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APPARATUS FOR HEATING AND COOLING LIQUIDS

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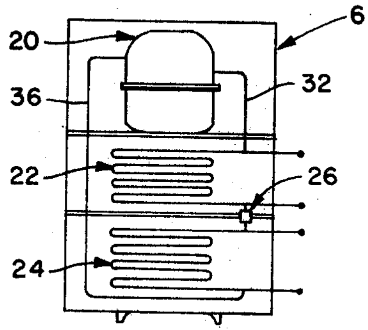

FIG. 1

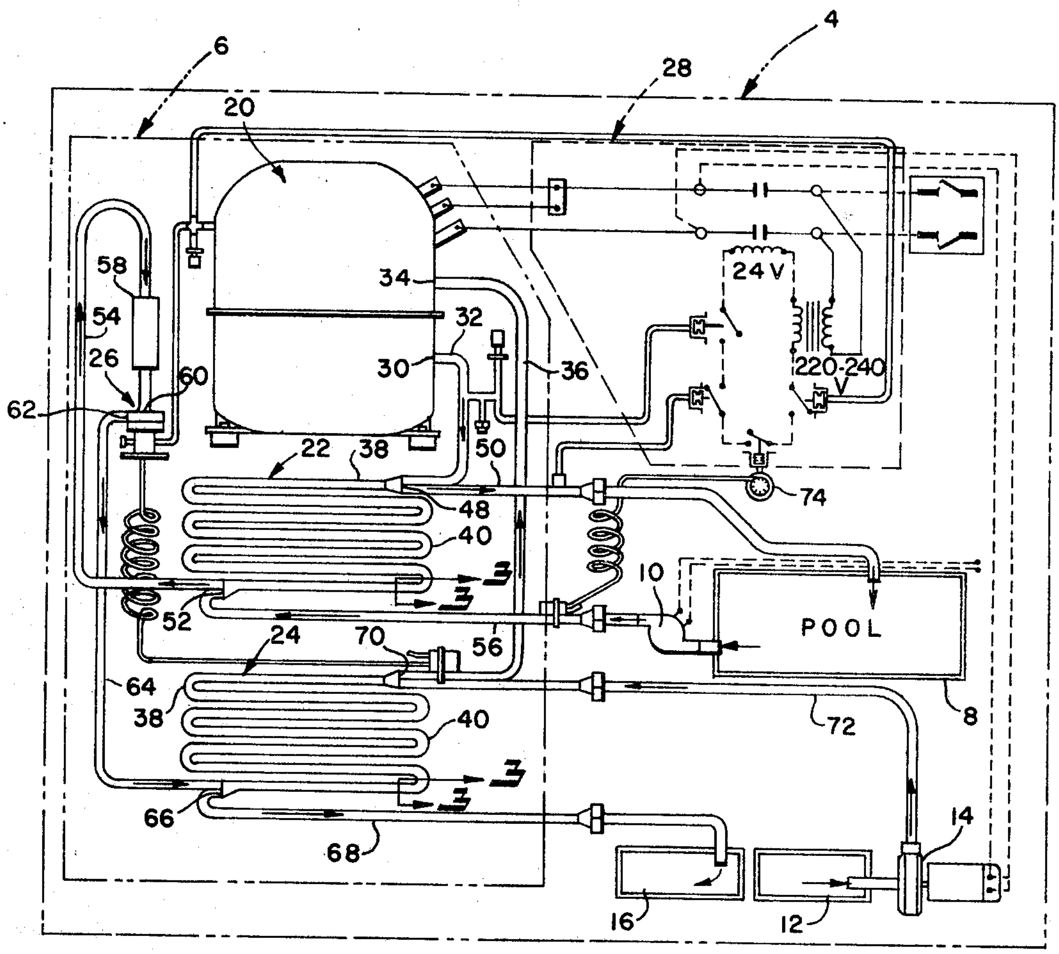

FIG. 2

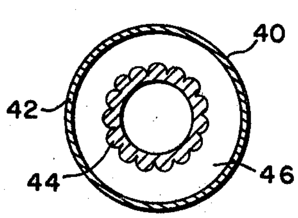

FIG. 3

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APPARATUS FOR HEATING AND COOLING LIQUIDS

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ABSTRACT OF THE DISCLOSURE

This invention contemplates a system for economically heating water in swimming pools and the like which includes the usual components which make up a compression type refrigeration system, i.e., compressor, motor; condenser, expansion valve, and evaporator.

The system of this invention utilizes any suitable refrigerant which is compressed in the compressor and discharged therefrom in a form of vapor under pressure through the condenser into heat, exchanging relation with water from the pool wherein the water is heated and returned to the pool and the hot refrigerant is condensed. This condensed vapor is metered at a controlled rate from the expansion valve into the evaporator where it is vaporized and returned to the compressor for recycling to the condenser.

Sensing means are incorporated in the system for controlling the temperature of the water in the pool by controlling the heat exchange relationship between the water in the pool and the hot gas in the condenser.

Background of invention

Many systems presently employed for heating water of a swimming pool, utilize electric, gas, or oil-fired heating units for warming the water. These systems are usually bulky and expensive to operate. In the case of gas oil oil-fired units, there is the additional problem of disposing of the exhaust gases, which is normally accomplished by providing some type of venting, e.g., chimneys or pre-fabricated stacks, which adds considerable cost to the system. These systems also require a source of fuel supply. Moreover, the heating units operate at high temperatures which tend to create corrosion and depositing of minerals in the tubing used for carrying the water. Then to, the problem of possible explosion, fire, or asphyxiation due to leakage of the fuel or exhaust gases, is always present in such systems. It is the object of this invention to provide a system which reduces or substantially eliminates many of the aforementioned problems.

Briefly, the invention is in a system for raising the temperature of water in a swimming pool to a predetermined heated temperature. The system comprises certain components used in a compression-type refrigeration system such as a compressor, condenser, expansion valve and evaporator. Any suitable refrigerant, e.g. monchlorodifluoromethane is compressed in the compressor, and discharged therefrom as vapor, under pressure, through the condenser into heat exchanging relation with water from the swimming pool. The water is heated and returned to the swimming pool, and the hot refrigerant vapor is condensed. The condensed vapor is metered at a controlled rate from the expansion valve into the evaporator, where it becomes vaporized for return to the compressor and recycling to the condenser. Means are provided for sensing the temperature of water in the pool to control the heat exchanging relationship of the water and hot gas in the condenser. Fluid circulated through the evaporator for vaporizing the condensed gas, is naturally

cooled. It can be appreciated from this brief description that the system can be used to separately heat or cool fluids, or simultaneously heat and cool fluids.

The following description of the invention will be better understood by referring to the annexed drawing, wherein:

FIG. 1 is a sectional view of the apparatus used in the system for heating water from a swimming pool;

FIG. 2 is a schematic drawing of the system for heating water from a swimming pool; and

FIG. 3 is a sectional view of the condenser and evaporator used in said system, said section being taken in the plane indicated by the line 3—3 of FIG. 2.

Referring to the drawing and more particularly to FIG. 2, there is shown a system, generally indicated at **4**, for heating water in a swimming pool. The system **4** comprises an apparatus, generally indicated at **6**, for heating water from the swimming pool designated at **8**. The apparatus **6** will hereinafter for convenience be referred to as a H-C unit, the H and C naturally standing for heating and cooling.

A conventionally designed pump **10** is provided for circulating water from the swimming pool **8**, through the H-C unit **6**, and back to the pool **8**.

A source of fluid, e.g. well **12**, is desirable for operating the H-C unit **6**. A conventionally designed pump **14** is provided for circulating water from the well **12** through the H-C unit **6**. The water is then discharged into a reservoir **16**, or some other system for carrying away said water.

The H-C unit **6** essentially comprises a compressor **26**; a condenser **22** through which heated refrigerant vapor from the compressor **20** and water from the swimming pool **8**, is circulated; an evaporator **24** through which condensed refrigerant vapor from the condenser **22** and water from the well **12**, is circulated; an expansion valve **26** from metering condensed refrigerant gas from the condenser **22** into the evaporator **24** at a controlled rate; and electrically operated controls, generally indicated at **28**, for automatically controlling the operation of the H-C unit **6**, whereby desired temperatures of water in the swimming pool are maintained.

The compressor **20** can be of any suitable design, e.g., a heat pump and air-conditioning compressor manufactured by Tucumseh Products Co. of Ohio. The compressor **20** is provided with an outlet port **30**. A high-pressure line or conduit **32** communicating with the condenser **22**, is connected to the outlet port **30** of the compressor **20**.

The compressor **20** is also provided with an inlet port **34**. A suction line or conduit **36** communicating with the evaporator **24**, is connected to the inlet port **34** of the compressor **20**.

The condenser **22** and the evaporator **24**, are preferably, of similar design, each comprising a coil **38** of coaxial tubing **40**. As seen in FIG. 3, the coaxial tubing **40** comprises an outer tube **42** with a centrally disposed smaller inner, finned tube **44**. Water from the swimming pool **8** and well **12**, are circulated through the inner tube **44** in one direction, while refrigerant is circulated in an opposite direction through the space **46** defined between the outer tube **42** and the inner tube **44**. Both the inner and outer tubes are preferably formed from corrosion resistant metal.

The condenser **22** is provided with an outlet or discharge port **48**. The conduit **32** communicating with the compressor **20** and a pipe **50** leading to the swimming pool **8**, are connected to the discharge port **48** of the condenser **22**. The condenser **22** is also provided with an inlet port **52**. A line or conduit **54** communicating with the expansion valve **26** and a pipe **56** from the swimming pool **8**, are connected to the inlet port **52** of the condenser **22**.

The pump **10** is disposed in the inlet pipe **56** and acts to pump or circulate water from the swimming pool **8**, through the condenser **22**, and back into the swimming pool **8** through the return pipe **50**.

A strainer-receiver **58** is disposed in the conduit **56** adjacent the expansion valve **26**, for holding condensed refrigerant under pressure until it is metered into the evaporator **24**.

The expansion valve **26** can be of any suitable design, e.g., an expansion valve of the pressure type manufactured by Alco Controls Corporation of Missouri. The expansion valve **26** is provided with an inlet port **60** and an outlet or discharge port **62**. The conduit **54** from the condenser **22** and strainer-receiver **58**, is connected to the inlet port **60**. A conduit **64** leading to the evaporator **24**, is connected to the outlet port **62** of the expansion valve **26**.

The evaporator **24**, as previously indicated, similarly comprises a coil **38** of coaxial tubing **40** (FIG. 3). The evaporator **24** is provided with an outlet or discharge port **66**. The conduit **64** from the expansion valve **26**, and a pipe **68** from the reservoir **16**, are connected to the discharge port **66** of the evaporator **24**.

The evaporator **24** is also provided with an inlet port **70**. The suction line or conduit **36** communicating with the compressor **20**, and a pipe **72** leading to the well **12**, are connected to the inlet port **70** of the evaporator **24**.

Operation of the system

For convenience, it will be assumed that water from the swimming pool **8** is circulating through the condenser **22**, and water from the well **12** is circulating through the evaporator **24**. Further, that the water in the swimming pool **8** requires heating, as its temperature is below that desired.

A thermostat **74** is disposed in heat sensing relation to water flowing in the inlet pipe **56** leading from the pool **8**. Since the temperature of the water is below the required temperature, the thermostat **74** coacts with the controls **28** to operate, or turn on the compressor **20**. The compressor **20** compresses and heats refrigerant vapor to temperatures, for example, of about 105° F. The compressor **20** discharges heated refrigerant vapor, at high pressure, into the conduit **32** for circulation through the condenser **22**. The heated refrigerant vapor and water from the swimming pool **8**, are circulated in opposite, segregated, heat exchanging relation through the condenser **22**. The water is heated and returned to the swimming pool **8** through the discharge pipe **50**. Using a 2½ horsepower compressor, for example, water circulated at 12 gallons per minute through the condenser **22**, will have its temperature raised from about 75° F. to about 83.5° F. The refrigerant vapor condenses and moves under high pressure into the strainer-receiver **58** and expansion valve **26**.

The pressure of the refrigerant is maintained at different levels in the condenser **22** and evaporator **24**, of the H-C unit **6**, by the compressor **20** at one point, and the expansion valve **26** at another point. The function of the expansion valve **26** is to allow the refrigerant under high pressure in the strainer-receiver **58**, to pass at a controlled rate into the evaporator **24**, or low-pressured part of the system. Some of the condensed refrigerant vaporizes the instant it passes from the expansion valve **26**, but the greater portion is vaporized in the evaporator **24** at the low pressure, which is maintained by the exhausting action of the compressor **20**. The condensed refrigerant is vaporized within the evaporator **24**, as it is brought into heat exchanging relation with the water from the well **12**. The temperature of the refrigerant leaving the evaporator **24**, for example, is about 55° F. The water from the well **12** circulating through the evaporator **24** at the same rate of about 12 gallons per minute, has its temperature lowered, for example, from about 75° F. to about 68° F. Similar to a compression refrigeration system, the vaporiz-

ing stage is important to keep liquid refrigerant from being sucked or drawn into the compressor **20**.

When water from the swimming pool **8** is at the required temperature, the thermostat **74** coacts with the controls **28** to turn off, or stop operation of the compressor **20**, thereby stopping circulation of heated refrigerant vapor through the condenser **22**. The operation of the well pump **14**, is also shut down to prevent wasting water from the well **12**. The pump **10**, preferably, continues to circulate water from the swimming pool **8** through the condenser **22** and back to the pool **8**. However, the water is not exposed to the hot refrigerant vapor in the condenser **22**, since the compressor **20** is shut down. When the temperature of the water drops below the desired temperature, the operation or cycle is repeated.

Similarly, liquid can be cooled to a desired temperature by placing a similar thermostat **74** in communication with fluid flowing in the pipe **72** leading to the evaporator **24**.

A typical H-C unit **6** used for heating water from a farily large-sized pool required about 124 gallons per minute, measures about 2 ft. by 2 ft. by 2 ft. Because of its small size the unit is naturally easily installed. Further, the unit has relatively few operating parts outside of the hermetically-sealed compressor, which makes it practically maintenance free as compared to other systems presently used.

The electrical controls **28** have not been described in detail, since it employs conventionally designed components for starting and stopping the compressor and well pump in response to reactions of the thermostat to changes in temperature of the water in the swimming pool. Naturally, means are provided for completely shutting down operation of the system **4**, including turning off the pump **10** to discontinue circulation of water through the condenser **22**. Thus, there has been described a unique system for heating water from a swimming pool.

We claim:

1. A system for maintaining water in a swimming pool at a predetermined heated temperature, comprising in combination:

(a) a swimming pool for holding water;

(b) a condenser disposed in communicating relation with the pool;

(c) means for circulating water, under pressure, from the pool, through the condenser and back to the pool;

(d) a source of refrigerant vapor;

(e) a compressor disposed in communicating relation with the condenser and source of refrigerant, for increasing the pressure of the refrigerant vapor, whereby the temperature of the vapor is raised to a predetermined temperature higher than the temperature of water in the pool, the compressor circulating heated refrigerant vapor under pressure, through the condenser;

(f) means for circulating water, from the pool, and heated refrigerant vapor, through the condenser in opposed, segregated, heat exchanging relation, whereby the water is heated and the refrigerant vapor is condensed;

(g) means for maintaining water, from the pool, and heated refrigerant vapor, out of heat exchanging relation in the condenser when water in the pool reaches a predetermined heated temperature;

(h) means for reclaiming condensed refrigerant from th condenser for reuse in the system;

(i) the reclaiming means including means for vaporising condensed refrigerant from the condenser, for return to the compressor and recycling to the condenser;

(j) the vaporizing means including;

(k) a source of fluid at at predetermined temperature higher than the evaporating temperature of condensed refrigerant from the condenser;

(l) an evaporator disposed in communicating relation with the source of fluid, condenser, and compressor;

(m) means for circulating fluid from said source, under pressure through the evaporator;
(n) means for storing, under pressure, condensed refrigerant from the condenser;
(o) means for metering condensed refrigerant from the storage means, at a predetermined controlled rate for circulation through the evaporator at a predetermined lower pressure;
(p) means for circulating fluid and condensed refrigerant through the evaporator in opposed segregated, heat exchanging relation, whereby the fluid is cooled and the condensed refrigerant is vaporized;
(q) the means for circulating water and heated refrigerant through the condenser including coaxial tubing in the condenser, said tubing comprising an outer tube, and a smaller inner tube concentrically disposed within the outer tube and sealed therefrom; and
(r) the means for circulating fluid and refrigerant through the evaporator including coaxial tubing similar to the coaxial tubing in the condenser.

2. A system for maintaining water in a swimming pool at a predetermined heated temperature, comprising in combination;
(a) a swimming pool for holding water;
(b) a condenser disposed in communicating relation with the pool;
(c) means for circulating water, under pressure, from the pool, through the condenser and back to the pool;
(d) a source of refrigerant vapor;
(e) a compressor disposed in communicating relation with the condenser and source of refrigerant, for increasing the pressure of the refrigerant vapor, whereby the temperature of the vapor is raised to a predetermined temperature higher than the temperature of water in the pool, the compressor circulating heated refrigerant vapor under pressure, through the condenser;
(f) means for circulating water, from the pool, and heated refrigerant vapor, through the condenser in opposed, segregated, heat exchanging relation, whereby the water is heated and the refrigerant vapor is condensed;
(g) means for maintaining water, from the pool, and heated refrigerant vapor, out of heat exchanging relation in the condenser when water in the pool reaches a predetermined heated temperature;
(h) the means for maintaining water and refrigerant out of heat exchanging relation in the condenser includes means for stopping circulation of heated refrigerant vapor through the condenser;
(i) the means for stopping circulation of heated refrigerant vapor through the condenser includes means for sensing heat in water of the pool, and means coacting with the heat sensing means for operating the compressor; and
(j) means for circulating water through the condenser which includes means for continuing circulation of water through the condenser when the compressor is not operating and circulating refrigerant through the condenser.

3. A system for maintaining water in a swimming pool at a predetermined heated temperature, comprising in combination:
(a) a swimming pool for holding water;
(b) a condenser disposed in communicating relation with the pool;
(c) means for circulating water, under pressure, from the pool, through the condenser and back to the pool;
(d) a source of refrigerant vapor;
(e) a compressor disposed in communicating relation with the condenser and source of refrigerant, for increasing the pressure of the refrigerant vapor, whereby the temperature of the vapor is raised to a predetermined temperature higher than the temperature of water in the pool, the compressor circulating heated refrigerant vapor under pressure, through the condenser;
(f) means for circulating water, from the pool, and heated refrigerant vapor, through the condenser in opposed, segregated, heat exchanging relation, whereby the water is heated and the refrigerant vapor is condensed;
(g) means for maintainnig water, from the pool, and heated refrigerant vapor, out of heat exchanging relation in the condenser when water in the pool reaches a predetermined heated temperature;
(h) the means for maintaining water and refrigerant out of heat exchanging relation in the condenser includes means for stopping circulation of heated refrigerant vapor through the condenser;
(i) the means for stopping circulation of heated refrigerant vapor through the condenser includes means for sensing heat in water of the pool, and means coacting with the heat sensing means for operating the compressor;
(j) means for circulating water through the condenser which includes means for continuing circulation of water through the condenser when the compressor is not operating and circulating refrigerant through the condenser; and
(k) the refrigerant is monochlorodifluoromethane.

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MEYER PERLIN, Primary Examiner

U.S. Cl. X.R.

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