Aug. 19, 1941. M. LICHTENSTEIN 2,252,775

TURBINE DRIVEN REFRIGERATOR

Filed Oct. 12, 1939 2 Sheets-Sheet 1

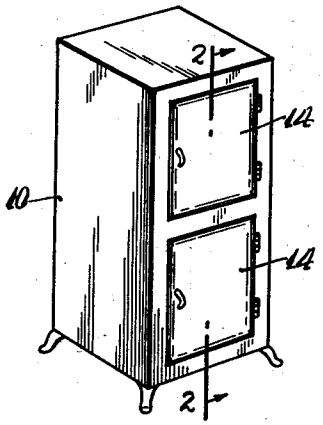


Fig. 1.

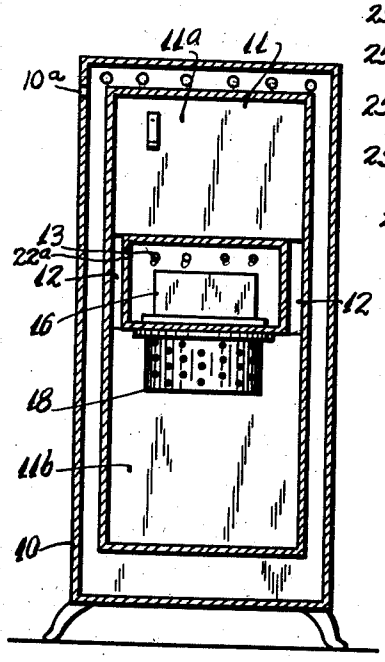


Fig. 3.

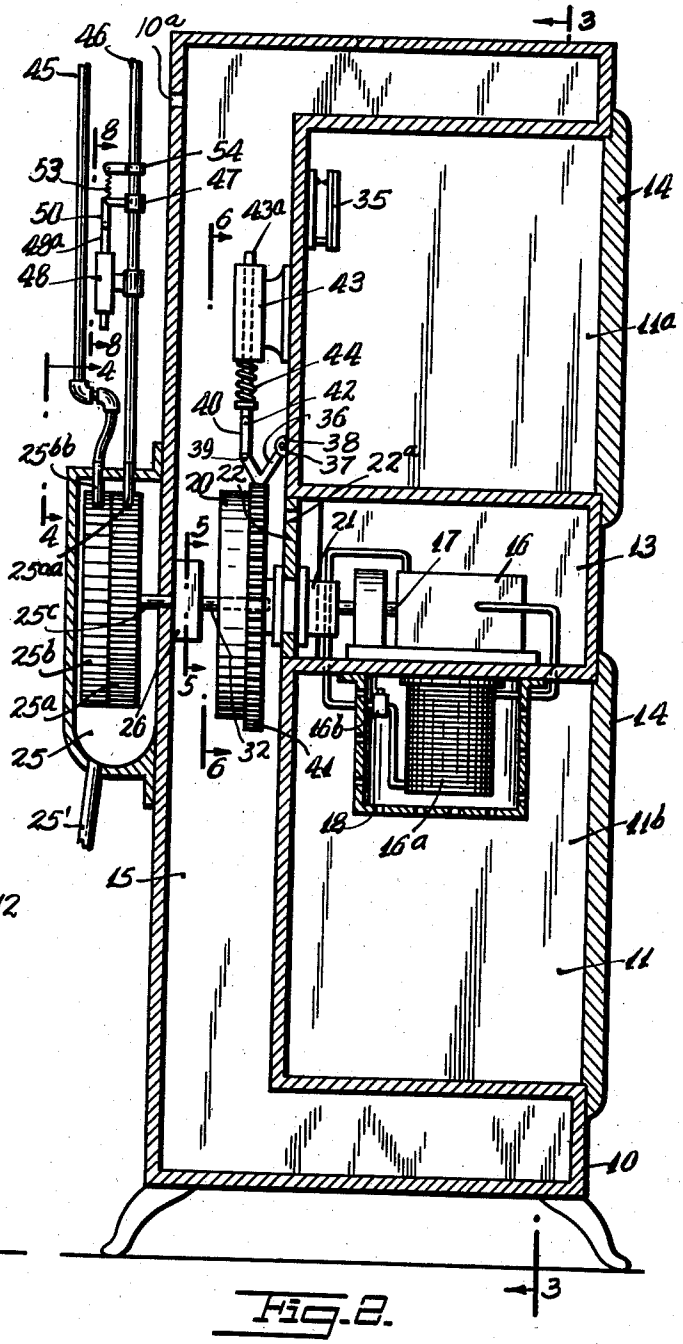


Fig. 2.

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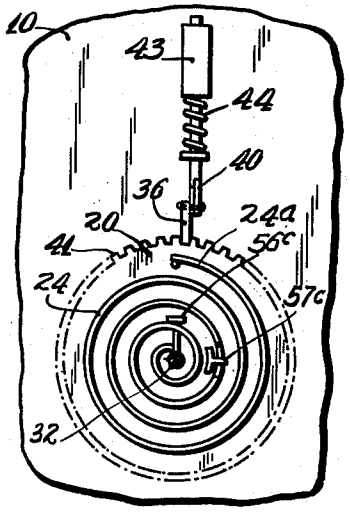


Fig. 6.

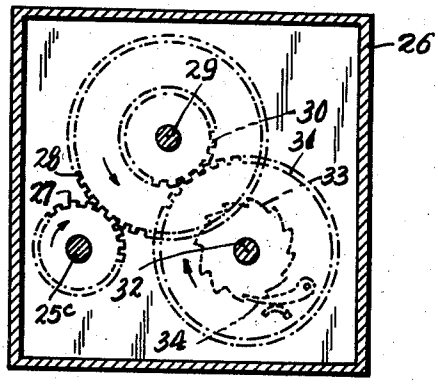


Fig. 5.

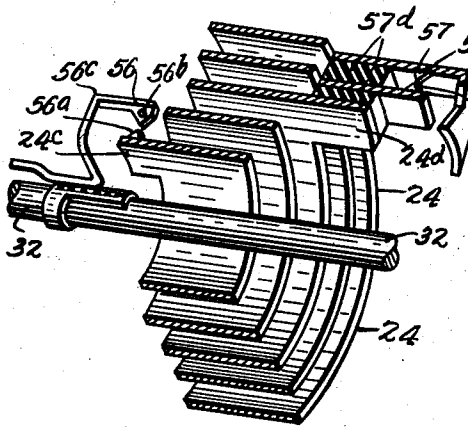


Fig. 7.

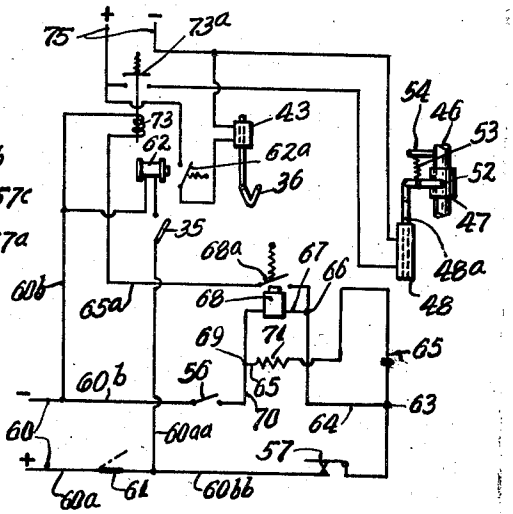


Fig. 9.

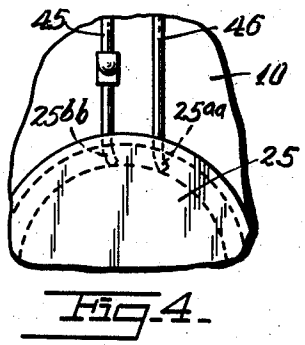


Fig. 4.

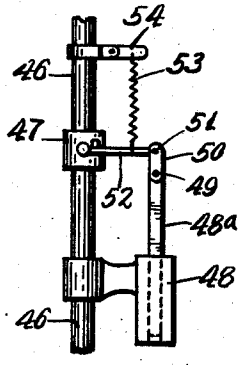


Fig. 8.

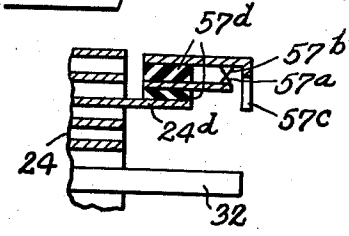


Fig. 7A.

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UNITED STATES PATENT OFFICE

2,252,775

TURBINE DRIVEN REFRIGERATOR

Moe Lichtenstein, New York, N. Y.

Application October 12, 1939, Serial No. 299,093

8 Claims. (Cl. 62—4)

This invention relates to new and useful improvements in a turbine driven refrigerator.

This application relates to the same subject matter as that contained in my prior application filed on November 13, 1937 under Serial No. 174,402 and abandoned on May 12, 1939.

The invention particularly proposes the construction of a refrigerator which is adapted to receive its operating power from waste water. Moreover it is contemplated to so arrange the refrigerator mechanism that in the event there is an insufficient quantity of waste water to operate the same, then other water is used for this purpose.

The invention is particularly intended to make use of large quantities of waste water in numerous commercial plants and under favorable conditions it is intended to also function from waste water in the household. This is particularly true in the larger apartments where a sufficient head may be obtained in the waste supply line.

Still further the invention proposes the construction of a turbine driven refrigerator embodying the essence of the objects previously mentioned, which is simple and durable and which may be manufactured and sold at a reasonable cost.

For further comprehension of the invention, and of the objects and advantages thereof, reference will be had to the following description and accompanying drawings, and to the appended claims in which the various novel features of the invention are more particularly set forth.

In the accompanying drawings forming a material part of this disclosure:

Fig. 1 is a perspective view of a turbine driven refrigerator constructed in accordance with this invention.

Fig. 2 is an enlarged vertical sectional view taken on the line 2—2 of Fig. 1.

Fig. 3 is a reduced vertical sectional view taken on the line 3—3 of Fig. 2.

Fig. 4 is a fragmentary elevational view looking in the direction of the line 4—4 of Fig. 2.

Fig. 5 is a fragmentary enlarged vertical sectional view taken on the line 5—5 of Fig. 2.

Fig. 6 is a fragmentary vertical sectional view taken on the line 6—6 of Fig. 2, and particularly illustrating a spring motor used in the device.

Fig. 7 is a fragmentary schematic view of a portion of the spring motor.

Fig. 7A is an elevational view of a portion of Fig. 7.

Fig. 8 is a fragmentary elevational view looking in the direction of the line 8—8 of Fig. 2.

Fig. 9 is a schematic diagram of the device.

The turbine driven refrigerator in accordance with this invention includes a body 10 having a refrigeration compartment 11. This refrigeration compartment has two sections, an upper section 11a and a lower section 11b. These sections are connected with each other at the sides by passages 12. Between the passages 12 and between the upper and lower sections of the refrigeration compartment there is a compartment 13 in which a refrigeration compressor for the device is housed. The passages 12 have no connection with the compartment 13 or the space located to the rear of the refrigeration compartment 11. This latter space is to be hereinafter identified.

Each of the refrigeration compartments 11a and 11b is provided with a hinged door 14 by which it is accessible. The body 10 is also provided with a compartment 15 in which certain of the operating mechanism of the device is housed. Within the compartment 13 there is a refrigerant liquefying portion 16 of a refrigeration system which may be of any of the general designs now on the market. This refrigerant liquefying portion has an operator shaft 17 which is rotated during the operation thereof. The details of the refrigeration compressor and system and its principle of operation will not be given in this specification since it forms no part of this invention. However, it is pointed out that the refrigeration compressor and system includes a freezing coil 16a mounted in a shell 18, the latter being mounted within the lower compartment 11b of the body 10. This freezing coil 16a is controlled by the ordinary expansion valve 16b. The freezing coil is adapted to absorb heat from the refrigeration compartment 11.

A member 20 has a hub portion 21 which is rotatively supported upon a web member 22 mounted transversely across the compartment 13. Thus the member 20 may rotate. The web 22 normally closes the back of the compartment 13, but this web is formed with openings 22a through which the heat developed by the refrigerant liquefying portion 16 passes to reach the compartment 15. The back wall of the body 10 is formed with openings 10a through which the heat is adapted to discharge into the atmosphere. A spring 24 is arranged coaxially of the member 20 and has one of its ends, namely the end 24a, attached to the member 20. A water turbine 25 is mounted upon the body 10 and is provided with a high pressure water stage 25a and a low pressure water stage 25b. A transmission system indirectly connects the turbine shaft 25c with the

inner end of the said spring 24 for winding the same. The turbine 25 is provided with a high pressure nozzle 25^{aa} and a low pressure nozzle 25^{bb} in said stages thereof.

The transmission system includes a housing 26 which is mounted upon the body 10 and contains a gear transmission system. More particularly the shaft 25^{c} of the turbine extends into the housing and supports a pinion 27 which meshes with a large gear 28 fixedly mounted on a rotatively supported shaft 29 provided with a pinion 30 which meshes with a large gear 31 freely mounted on another rotative shaft 32. This shaft 32 is provided with a ratchet wheel 33 which is fixedly mounted on the shaft 32. The gear 31 is free upon the shaft. A spring urged pawl 34 is mounted upon the gear 31 and engages the ratchet wheel 33 so as to transmit rotations in one direction only. The transmission system may be traced from the turbine shaft 25^{c} through the various gear drives to the shaft 32. This shaft 32 extends coaxially into the member 20 so as to be free to rotate. The inner end 24^{b} of the spring 24 is fixedly attached to the shaft 32. Rotations of the turbine are transmitted to rotate the shaft 32 which winds the spring 24. The spring may unwind by driving the member 20.

A means is provided for releasably holding the member 20 against rotating and this means is controlled by a thermostat located within the refrigeration compartment 11^{a}. The thermostat 35 controls the release of the member 20 when the temperature within the refrigeration compartment 11^{a} rises above a predetermined level. The holding means includes an L-shaped detent 36 which is pivotally supported at one end by a pintle 37 mounted on a stationary bracket 38. The other end of the L-shaped detent 36 is connected by a pintle 39 with a link 40. The central portion of the L-shaped detent 36 normally engages teeth 41 formed on the periphery of the member 20. The link 40 is pivotally connected by a pintle 42 with the core 43^{a} of a solenoid 43. The spring 44 tends to normally urge the solenoid core downwards so that the L-shaped detent 36 engages the teeth 41. The electric circuit by which the thermostat 35 controls the solenoid 43 will be hereinafter given in greater details.

A low pressure water supply 45 is connected with the low pressure nozzle 25^{bb} and with the low pressure stage of the turbine 25. The high pressure water supply 46 is connected with the high pressure nozzle 25^{aa} and the high pressure stage of the water turbine 25. The low pressure water supply 45 may comprise the waste water in a commercial plant or domestic residence. Of course it is required that this waste water have a sufficient head to have usable power. The high pressure water supply 46 may comprise the regular high pressure water supply contained in commercial plants and in the home. A valve 47 is provided for normally shutting off the high pressure water supply.

A means is also provided for temporarily opening the valve 47 when the spring 24 is unwound to a certain degree. This means includes a solenoid 48. This solenoid has a core 48^{a} which is connected by a pintel 49 with a link 50 in turn connected by a pintle 51 with the control handle 52 of the valve 47. A spring 53 connects with the handle 52 and with a stationary bracket 54 mounted on the pipe line 46 and acts to normally urge the valve 47 closed. The arrangement is such that when the solenoid 48 is energized the handle 52 will be moved so that the valve 47 is open.

The spring 24 is provided with two switches. There is a switch 56 which is normally open and another switch 57 which is normally closed. The switch 56 includes a contact 56^{a} mounted upon a projection 24^{c} on one of the inner turns of the spring 24. This contact 56^{a} is engageable with a complementary contact 56^{b} when the spring 24 is unwound to a predetermined degree. The contact 56^{b} is supported on an arm 56^{c} which is mounted on the shaft 32. The switch 57 includes a contact 57^{a} mounted upon a projection 24^{d} upon another one of the turns of the spring 24. This contact 57^{a} is normally in engagement with a complementary contact 57^{b} mounted on a flexible arm 57^{c}. This arm 57^{c} is rigidly supported at its inner end upon an insulation block 57^{d}. The contacts 57^{a} and 57^{b} are insulated from each other and from the shaft 32 by the insulation blocks 57^{d} which are interposed between these parts. The outer end of the arm 57^{c} is adapted to strike against the shaft 32 when the spring 24 is fully wound. The engagement of the arm 57^{c} against the shaft 32 will separate the contacts 57^{b} from the contact 57^{a}. The switch 56 is used to control the energization of the solenoid 43 which in turn releases the member 20. The switch 57 is used to indirectly cause the deenergization of the solenoid which indirectly causes the holding of the member 20. The details of the electric circuit (see Fig. 9) are as follows:

There is a main circuit 60 which may be connected with the household or commercial power lines. This main circuit 60 has a high tension lead 60^{a} which is controlled by a main switch 61 and a negative lead 60^{b}. The high tension lead 60^{a} connects with a branch lead 60^{aa} and another branch lead 60^{bb}. The lead 60^{aa} connects with the thermostat switch 35. The circuit from this switch continues through the coil 62 of a relay and back to the negative lead 60^{b} of the circuit 60.

The branch lead 60^{bb} contains the switch 57 and extends to the point 63. From this point there are two branches, namely the branch 64 and the branch 65. The branch 64 continues to a point 66 from which there are two additional branches, namely the branch 67 and the branch 65^{a}. The branch 67 passes through the coil 68 of the relay and then continues to the point 69. At the point 69 there are two branches, namely the branch 70 and said branch 65. The branch 70 includes said switch 56 and then continues to the negative lead 60^{b} of the circuit 60. The branch 65 includes a resistance 71 and then continues through the coil 68 of the relay and then continues through the lead 67 to the point 66 and then through the switch 68^{a} of the relay having the coil 68 when the switch 68^{a} is closed. The circuit then continues along the lead 65^{a} to a coil 73 of another relay and then continues to the negative lead 60^{b} of the main circuit 60.

The relay having the coil 73 has a relay switch 73^{a} which controls an auxiliary electric circuit 75. This auxiliary circuit 75 is connected with the solenoid 48 which controls the valve 47. The auxiliary circuit 75 also includes in parallel the solenoid 43 which controls the member 20'. The solenoid 43 is directly controlled by the switch 62^{a} of the relay having the coil 62.

The operation of the device is as follows:

Let us assume that the temperature of the compartment 11a is sufficiently low so that the thermostat switch 35 is open. In this condition of the device the member 20 is stationarily held by the L-shaped detent 36. Any waste water which passes through the low pressure line 45 will discharge into the low pressure turbine nozzle 25bb to drive the turbine. The waste through the turbine discharges through the turbine discharge 25'. The action of the turbine will be transmitted to the turbine shaft 32 to wind the spring 24 which now is storing up power.

Now let us assume that the temperature in the compartment 11a rises a sufficient amount so that the thermostat switch 35 is closed. This immediately affects the coil 62 of the relay having the switch 62a. The relay switch 62a is then closed energizing the solenoid 43 which operates indirectly to release the member 20 by lifting the L-shaped detent 36. The spring 24 now rotates the member 20 which in turn drives the refrigeration compressor and system 16 setting the refrigeration system into operation so that heat is absorbed by the freezing coil 16a. The operation continues until the temperature within the compartment 11a falls a sufficient amount so that the thermostatic switch 35 opens. This breaks the circuit through the coil 62 and the relay switch 62a opens to deenergize the solenoid 43. The spring 44 immediately moves the L-shaped detent 36 to again engage the teeth 41 of the member 20 to hold the member against any further rotation.

Now assume that the spring 24 delivers more energy than it receives during the operation of the refrigerator. Consequently the spring 24 becomes unwound. When it reaches a certain degree of slackness the switch 56 will be closed. This closes the circuit 60 so that the current flows through the coil 68 of the relay controlling the switch 68a. This closes the switch 68a. This controls the coil 73 of the relay having the switch 73a. When the switch 73a closes the solenoid 48 is energized opening the valve 47. Now the high pressure water supply is functioning, discharging high pressure water through the turbine nozzle 25aa and operating the turbine. The turbine shaft 32 is now rotating and starts winding the spring 24. Instantly the switch 56 is opened as the turn upon which the contact 56a is mounted starts winding up. However the relay coil 68 will remain energized because even though the circuit is broken at the point 56 it will remain closed through the coil 68 because the current may now pass from the point 63 through the lead 65 and the resistance 71 to the point 69, then through the coil 68 to the lead 67 and the point 66. Because the coil 68 remained energized the switch 68a will remain closed. The current will therefore pass from the point 66 through the switch 68a along the lead 65a, through the coil 73 and lead 60b to the negative lead of the circuit 60. Consequently the relay coil 73 will remain energized and the valve 47 will remain open.

The turbine keeps functioning until the spring 24 is wound to a certain degree and then the arm 57c will strike the shaft 32 opening the switch 57. Now the switches 57 and 56 are both open, and this will cause the breaking of the circuit through the relay coils 68 and 73. The relay switches 68a and 73a now open, which cause the deenergization of the solenoid 48. The spring 53 now moves the handle 52 of the valve 47 to close the high pressure water supply.

The switch 57 will remain open until such time as the spring 24 slightly unwinds freeing the arm 57c from its engagement with the shaft 32. However, since the switch 56 is open at this time, and the switch 68a opened when the switch 57 was opened, current will not flow through the coil 68. The parts are now in their original condition.

The spring 24 and the water turbine 25 are so designed that the low pressure water supply 45 cannot overwind and damage the spring 24.

While I have illustrated and described the preferred embodiments of my invention, it is to be understood that I do not limit myself to the precise constructions herein disclosed and the right is reserved to all changes and modifications coming within the scope of the invention as defined in the appended claims.

Having thus described my invention, what I claim as new, and desire to secure by United States Letters Patent is:

1. In a turbine driven refrigerator unit including a compressor, an operator shaft for driving said compressor, a rotatively supported member connected with said operator shaft, a spring coaxial of said member and having its outer end attached to said member, a water turbine having a high water pressure stage and a low water pressure stage, a transmission system connecting said turbine with the inner end of said spring for winding same, means for releasably holding said member against rotating and controlled by a thermostatic switch for releasing said member when the temperature of the medium surrounding said switch rises above a predetermined level, a low pressure water supply to the low pressure stage of said turbine, a high pressure water supply to the high pressure stage of said turbine, a valve for normally shutting off the high pressure water supply, and means for temporarily opening said valve when said spring is unwound to a certain degree.

2. In a turbine driven refrigerator unit including a compressor, an operator shaft for driving said compressor, a rotatively supported member connected with said operator shaft, a spring coaxial of said member and having its outer end attached to said member, a water turbine having a high water pressure stage and a low water pressure stage, a transmission system connecting said turbine with the inner end of said spring for winding same, means for releasably holding said member against rotating and controlled by a thermostatic switch for releasing said member when the temperature of the medium surrounding said switch rises above a predetermined level, a low pressure water supply to the low pressure stage of said turbine, a high pressure water supply to the high pressure stage of said turbine, a valve for normally shutting off the high pressure water supply, and means for temporarily opening said valve when said spring is unwound to a certain degree, said transmission system including a ratchet and pawl to limit the rotations in one direction.

3. In a turbine driven refrigerator unit including a compressor, an operator shaft for driving said compressor, a rotatively supported member connected with said operator shaft, a spring coaxial of said member and having its outer end attached to said member, a water turbine having a high water pressure stage and a low water pressure stage, a transmission system connecting said turbine with the inner end of said spring for winding same, means

for releasably holding said member against rotating and controlled by a thermostatic switch for releasing said member when the temperature of the medium surrounding said switch rises above a predetermined level, a low pressure water supply to the low pressure stage of said turbine, a high pressure water supply to the high pressure stage of said turbine, a valve for normally shutting off the high pressure water supply, and means for temporarily opening said valve when said spring is unwound to a certain degree, said means for releasably holding said member against rotation including teeth formed on the periphery of the member, a detent pivotally supported at one end and having an intermediate portion normally engaging said teeth, and a solenoid connected with said detent to move the same out of contact with the said teeth upon energization.

4. In a turbine driven refrigerator unit including a compressor, an operator shaft for driving said compressor, a rotatively supported member connected with said operator shaft, a spring coaxial of said member and having its outer end attached to said member, a water turbine having a high water pressure stage and a low water pressure stage, a transmission system connecting said turbine with the inner end of said spring for winding same, means for releasably holding said member against rotating and controlled by a thermostatic switch for releasing said member when the temperature of the medium surrounding said switch rises above a predetermined level, a low pressure water supply to the low pressure stage of said turbine, a high pressure water supply to the high pressure stage of said turbine, a valve for normally shutting off the high pressure water supply, and means for temporarily opening said valve when said spring is unwound to a certain degree, said means for releasably holding said member against rotation including teeth formed on the periphery of the member, a detent pivotally supported at one end and having an intermediate portion normally engaging said teeth, and a solenoid connected with said detent to move the same out of contact with the said teeth upon energization, and resilient means for urging said detent into its operative position.

5. In a turbine driven refrigerator unit including a compressor, an operator shaft for driving said compressor, a rotatively supported member connected with said operator shaft, a spring coaxial of said member and having its outer end attached to said member, a water turbine having a high water pressure stage and a low water pressure stage, a transmission system connecting said turbine with the inner end of said spring for winding same, means for releasably holding said member against rotating and controlled by a thermostatic switch for releasing said member when the temperature of the medium surrounding said switch rises above a predetermined level, a low pressure water supply to the low pressure stage of said turbine, a high pressure water supply to the high pressure stage of said turbine, a valve for normally shutting off the high pressure water supply, and means for temporarily opening said valve when said spring is unwound to a certain degree, said means for releasably holding said member against rotation including teeth formed on the periphery of the member, a detent pivotally supported at one end and having an intermediate portion normally engaging said teeth, and a solenoid connected with said detent to move the same out of contact with the said teeth upon energization, said solenoid being included in a circuit indirectly controlled by said thermostatic switch.

6. In a turbine driven refrigerator unit including a compressor, an operator shaft for driving said compressor, a rotatively supported member connected with said operator shaft, a spring coaxial of said member and having its outer end attached to said member, a water turbine having a high water pressure stage and a low water pressure stage, a transmission system connecting said turbine with the inner end of said spring for winding same, means for releasably holding said member against rotating and controlled by a thermostatic switch for releasing said member when the temperature of the medium surrounding said switch rises above a predetermined level, a low pressure water supply to the low pressure stage of said turbine, a high pressure water supply to the high pressure stage of said turbine, a valve for normally shutting off the high pressure water supply, and means for temporarily opening said valve when said spring is unwound to a certain degree, comprising a normally opened switch mounted on said spring and adapted to be closed when the spring becomes unwound to a certain degree, a normally closed switch mounted upon said spring and adapted to be opened when said spring becomes wound to a certain degree, and said switches being connected in a circuit for indirectly controlling said valve.

7. In a turbine driven refrigerator unit including a compressor, an operator shaft for driving said compressor, a rotatively supported member connected with said operator shaft, a spring coaxial of said member and having its outer end attached to said member, a water turbine having a high water pressure stage and a low water pressure stage, a transmission system connecting said turbine with the inner end of said spring for winding same, means for releasably holding said member against rotating and controlled by a thermostatic switch for releasing said member when the temperature of the medium surrounding said switch rises above a predetermined level, a low pressure water supply to the low pressure stage of said turbine, a high pressure water supply to the high pressure stage of said turbine, a valve for normally shutting off the high pressure water supply, and means for temporarily opening said valve when said spring is unwound to a certain degree, comprising a normally opened switch mounted on said spring and adapted to be closed when the spring becomes unwound to a certain degree, a normally closed switch mounted upon said spring and adapted to be opened when said spring becomes wound to a certain degree, and said switches being connected in a circuit for indirectly controlling said valve, said circuit including a solenoid having its core connected with the valve head for opening the valve when energized.

8. In a turbine driven refrigerator unit including a compressor, an operator shaft for driving said compressor, a rotatively supported member connected with said operator shaft, a spring coaxial of said member and having its outer end attached to said member, a water turbine having a high water pressure stage and a low water pressure stage, a transmission system connecting said turbine with the inner end of said spring for winding same, means for releasably holding said member against rotating and controlled by a thermostatic switch for releasing said member when the temperature of the medium sur-

rounding said switch rises above a predetermined level, a low pressure water supply to the low pressure stage of said turbine, a high pressure water supply to the high pressure stage of said turbine, a valve for normally shutting off the high pressure water supply, and means for temporarily opening said valve when said spring is unwound to a certain degree, comprising a normally opened switch mounted on said spring and adapted to be closed when the spring becomes unwound to a certain degree, a normally closed switch mounted upon said spring and adapted to be opened when said spring becomes wound to a certain degree, and said switches being connected in a circuit for indirectly controlling said valve, said circuit including a solenoid having its core connected with the valve head for opening the valve when energized, said normally closed switch having an arm engageable against said operator shaft to cause opening of the switch when the spring is wound.

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