connected to said pistons, said shafts extending to operating means operative to reciprocate said pistons, and control means for said operating means adapted to position said first piston for closing off said outlet opening while said inlet opening is situated between said pistons whereby said inlet opening communicates with said cylindrical member to permit introduction of said material into said cylindrical member, said control means operating to move said second piston toward said first piston to thereby close off said inlet opening with said material disposed between said pistons, said control means operating to move each of said pistons to open said outlet opening whereby the material between said pistons can be passed out of said cylindrical member, and said control means operating to move said first piston toward said second piston to displace substantially all substances from the space between said pistons, and wherein the leading edge of at least said second piston includes a renewable hardened ring member, and on at least part of the peripheral edge of said inlet opening, a cooperating renewable hardened curved member, whereby substances caught between said edges are sheared off during the closing of said inlet opening by the second piston.

6. An apparatus for transferring fibrous material and the like from one location to another, said apparatus comprising a cylindrical member having an inlet opening and an outlet opening, first and second pistons, shafts connected to said pistons, said shafts extending to operating means operative to reciprocate said pistons, and control means for said operating means adapted to position said first piston for closing off said outlet opening while said inlet opening is situated between said pistons whereby said inlet opening communicates with said cylindrical member to permit introduction of said material into said cylindrical member, said control means operating to move said second piston toward said first piston to thereby close off said inlet opening with said material disposed between said pistons, said control means operating to move each of said pistons to open said outlet opening whereby the material between said pistons can be passed out of said cylindrical member, and said control means operating to move said first piston toward said second piston to displace substantially all substances from the space between said pistons, and including an annular groove in said cylindrical member adjacent said inlet opening, a circular sealing ring fitted into said groove, the internal diameter of said ring being greater than the external diameter of said second piston so as to permit of the latter's unhindered entry, timed valve means to introduce fluid under pressure to said groove subsequent to the entry of the piston, whereby the sealing ring is compressed around the piston to prevent leakage from within the cylindrical member, and means to relieve the fluid and decompress the sealing ring just prior to its being disengaged by the piston during its return cycle.

7. An apparatus in accordance with claim 6 including fluid inlet means defined by said cylindrical member at a point adjacent said outlet whereby fluid can be forced into said cylindrical member to assist in removal of said material through said outlet, and in which the fibrous material is transferred to a digester and said last mentioned fluid is supplied from said digester, whereby any leakage may be returned directly to said digester by by the movement of said second piston.

8. An apparatus for transferring fibrous material and the like from one location to another, said apparatus comprising a cylindrical member having an inlet opening and an outlet opening, first and second pistons, shafts connected to said pistons, said shafts extending to operating means operative to reciprocate said pistons, and control means for said operating means adapted to position said first piston for closing off said outlet opening while said inlet opening is situated between said pistons whereby said inlet opening communicates with said cylindrical member to permit introduction of said material into said cylindrical member, said control means operating to move said second piston toward said first piston to thereby close off said inlet opening with said material disposed between said pistons, said control means operating to move each of said pistons to open said outlet opening whereby the material between said pistons can be passed out of said cylindrical member, said control means operating to move said first piston toward said second piston to displace substantially all substances from the space between said pistons, valve means operatively associated with said control means, said valve means being opened and closed by a single motor means whereby movement of said pistons can be undertaken automatically in accordance with a predetermined pattern, and including a first additional opening defined in said cylindrical mem-

ber between said inlet and outlet openings whereby excess fluids in said material can be expelled when said second piston is moved toward said first piston, a second additional opening communicating with said cylinder in the vicinity of said outlet opening, an additional valve means associated with said second additional opening, said additional valve means being operatively connected to said motor means, and a source of high pressure fluid adapted to be brought into communication with said second additional opening when said additional valve means is opened by said motor means.

9. An apparatus for transferring fibrous material and the like from one location to another, said apparatus comprising a cylindrical member having an inlet opening and an outlet opening, first and second pistons, shafts connected to said pistons, said shafts extending to operating means operative to reciprocate said pistons, and control means for said operating means adapted to position said first piston for closing off said outlet opening while said inlet opening is situated between said pistons whereby said inlet opening communicates with said cylindrical member to permit introduction of said material into said cylindrical member, said control means operating to move said second piston toward said first piston to thereby close off said inlet opening with said material disposed between said pistons, said control means operating to each of said pistons to open said outlet opening whereby the material between said pistons can be passed out of said cylindrical member, said control means operating to move said first piston toward said second piston to displace susbtantially all substances from the space between said pistons, valve means operatively associated with said control means, said valve means being opened and closed by a single motor means whereby movement of said

pistons can be undertaken automatically in accordance with a predetermined pattern, and including annular groooves defined by said cylindrical member and cylindrical sealing rings fitted into said grooves, said rings engaging the surfaces of said pistons to prevent leakage from within said cylindrical member, at least one of said grooves being connected to a source of high pressure fluid whereby an associated ring can be pressed into intimate contact with the surface of an associated piston, and additional valve means operatively connected to said motor means whereby the fluid pressure to said grooves can be shut off when said piston moves beyond the position of said grooves.

10. In an apparatus for transferring fibrous material or the like from one location to another by means of a transporting cylinder and a piston sliding therein, one of said locations being under pressure, an annular groove on said cylinder located intermediate the path of travel of said piston, a circular sealing ring fitted into said groove, the internal diameter of said ring being greater than said piston, and means to introduce fluid under pressure to said groove subsequent to the entry of said piston into said ring whereby said ring is compressed about said piston to prevent leakage outwards between said ring and piston and means to release the fluid and decompress said ring just prior to withdrawal of said piston during its return stroke.

References Cited by the Examiner

FOREIGN PATENTS

888,839 9/1953 Germany.

ANDRES H. NIELSEN, *Primary Examiner.*