W. P. WIEMANN.

REFRIGERATING MACHINE.

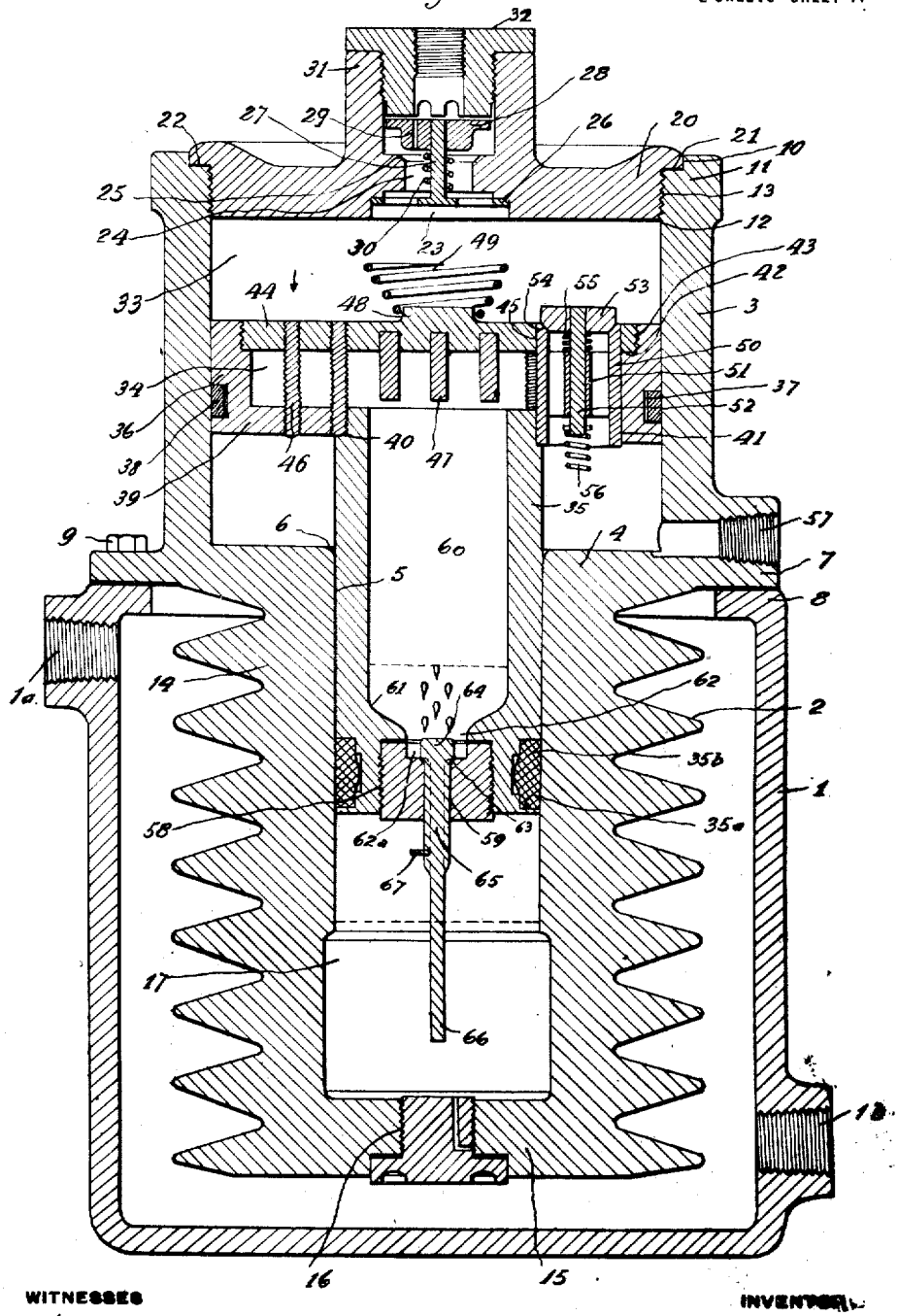
APPLICATION FILED MAR. 3, 1916.

1,204,918.

Patented Nov. 14, 1916.

2 SHEETS—SHEET 1.

Fig. 1



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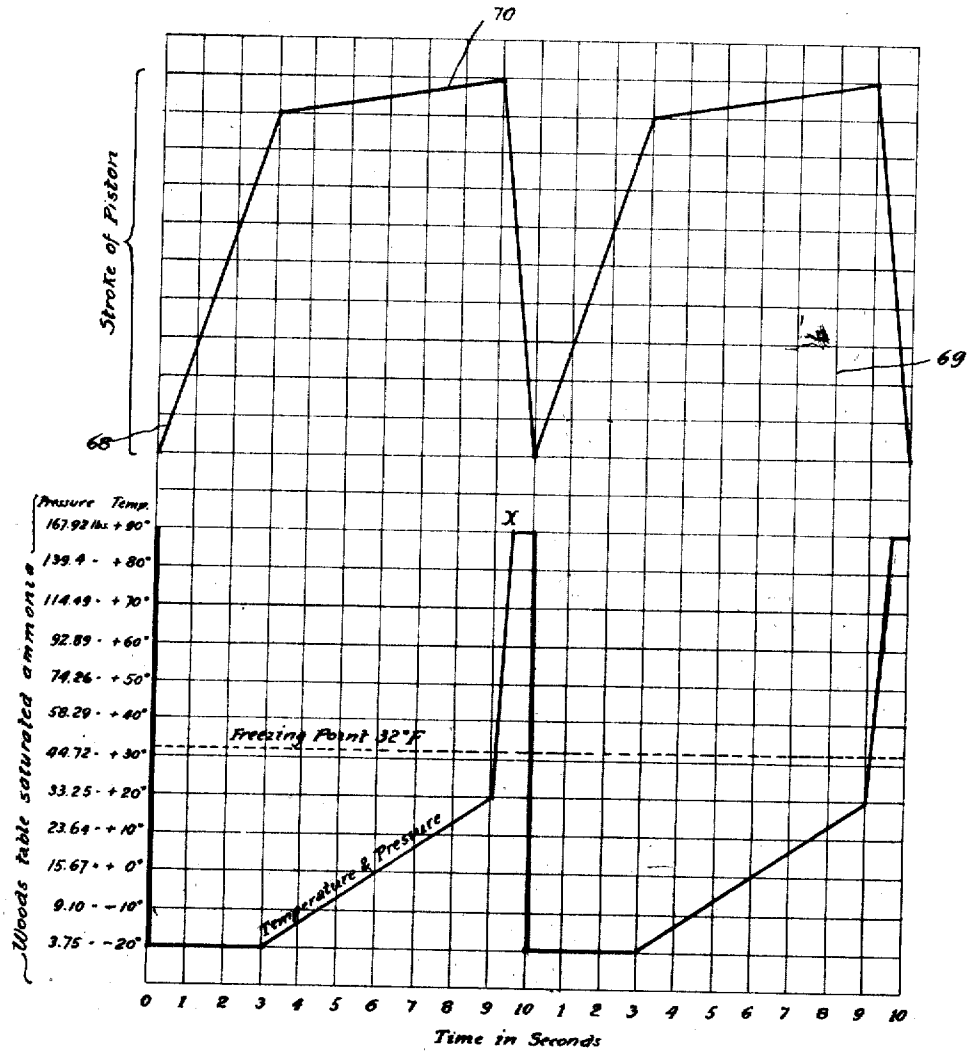
2 SHEETS—SHEET 2.

Fig. 2



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REFRIGERATING-MACHINE.

1,204,918. Specification of Letters Patent. Patented Nov. 14, 1916.

Application filed March 3, 1916. Serial No. 81,860.

To all whom it may concern:

Be it known that I, WILLIAM P. WIEMANN, a citizen of the United States, residing at Pittsburgh, in the county of Allegheny and State of Pennsylvania, have invented certain new and useful Improvements in Refrigerating-Machines, of which the following is a specification.

This invention relates to refrigerating machines, and has for its object to provide a machine of such class, in a manner as hereinafter set forth, designed primarily for domestic use to overcome the employment of ice as a refrigerant thereby eliminating the attending unsanitary conditions, as well as the inconvenience arising when using a refrigerant of such character, and to further provide a refrigerating machine for domestic purposes whereby a lower cooling temperature than that of ice can be secured.

A further object of the invention is to provide a refrigerating machine, altogether embodying all the elements of the compression system now in general use, *i. e.* receiver, expansion coils, compressor and condenser, each being a separate and distinct part of said compression system, yet setting up the receiver and condenser as one element, the expansion coils or chamber and compressor as one element, and by such an arrangement the elements of the machine are reduced to three viz: operating cylinder, receiver-condenser and expansion-compressor, thus reducing the cost of the machine and also facilitating the refrigerating operation.

Further objects of the invention are to provide a refrigerating machine which is automatic in its operation, operated by water pressure from the mains of a city water supply which provides against excessive pressure in the machine and containing means for regulating the temperature at which the machine is to operate.

Further objects of the invention are to provide a refrigerating machine designed primarily for domestic use, although the machine can be employed for any purposes wherein it is found applicable, which is simple in its construction and arrangement, strong, durable, efficient and convenient in its use, and inexpensive to operate and manufacture.

With the foregoing and other objects in view the invention consists of the novel construction, combination and arrangement of parts as hereinafter more specifically described and illustrated in the accompanying drawings, wherein is shown an embodiment of the invention, but it is to be understood that changes, variations and modifications can be resorted to which come within the scope of the claims hereunto appended.

In the drawings wherein like reference characters denote corresponding parts throughout the several views: Figure 1 is a vertical sectional view of a refrigerating machine in accordance with this invention and also showing a brine tank attached. Fig. 2 is a diagrammatic view of a chart illustrating the movement of the piston of the machine during two complete cycles thereof and further showing pressure and corresponding temperature in the refrigerant cylinder during action of the piston.

In the drawings the machine is illustrated with a brine tank 1, which is only employed when it is desired to decrease the temperature of brine and after cooling can be conducted to any desired point. When the machine is employed in connection with an ice box or a household refrigerator it will have its upper portion positioned exteriorly to the part to be refrigerated, the brine case or tank being removed, and the lower portion extended into the part to be refrigerated. This lower portion has the periphery thereof corrugated, as at 2, to present a large radiating surface to refrigerate the surrounding media.

In the drawings 3 indicates the body of the machine, which is cylindrical in contour and has a bottom 4, formed with a centrally disposed circular opening 5, with the top edge of the wall thereof flaring, as at 6, to provide a clearance to facilitate the entrance of packing 35^b. The lower end of the body 3, has a laterally extending annular flange 7 to which the inwardly extending flange 8, of the brine tank or casing 1, can be attached by the securing devices 9, only one shown. The top edge of the body 3, is cutaway to form a shoulder 10 and seat 11, and the inner face of the body 3, below the seat 11 is cut away to provide a seat 12, and that part of the inner face of the body 3, between the seats 11 and 12 is threaded, as at 13.

Formed integral with and depending from the bottom 4, is a cylindrical extension 14, having a bottom 15, provided with a centrally disposed opening 16. The exten-

sion 14 forms a chamber 17 of two different diameters, the larger at the lower and the smaller at the upper portion of the chamber. That part of smaller diameter of the chamber 17 is of the same diameter as the opening 5 and registers therewith. The extension 14 has the corrugations 2. The opening 16 is closed by a threaded charging plug 18 having a vent 19 to relieve charge. The wall of the opening 16 is threaded for engagement with the threads of the plug.

The top of the body 3 of the machine is closed by a flanged cap or head 20 having threads for engagement with the threads 13. When the cap 20 is mounted to close the body 3, it is positioned on the seats 11 and 12, and a gasket 21 is interposed between the flange 22 of the cap 20 and the seat 11. The cap 20 has its lower face provided with a pocket 23, which communicates with an opening 24 of less diameter and the top of the wall of the opening 24, is beveled, as at 25, to provide a valve seat. Secured with the top of the pocket 23, is a spider 26, having a vertically disposed valve stem 27, which projects through and above the opening 24. Slidably mounted on the stem 27 is a flanged valve disk 28, which is formed with a vent 29, and interposed between the valve-disk 28 and the spider 26, and surrounding the stem 27, is a coiled spring 30. Integral with the upper face of the cap 20 and surrounding the stem 27, is an interiorly threaded nipple 31, having a bushing 32 connected therewith which provides means for attaching with the machine an inlet water connection, by way of example city water connection.

The valve disk 28 is termed the inlet valve and operates on the stem 27, and is normally held open by the spring 30. The upper part of the valve is flanged and the valve is so adjusted that a normal flow of water will pass the valve without disturbing it. On a reduction of pressure beneath the valve the latter will be forced to its seat by the pressure above, and on an equalization of pressure, above and below, by flow through vent 29, the valve will be caused to rise by the spring 30.

The body 3, in connection with the extension 14, forms a pair of differential cylinders, one indicated at 17 (chamber) and the other at 33. That part of the machine, which constitutes the extension 14, becomes cold, by the evaporation of the ammonia in the cylinder (chamber) 17.

Operating within the differential cylinders 17 and 33 is a differential piston, one section indicated at 34, the head, and the other section at 35, the receiver-condenser. The section 34, is of greater diameter than the section 35 and operates in the cylinder 33. The section 35 reciprocates in the cylinder 17.

The section 34, is formed of an annular member 36, having its periphery grooved at 37, for a packing ring 38. Integral with the lower end of the member 36 is a bottom plate 39 having a central opening 40. At one side of the opening 40, the plate 39, has an opening 41. The inner face of the member 36, at the top thereof is cut-away to form a ledge 42, and above the latter the said inner face is threaded as at 43. The top of the member 36 is closed by a periphery threaded circular disk 44, which engages with the threads 43 and seats upon the ledge 42. The disk 44 has an opening 45 which registers with the opening 41. Tie bolts 46 are employed for securing the disk 44 with the bottom plate 39. Depending from the lower face of the disk 44 are radiating pins 47. The upper face of the disk 44 has a central boss 48 and surrounding the latter is the lower end of an inverted coiled spiral spring 49.

Secured in the openings 41 and 45 and extending from the plate 39 to the disk 44 is a cylindrical casing 50, having a hollow guide member 51 secured therein intermediate the ends thereof. Extending down through the guide member 51, is a shiftable valve stem 52, which has fixed to its upper end a valve disk 53, normally engaging a seat 54, at the upper end of the casing 50. Surrounding the stem 52 and interposed between the valve-disk 53 and the upper end of the guide member 51 is a coiled spring 55. Connected to the lower end of the stem 52 and depending therefrom is a coiled spring 56. The casing 50 forms a water passage, through the section 34 of the differential piston and establishes communication between the upper and lower portions of the differential cylinder 33, the latter has an outlet 57. The valve-disk 53 is closed by coming in contact with the cap 20 and is opened by the stem engaging in the bottom 4.

The section 35 of the differential piston is cylindrical and hollow and has an opening in its bottom closed by an apertured plug 58, the opening in the latter is indicated at 59. The chamber formed by the section 35 provides the receiver-condenser 60 and the bottom of the latter is contracted as at 61 and terminates in an outlet 62, which opens into a pocket 62^a on the upper face of the plug 58. The top of the wall of the opening 59, is beveled to form a valve seat 63, normally engaged by a valve 64, carried by a shiftable valve stem 65, which extends down through the opening 59 and is provided with an extension 66. The stem 65, has a stop 67. The opening 59 provides a passage through which the ammonia passes from the differential cylinder 17 into the receiver-condenser 60. The extended stem 65 causes a positive inserting of the

valve 64, which controls the opening 59, during the lowering movement of the differential piston.

The brine tank or casing 1 has an inlet 1^a and an outlet 1^b. The section 35, is grooved at 35^a for a packing ring 35^b.

The spring 49 attached to the head of the piston is to retard the last part of the stroke of the latter on the up movement thereof, the stronger the spring, the higher the pressure required to complete the stroke of the piston and close the valve 53 for the return stroke resulting in a higher maximum temperature in the chamber (cylinder) 17. A weaker spring will permit of the reverse movement of the piston at a lower temperature, resulting in a lower maximum temperature in the chamber (cylinder) 17. The foregoing will be more clearly understood in the operation of the machine to be presently referred to.

The piston which is hollow, forms the receiver-condenser 60, into which the expanded gases pass from the chamber (cylinder) 17, during the down stroke of the piston, and are condensed by the water surrounding the piston. The liquid is discharged back into chamber 17, at the lower part of the down stroke of the piston as will be fully referred to in the operation of the machine to be presently described.

Ammonia charge.—When the piston is at lowest point, the anhydrous or liquid ammonia should fill chamber (cylinder) 17 and extend up into the condenser chamber 60 to the dotted line, or far enough to exclude all gas from chamber (cylinder) 17 and insure liquid seal of the valve 64.

The chart as illustrated in Fig. 2 gives a graphic description of the action of the machine, during the period of two strokes of the differential piston, the vertical lines 68 are spaced in seconds of time, the horizontal lines 69 are spaced in pounds pressure and corresponding ammonia temperature. The upper diagram 70 shows motion of piston, while the lower diagram 71 indicates pressure and corresponding temperature. While the table of Wood's Properties of Saturated Ammonia is used, to explain the operation of the machine, it will be stated that other refrigerants such as sulfur dioxid may be used.

Operation of machine.—When the differential piston is at its highest point the valve 28 is open and the valve 53 closed. The vent 29 of the valve 28 is always open. Water is supplied through the bushing 32 and the water pressure acting on the differential piston forces the latter down until the valve spring 56 is in contact with the bottom 4 of the body 3, and a continued movement of the piston compresses the spring 56, until the pressure on the valve 53 is overcome and the latter is then opened by spring 56. The water pressure on the piston now being reduced, the difference of pressure on the valve 28 causes it to close, and permit only a small portion of water to be supplied, which is through the vent 29. During the up stroke of the piston, the water above the latter, passes down through the member 50, to the under side of the piston, and is discharged at the outlet 57. It will be seen that the piston which contains the condenser is almost surrounded with water, the temperature of which condenses the ammonia gases within the piston. When the piston is at its highest point and is started down, the ammonia pressure is 33 lbs. and the temperature is 20 degrees F. The piston continues downwardly until the pressure reaches 167 lbs., this now being the pressure in the condenser 60, the temperature at this stage is 90 degrees F. At this point the valve 64 opens and the gas is forced by the higher pressure into the chamber 17. The piston continues on its downward movement until the stem of the valve 64, rests on the plug which closes the opening 16 and which holds the valve 64 open during the last fraction of the downward movement of the piston and the first fraction of the upward movement of the piston. During the last fraction of the downward movement of the piston the gas having all passed into the piston, some of the liquid passes from the chamber 17 into chamber 60, but on the upstroke the liquid passes from chamber 60 into chamber 17 until the valve 64 seats, there being no pressure of water on the piston it is free to ascend, the expanding ammonia in chamber 17 now forces the piston up until the spring 49 reaches the cup 20, at this stage the pressure is 3 lbs. and the temperature 20 degrees below zero, forces the piston up to this point. The piston now is retarded by the spring 49 in its further travel, which gives the ammonia time to further evaporate in chamber 17 and increases the pressure and temperature. As the pressure is building up the spring 49 is being more compressed, this continues until the pressure is again 33 lbs., temperature 20 degrees F., when the cycle is complete.

Cycle and time.—While the cycle of refrigeration as used in the machine is very important, the period of time consumed during the several steps of the cycle are of greater importance, in the compression machine now in general use, the motion of the piston (as regards time) is the same on the suction as on the discharge stroke, in this machine the strokes are not uniform, following the graphic drawing 2, (which is approximate only.) The piston travels up nine-tenths of its stroke in 3 sec. during this time the pressure remains 3.75 lbs. the tem. 20 deg. below zero, F. The piston travels up one-tenth of its stroke in 6 sec,

during this time the pressure will rise to 33.25 lbs. tem. 20 deg. above zero, F. The piston now travels down its full stroke in 1 sec. during this time the pressure rises to 167 lbs. tem. 90 deg. above zero, F, and then falls to 33.25 lbs. tem. 20 deg. below zero, immediately upon the piston starting upwardly. It will now be seen that during nine-tenths of the time, the temperature is below the freezing point, and averages about 6.7 degrees, below zero in the cylinder, while about one-tenth of the time the temperature is above the freezing point (32 degrees F.) giving a refrigerating effect of about 90%, and an average temperature of about 3 degrees, above zero during each cycle of operation of the piston.

All the working parts of the machine are inclosed, and any ammonia leaks developing in the machine will pass out with the operating water and prevent odors.

What I claim is:—

1. In a refrigerating machine, a machine body providing differential communicating cylinders, and a differential hollow piston, operating within said cylinders for condensing a refrigerant gas.

2. In a refrigerating machine, differential cylinders, one opening into the other, and a hydraulic operated differential piston operating in said cylinders for compressing a refrigerant gas, the smaller of said cylinders having its periphery corrugated or ribbed to increase the radiating surface thereof.

3. In a refrigerating machine, differential cylinders, a differential piston operating therein, and means to provide for the supply of water against and the passage of water through a portion of the piston to operate the latter.

4. In a refrigerating machine a body portion inclosing a water operating machine, refrigerant compartments, receiver-condenser, compressor and expansion chamber.

5. In a refrigerating machine, differential cylinders, a differential hollow piston operating in said cylinder for condensing a refrigerant gas, and means for intermittently circulating water through one of said cylinders to operate the piston.

6. In a refrigerating machine, differential cylinders, a differential hollow piston operating in said cylinders for condensing a refrigerant gas, and means for intermittently circulating water through one of said cylinders to a portion of the piston for operating said piston.

7. In a refrigerating machine, differential cylinders, a water controlled valve associated with one of said cylinders, a differential hollow piston operating in said cylinder and having a passage through a portion thereof for conducting water from one side to the other side of a section of said piston, and a controlling valve in said passage, that cylinder having a water controlling valve provided with an outlet.

8. In a refrigerating machine, differential cylinders, a differential hollow piston operating in said cylinders and having a passage through one section thereof for conducting water from one side of said section to another, and a controlling valve in said passage.

9. In a refrigerating machine, differential cylinders, a water controlled valve associated with one of said cylinders, a differential hollow piston operating in said cylinder and having a passage through a portion thereof for conducting water from one side to the other side of a section of said piston, and a controlling valve in said passage, that cylinder having a water controlling valve provided with an outlet, said water controlling valve automatically supplying a full quantity of water on the down stroke of the piston and having means for supplying a small quantity of water on the up stroke of the piston.

10. In a refrigerating machine, differential cylinders, and a differential hollow piston operating in said cylinders, the lower end of said piston constituting a refrigerating end and having a valve therein to permit a refrigerant gas to enter the piston on the compression stroke and discharge a refrigerant liquid on the expansion stroke.

11. In a refrigerating machine, differential cylinders, differential hollow piston operating therein, means whereby said piston is operated on the compression stroke by water pressure, means whereby said piston is operated on the expansion stroke by the expanding of a refrigerant gas.

12. In a refrigerating machine a body portion having two cylindrical compartments, one opening into the other and one of different area with respect to the other, and a hollow differential piston operating in said compartment.

13. In a refrigerating machine, differential cylinders, smaller of which contains a refrigerant gas, a hollow differential piston operating in said cylinders, means provided in the larger of the cylinders for operating said piston by water pressure to compress the refrigerant gas in the smaller cylinder.

14. In a refrigerating machine, differential cylinders, a differential piston operating therein and provided with a condensing chamber, and a valve at the lower end of said piston for controlling the admission of a refrigerant gas to and a refrigerant liquid from the said chamber.

15. In a refrigerating machine differential cylinders, and a differential piston operating therein, the lower end of the smaller of the cylinders having a screw plug provided with a release vent for charging or

discharging a refrigerant to or from the said cylinders.

16. In a refrigerating machine differential cylinders, differential hollow piston operating within said cylinders and having a water passage, said piston operated in one direction by water pressure, a spring loaded valve having a stem arranged within said passage and a spring at the lower end of its stem, said valve capable of opening to release a water pressure above the piston when the latter is at the lower end of its stroke and to close when the piston is at the top of its stroke by coming in contact with the cylinder heads.

17. In a refrigerating machine, differential cylinders, differential hollow piston operating therein and providing a compression stroke on its downward movement and an expansion stroke in its upward movement, and means to retard the termination of the expansion stroke of the piston to secure a higher expansion pressure of a refrigerant gas before the stroke of the piston is reversed.

18. In a refrigerating machine, differential cylinders, a differential hollow piston operating therein providing on its downward movement a compression stroke and on its upward movement an expansion stroke, and a spring arranged on the top of the piston to retard the termination of the expansion stroke thereof to secure a higher expansion pressure of a refrigerant gas before the stroke of the piston is reversed.

19. In a refrigerating machine a body portion inclosing differential cylinders, and a hollow differential piston operating therein and provided at its lower end with a periphery packing to retain a refrigerant during the movement of the piston.

20. In a refrigerating machine, differential cylinders, a piston operating therein, the smaller of said cylinders having a corrugated periphery, and a case or jacket surrounding or inclosing said smaller cylinder and through which liquids or gases may be passed to be cooled.

21. In a refrigerating machine differential cylinders, a differential hollow piston operating therein, means whereby said piston, during the operating thereof, will condense a refrigerant gas and contain the excess or condenser pressure within the cylinder.

22. In a refrigerating machine, differential cylinders, and a differential hollow piston operating therein, one of said cylinders extending beyond the lower end of the piston for retaining a refrigerant liquid.

23. In a refrigerating machine, differential cylinders, and a differential hollow piston operating therein, and means whereby an expansion of a refrigerant gas will be had to cause refrigeration during one stroke of the piston and a compression of the gas during the return stroke of the piston will be had in the smaller of said cylinders.

24. In a refrigerating machine differential cylinders, one communicating with the other, the lower of said cylinders being of less diameter than the upper whereby the bottom of the latter provides means for detachably connecting therewith a tank or jacket through which liquids or gases may be passed to be cooled.

25. In a refrigerating machine differential cylinders one communicating with the other, the lower of said cylinders being of less diameter than the upper whereby the bottom of the latter provides means for detachably connecting therewith a tank or jacket through which liquid or gases may be passed to be cooled, said lower cylinder being provided with peripheral ribs.

26. In a refrigerating machine, differential cylinders, a hollow differential piston operating therein and providing a chamber for condensing gases, said piston having its lower end provided with a passage through which the gases pass on compression or down stroke of the piston, and a valve for controlling said passage, said valve having a stem extending down so as to come in contact with the bottom of the lower of said cylinders whereby the valve is held open during a part of the expansion or up stroke of the piston to receive a part of a liquid refrigerant within said lower cylinder.

27. In a refrigerating machine, differential cylinders, the upper of which provides a water space, and a hollow differential piston operating within said cylinders and forming a condenser chamber for condensing a refrigerant gas.

28. In a refrigerating machine, differential cylinders, the smaller of which is provided with a refrigeratory agent, and a differential piston operating within said cylinders for alternately expanding and compressing said agent to cool a refrigerant within the smaller of the cylinders.

29. In a refrigerating machine, differential cylinders, the smaller of which is provided with a refrigeratory agent, and a differential piston operating within said cylinders for alternately expanding and compressing said agent to cool a refrigerant within the smaller of the cylinders, and means for circulating city water through the larger of said cylinders to the upper portion of said piston to cause the operation of the latter.

30. In a refrigerating machine, differential cylinders, one of which provides a refrigerant cylinder forming a gas space, a piston operating in said cylinder and in said gas space, means to provide a down or compression stroke of said piston, means to provide an up or expansion stroke of said piston, and means for causing the expansion

stroke to be of longer duration than the compression stroke.

31. In a refrigerating machine, differential cylinders, one of which contains a refrigerant agent, a piston operating therein, and means for imparting an intermittent motion to the piston to cause a greater total cooling effect on the expansion stroke of the piston than the total heating effect of the compression stroke within that cylinder containing the refrigerant agent.

32. In a refrigerating machine, differential cylinders, a piston operating therein, one of said cylinders containing a refrigerant agent, means for initially operating said piston by water pressure, and means for causing intermittent motion to the piston.

33. In a refrigerating machine, differential cylinders, a differential piston operating within said cylinders and provided with an expansion chamber, means for circulating water to one of said cylinders to initially operate said piston, a refrigerating agent in the other of said cylinders, means for causing an intermittent motion of the piston.

In testimony whereof I affix my signature in the presence of a witness.

WILLIAM P. WIEMANN.

Witness:

LUELLA H. SIMON.