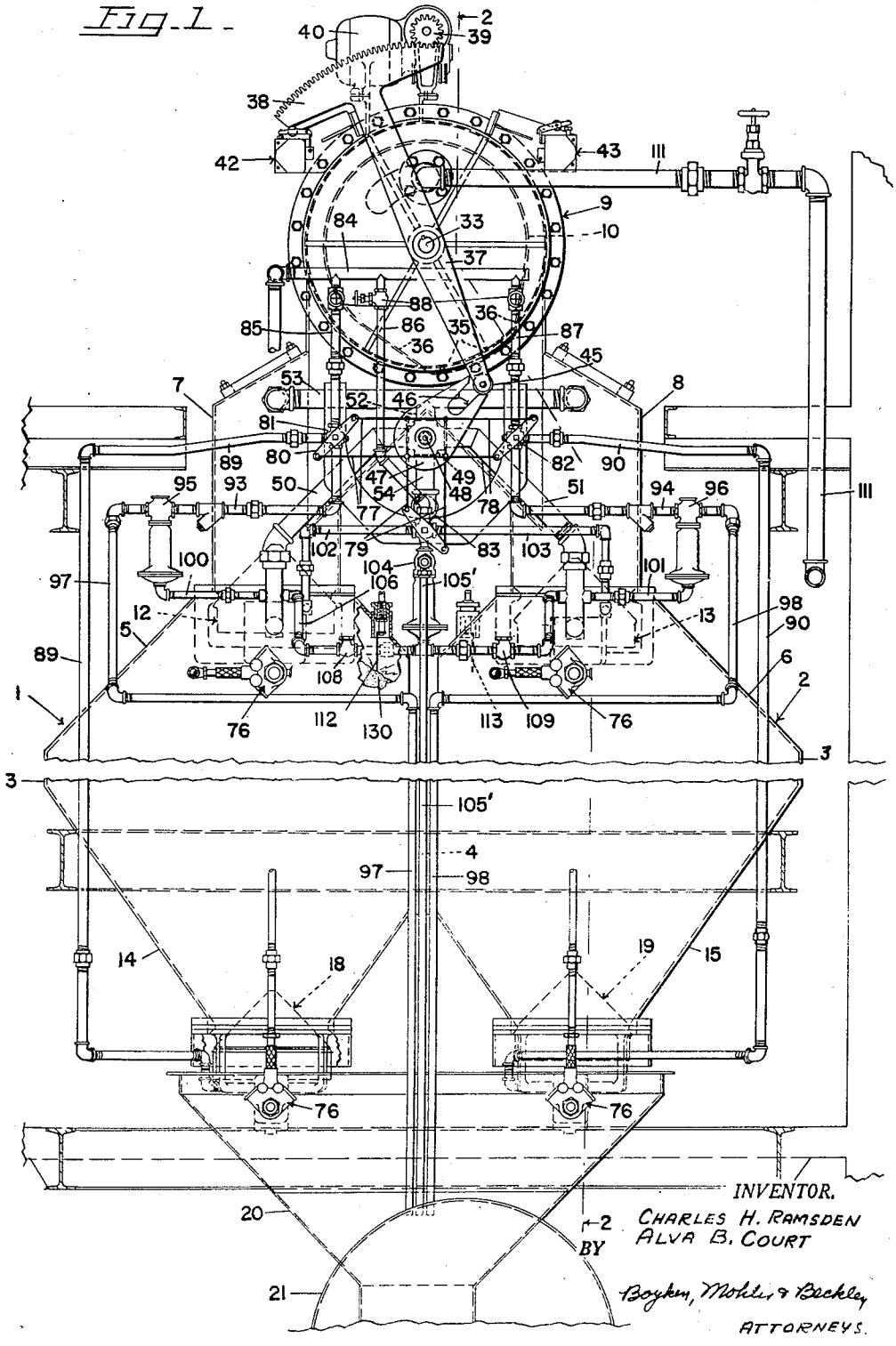
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Fig. 1.



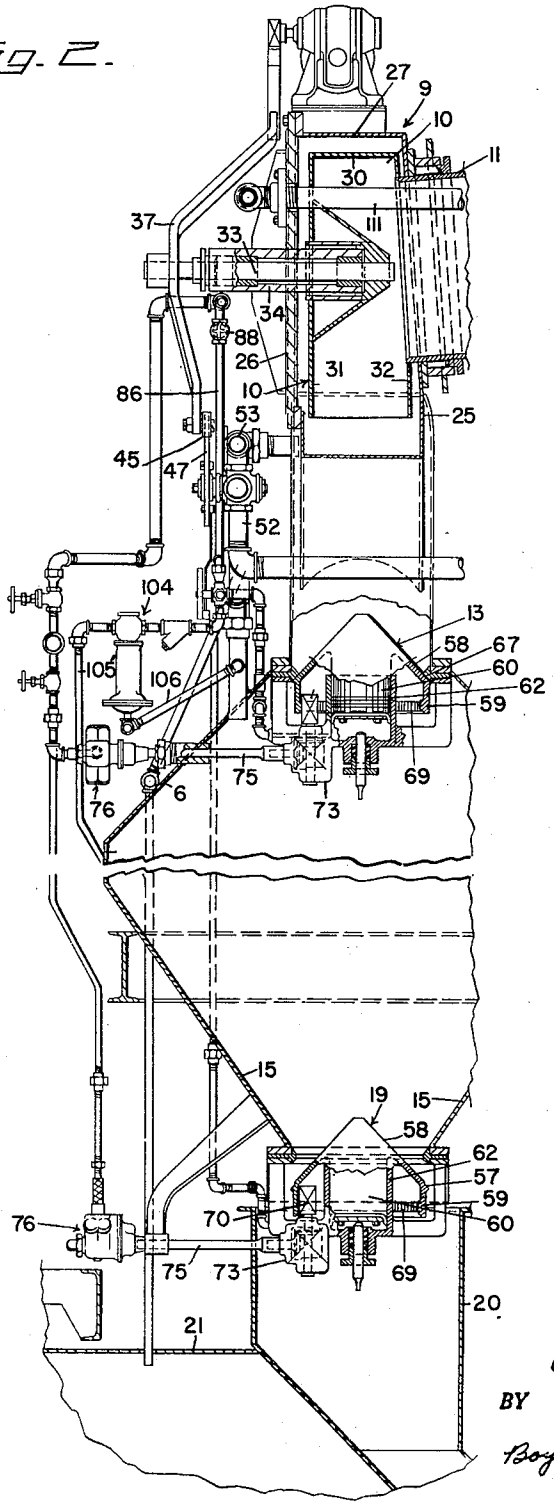
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Fig. 2.



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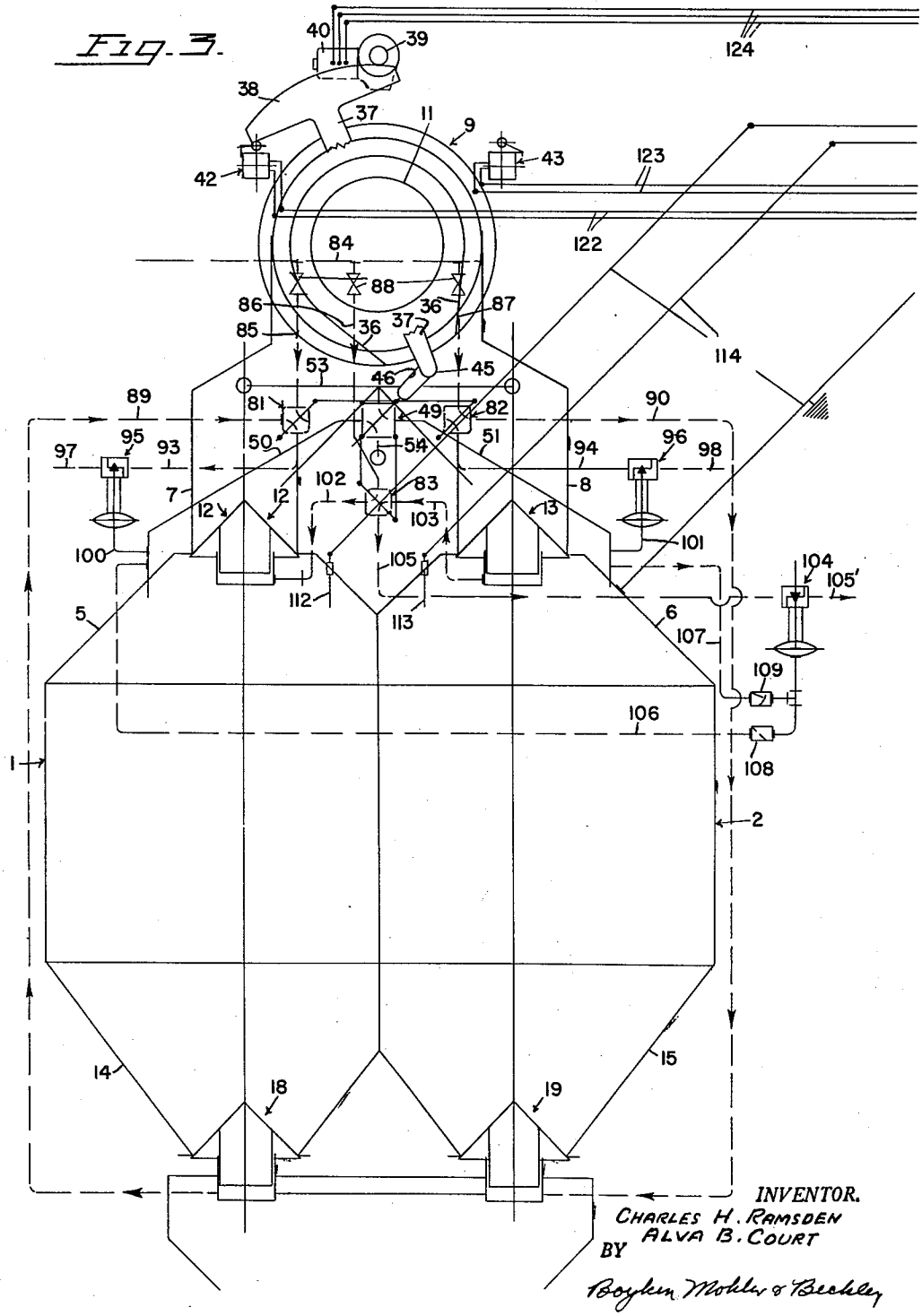
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Fig. 3.



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Fig. 4.

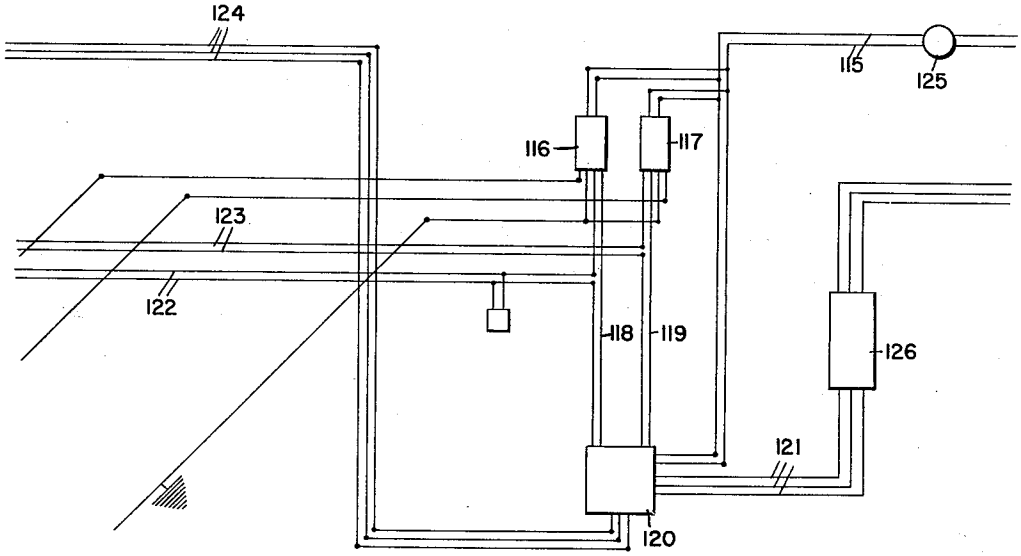
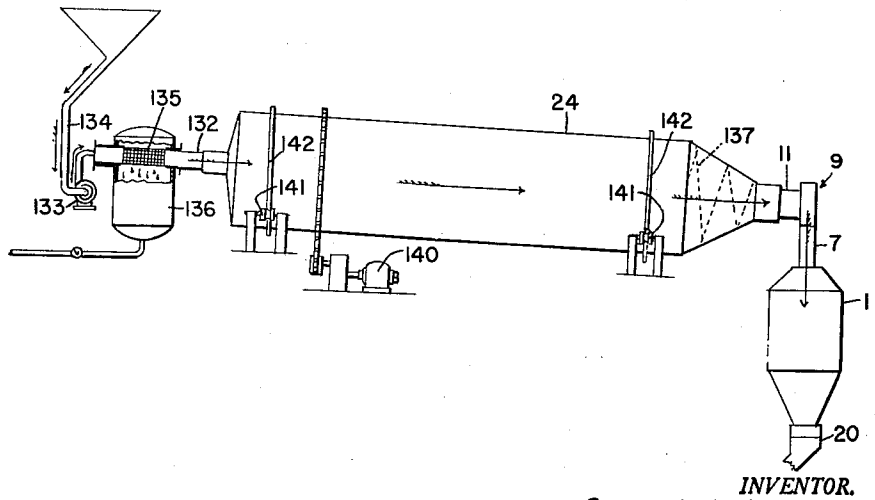


Fig. 5.



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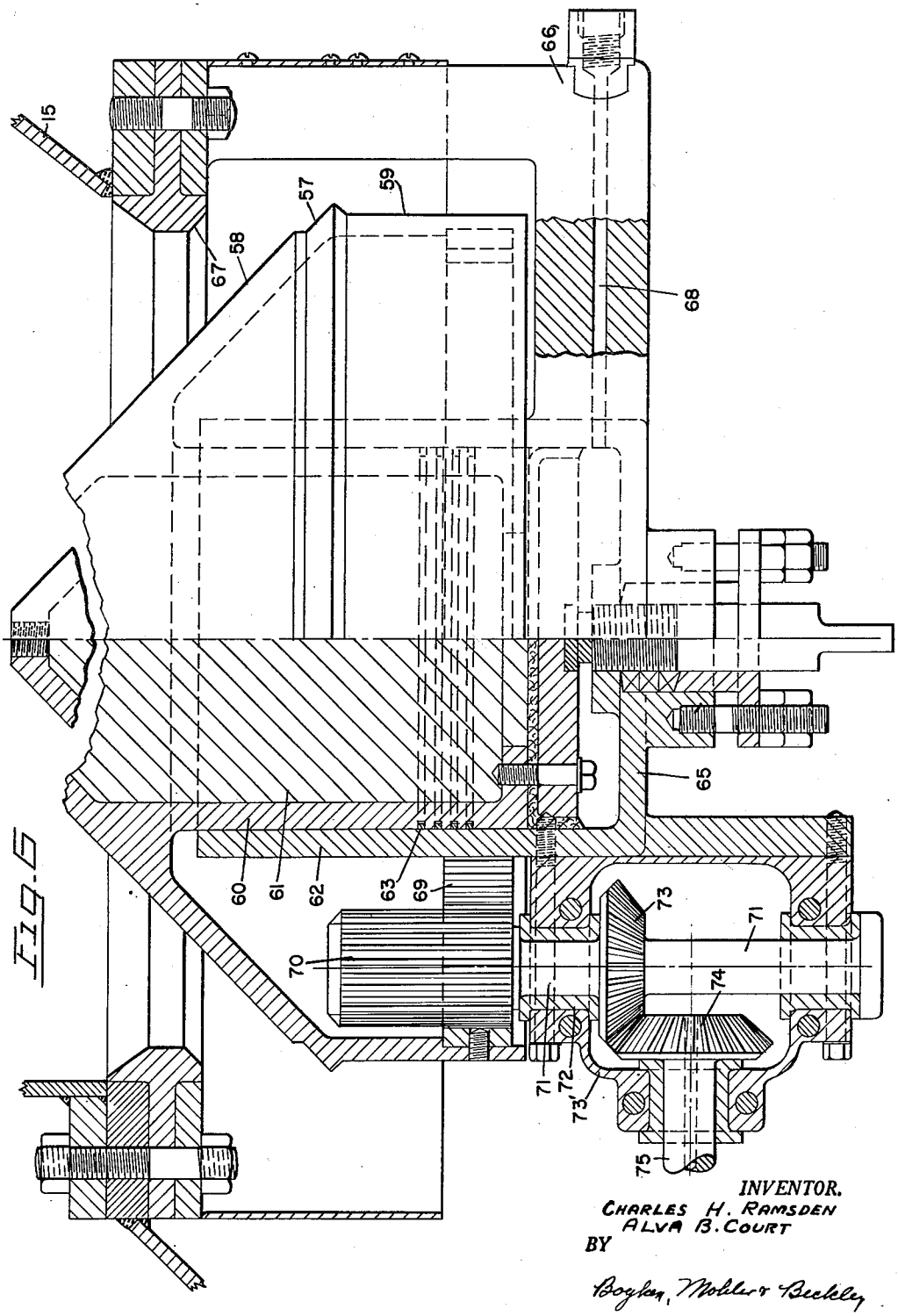


Fig. 5

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UNITED STATES PATENT OFFICE

2,567,447

FEED DEVICE

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Application May 10, 1947, Serial No. 747,240

15 Claims. (Cl. 99—80)

1

This invention relates to a feed device adapted to feed material into and from an enclosed space of above atmospheric pressure into a lower pressure without noticeable reduction in pressure and without stopping the flow.

One of the particular uses of the present invention is illustrated in co-pending application for United States Letters Patent, Serial No. 698,736, now Patent No. 2,525,137, of Watkins W. Jones, George W. Brewer and Alva B. Court, filed September 23, 1946, for a "Rice Treating Process." In this application the device is referred to as including "depression" chambers into which rice is alternately fed from a steamer and from which the rice is alternately discharged after a relatively short period during which the pressure is reduced at a controlled rate of speed.

One of the objects of this invention is the provision of improved means for withdrawing material from an enclosed pressure area through which the material is continuously moved without noticeably reducing the pressure in said area and without noticeable cessation in the discharge of such material from said area.

Another object of the invention is the provision of improved means for withdrawing material from an enclosed pressure area through which the material is moved without noticeably reducing the pressure in said area and without noticeable cessation in the volume and rate of discharge from said area, and which means is adapted to reduce the pressure of material discharged from said area at a controlled rate of speed.

Another object of the invention is the provision of means for more efficiently and economically substantially continuously moving a predetermined volume of material per hour in a path of travel through a relatively high pressure area in said path.

Heretofore, and in the rice industry in particular, it has been the practice in performing the so-called parboiling of the rice paddy to subject the rice paddy, in batches, to the influence of steam at a pressure above atmospheric pressure for a predetermined length of time. However, this was relatively costly from the standpoint of time and power inasmuch as the steamers were tied up during the loading and unloading operations, and the steam was lost.

Inasmuch as the above described process preferably required a progressive and controlled reduction in pressure after subjecting the paddy to the influence of steam under pressure, the problem to be solved was further complicated. The ordinary batch process was simple since the steam

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pressure could readily be reduced in the steamer, but at the expense of steam inasmuch as the steam in the steamer was exhausted to accomplish the desired reduction.

By the present invention the steam in the steamer is retained, and the steam loss is restricted to only the relatively small amount of steam that is used to hold the rice under a controlled pressure for a predetermined length of time after its discharge from the steamer.

Other objects and advantages will appear in the description and in the drawings.

In the drawings, Fig. 1 is a side elevational view of the feed device, certain parts of pipes being omitted for clarity and the height of the device being reduced by omitting the central portion so as to accommodate the view to the sheet.

Fig. 2 is a sectional view taken substantially along line 2—2 of Fig. 1.

Figs. 3, 4 are to be considered as one view inasmuch as one sheet is inadequate for both, and they represent a diagrammatic view of the device with fluid pressure and electrical systems schematically indicated.

Fig. 5 is a diagrammatic view of the feed device and the steamer from which material is fed to the feed device with the means for maintaining the pressure in the steamer at its inlet end.

Fig. 6 is an enlarged sectional view of one of the valves in the feed device, there being four in the said device, all being identical in structure.

Briefly described, one preferred example of the present invention as shown in the drawings contemplates subjecting rice paddy to steam under a predetermined pressure for a certain length of time, and at the end of that time to reduce the pressure to a predetermined degree above atmospheric pressure and finally to discharge the rice at atmospheric pressure.

For purpose of illustration, it may be assumed that the rice is to be subjected to steam at 15 lbs. per square inch for a period of about 30 minutes, and then the pressure is to be gradually reduced to about 3 to 4 lbs. per square inch over a period of about 3 to 4 minutes and then discharged at atmospheric pressure, all as substantially described in said co-pending application for Letters Patent.

The present invention is concerned with a device that is adapted to accomplish what might be best termed the "decompression" of the rice or the reduction in pressure and discharge without affecting the main body of rice in the high pressure steamer. In other words, the rice is discharged from the high pressure steamer into

the decompression device where the pressure is reduced without stopping the discharge of rice from the steamer or its movement therethrough and without noticeably reducing the pressure in said steamer.

It is to be understood that the detailed description and drawings are not, however, to be considered restrictive of the invention, but they are merely illustrative of a preferred form thereof that has been found most satisfactory for use in the process described in said co-pending application. The invention is obviously adapted for use where similar circumstances exist and a similar problem is to be solved.

Referring to the drawings, the decompression device comprises a pair of chambers 1, 2, preferably having outer walls 3 and a common central partition or wall 4. Chambers 1, 2 have corresponding upwardly tapering top walls 5, 6, respectively, that centrally connect at their upper ends with conduits 7, 8 that in turn extend upwardly from top walls 5, 6 and connect with a common valve housing, generally designated 9, in which is a selector valve 10 that is adapted to divert material from the discharge trunnion 11 (Fig. 2) of a steamer 24 (Fig. 5) into either conduit 7 or 8, as will be later described in more detail.

At the junctures between conduits 7, 8 and top walls 5, 6 are power actuated valves 12, 13 (Figs. 1, 3) for opening and closing the conduits to flow of material therefrom into chambers 1, 2.

The bottom walls 14, 15 of chambers 1, 2 taper downwardly, each having a discharge opening in the lower end thereof, and valves 18, 19 are at said openings for opening and closing the same to discharge of material from the chambers 1, 2. The said discharge openings are adapted to discharge into a feed hopper 20 that is adapted to feed the material to any desired point, such as a rotary cooler 21 (Figs. 1, 2).

Referring more in detail to the selector valve, the valve housing 9 (Fig. 2) is generally drum-shaped with one lateral side 25 formed with an opening through which the trunnion 11 rotatably extends. The opposite side of the housing is in the form of a removable head 26 bolted to the generally cylindrical sides 27 (Fig. 1) of the housing.

The valve 10 (Figs. 1, 2) is generally drum-shaped, having cylindrical walls 30 and opposed side walls 31, 32. Wall 31 is adjacent head 26 while wall 32 is adjacent wall 25 and is formed with an opening into which the outer end of hollow feed trunnion 11 extends for discharge of material from the steamer carried at one end by said trunnion.

A shaft 33 rotatably extends through the head 26 and supports the valve 10 for rotation, said head 26 having a bearing 34 for supporting said shaft 33.

The lower side of the wall 30 is formed with a discharge opening 35 and the wall 30 at opposite sides of said opening extends tangentially outwardly as indicated in dash lines 36 (Fig. 1) to form more or less of a spout. The spout thus formed may be directed for discharge of material within the valve into either the conduit 7, or 8, according to whether the valve is rotated in one direction or the other. In Fig. 1 the spout is directed into the conduit 8.

The means for rotating shaft 33 and consequently valve 10 is a quadrant lever 37 that is keyed to shaft 33 at a point intermediate its ends. The lever extends generally vertically as seen in Fig. 1 and carries a toothed quadrant 38 at its upper end. The teeth of the quadrant are in mesh with the teeth of a pinion 39 that is rotated through a reduction gear box by a reversible motor 40.

The lever 37 oscillates between two positions, one of which brings the valve spout over conduit 7 and the other of which brings the spout over conduit 8. A limit switch 42 at one side of the lever in an electrical circuit controls motor 40 for limiting the swing of lever 37 in one direction, while a corresponding limit switch 43 limits the swing in the opposite direction.

The lower end of lever 37 below shaft 33 carries a roller 45 that is adapted to be received in an outwardly opening slot 46, formed in the outer end of a flat crank plate or bootjack 47. Said plate is secured on the stem 48 of a four-way valve 49 and slot 46 extends radially outwardly relative to said stem. Upon oscillation of lever 37 the crank plate 47 will be similarly rotated and the valve 49 will be moved to either of two different positions according to the direction of movement of said lever.

The valve 49 is in a relatively large steam pressure line, two branches 50, 51 of which connect at one of their ends with two of the ports of the valve 49. The opopsite ends of said branches respectively communicate with the interior of chambers 1, 2 at the upper ends of the latter adjacent valves 12, 13. Pipe 52 connects between one of the remaining two ports of valve 49 and a header 53 that in turn communicates with conduits 7, 8 respectively, adjacent the upper ends of the latter. The remaining port of valve 49 communicates with an exhaust line 54.

The steam pressure in the steamer 24 may be at say about 15 lbs. per square inch, and as the selector valve 10 is always open to either conduit 7 or 8, according to how the quadrant 38 is actuated, it will be seen that the pipe 52 communicating with one of the ports of valve 49 always has the process pressure or 15 lbs. per square inch. The ports of valve 49 are arranged so that either branch 50 or 51 is in communication with pipe 52 according to how the valve is turned. In Fig. 3 it is shown with the branch 51 in communication with pipe 52 and when this occurs, the branch 50 is in communication with the exhaust line 54. When branch 50 connects with the pressure, then branch 51 connects with the exhaust line.

Valves 12, 13, 14 and 15 are similar in structure and in operation, therefore, only one of the valves will be described in detail. The valve comprises a hollow valve member (Fig. 6) having an annular tapered seat 57 that is stepped down from the margin of a conical central portion 58. The latter portion is directed upwardly in each instance so that the material entering and leaving the chambers 1, 2 will freely flow into and out of said chambers over said portion of each valve.

A depending cylindrical flange 59 extends downwardly from the seat portion of the valve member. Centrally within the valve member, coaxial with flange 59 and spaced from the latter, is a piston 60 integrally connected with said valve member at the apexial upper end of the latter. This piston 60 is preferably hollow and filled with lead 61 to weight the same so that it will open by gravity in the absence of any force maintaining it elevated.

The piston 60 is vertically reciprocable in a cylinder 62 and conventional packing or rings 63

may effect a fluid-tight seal between the cylinder 62 and piston 60.

The cylinder 62 opens upwardly to receive piston 60 through the upper open end of the former, and said cylinder has a head 65 closing its lower end. Several bracket arms 66 secure the cylinder and its head to the chamber in which the valve is positioned, and also serve to hold the valve member coaxial with the annular tapered seat 67 that is carried by the chamber in its inlet and outlet opening.

A steam duct 68 extends through one of the arms 66 to the lower end of the cylinder 62 below the head of piston 60. Thus upon admission of steam to the cylinder, the valve member will be moved upwardly to effect a closing of the inlet or outlet opening in chambers 1, 2 according to which of the valves the steam is applied, and upon opening the steam duct 68 to exhaust the steam, the valve member will move downwardly by gravity due to its weight and the weighted piston that is rigid therewith.

Means is provided for rotating the valves during movement thereof, which means comprises an internal gear 69 secured within flange 59 and thereto. The teeth of this gear 69 are in mesh with the teeth of a vertically elongated gear 70. A shaft 71 depends from gear 70 and is rotatable in a bearing 72 that is carried by a housing 73 that in turn is secured to cylinder 62. Shaft 71 carries a miter gear 73 at its lower end, the teeth of which are in mesh with the teeth of a miter gear 74 that in turn is connected by a drive shaft 75 with a conventional fluid or air motor 76 (Fig. 2), the latter being adapted to be actuated by air or steam, preferably the former, from any suitable pressure source. Fluid pressure lines leading to these motors are valved (Fig. 2) for occasional manual operation as desired in order to insure efficient operation of the valves at all times.

In the head 65 an adjustable stop is provided, as seen in Fig. 6, to limit the downward movement of the valve member. The piston will engage said stop when the piston is at the lower end of its stroke.

Connected with the bootjack or crank plate 47 are three pairs of connecting rods 77, 78 and 79 (Fig. 1). The pair of rods 77 are pivotally connected at one of their ends with plate 47 and their opposite ends are pivotally connected with opposite ends of a T-handle 80, which handle is on the operating stem of a four way valve 81. The pair of rods 78 are similarly connected at one of their ends with plate 47 and their opposite ends are connected with a T-handle on the operating stem of a four way valve 82. The rods 79 are pivotally connected at one of their ends with the plate 47 while their opposite ends are connected with a T-handle on a four way valve 83. Upon rotating the plate 47 by oscillation of the segment lever 37, the valves 49, 81, 82 and 83 will all be actuated simultaneously.

A steam header 84 carrying steam at a substantially higher pressure than the header 53, say about 100 lbs. to the square inch, connects by branches 85, 86, 87 with one of the ports in each of the valves 81, 82, 83 and a regulating needle valve 88 is in each of said branches.

Pipes 89, 90 respectively communicate between one of the other ports in each of the valves 81, 82 and the ducts 68 of the discharge valves 18, 19 at the lower end of chambers 1, 2.

The third of the ports in valves 81, 82 connect by pipes 93, 94 with pressure actuated valves 95, 96 respectively, which latter valves also communicate with exhaust pipes 97, 98 for establishing a communication between said exhaust pipes and the pipes 89, 90 in one position of valves 81, 82, while in another position of valves 81, 82 the steam header 84 is in communication with the ducts 68 of valves 18, 19 for opening the latter.

The valves 95, 96 are preferably pressure actuated diaphragm type valves in which the valves are normally open until the pressure at the pressure side of the diaphragm reaches a predetermined amount.

Steam pipes 100, 101 respectively connect between the pressure sides of the diaphragm in valves 95, 96 and the branch lines 50, 51 of relatively low or process pressure (Fig. 3). In the present example, this would be 15 lbs. per square inch or it could be any pressure up to that in lines 50, 51. The remaining port in each valve 81, 82 is closed off by a plug.

The second and third of the ports of valve 83 communicate by pipes 102, 103 with the ducts 68 of the upper valves 12, 13 in chambers 1, 2. As has already been noted, the first port of valve 83 connects by pipe 86 with the steam header 84.

The fourth port of valve 83 communicates by pipe 105 with pressure actuated valve 104, which valve is adapted to establish communication between either of the pipes 102, 103 and a discharge pipe 105'.

The valve 104 is similar to valves 95, 96 having a diaphragm with a pressure side that is in communication with the low pressure branch pipes 50, 51, through pipes 106, 107. Check valves 108, 109 are in pipes 106, 107 respectively, which valves are normally closed but open to admit steam to the pressure side of the diaphragm from pipes 106 or 107. This could be any pressure up to the pressure in pipes 50, 51 according to how the valve is set, which is also true of valves 95, 96. Valve 104 opens under pressure in pipes 106 or 107 while valves 95, 96 are closed under pressure in pipes 100, 101.

The pipe 111 (Fig. 1) may supply the steamer with steam at the process pressure which in the present example will be at about 15 lbs. per square inch.

Carried within the top of each chamber 1, 2 is a conventional electric probe. These are indicated at 112 and 113 and are in a grounded circuit 114 that connects with a two wire operating circuit 115 (Figs. 3 and 4) through electronic relays 116, 117. Wires 118, 119 respectively connect said relays with a conventional magnetic reversing starter 120 that is also in circuit 115 and in a three wire power supply circuit 121 of higher voltage than the operating circuit. The limit switches 42, 43 are in circuits 122, 123 that connect with the relays 116, 117 and with the starter 120, while the motor 40 that operates the quadrant lever 37 is in a three line circuit 124 connecting it with the starter 120. Switches 125, 126 may be positioned in circuits 115, 121 respectively.

Upon the level of material 130 (Fig. 1) in chamber 1, for example, to a predetermined point substantially filling the chamber, the reversing starter will be actuated to start motor 40 for rotating the quadrant lever clockwise, as seen in Fig. 1, thereby actuating the selector valve 10 and valves 12, 13, 18, 19 in chambers 1, 2 and the four way valves 49, 81, 82, 83, which will in turn result in actuation of valves 95, 96, 104, as will later be described more in detail.

The pressure within the steamer 24 is main-

tained at the inlet end (opposite the trunnion 11) by the head pressure of material that is constantly fed through the trunnion 132 at said inlet end. A pump 133 pumps the material 130 from a feed column 134, together with water, through a perforated extension 135 of trunnion 132. This perforated portion is within an enclosed tank 136 into which the water falls, being replaced by the steam from the steamer.

The steamer is of the horizontally elongated rotary type and has conventional flights therein. It is inclined from the inlet to the discharge end and a spiral flight 137 in the tapered discharge end functions to keep a constant discharge of material 130 through trunnion 11 into one or the other of the decompression chambers 1, 2, according to the setting of the various valves.

In operation, the steam within the steamer 24 is maintained at a predetermined pressure. For the present purpose this will be considered from about 15 lbs. per square inch, the steam being admitted by the pipe 111 that extends through the discharge trunnion 11. The inlet trunnion 132, 135 will be closed to the escape of steam by reason of the water and paddy therein, the paddy being continuously fed into the inlet end of the steamer. As the steamer revolves the material moves generally horizontally to the discharge end where it continuously moves through the outlet trunnion 11 into and through the selector valve 10 and into one or the other of the chambers 1, 2.

The drawings, Figs. 1, 2, show the valves in the decompression device immediately after the chamber 1 has been filled to the level where the electronic probe 112 is contacted by the material and the lower discharge valve 18 has opened and the upper inlet valve 13 in chamber 2 is opened. The upper valve 12 in chamber 1 and the lower valve 19 in chamber 2 are closed.

The positions of the valves in Fig. 3 are at the precise moment after the change-over of the selector valve from a full to an empty chamber and in which the valves 12, 13, 18, 19 are momentarily closed. This condition occurs just prior to the position of the valves in Figs. 1, 2 but does not affect the discharge of material from the steamer into the selector valve. Therefore, the flow through the steamer is continuous.

As seen in Fig. 1, the valve 18 is open and chamber 1 is filled, therefore, the material within said chamber is flowing through the discharge outlet into the feed hopper 20. The valve 13 in the upper end of chamber 2 is open which means that the material from the steamer is flowing through the selector valve into chamber 2. Lower discharge valve 19 in chamber 2 is closed. The steam pressure within chamber 2 is at the process pressure of say 15 lbs. per square inch which is the same as the pressure within the steamer 24. The upper valve 12 in chamber 1 is closed. This is because the branch 51 is open at one end into chamber 2 and at its opposite end into conduit 8 which in turn is open through the selector valve into the steamer. Valve 49 has established this condition.

The conduit 50 that communicates between the chamber 1 and the valve 49 is open to the atmosphere through exhaust pipe 54. Thus there is no pressure in chamber 1.

Steam pressure at 100 lbs. per square inch is effective on the pistons in valves 12, 19, holding them closed, inasmuch as four way valves 83 and 82 are positioned to admit steam at the main pressure of 100 lbs. per square inch through pipes 102 and 90 to said valves respectively. The pipes 89 and 103 respectively extending from four way valves 81 and 83 to valves 18, 13 are open to exhaust through pressure actuated valves 95, 104 respectively inasmuch as there is no pressure on the pressure side of the diaphragm of valve 95 for holding valve 95 closed, and inasmuch as the valve 104 is open for exhausing the pressure in pipe 105 due to the 15 lbs. pressure on the pressure side of the diaphragm through pipe 107 that communicates with header 53 through four way valve 49. The check valve 108 in pipe 106 leads to valve 104 prevents escape of pressure through said pipe while check valve 109 opens to admit steam through pipe 107.

In the present example, when the material in chamber 2 reaches the electronic probe 113 the motor 40 will instantly operate to swing the selector valve 10 so its discharge opening will discharge material into conduit 7, the latter being under 15 lbs. pressure inasmuch as it is always in communication through header 52 with conduit 8.

The swinging of quadrant lever 37 will rotate valve 83 to establish communication between the pipe 103 leading to upper valve 13 in chamber 2 and the steam line 86 that connects through needle valve 88 with the steam header 84. This will result in closing valve 13 at a predetermined rate of speed determined by the setting of the needle valve.

The swinging of quadrant lever 37 will also actuate four way valve 82 for establishing communication between the steam line 90 that extends to lower valve 19 in chamber 2 and the line 94 that leads to diaphragm actuated valve 96, which latter valve is closed and will not open until the pressure in steam line 101 is reduced from about 15 lbs. per square inch to about 3 to 4 lbs. per square inch. Inasmuch as the rotation of valve 49 by swinging of lever 37 opens lines 101, 51 to exhaust 54, the pressure in line 101 will drop in about 3 to 4 minutes time to 3 to 4 lbs. pressure per square inch and the valve 19 will then drop by gravity to commence discharge of material from chamber 2. This gradual reduction in pressure in chamber 2 to 3 to 4 lbs. pressure per square inch is important inasmuch as too fast a drop is detrimental to the paddy and any suitable valve means in the exhaust line will be adequate to regulate the rate of discharge of steam from the chamber. The size of the porting of valve 49 is utilized in the present instance but a valve may be in the exhaust line.

In so far as chamber 1 is concerned, the swinging of lever 37 will cause four way valve 81 to establish communication between steam line 89 that leads to lower valve 18 and the steam header 84 through needle valve 88 in line 85 for closing valve 18 at the desired rate according to the setting of the needle valve. At the same time the four way valve 83 will be moved to connect the upper valve 12 with the valve 104 through line 105 and valve 49 will be moved to connect the pressure side of the diaphragm of valve 104 with the steam header 53 through branch steam line 50 and steam line 106. As the valve 104 will not open to permit exhaust of steam from valve 12 until the pressure on the diaphragm of valve 104 is substantially at 15 lbs. per square inch, or the pressure in the steamer, it is seen that the steam pressure in the chamber 1 will be raised to 15 lbs. per square inch before valve 12 is permitted to open, whereby no pressure will be lost from the cooker. A rel-

atively short time is required for this operation, and then the material 130 in conduit 7 will commence to flow into chamber 1. In the meantime chamber 2 is emptying and as soon as the chamber 1 is refilled, the cycle described will be repeated.

The steamer 24 is revolved in the conventional manner, as by a motor 140, and while the term "trunnion" has been used to designate the centrally positioned inlet and outlet passageways in the ends of the steamer, the steamer is not necessarily supported by passageways but may be supported for rotation in any other conventional manner, as on rollers 141 that receive annular tracks 142 that are on the steamer.

We claim:

1. In combination with a pressure steamer having an inlet at one end and a discharge outlet at the other end and means for supplying steam thereto for creating a predetermined steam pressure within said steamer, means for causing continuous movement of material into said steamer through said inlet and through said steamer and said outlet, means for sealing said steamer against substantial loss of pressure during said movement of said material, said means including a pair of enclosed chambers adjacent said outlet, enclosed passageways respectively connecting said chambers with said outlet, and means for alternately diverting material from said steamer into one or the other of said passageways for discharge into one or the other of said chambers.

2. In combination with a pressure steamer having an outlet for material discharged therefrom, a receiver connecting with said outlet for receiving said material so discharged therefrom, means for maintaining a predetermined pressure in said steamer during said discharge, means for maintaining a pressure in said receiver above atmospheric pressure and lower than said predetermined pressure for a predetermined period of time after said material is discharged into said receiver, said receiver comprising a pair of enclosed compartments, means for holding one or the other thereof in communication with said steamer at all times.

3. In combination with a pressure steamer having an outlet for material discharged therefrom, a receiver connecting with said outlet for receiving said material so discharged therefrom, means for maintaining a predetermined pressure in said steamer during said discharge, means for maintaining a pressure in said receiver above atmospheric pressure and lower than said predetermined pressure for a predetermined period of time after said material is discharged into said receiver, said receiver comprising a pair of enclosed compartments, means for holding one or the other thereof in communication with said steamer at all times, said means including valves periodically movable to establish connection between one of said compartments and said steamer and to close off the communication between the other compartment and said steamer, and means for so moving said valves.

4. In combination with a pressure steamer having an outlet for material discharged therefrom, a receiver connecting with said outlet for receiving said material so discharged therefrom, means for maintaining a predetermined pressure in said steamer during said discharge, means for maintaining a pressure in said receiver above atmospheric pressure and lower than said predetermined pressure for a predetermined period of time after said material is discharged into said receiver, said receiver comprising a pair of enclosed compartments, means for holding one or the other thereof in communication with said steamer at all times, said means including valves periodically movable to establish connection between one of said compartments and said steamer and to close off the communication between the other compartment and said steamer, and means actuated by the material received in said one or the other of said compartments for causing said movement of said valves upon the material rising to a predetermined level in one of said compartments or the other as the case may be.

5. A decompression feed device in a fluid pressure system comprising a pair of compartments each having an inlet and an outlet feed means for feeding material to each of said inlets, a valve system including first valve means at said inlets movable for opening and for closing said inlets and second valve means at said outlets movable for opening and for closing said outlets, means controlled by the fluid pressure in said system for causing actuation of said first and said second valve means for maintaining said second valve means closed and said first valve means open in one compartment of said pair and said first valve means closed and said second valve means open in the other compartment of said pair when material is being fed into said one compartment and discharged from said other and means controlled by the fluid pressure in said system for reversing the positions of said first and said second valve means upon said one compartment being filled with said material to a predetermined level.

6. A decompression feed device in a fluid pressure system comprising a pair of compartments each having an inlet and an outlet feed means for feeding material to each of said inlets, a valve system including first valve means at said inlets movable for opening and for closing said inlets and second valve means at said outlets movable for opening and for closing said outlets, means controlled by the fluid pressure in said system for causing actuation of said first and said second valve means for maintaining said second valve means closed and said first valve means open in one compartment of said pair and said first valve means closed and said second valve means open in the other compartment of said pair when material is being fed into said one compartment and discharged from said other and means controlled by the fluid pressure in said system for reversing the positions of said first and said second valve means upon said one compartment being filled with said material to a predetermined level, said feed means including a conduit for said material and a selector valve movable therein for diverting said material to one or the other of said inlets, means actuated by the material in the compartment being filled upon said material reaching said predetermined level for moving said selector valve to a position diverting the material in said conduit to the other of said compartments.

7. A decompression feed device in a fluid pressure system comprising a pair of compartments each having an inlet and an outlet, feed means including a conduit having a movable selector valve therein feeding material to one or the other of said inlets at one time according to the position of said valve, means for maintaining a predetermined pressure in said conduit above at-

mospheric pressure, first valve means at said inlets movable for opening and for closing said inlets, second valve means at said outlets for opening and closing said outlets, and pressure controlled means for actuating said first mentioned valve means for opening the same only upon the pressure in said compartments being substantially equal to the pressure in said conduit, and pressure controlled means for maintaining said second valve means closed until the pressure in said compartments is substantially equal to the pressure in said conduit.

8. A decompression feed device in a fluid pressure system comprising a pair of compartments each having an inlet and an outlet, feed means including a conduit having a movable selector valve therein feeding material to one or the other of said inlets at one time according to the position of said valve, means for maintaining a predetermined pressure in said conduit above atmospheric pressure, first valve means at said inlets movable for opening and for closing said inlets, second valve means at said outlets for opening and closing said outlets, and pressure controlled means for maintaining said second valve means closed until the pressure in said compartments is substantially equal to the pressure in said conduit, and means actuated by movement of said selector valve for causing actuation of said pressure controlled means.

9. A decompression feed device in a fluid pressure system comprising a pair of compartments each having an inlet and an outlet, feed means including a conduit having a movable selector valve therein feeding material to one or the other of said inlets at one time according to the position of said valve, means for maintaining a predetermined pressure in said conduit above atmospheric pressure, first valve means at said inlets movable for opening and for closing said inlets, second valve means at said outlets for opening and closing said outlets, and pressure controlled means for actuating said first mentioned valve means for opening the same only upon the pressure in said compartments being substantially equal to the pressure in said conduit, and pressure controlled means for maintaining said second valve means closed until the pressure in said compartments is substantially equal to the pressure in said conduit, means actuated by material in the one compartment of said pair that is being filled for causing movement of said selector valve to divert material to the inlet of the other compartment of said pair when said material is at a predetermined level in said one compartment, and means actuated by movement of said selector valve for causing actuation of said pressure control means for opening said second valve means in the compartment so filled, and for opening the first mentioned valve means in the other compartment of said pair.

10. The method of steaming rice paddy at a predetermined pressure in a continuous feed system that comprises the steps of: moving a body of rice paddy and water in one general direction in an enclosed path of travel and filling said path to a predetermined point therein with said body whereby said path to said point will be sealed against passage of steam therepast in a direction counter to said movement, continuing movement of said paddy through an enlarged space in said path, maintaining a predetermined steam pressure above that of the atmosphere in said enlarged space and displacing said water by steam from said space at said point, discharging said paddy continuously from said enlarged space while retaining said steam pressure in the latter.

11. The method of steaming rice paddy at a predetermined pressure in a continuous feed system that comprises the steps of: moving a body of rice paddy and water in one general direction in an enclosed path of travel and filling said path to a predetermined point therein with said body whereby said path to said point will be sealed against passage of steam therepast in a direction counter to said movement, continuing movement of said paddy through an enlarged space in said path, maintaining a predetermined steam pressure above that of the atmosphere in said enlarged space and displacing said water by steam from said space at said point, moving said paddy from said enlarged space directly into a space of lesser size than said enlarged space having the same steam pressure as said enlarged space, then gradually reducing the said pressure in said space of lesser size to atmospheric pressure while maintaining the pressure in said enlarged space, and then discharging said paddy from said space of lesser size into a space that is open to the atmosphere.

12. The method of steaming rice paddy at a predetermined pressure in a continuous feed system that comprises the steps of: moving a body of rice paddy in one general direction in an enclosed path of travel completely filling said path at a point therein and thereafter into and through an enlarged space in said path, maintaining steam at a predetermined pressure in said enlarged space and against the paddy in said space, continuously moving the paddy from said enlarged space and alternately into separate enclosed spaces alternately communicating with said enlarged space for alternately communicating with said enlarged space for alternately filling said separate spaces respectively to a predetermined level, discharging the paddy from each of said separate spaces upon the latter being filled and causing said movement of the paddy into one of said separate spaces only during discharge of paddy from the other space and when such other space is empty, maintaining steam at said predetermined pressure in each of said separate spaces just before communication is established between each of said separate spaces and said enlarged space and closing communication between each of said separate spaces and said enlarged space during the time paddy is discharged from said separate spaces.

13. In the parboiling of rice, the steps of continuously moving water carrying rice paddy to one end of an enclosed enlarged space containing steam under a predetermined pressure above that of the atmosphere, separating the free water from said rice paddy at said end, moving the rice so separated completely through said enlarged space and conducting the water away from said enlarged space, closing said end of said enlarged space by said rice and water against the loss of steam from said space, withdrawing said rice paddy from said enlarged space after it has passed through the latter into separate enclosed spaces in succession each having the same steam pressure as is in said enlarged space at the time of such withdrawal, closing off each of said separate spaces from said enlarged space after each is filled and thereafter discharging the rice from the separate space so filled to atmospheric pressure during the period in which the next separate space is being filled, closing each separate space after it is emptied and again reestablishing the

steam pressure thereon to equal the pressure within said enlarged space preparatory to withdrawal of rice thereinto after the separate space preceding the same in cyclic order has been emptied.

14. In the parboiling of rice, the steps of continuously moving water carrying rice paddy to one end of an enclosed enlarged space containing steam under a predetermined pressure above that of the atmosphere, separating the free water from said rice paddy at said end, moving the rice so separated completely through said enlarged space and conducting the water away from said enlarged space, closing said end of said enlarged space by said rice and water against the loss of steam from said space, withdrawing said rice paddy from said enlarged space after it has passed through the latter into separate enclosed spaces in succession each having the same steam pressure as is in said enlarged space at the time of such withdrawal, closing off each of said separate spaces from said enlarged space after each is filled and thereafter discharging the rice from the separate space so filled to atmospheric pressure during the period in which the next separate space is being filled, closing each separate space after it is emptied and again reestablishing the steam pressure thereon to equal the pressure within said enlarged space preparatory to withdrawal of rice thereinto after the separate space preceding the same in cyclic order has been emptied, gradually reducing the steam pressure in each of said separate spaces after each has been filled and before discharge of the rice paddy therefrom.

15. In the parboiling of rice paddy, the steps of continuously moving water carrying rice paddy to one end of an enclosed enlarged space containing steam under a predetermined pressure above that of the atmosphere, separating the free water from said rice at said one end, moving the rice so separated through said enlarged space and conducting the water separated therefrom away from said space, closing said end of said enlarged space by said rice and water against loss of steam from said space, moving the rice from said enlarged space and after it has passed completely through

said enlarged space into a restricted enclosed first space having the same steam pressure as said enlarged space until said first space is substantially filled with said rice, then closing communication between said first space and said enlarged space and at the same time establishing communication between said enlarged space and a restricted enclosed second space having the same steam pressure as said enlarged space and moving rice from said enlarged space into said second space until said second space is substantially filled, withdrawing said rice from said first space into a space of atmospheric pressure during the filling of said second space, then closing said first space after it is emptied and reestablishing the pressure therein to equal that in said enlarged space and then a predetermined period of time after said second space is filled and after said pressure is established in said first space closing off said second space from said enlarged space and moving the rice therefrom into a space of atmospheric pressure and at the same time opening said first space for withdrawal of rice into the same and repeating the aforesaid cycle.

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