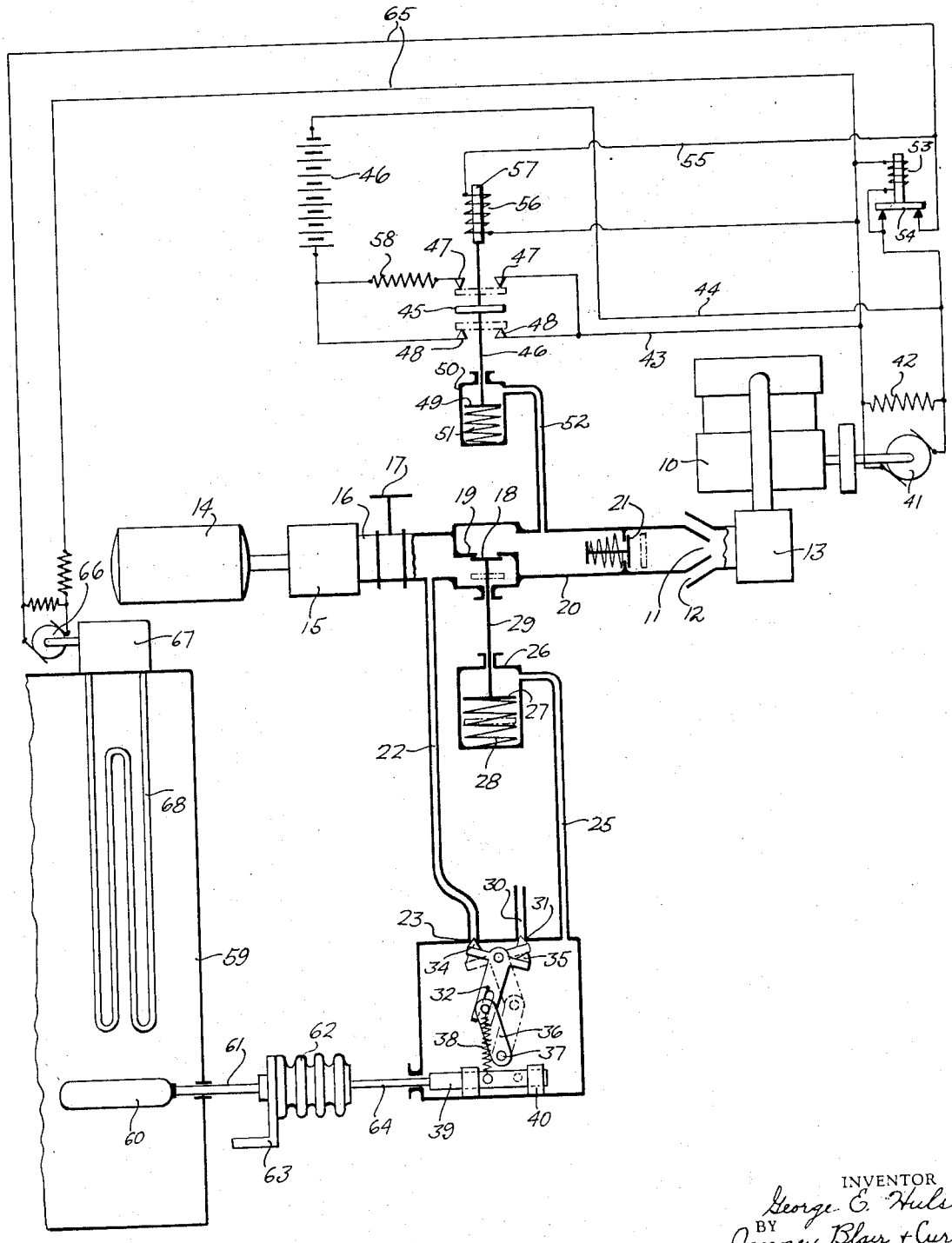
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TEMPERATURE REGULATING APPARATUS

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TEMPERATURE REGULATING APPARATUS

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This invention relates to apparatus for the regulation of temperature, and, with regard to its more specific features, to cooling or refrigeration.

One of the objects thereof is to provide practical apparatus of the above nature of efficient and dependable action. Another object is to provide apparatus of the above nature characterized by simplicity of construction and positive operation of the parts. Another object is to provide apparatus of the above nature in which the materials used are effectively controlled and economically employed. Other objects will be in part obvious and in part pointed out hereinafter.

The invention accordingly consists in the features of construction, combinations of elements, and arrangements of parts, as will be exemplified in the structure to be hereinafter described and the scope of the application of which will be indicated in the following claims.

The drawing, in which is shown one of various possible embodiments of this invention, is a diagrammatic plan.

Referring now to this drawing in detail, there is shown at 10 an internal combustion engine adapted to run on gaseous fuel supplied through the nozzle 11, provision for the entry of air being indicated at 12, and suitable charge-preparatory devices being provided at 13.

At 14 is a source of supply of fuel under high pressure connected with a pressure reducing regulator 15 of any desired type, which is adapted to supply to the conduit 16 gaseous fuel under a substantially constant pressure of the desired value. In this conduit 16 is a hand-controlled valve 17, and beyond this an automatic valve 18 coacting with a seat 19 and controlling the discharge to the portion 20 of the conduit. In this conduit portion 20 leading to the nozzle 11 is a spring-retracted check valve 21 so proportioned and adjusted that it will remain closed unless simultaneously subjected on one side to the pressure of the fuel supply and on the other side to the suction from the turning over of the engine 10.

Leading from the conduit 16 between the valves 17 and 18 is a by-pass tube 22 terminating in a seat 23 in the walls of a chamber 24. Leading from this chamber 24 is a tube 25, which terminates in the upper end of a cylinder 26 provided with a piston 27 normally urged upwardly by the spring 28 and connected, as by rod 29, with the valve 18. In the absence of pressure on the upper side of the piston 27, the spring 28 holds the valve 18 firmly against its seat 19.

An exhaust tube 30 leads from a port 31 in the wall of the chamber 24 adjacent the port 23, and a rocking member 32, pivoted at 33, is provided with a pair of valves 34, and 35, respectively coacting with the ports or valve seats 23 and 31. This swinging valve member is so arranged that in the position shown in full lines, the valve 34 closes the end of the tube 22, but leaves open the exhaust tube 30, whereas if it be swung to the position shown in dotted lines, it opens the end of tube 22 and closes the exhaust tube 30. The lower end of the member 32 has a slotted connection with a swinging link 36 pivoted at 37 and having its upper end urged downwardly by the tension spring 38 connected with a sliding rod 39. Thus, as this rod 39 slides in its guides 40, it will, when in its leftward position as shown in the drawing, so positioned spring 38 that it presses valve 34 against the port or seat 23. If, however, the rod 39 slides toward the right, it will cause the spring 38, when it passes the axis of the pivot 37, to snap the parts over into the position shown in dotted lines, opening port 23 and closing port 31. In this manner, with the parts as shown in full lines, the valve 18 is held firmly against its seat by a spring 28, but when the rod 39 slides a sufficient distance to the right, the snapping over of the member 32 will close the exhaust tube 30, by which absence of pressure in cylinder 26 has been assured, and will admit pressure from the fuel in the conduit 16, if the valve 17 be open, and this gas under pressure passing through tube 25 will force downwardly the piston 27 and move valve 18 into the open position shown in dotted lines.

Before considering the method of control of rod 39, illustratively shown in the drawing, it is to be noted that the engine 10 is directly connected in driving relation to a dynamo 41, provided with a field 42, and connected, as by the leads 43 and 44, through a switch 45, with a storage battery 46. This connection depends upon the closing of the switch member 45, and it may be noted that this member is mounted upon a rod 46 adapted to move the member upwardly so as to bridge a pair of contacts 47, or downwardly to bridge a pair of contacts 48. The lower end of the rod terminates in a piston 49 positioned in a cylinder 50 and held upwardly by a spring 51 so as normally to hold the switch member 45 in mid position with both sets of coacting contacts open-circuited. If, however, gas under pressure be present in the portion 20 of the supply conduit, it will pass through a tube 52 to the upper end of the cylinder 50 and force the piston 49 downwardly so as to cause switch 45 to bridge the contacts 48. There will thus be completed a direct connection from the storage battery 46 to the dynamo 41, and when this takes place, the latter, acting as a motor, will turn over the internal combustion engine 10.

Considering now the action of the apparatus thus far described, and assuming the hand valve 17 to be open, if the swinging member 32 be moved into the position shown in dotted lines, the valve 18 will be opened, as hereinbefore described, and fuel under pressure admitted to the conduit portion 20. Thereupon the switch 45 will

be closed, as above described, and the engine 10 turned over by the dynamo 41. The combined effect of the pressure of the fuel in conduit portion 20 with the suction caused by the turning over of the engine will open check valve 21, thus supplying fuel to the engine, and the latter will start under its own power, ignition being had by any suitable well-known means. When this happens, the drop in pressure in the conduit section 20, due to the flow of gas to the engine, will so relieve the pressure on the upper side of the piston 49 as to permit spring 51 to raise the contact member 45 into the mid position shown in full lines. This action breaks the circuit at the contacts 48 and stops the flow of current from the battery to the dynamo irrespective of the voltage of the latter. The dynamo 41, then driven as a generator, will, when it develops a predetermined voltage, close the switch 54 by means of the voltage coil 53, thus leading current through conductor 55 and a voltage solenoid 56. The core 57 of solenoid 56 will then draw the bridge member 45 upwardly from its mid position until it bridges the contacts 47. This action closes a connection between the generator 41 and battery 46 through a resistance 58 and permits the generator to charge the battery.

The above action will continue as long as the parts remain in the position above described, but if the member 32 be snapped over into the position shown in full lines in the drawing, the valve 34 will close the end of the tube 22 and open tube 25 through the chamber 24 and exhaust pipe 30 to the atmosphere. This will relieve the pressure on the upper side of piston 27, permitting spring 28 to close the valve 18, and thus cut off the fuel supply to the engine 10, and cause it to stop. Failure of current will then de-energize coil 53, permitting switch 54 to open and coil 56 permitting switch 45 to resume its position indicated in full lines, in which both pairs of contacts 47 and 48 are open-circuited.

Turning now to the method of control of the member 32 shown in the drawing, there is indicated at 59 a chamber, the interior of which it is assumed is to be maintained at or below a predetermined temperature. Mounted in this chamber is a cell 60 containing a volatile fluid and connected, as by the tube 61, with an expansible capsule 62. One end of this capsule is assumed to be anchored at 63, and the opposite end connected by a rod 64 with the sliding rod 39. These elements are so chosen and proportioned that when the temperature within the chamber 59 tends to exceed the maximum desired value, the pressure within the capsule 62 will be such as to snap the rod 39 over to the right, having reference to the drawing, causing the swinging of the rocking member 32, the starting of the engine 10, and the remaining actions above described. With the dynamo 41 thus running as a generator and developing its full output, the current is led through the mains 65 to a motor 66 which drives refrigerating apparatus, diagrammatically indicated at 67, the effective cooling element 68 of which is positioned within the chamber 39. The cooling element 68 being in operation, the temperature within the chamber 59 is reduced, and when the resultant fall in internal pressure in the cell 60 reaches a predetermined value, the contraction of the capsule 62 will snap the rod 39 to the left, thus rocking the member 32 into its full line position and causing the stopping of the engine, as hereinbefore noted.

It will thus be seen that there is provided apparatus in which the various objects of this invention are accomplished and the advantages hereinbefore noted are attained. Many of the features of this apparatus are of independent value, but they are of especial value when combined with one or more of the other features as hereinbefore described.

As many possible embodiments may be made of the above invention, and as many changes might be made in the embodiment above set forth, it is to be understood that all matter hereinbefore set forth or shown in the accompanying drawing is to be interpreted as illustrative and not in a limiting sense.

I claim:

1. In temperature regulating apparatus, in combination, means adapted to contain a medium whose temperature is to be governed, an internal combustion engine, a dynamo operatively connected thereto and adapted to drive said engine and to be driven thereby, a source of current, means in thermal contact with said medium and adapted to connect said dynamo to said source of current and thereby start said engine when the temperature of said medium passes a predetermined value, and means actuated by current from said dynamo adapted upon said engine being started and driving said dynamo to act upon said medium and return its temperature to said value.

2. In temperature regulating apparatus, in combination, means adapted to contain a medium whose temperature is to be governed, an internal combustion engine, a dynamo operatively connected thereto and adapted to drive said engine and to be driven thereby, a source of current, means in thermal contact with said medium and adapted to connect said dynamo to said source of current and thereby start said engine when the temperature of said medium passes a predetermined value, means actuated by current from said dynamo adapted upon said engine being started and driving said dynamo to act upon said medium and return its temperature to said value, and means adapted to affect the connection between said source of current and said dynamo when said engine starts.

3. In temperature regulating apparatus, in combination, means adapted to contain a medium to be cooled, an internal combustion engine, a dynamo operatively connected thereto and adapted to drive said engine and to be driven thereby, a source of current, means in thermal contact with said medium and adapted to connect said dynamo to said source of current and thereby start said engine when the temperature of said medium reaches a predetermined value, and means actuated by current from said dynamo adapted upon said engine being started and driving said dynamo to cool said medium.

4. In temperature regulating apparatus, in combination, means adapted to contain a medium whose temperature is to be governed, means including an internal combustion engine adapted to drive an element of a refrigeration unit for said last mentioned means, means adapted to supply gaseous fuel under pressure to said engine, pressure reducing means interposed between said supply and said engine, and means responsive to the temperature of said medium for controlling the action of said pressure reducing means.

5. In temperature regulating apparatus, in combination, an internal combustion engine,

means adapted to supply gaseous fuel under pressure to said engine, pressure-reducing means interposed between said supply and said engine, means adapted to contain a medium whose temperature is to be governed, means responsive to the temperature of said medium for controlling the flow of gas to said engine, and means driven by said engine adapted upon said engine being started to alter the temperature of said medium.

6. In temperature regulating apparatus, in combination, an internal combustion engine, means adapted to supply gaseous fuel under pressure to said engine, pressure-reducing means interposed between said supply and said engine, means adapted to contain a medium whose temperature is to be maintained cool, means responsive to the temperature of said medium adapted to admit said gas to said engine, and cooling means operatively related to said medium and driven from said engine.

7. In temperature regulating apparatus, in refrigerating means for a space including an internal combustion engine, a source of supply of gaseous fuel under pressure, means actuated by the pressure of said fuel adapted to connect said source of supply with said engine, and thermostatic means responsive to the temperature of said space for controlling said connecting means.

8. In temperature regulating apparatus, in combination, an internal combustion engine, means adapted to supply gaseous fuel under pressure to said engine, a dynamo connected with said engine, a source of current, and means actuated by the pressure of said fuel adapted to connect said source of current with said dynamo.

9. In temperature regulating apparatus, in combination, an internal combustion engine, a fuel supply under pressure for said engine, a dynamo driven from said engine, thermostatic means controlling the starting and stopping of said engine by regulating the pressure of said fuel supply, electrically operated means adapted to vary temperature at a predetermined point, and means adapted to connect said dynamo with said electrically operated means upon the voltage of said dynamo reaching a predetermined value.

10. In temperature regulating apparatus, in combination, an internal combustion engine, means containing a medium whose temperature is to be governed, thermostatic means operatively related to said medium and controlling the starting and stopping of said engine, a dynamo driven from said engine, means operated by current output of said dynamo adapted to affect the temperature of said medium, a storage battery, and means adapted to make a connection between said dynamo and said storage battery when the voltage of said dynamo reaches a predetermined value.

11. In temperature regulating apparatus, in combination, means adapted to contain a medium whose temperature is to be governed, an internal combustion engine, a dynamo operatively connected thereto and adapted to drive the same and to be driven thereby, a source of current, thermostatic means operatively related to said medium and adapted to connect said dynamo to said source of current and thereby start said engine when the temperature of said medium passes a predetermined value, means comprising a source of supply of gaseous fuel under pressure for said engine, the flow of which to said engine is controlled by said thermostatic means and means actuated by current from said dynamo adapted upon said engine being started to act upon said medium and return its temperature to said value.

12. In temperature regulating apparatus, in combination, means adapted to contain a medium whose temperature is to be governed, an internal combustion engine, a dynamo operatively connected thereto and adapted to drive the same and to be driven thereby, a source of current, thermostatic means operatively related to said medium and adapted to connect said dynamo to said source of current and thereby start said engine when the temperature of said medium passes a predetermined value, means actuated by current from said dynamo adapted upon said engine being started and driving said dynamo to act upon said medium and return its temperature to said value, and means adapted upon said engine being started to alter the connection between said dynamo and said source of current.

13. In temperature regulating apparatus, in combination, an internal combustion engine, means adapted to supply gaseous fuel under pressure to said engine, a dynamo connected with said engine, a storage battery, thermostatic means, and means controlled by said thermostatic means and actuated by the pressure of said fuel adapted to control the actuation of said dynamo to start and stop said engine, and means for cooling a space operatively responsive to the starting of said engine.

14. In temperature regulating apparatus, in combination, means forming a space whose temperature is to be regulated, a refrigeration unit for said space, means including an internal combustion engine for actuating an element of said unit, a source of fuel under pressure for said engine, means responsive to the pressure of said fuel for controlling the operation of said engine, and means responsive to the temperature of said space for controlling the action of said fuel pressure on said controlling means.

15. In temperature regulating apparatus, in combination, means forming a space whose temperature is to be regulated, a refrigeration unit for said space, means including an internal combustion engine for actuating an element of said unit, a source of fuel under pressure for said engine, means for conducting said fuel to said engine, means responsive to the pressure in said conducting means for controlling the actuation of said engine, and temperature responsive means for controlling the flow of fuel into said conducting means.

16. In temperature regulating apparatus, in combination, means forming a space whose temperature is to be regulated, a refrigeration unit for said space, means including motive means for driving an element of said refrigeration unit, a source of fuel under pressure for said motive means, means for controlling the flow of said fuel to said motive means, temperature responsive means for controlling said last mentioned means, and means for actuating said engine responsive to the pressure of said fuel when first conducted to said motive means.

17. In temperature regulating apparatus, in combination, means forming a medium whose temperature is to be regulated, means including refrigerating means operatively related to said medium, motive means for an element of said refrigeration unit adapted to operate upon the application of current thereto, a dynamo for supplying current to said motive means, an internal combustion engine for driving said dynamo, said dynamo adapted to start said engine upon the application of current thereto, a source of current,

means for controlling the application of said source of current to said dynamo, a source of fuel under pressure for said engine, means for conducting said fuel to said engine, the pressure of said fuel when in said conducting means actuating said controlling means, means responsive to the temperature of said space for regulating the flow of fuel into said conducting means.

18. In temperature regulating apparatus, in combination, means adapted to contain a medium whose temperature is to be governed, an internal combustion engine, dynamo electric means adapted to drive said engine for starting and to be driven thereby, a storage battery adapted to supply current to said dynamo electric means and to be charged thereby, means for supplying gaseous fuel to said engine, means deriving energy from said engine and adapted to affect the temperature of said medium, and means responsive to the temparature of said medium for controlling the flow of fuel to said engine and for connecting said storage battery to said dynamo electric means.

19. In temperature regulating apparatus, in combination, means adapted to contain a medium whose temperature is to be governed, an internal combustion engine, dynamo electric means adapted to drive said engine for starting and to be driven thereby, a storage battery adapted to supply current to said dynamo electric means and to be charged thereby, means for supplying gaseous fuel to said engine, means deriving energy from said engine and adapted to affect the temperature of said medium, means responsive to the temperature of said medium for controlling the flow of fuel to said engine, and means responsive to the flow of fuel to said engine for controlling the connection of said storage battery to said dynamo electric means.

20. In temperature regulating apparatus, in combination, means adapted to contain a medium whose temperature is to be governed, an internal combustion engine, dynamo electric means adapted to drive said engine for starting and to be driven thereby, a storage battery adapted to supply current to said dynamo electric means and to be charged thereby, means for supplying gaseous fuel to said engine, means deriving energy from said engine and adapted to affect the temperature of said medium, means responsive to the temperature of said medium for controlling the flow of fuel to said engine, a two-way switch, current-limiting means, circuit connections adapted when said switch is in one position to interpose said current-limiting means between the storage battery and said dynamo electric means and when said switch is in its other position to remove said current-limiting means, pressure responsive means for moving said switch into one position, and means controlled by said engine for moving said switch into its other position.

21. In temperature regulating apparatus, in combination, means adapted to contain a medium whose temperature is to be governed, an internal combustion engine, dynamo electric means adapted to drive said engine for starting and to be driven thereby, a storage battery adapted to supply current to said dynamo electric means and to be charged thereby, means for supplying gaseous fuel to said engine, means deriving energy from said engine and adapted to affect the temperature of said medium, means responsive to the temperature of said medium for controlling the flow of fuel to said engine, a two-way switch, current-limiting means, circuit connections adapted when said switch is in one position to interpose said current-limiting means between the storage battery and said dynamo electric means and when said switch is in its other position to remove said current-limiting means, means responsive to the actuation of said temperature responsive means for moving said switch into one position, and means functioning after said engine has been started for moving said switch into its other position.

22. In temperature regulating apparatus, in combination, means adapted to contain a medium whose temperature is to be governed, an internal combustion engine, dynamo electric means adapted to drive said engine for starting and to be driven thereby, a storage battery adapted to supply current to said dynamo electric means and to be charged thereby, means for supplying gaseous fuel to said engine, means deriving energy from said engine and adapted to affect the temperature of said medium, means responsive to the temperature of said medium for controlling the flow of fuel to said engine, a two-way switch, current-limiting means, circuit connections adapted when said switch is in one position to interpose said current-limiting means between the storage battery and said dynamo electric means and when said switch is in its other position to remove said current-limiting means, means responsive to the pressure of fuel for moving said switch into one position, and means functioning after said engine has started for moving said switch into its other position.

23. In temperature regulating apparatus, in combination, means adapted to contain a medium whose temperature is to be governed, an internal combustion engine, dynamo electric means adapted to drive said engine for starting and to be driven thereby, a storage battery adapted to supply current to said dynamo electric means and to be charged thereby, means for supplying gaseous fuel to said engine, means deriving energy from said engine and adapted to affect the temperature of said medium, means responsive to the temperature of said medium for controlling the flow of fuel to said engine, a two-way switch, current-limiting means, circuit connections adapted when said switch is in one position to interpose said current-limiting means between the storage battery and said dynamo electric means and when said switch is in its other position to remove said current-limiting means, means responsive to the actuation of said temperature responsive means for moving said switch into one position, and means responsive to the function of the output of said dynamo electric means for moving said switch into its other position.

24. In temperature regulating apparatus, in combination, means adapted to contain a medium whose temperature is to be governed, an internal combustion engine, dynamo electric means adapted to drive said engine for starting and to be driven thereby, a storage battery adapted to supply current to said dynamo electric means and to be charged thereby, means for supplying gaseous fuel to said engine, electric-motor-driven means for affecting the temperature of said medium, and means responsive to the actuation of said temperature responsive means for first connecting said battery to said dynamo electric means to cause the latter to start the engine and then to connect said motor-driven means to said dynamo electric means.

25. In temperature regulating apparatus, in combination, means adapted to contain a medium whose temperature is to be governed, an internal combustion engine, dynamo electric means adapted to drive said engine for starting and to be driven thereby, a storage battery adapted to supply current to said dynamo electric means and to be charged thereby, means for supplying gaseous fuel to said engine, electric-motor-driven means for affecting the temperature of said medium, and means responsive to the pressure of fuel supplied to said engine for first connecting said battery and said dynamo electric means and then connecting the latter to said motor-driven means.

26. In temperature regulating apparatus, in combination, means adapted to contain a medium whose temperature is to be governed, an internal combustion engine, dynamo electric means adapted to drive said engine for starting and to be driven thereby, a storage battery adapted to supply current to said dynamo electric means and to be charged thereby, means for supplying gaseous fuel to said engine, electric-motor-driven means for affecting the temperature of said medium, a resistance, a two-way switch, circuit connections adapted to interpose said resistance between said battery and said dynamo electric means when said switch is in one position and to remove said resistance therefrom when the switch is in another position, means responsive to the actuation of said temperature responsive means for moving said switch into one position, and means responsive to the function of the output of said dynamo electric means for moving said switch into its other position and for connecting said dynamo electric means to said motor-driven means.

27. In temperature regulating apparatus, in combination, means adapted to contain a medium whose temperature is to be governed, an internal combustion engine, electric-motor-driven means for affecting the temperature of said medium, dynamo electric means adapted to drive said engine and to be driven thereby, a source of current, and means responsive to the temperature of said medium for first connecting said source to said dynamo electric means, then to disconnect the two after said engine has started, and then to connect said motor-driven means to said dynamo electric means.

28. In temperature regulating apparatus, in combination, means adapted to contain a medium whose temperature is to be governed, an internal combustion engine, electric-motor-driven means for affecting the temperature of said medium, dynamo electric means adapted to drive said engine and to be driven thereby, a source of current, means responsive to the temperature of said medium for connecting said source to said dynamo electric means, and means responsive to the functioning of said engine for disconnecting said source from and for connecting said motor-driven means to said dynamo electric means.

29. In temperature regulating apparatus, in combination, means adapted to contain a medium whose temperature is to be governed, an internal combustion engine, electric-motor-driven means for affecting the temperature of said medium, dynamo electric means adapted to drive said engine and to be driven thereby, a source of current, means supplying gaseous fuel to said engine, means responsive to the temperature of said medium for controlling the fuel, and means including a means responsive to fuel pressure for controlling the connection between said source and said dynamo electric means and the connection between the latter and said motor-driven means.

30. In temperature regulating apparatus, in combination, means adapted to contain a medium whose temperature is to be governed, an internal combustion engine, electric-motor-driven means for affecting the temperature of said medium, dynamo electric means adapted to drive said engine and to be driven thereby, a source of current, means supplying gaseous fuel to said engine, means responsive to the temperature of said medium for controlling the fuel, switching means adapted to control the connection of said source to said dynamo electric means and its subsequent disconnection and for connecting said motor-driven means to said dynamo electric means, and means including means responsive to fuel pressure for controlling said switching means.

31. In temperature regulating apparatus, in combination, means adapted to contain a medium whose temperature is to be governed, an internal combustion engine, means deriving energy from the latter for affecting the temperature of said medium, a starting motor for said engine, a source of current, means responsive to the temperature of said medium for controlling the flow of fuel to said engine, and means responsive to the flow of fuel to the engine for controlling the connection of said source of current to said motor.

32. In temperature regulating apparatus, in combination, means containing a medium whose temperature is to be regulated, an internal combustion engine, refrigerating means associated with said first-mentioned means and adapted to derive energy from said engine, a source of gaseous fuel under pressure, a conduit connecting said engine with said source of fuel, a valve in said conduit adapted to control the flow of fuel therethrough, and means responsive to the temperature of said medium for controlling the actuation of said valve.

33. In temperature regulating apparatus, in combination, means containing a medium whose temperature is to be regulated, an internal combustion engine, refrigerating means associated with said first-mentioned means and adapted to derive energy from said engine, a source of gaseous fuel under pressure, a conduit connecting said engine with said source of fuel, a valve in said conduit adapted to control the flow of fuel therethrough, a thermostatic device in thermal contact with said medium, and means operatively associated with said thermostatic device for controlling the action of said valve.

34. In temperature regulating apparatus, in combination, a space whose temperature is to be regulated, an internal combustion engine, refrigeration apparatus for affecting the temperature of said space and adapted to derive motive power from said engine, a starting motor for said engine, a source of power for said starting motor, a source of fuel under pressure for said engine, conduit means connecting said source of fuel with said engine, a valve associated with said conduit means and adapted to control the flow of fuel therethrough, and means responsive to the temperature of said space for controlling the operation of said starting motor power and said valve.

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