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COOLING APPARATUS AND METHOD

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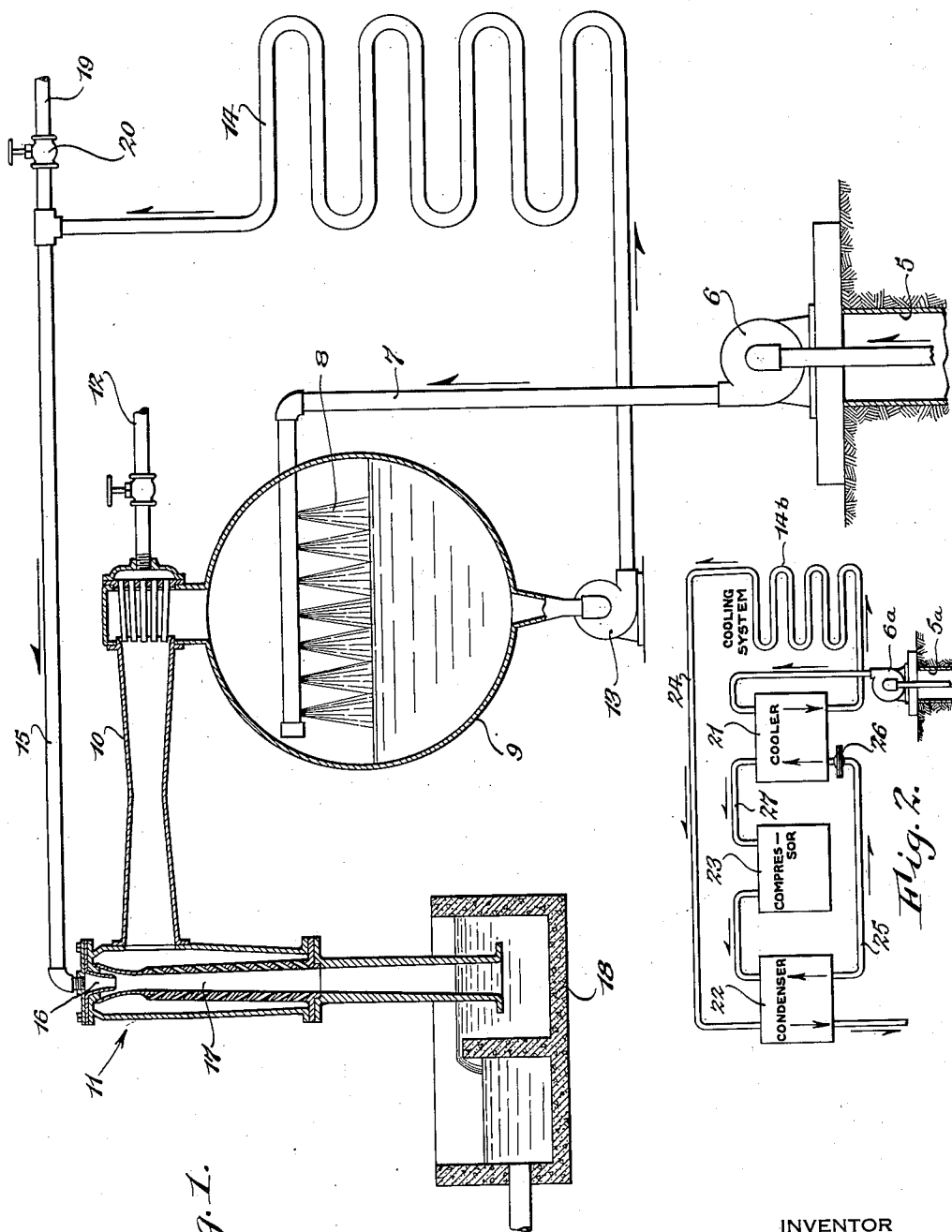


Fig. 1.

Fig. 2.

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COOLING APPARATUS AND METHOD

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13 Claims. (Cl. 62—152)

This invention relates to a cooling apparatus and method of cooling and its principal object is to employ water withdrawn from a natural well fed by subsurface springs to effect a saving both in the cost of operation of the apparatus and in the cost of the equipment.

In accordance with the invention the well water is first cooled by means of a mechanical refrigerating mechanism to a temperature suitable for air conditioning, passed through a cooling system, preferably of the closed coil type, where it is used to cool the air, and the spent water is employed in the condenser of the mechanical refrigerating mechanism. Since it is unnecessary to pass the entire quantity of spent water through the condenser of the mechanical refrigerating mechanism a substantial amount of this water is available and can be withdrawn for other uses. While any form of mechanical refrigerating means can be used it is preferable to employ steam jet refrigeration, since this type is very economical, especially in cooling large quantities of water a relatively small degree, and also requires large amounts of condenser water to obtain economy in steam consumption, there being, in the system outlined, an excess of condenser water for this purpose.

The primary object of the invention is to take well water or the like, cool it to the required temperature and then usefully heat it a greater number of degrees than it was cooled so that the well water itself is used in direct cooling. The secondary object is to use the spent but still cool well water as the condensing medium for the mechanical refrigerating means, thereby effecting a further economy, the spent water being in motion and very much cooler than tower cooled or summer lake water.

In the accompanying drawing:

Fig. 1 is a schematic representation of one form of my invention in which a steam jet refrigerator is employed to cool the well water.

Fig. 2 is a diagrammatic representation of a similar system in which a refrigerator of the compressor-condenser-expander type is employed.

50° F. well water is rather prevalent in large quantities in the North Atlantic and Central States but is not cool enough by about 5° to properly dehumidify 75° air to a dewpoint of 55°, a condition necessary in an air conditioning system to obtain the desired conditioning of air under all external conditions usually encountered. In accordance with the form of the invention shown in Fig. 1, the well water at

the assumed temperature of 50° is withdrawn from a well 5 by means of a pump 6 and is discharged through a line 7 in the form of sprays 8 into a spray evaporator chamber 9. A vacuum or sub-atmospheric pressure is maintained in the spray evaporator chamber 9 by means of a steam jet ejector 10 which forms part of a steam jet condenser indicated generally at 11. This steam jet condenser can be of any usual and well known construction and preferably operates from two pounds exhaust steam supplied through a steam line 12.

The vapor evaporated from the sprays 8 is, of course, ejected by means of the steam ejector and this evaporation cools the spray water collecting in the bottom of the spray evaporator chamber to the desired operating temperature of, say 45°. This spray water is withdrawn by means of a pump 13 and is passed through a cooling system which preferably comprises a series of coils 14, the air to be conditioned being, of course, drawn over these coils. The coils 14 are shown diagrammatically but are preferably of the form shown in my co-pending applications for cooling and ventilating systems, Ser. No. 666,152, filed April 14, 1933 and Ser. No. 683,783, filed August 5, 1933 and provided with similar controlling means.

After passing through the coils 14 the spent cooling water is ideal for condensing the steam and vapors discharged by the steam jet. For this purpose the outlet of the coils 14 is connected by a line 15 with the jet 16 of the steam jet condenser, this jet discharging into a venturi 17 into which the steam and vapor is drawn and cooled and condensed by the water. The water, condensed steam and vapor, and other entrained or non-condensable gases are discharged into the usual hot well 18.

The cooling of well water and its subsequent use as condensing or cooling water in a mechanical refrigeration system is particularly applicable to steam jet refrigeration as described for the reason that steam jet refrigerating systems take more condensing water than other types because the condensing water condenses not only the vapor given off by the sprays in the vacuum cooler but also condenses the steam used in the steam ejector. This steam must be condensed at a relatively low temperature well under 100° F., preferably 70° to 80°, the lower the better because a lower temperature of condensation reduces the differential pressure against which the steam jet has to work. As this differential increases more steam is required

to operate the system and consequently more water is required to condense the steam, so that these factors always work against one another when the condenser water cannot be supplied in adequate quantities and at a low temperature. Since the well water is at 50°, only a small amount of refrigeration is required to cool it to the full or 45° temperature and after this water has done its work in cooling and its temperature is raised to 55° it is ideal for condensing purposes with a steam jet condenser and reduces the steam used in the steam ejector, thus requiring less condensing water.

A substantial amount of the spent cooling water is not required in the steam jet condenser and this can be withdrawn through a line 19 having a valve 20, this valve being regulated so as to prevent the withdrawal of the spent cooling water in excess of that required for the efficient operation of the steam jet condenser. The water withdrawn through the line 19 is, of course, available for any purpose.

As an example of the savings in refrigeration effected by the present invention the following calculations of a job figured are offered showing the relative operating requirements and equipment costs of a closed circuit steam jet refrigerating system, and of a system embodying my invention, where well water at 50° is available for both. It is assumed in both that the equivalent of 500 tons of ice per day is to be supplied with a cooling coil system supplied with 1,200 gallons per minute of cooling water.

With the cooling furnished by 1,200 gallons per minute of cooling water recirculated and all refrigerated 50° to 40° or 55° to 45° by a spray evaporator system the system would require 16,000 pounds per hour of exhaust steam under 2 pounds pressure and the amount of 50° well water necessary to condense the steam and vapor in the jet condenser would amount to 2,000 gallons per minute. The cost of the equipment was calculated at \$25,000.00.

Operating according to the present invention would require but 250 tons of refrigeration since the well water is merely cooled 5° as compared with the 10° required in a closed or recirculating water system and hence the amount of exhaust steam, under 2 pounds pressure, would be only 6,000 pounds per hour and the 1,200 gallons per minute of spent water from the cooling system would be more than adequate for condensing the steam and vapor. The cost of the plant was calculated at \$12,000.00.

It is therefore apparent that the present invention, as compared with a closed system steam jet cooling plant, requires but 37½% as much steam, requires 60% as much well water (assuming well water to be used for condensing in both cases) and costs 48% as much to install.

It is apparent that the invention can also be applied to an ammonia system of the compressor-condenser-expander type to cool the well water the necessary 5° and then using the spent well water for condensing, although the invention is peculiarly applicable to steam jet evaporator systems for the reasons set forth. An ammonia system is shown diagrammatically in Fig. 2 in which the numeral 5a represents the well from which water is pumped by the pump 6a and delivered through the cooler 21 to the cooling system comprising a coil 14b, as in the preferred construction. From the cooling coil the spent water passes through a condenser 22 from which it is discharged, this condenser con-

densing the ammonia delivered from a compressor 23 through a line 24. The condensed ammonia passes from the condenser through line 25 and through an expansion valve 26 into the cooler 21 where it cools the well water and from which it is withdrawn through line 27 into the compressor. It is apparent that by this system the well water is first cooled to the necessary extent and after being spent in air conditioning work is used to condense the refrigerating medium.

From the foregoing it is apparent that the present invention provides a very simple and inexpensive apparatus for utilizing well water to the best advantage in air conditioning work although it is, of course, understood that the invention can also be practiced in fields other than air conditioning and the invention is therefore not to be construed as being limited to any particular field or to any particular mechanism except as set forth in the following claims.

I claim as my invention:

1. A cooling apparatus employing relatively cool water withdrawn from a natural well fed by subsurface spring water, comprising mechanical refrigerating means, means for withdrawing said natural well water, means for cooling said water in said refrigerating means, means for conducting said cooled water through a cooling system wherein it usefully absorbs heat and means for absorbing the heat generated by said refrigerating means through the spent water from said cooling system.

2. A cooling apparatus employing relatively cool water withdrawn from a natural well fed by subsurface spring water, comprising mechanical refrigerating means, means for withdrawing said natural well water, means for cooling said water in said refrigerating means, means for conducting said cooled water through a cooling system and usefully warming said water to a temperature above its original temperature and means for absorbing the heat generated by said refrigerating means through the spent water from said cooling system.

3. A cooling apparatus employing relatively cool water withdrawn from a natural well fed by subsurface spring water, comprising mechanical refrigerating means of the fluid expansion and contraction type, means for withdrawing said natural well water, means for cooling said water in said refrigerating means through heat absorbed in the expansion of said fluid, means for conducting said cooled water through a cooling system wherein it usefully absorbs heat and means for absorbing the heat generated in said contraction of said fluid through the spent water from said cooling system.

4. A cooling apparatus employing relatively cool water withdrawn from a natural well fed by subsurface spring water, comprising mechanical refrigerating means including means for expanding a liquid medium into a gas and means for condensing the gas into a liquid, means for withdrawing said natural well water, means for cooling said water in said expanding means through heat absorbed in the expansion of said liquid, means for conducting the cooled water through a cooling system wherein it usefully absorbs heat, and means for conducting the spent water from said cooling system through said condensing means to condense said gas.

5. A cooling system employing relatively cool water withdrawn from a natural well fed by subsurface spring water, comprising a spray

evaporator chamber, a steam jet condenser for maintaining a sub-atmospheric pressure in said spray evaporator chamber, means for withdrawing said natural well water, means for spraying
 5 said water into said spray evaporator chamber, means for withdrawing the cooled spray water from said evaporator chamber and for conducting it through a cooling system wherein it usefully absorbs heat and means for conducting the
 10 spent water from said cooling system to said steam jet condenser to condense the steam and vapors given off by the sprays.

6. A cooling system employing relatively cool water withdrawn from a natural well fed by subsurface spring water, comprising a spray
 15 evaporator chamber, a steam jet condenser for maintaining a sub-atmospheric pressure in said spray evaporator chamber, means for withdrawing said natural well water, means for spraying said water into said spray evaporator
 20 chamber, means for withdrawing the cooled spray water from said evaporator chamber and for conducting it through a cooling system wherein it usefully absorbs heat and is warmed to a temperature above its original tempera-
 25 ture, and means for conducting the spent water from said cooling system to said steam jet condenser to condense the steam and vapors given off by the sprays.

7. A cooling system employing relatively cool water withdrawn from a natural well fed by subsurface spring water, comprising mechanical refrigerating means of the compressor-condenser-expander type, means for withdrawing
 30 said natural well water, means for cooling said water through heat absorbed through the expansion in said expander, means for conducting the cooled water through a cooling system wherein it usefully absorbs heat, and means for
 35 conducting the spent water from said cooling system through said condenser.

8. A cooling apparatus employing relatively cool water withdrawn from a natural well fed by subsurface spring water, comprising mechanical refrigerating means, means for withdrawing
 45 said natural well water, means for cooling said water in said refrigerating means, means for conducting said cooled water through a closed coil cooling system wherein it usefully
 50 absorbs heat and means for absorbing the heat generated by said refrigerating means through the spent water from said cooling system.

9. A cooling system employing relatively cool water withdrawn from a natural well fed by subsurface spring water, comprising a spray
 55 evaporator chamber, a steam jet condenser for maintaining sub-atmospheric pressure in said spray evaporator chamber, means for withdraw-

ing said natural well water, means for spraying said water into said spray evaporator chamber, means for withdrawing the cooled spray water from said evaporator chamber and for conducting it through a closed coil cooling system
 5 wherein it usefully absorbs heat, and means for conducting the spent water from said cooling system to said steam jet condenser to condense the steam and vapors given off by the sprays.

10. A cooling system employing relatively cool water withdrawn from a natural well fed by subsurface spring water, comprising mechanical refrigerating means of the compressor-condenser-expander type, means for withdrawing
 15 said natural well water, means for cooling said water through heat absorbed through the expansion in said expander, means for conducting the cooled water through a closed coil cooling system wherein it usefully absorbs heat, and
 20 means for conducting the spent water from said cooling system through said condenser.

11. A cooling apparatus employing relatively cool water from a natural well fed by subsurface springs, comprising mechanical refrigerating means, means for withdrawing said natural
 25 well water, means for cooling said water in said refrigerating means, means for conducting said cooled water through a cooling system wherein it usefully absorbs heat, means for absorbing the heat generated by said refrigerating means
 30 through the spent water from said cooling system, and means for withdrawing an amount of said spent water not exceeding that required for absorbing said generated heat.

12. The method of cooling which consists in withdrawing water from a natural well fed by subsurface springs, artificially cooling said well
 35 water, usefully heating said cooled water a greater number of degrees than it was cooled by said artificial cooling means, and using said warmed water to absorb the heat generated by
 40 said artificial cooling means.

13. A cooling apparatus employing relatively cool water withdrawn from a natural well fed by subsurface spring water, comprising mechanical refrigerating means, means for withdrawing
 45 said natural well water, means for cooling said water in said refrigerating means, means for conducting said cooled water through a cooling system wherein it usefully absorbs heat, means for absorbing the heat generated by said
 50 refrigerating means through the spent water from said cooling system, and means for withdrawing an amount of water from the apparatus not exceeding that required for absorbing the
 55 generated heat.

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