

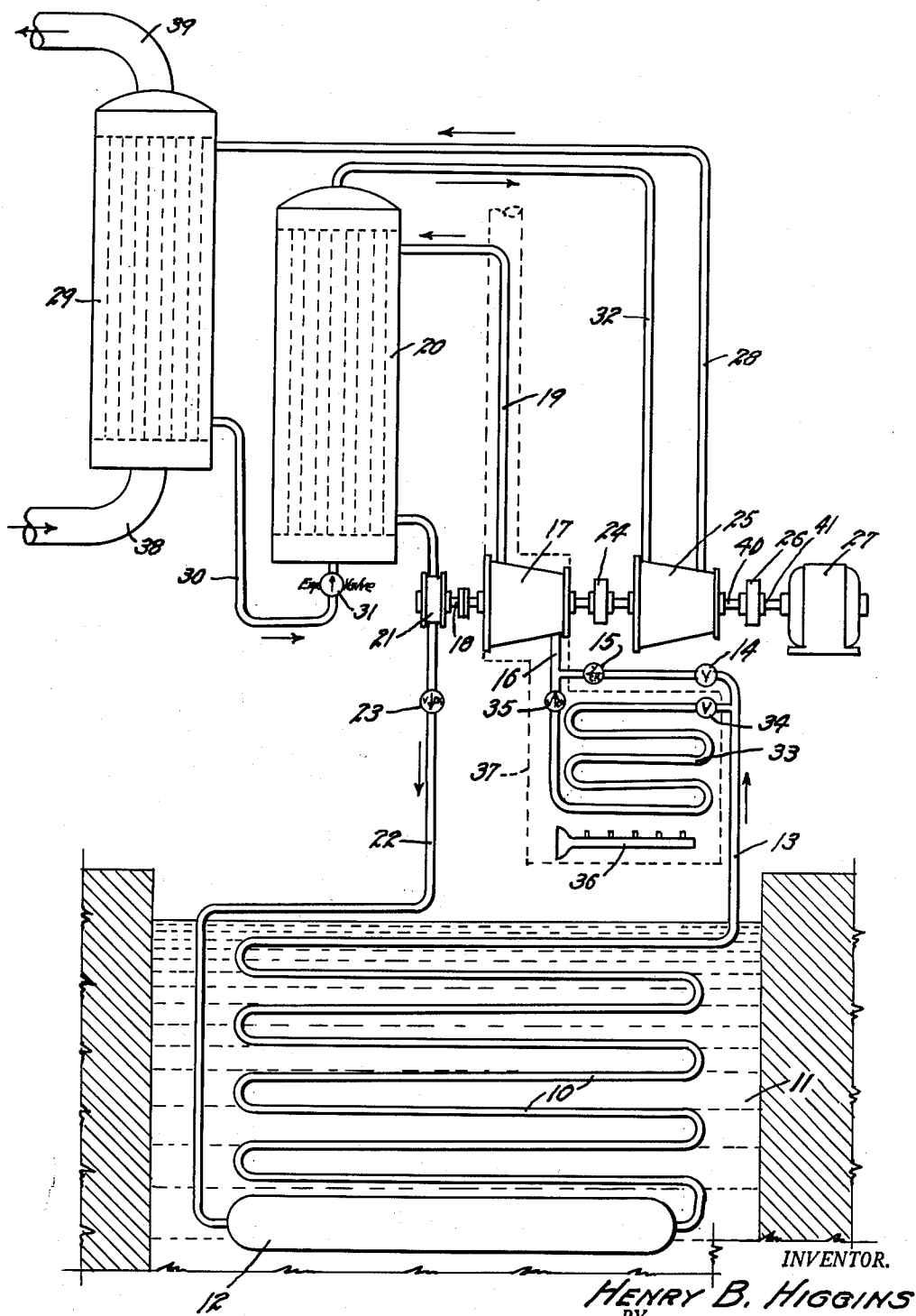
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HEAT CONCENTRATOR

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HEAT CONCENTRATOR

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This invention relates to a system, and means for carrying out the system, whereby heat is caused to flow from a low-temperature region to a region of higher temperature by the application of energy. Such a device is known as a "heat pump," the general purpose of which is to remove heat from a relatively abundant supply where it is either unusable or detrimental, and transfer this heat to a region where it is useful in the first instance or harmless in the second. In the first instance, heat may be thus obtained from a "natural" reservoir such as the earth, a body of water, etc. and transferred at a usable temperature into a space requiring it. In the second instance, heat may be removed from a space to be cooled and transferred to a natural reservoir as mentioned above. This invention contemplates a method and means for accomplishing either of the above functions which can be easily converted at any time from one function to the other.

The principal object of the present invention is to provide a more efficient heat pump than those heretofore known; to provide a heat pump in which the work energy necessary for causing the heat flow will be derived from the natural temperature differentials in the system without the necessity for outside power; and to provide a system of this character to which external supplemental heat may be applied as an accelerator, if desired, and which will deliver heat units far in excess of those applied by the said supplemental heat.

Other objects and advantages reside in the detail construction of the invention, which is designed for simplicity, economy, and efficiency. These will become more apparent from the following description.

In the following detailed description of the invention, reference is had to the accompanying drawing which illustrates in diagram the various elements and the directions of flow in the improved heat pump. The improved heat pump employs two closed refrigerant cycles, containing any suitable low-temperature vaporizing refrigerants such as sulphur dioxide, "Freon" and the like. The first refrigerant cycle includes a conduit or pipe coil 10 which is charged with refrigerant and forms the primary evaporator and superheater of the improved heat pump. The coil 10 is buried in the earth or immersed in any source of natural heat. As illustrated, the coil 10 is immersed in the water, indicated at 11, of a shallow well. A refrigerant reservoir 12 is incorporated in, and is in circuit with, the lowermost portion of the coil 10.

Vaporized refrigerant flows from the coil 10 through a vapor riser 13 controlled by a shut-off valve 14 and communicating, through a non-return check valve 15, with an intake 16 of a vapor-pressure-driven motor 17 arranged to drive a motor shaft 18.

The exhaust vapor from the motor 17 flows through an exhaust pipe 19 to the jacket of a first heat exchanger or condenser 20. The condensed refrigerant from the condenser 20 is drawn off by a condensate pump 21 driven from the shaft 18, and pumped back to the refrigerant reservoir 12, through a refrigerant return pipe 22 con-

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trolled by a second non-return check valve 23, from whence it returns to the evaporator and superheater coil 10. This completes the first refrigerant cycle of the improved system.

The shaft 18 also drives, through the medium of a suitable coupling 24, a compressor shaft 40 of a multi-stage compressor 25, and the compressor shaft 40 is connected, through an over-running clutch 26, with a motor shaft 41 of an electric motor 27. The clutch 26 is so arranged that the compressor shaft 40 can rotate at a higher speed than the motor shaft 41. The second refrigerant cycle employs the compressor 25 to compress the second refrigerant and force the latter under pressure through a pressure pipe 28 into the jacket of a heat exchanger 29. The chilled vapors from the jacket of the heat exchanger are conducted through a discharge pipe 30 to an expansion valve 31, from which they flow through the tubes of the condenser 20 and return to the compressor 25 through a return pipe 32 to complete the second refrigerant cycle.

The description and construction of the condenser 20 and the heat exchanger 29 are simply illustrative of any type of device which will serve to exchange heat from one medium to another without intermingling the mediums.

A by-pass may be provided in the vapor riser 13 through a supplemental heating coil 33 valved from the riser 13 by means of a suitable by-pass valve 34 and discharging to the motor intake 16 through a non-return check valve 35. The coil 33 can be heated from any suitable source of supplemental heat, such as indicated by a gas burner 36.

The compressor 25 is preferably operated adiabatically so as to retain all possible compression heat in the pressure pipe 28. The heat from the supplemental coil 33 may be conserved by means of an enclosing jacket, indicated in broken line at 37, and this jacket may also include the vapor motor 17 and the motor exhaust 19 to return all possible heat to the heat exchanger 29.

The air or other medium to be heated is passed through the heat exchanger 29, as indicated by the intake and exhaust conduits 38 and 39, respectively.

Operation

The operation will be first discussed without application of supplemental heat. Let us assume that the valve 34 is closed and that a proper charge of refrigerant is in the reservoir 12 and in the coil 10. The refrigerant will be vaporized and super-heated by the temperature of the well water 11. The super-heated, vaporized refrigerant will flow under pressure through the vapor riser 13 to the motor intake 16 of the vapor motor 17. At this time the latter is being driven by the electric motor 27, so that the vapor under pressure will flow through the vapor motor 17, and from thence to the condenser 20, where it will liquefy and chill to create a vapor pressure differential between the intake and the exhaust of the vapor motor 17. The condensed refrigerant will be returned by the condensate pump 21 through the check valve 23 to the coil 10.

The compressor 25 is also being operated by the motor 27 to compress the second refrigerant to vaporize and increase the heat content thereof. This compressed, heated refrigerant vapor flows through the heat exchanger 29, where it will lose a portion of its heat to the medium in the conduits 38 and 39, thence through the expansion valve 31, where it will expand and chill the condenser 20. Thus, both refrigerant cycles are in operation.

The differential in pressure at the vapor motor 17 will increase and will eventually reach a point where there is sufficient pressure difference to cause the motor 17 to pick up the load of the condensate pump 21 and

the compressor 25, allowing the motor 27 to be shut off, the shafts 40 and 41 being disconnected through the over-running clutch 26 so that the operation will be independent of outside power.

Vapor from the coil 10 generated and super-heated by the relatively low, temperature-sensible heat from the water 11 continuously flows through the valve 14 and the check valve 15 into the motor 17, where a portion of the heat is converted into work by driving the motor 17 and the pump 21. Another portion is, of course, lost in friction, radiation, etc. Most of the latent heat of vaporization, as well as the superheat is, however, carried to the condenser 20, where it is transferred to the second refrigerant cycle.

The heat thus transferred in the condenser 20 vaporizes the secondary refrigerant and may super-heat it to some degree. This vaporized and super-heated vapor is withdrawn by the compressor 25 and compressed to a relatively high pressure and super-heat by the heat of compression. This compression is adiabatic, and the compressor is preferably insulated to reduce heat loss.

This super-heated, compressed vapor flows through the heat exchanger 29, wherein its contained heat is transferred to the medium circulating through the conduits 38 and 39. The cold condensate is returned by the pump 21 through the check valve 23 to the coil 10 immersed in the relatively warm water 11, where it is again vaporized for a return through its cycle.

Operation of the system without supplemental heat involves relatively small temperature and pressure differentials, hence requires relatively large volumes of gases to convey the quantities of heat required. Furthermore, due to the small differences in temperatures, heat transfer from one phase to the other is relatively sluggish and requires large transfer surfaces, and the small temperature and pressure differentials on the motor 17 may render its operation sluggish and somewhat critical.

To overcome these limitations, it may be found desirable to add heat to the vapor emerging from the primary evaporation and super-heating coil 10 before this vapor is admitted to the motor 17. For such operations the valve 14 is closed and the valve 34 is opened to direct the vapor through the supplemental heating coil 33, where it will be super-heated from an outside source, such as from the burner 36.

Except for the higher temperature thus imparted, making heat transfers throughout the system more effective and operation of the vapor motor 17 more positive, the operation of the system is exactly as above described. The heat added at the supplemental heating coil 33 will, of course, be added to the medium to be heated.

In case it is desired to use this system as a space cooler as well as a heater, suitable connections may be arranged whereby the functions of the condenser 20 and the primary evaporator 10 can be interchanged, thus abstracting heat from the space to be cooled and transferring it to the original source 11, whence it will be dissipated into the earth.

As may be realized from the foregoing description, this heat concentrator will require little or no fuel or extraneous energy for its operation. Equipment employed in it is simple, durable, not highly stressed, and of orthodox types. Thus, installation and maintenance

costs will be relatively low. These features mark it as a major improvement in air conditioning apparatus.

While a specific form of the improvement has been described and illustrated herein, it is to be understood that the same may be varied, within the scope of the appended claims, without departing from the spirit of the invention.

Having thus described the invention, what is claimed and desired secured by Letters Patent is:

1. A heat pump comprising a refrigerant reservoir, an evaporating coil communicating at its one extremity with said reservoir, said reservoir and said evaporating coil being disposed at a source of natural heat, a vapor pressure motor having a drive shaft, a vapor conveying conduit having opposite ends thereof in communication with the other extremity of said coil and said motor, a heat exchanger, a conduit in communication with said motor and said heat exchanger for conveying exhaust vapors from said motor to said heat exchanger, a condensate pump operatively connected to said motor shaft, a condensed vapor conveying conduit in communication with said heat exchanger and said pump, a conduit in communication with said pump and said refrigerant reservoir for discharging condensate from said pump to said reservoir, a compressor operatively connected to said motor shaft, a second heat exchanger, a conduit between said first heat exchanger and said compressor for conveying refrigerant vapor from the former to the latter, a conduit between said second heat exchanger and said compressor for conveying compressed refrigerant from the latter to the former, a conduit in communication with said first heat exchanger and said second heat exchanger for conveying the compressed refrigerant from the latter to the former, and an expansion valve in said last conduit for expanding the compressed refrigerant into the first heat exchanger, and an electric motor having a driven shaft co-axial with said first shaft, an over-running clutch disposed between said first and second shafts for the purpose set forth, means for passing fluid through said second heat exchanger in heat exchanging relation therewith so as to increase the temperature of said fluid.

2. A heat pump according to claim 1, together with supplemental heating means comprising a conduit coil connected at both of its extremities to said first conduit, valving means adapted to selectively cause the vapor in said first conduit to flow either through said conduit coil or to by-pass said conduit coil, as desired, and a gas burner disposed adjacent said coil for heating the latter.

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