

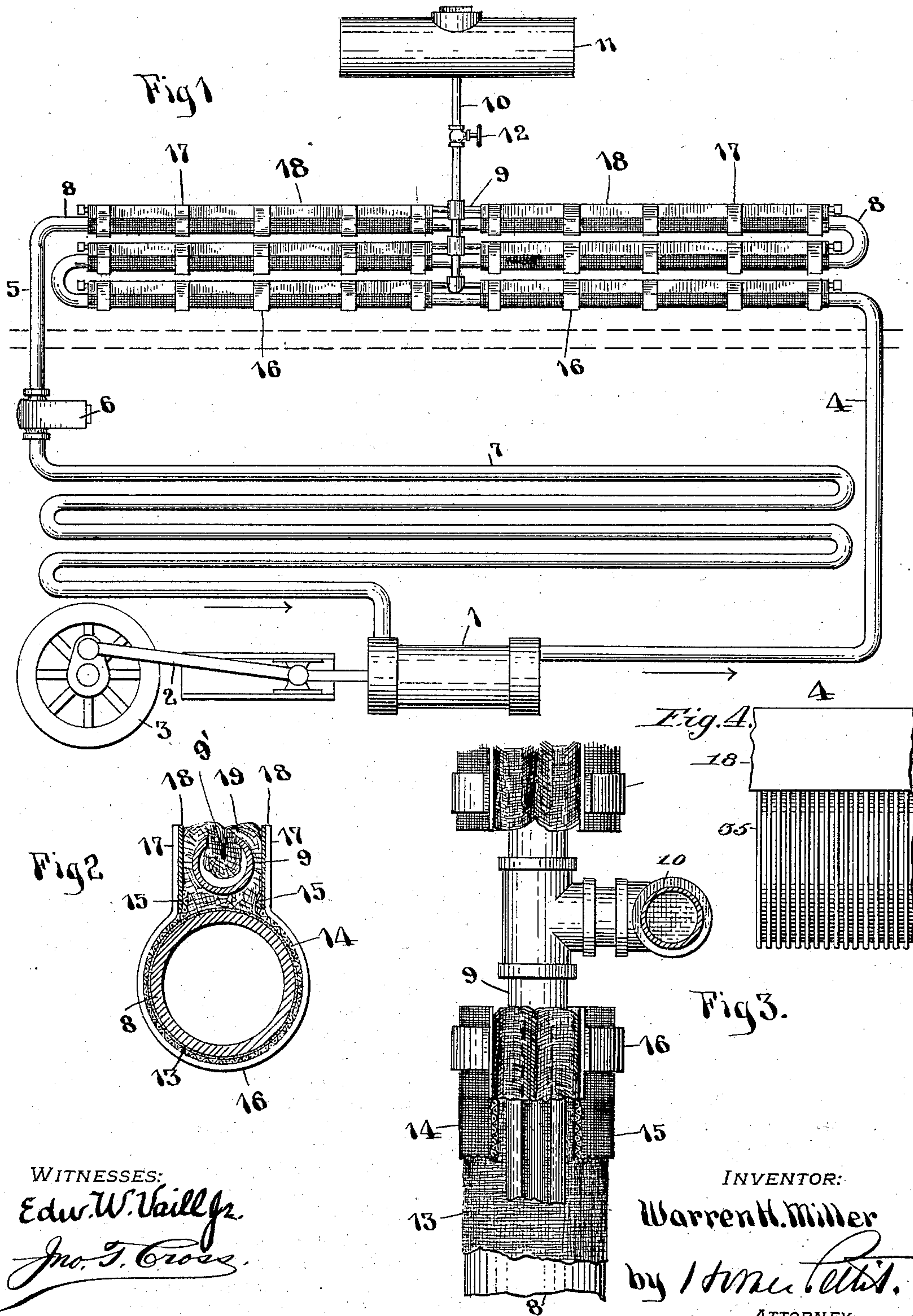
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W. H. MILLER.  
EVAPORATIVE COOLER OR CONDENSER.

APPLICATION FILED NOV. 19, 1902.

NO MODEL.



WITNESSES:

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# UNITED STATES PATENT OFFICE.

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## EVAPORATIVE COOLER OR CONDENSER.

SPECIFICATION forming part of Letters Patent No. 748,296, dated December 29, 1903.

Application filed November 19, 1902. Serial No. 131,969. (No model.)

*To all whom it may concern:*

Be it known that I, WARREN H. MILLER, a citizen of the United States, and a resident of the city of New York, State of New York, have  
5 invented certain new and useful Improvements in Evaporative Coolers or Condensers, of which the following is a full, clear, and complete disclosure.

My invention consists in providing any apparatus in which a cooling or condensing action is required with means for cooling the gases or other fluids used therein by means of the evaporation of water or any other suitable liquid having a comparatively low point  
15 of evaporation, whereby the latent heat of evaporation of the evaporative liquid is subtracted from the fluid to be cooled or condensed without any demand upon the cooling effect required of the apparatus itself.

My invention consists especially in providing means whereby a constant supply of the evaporating fluid is maintained in contact with the pipes to be cooled, completely enveloping the same, and is brought about  
25 through the medium of absorbent or capillary action which conveys the cooling liquid from the source of supply.

My invention also consists in providing means for the even and reliable distribution  
30 of the evaporative liquid to the ducts carrying the fluid to be cooled without regard to the different motions and positions of the apparatus as a whole.

For a full, clear, and exact description of  
35 my invention reference may be had to the following specification and to the accompanying drawings, forming a part thereof, in which—

Figure 1 is an elevation of a complete refrigerating system showing my improved condenser in use in connection therewith. Fig.  
40 2 is a sectional view of one portion of the condenser. Fig. 3 is a plan view of the condenser, showing the ends of two adjacent evaporating-sections and a pipe-joint for supplying evaporating fluid thereto; and Fig. 4 is an elevation of an exterior portion only of another form.

I shall first proceed to describe the preferred form of my invention.

50 In the drawings the numeral 1 indicates a compression-pump of any well-known construction which is operated in any usual

manner, such as by a crank and pulley connection 2 and 3.

4 indicates a pipe which leads from the  
55 compression-pump to the condenser 8.

5 is a pipe leading to the automatic expansion-valve 6, which regulates the supply of the refrigerating fluid to the pipes 7 within the refrigerator-chamber of the system. 60

Any suitable refrigerating fluid may be employed, such as anhydrous ammonia, carbon dioxide, &c.

The condenser proper comprises the ducts or pipes 8, which are arranged, preferably,  
65 parallel to one another and in the same vertical plane or where a number of sections of the condenser are used in several parallel vertical planes. Slightly above the parallel portions of these pipes are arranged the tanks  
70 or troughs 9. These tanks or troughs 9 may consist of pipes of sufficient size to convey the amount of fluid desired and have longitudinal openings or slots 9' in their upper portions or may consist merely of angular  
75 channels. These slots preferably do not extend entirely to the ends of the tube-section, but stop short of the same within the evaporator portion of the condenser. The water or other evaporative fluid is adapted to be  
80 supplied to these tanks in any suitable manner; but I have preferably shown said tanks divided into two sections and the water supplied at the inner or adjacent ends of said sections from a vertical feed-pipe 10, which  
85 is connected with the supply-reservoir 11. A valve 12 is provided in the feed-pipe 10 for regulating the supply of the evaporative fluid. The troughs or tanks 9 are maintained in position adjacent to the pipes 8 to be cooled in  
90 a manner hereinafter to be described.

As shown in Fig. 1 of the drawings, the reservoir is located a sufficient distance above the highest trough or tank to deliver liquid thereto under pressure. By thus delivering  
95 the liquid under pressure any uneven, intermittent, or unreliable supply of the liquid due to inclination or motion of the tanks is obviated; otherwise the pressure corresponding to the mere depth of the liquid in the  
100 tanks alone would not be sufficient to keep the latter continuously full at all points under variable conditions of position and motion.

The portion of the condenser which pro-



vides for the even distribution of the evaporative fluid over the condenser-pipes by means of capillary action is described as follows: The surfaces of the pipes 9 may be covered with  
 5 one or more thicknesses of a linen fabric known as "dimity," which being of very fine mesh or weave is adapted to very efficiently transmit or carry the evaporative fluid. I prefer to use one thickness of dimity, as I  
 10 find the same entirely sufficient for the required result, and even when no fabric is used the capillary action of the metallic covering to be described below is sufficient to maintain an even distribution of the fluid  
 15 over the surface of the pipe when said covering has once been moistened and its capillary action started. The dimity is preferably attached to a pipe by being sewed or stitched about the same in the form of a snugly and  
 20 evenly fitting tube, as indicated at 13. Over this covering of dimity is placed a similar covering of metallic filaments either in the form of a continuous winding of wire or of wire-gauze, either of which having very fine  
 25 interstices is also capable of very efficient capillary action. This latter covering does not completely inclose the condenser-pipe, but extends only to within a short distance of the highest point of the upper side thereof,  
 30 as indicated at 14 in Figs. 2 and 3. The wire-gauze then extends upwardly in parallel narrow strips 15.

It will be noticed that the capillary action of the dimity is due not only to the interstices formed by the fine mesh, but that the  
 35 fibers forming the threads thereof are cellular in structure and of themselves absorb the liquid, transmitting it from cell to cell throughout all portions of a single thread.  
 40 The capillary action of the metallic filaments is due only to the interstices between the same, and for this reason the surfaces thereof must be first moistened in order to set up or start the capillary action. It will therefore  
 45 be seen that the function of the dimity is to start a capillary action about the metallic filaments; but this may also be accomplished when the dimity is omitted by moistening said filaments by hand when the machine is  
 50 being started. It is also obvious that the covering of dimity or similar fabric may be used without the covering of metallic filaments; but this form is more liable to deterioration, although the evaporative action of the dimity is also very high. In some forms  
 55 pottery or similar porous material may be used instead of the coverings above described.

To further aid in the saturation of the coverings and distribution of the evaporating  
 60 liquid, either of the coverings may be impregnated with any deliquescent material, such as calcium chlorid or sulfuric acid, or any material having a chemical affinity for water. Such material not only aids in the  
 65 distribution of the evaporative liquid by the primary absorption of water from the air,

but keeps any portion of the evaporative surface moist in spite of any defect of the action of the capillary material. The deliquescent absorbent material may of itself  
 70 serve as an evaporative envelop without the use of a capillary or other absorbent covering, and from the fact that the surface of the duct is kept continually moist by reason of such material the distribution of the evap-  
 75 orative liquid over the surface will be constant and even. This chemical absorption acts, in connection with the surface of the duct or pipe, in a manner quite similar to the cellular absorption of a fabric covering, with  
 80 the additional feature that the initial moisture is subtracted from the adjacent surrounding air.

About the wire-gauze covering 14 are placed a plurality of horseshoe-shaped springs 16.  
 85 These springs extend about the pipes to an extent slightly less than that of the wire-gauze and the ends thereof extend upwardly, forming short plates or supports 17. To these  
 90 plates or supports are soldered or otherwise attached parallel strips 18, which extend the whole length of one section of the condenser. These strips, together with the upper surface of the condenser-pipe, practically inclose the  
 95 tank or trough 9, except on its upper side, which is left open so as to allow the drip from the next condenser above to be caught therein.

The space between the tank or trough 9, the strips 18, and the dimity-covered pipe 8 is filled with an absorbent or porous material,  
 100 such as absorbent cotton or a material called "linen mesh." This linen mesh also extends above the tank 9 and fills the slot in the upper side thereof, so as to be in contact with  
 105 the water or other fluid contained therein and to produce a hindrance or regulator to the passage of the evaporative fluid, so that the pressure which is required to maintain said tanks full under variable conditions will  
 110 not cause the liquid to be supplied to the evaporative covering too rapidly; but the latter will seep through the hindering porous material in even quantities through the entire length of the tanks 9 regardless of the  
 115 differences in motion and level of the same. Preferably the linen mesh does not completely fill said tube; but space is left for a liquid to pass through the same without being hindered by the said material, although  
 120 this is not essential to the operativeness. By means of a calking-hammer or other device the linen mesh is packed tightly into the opening of the trough and is thereby given a considerably greater density, which it retains,  
 125 owing to the gripping or compressing action of the edges of the outlet.

It will be seen that the tanks 9 for the evaporating fluid are held in position relative to the condenser-pipes 8 solely by the springs  
 130 16 and their connected strips 18. Said springs also hold the coverings closely about the condenser-pipes 8 and retain the linen mesh or



absorbent material in position about the tanks or troughs 9, so that the lower portion thereof contacts with the dimity and the wire-gauze.

A modified form of my condenser, which is in all substantial respects like that shown in Fig. 2, with the exception that the dimity covering has been omitted, may be used. This form of the condenser will usually have to be started by moistening the surface thereof before the capillary action will commence and depends for its action on the capillary action of the interstices of the gauze when filled with the evaporative liquid.

Fig. 4 shows an elevation of a section of the condenser, which is in all substantial respects similar to that illustrated in Figs. 1, 2, and 3, but which instead of having an outer covering of wire-gauze is provided with convolutions of fine wire, which are wound continuously about the condenser-pipe, so as to leave small spaces or interstices between consecutive convolutions thereof, which have a capillary action similar to those of the wire-gauze. This form may also be constructed with or without the inner covering of dimity or similar fabric.

The operation of the refrigerating system having my improved condenser in connection therewith is as follows: The refrigerating fluid is compressed in the pump 1, flows through the pipe 4 to the condenser-pipes 8. It is there relieved of the heat of compression and continues through the pipe 5 to the automatic expansion-valve 6. Here the pressure of the cooled gas is relieved, and the same expands into the pipe 7 of the refrigerating-chamber, after which it is again acted upon by the pump and compressed and then repeats the same cycle of changes. Since the water or other evaporative fluid flows through the pipe 10 or similar supply-pipe into the tanks or troughs 9, the linen mesh 19 or other capillary material is kept continuously saturated with the same, and when said material is in contact with the dimity covering 13 and the wire-gauze or metallic fibers 14 the liquid is very quickly distributed, so that it covers evenly the entire surface of all the condenser-pipes without any preliminary moistening. By this means a large surface for evaporation is exposed to the air, and the rate of the evaporative action is therefore very high. Evaporation may also be further increased by the use of suitable means, such as blowers, for creating a draft of air through and around the sections of the condenser, or if said condenser is located upon the outside of a moving vehicle, such as a refrigerator-car, to which my invention is especially adapted, evaporation will be also greatly increased. When used in connection with a refrigerator-car, my condenser is located upon the outside of the same, so that the air through which the car is rapidly moving when traveling may have

easy access to all parts of the surface of the evaporative covering.

Although my improved condenser is particularly adapted for use with refrigerating-machines, yet the same is of great utility and efficiency when used as a condenser with steam-engines, as a cooler for gas or oil engines, and in all places where an excess of heat is desired to be carried away.

I do not wish to be limited to the exact arrangement and position of parts herein set forth, for the same may be varied in many ways—such as, for instance, that of having the outlet of the tank in the bottom thereof rather than in the top, as suggested in Fig. 6—and the tanks need not be necessarily located in the position shown in regard to the pipes to be cooled.

Other changes in mechanical details may be made without departing from the spirit and scope of my invention; but

What I claim, and desire to protect by Letters Patent of the United States, is—

1. A cooler or condenser comprising in combination, ducts for conveying the fluid to be cooled, an envelop of absorbent material covering said ducts, secondary ducts having an opening or openings along the lengths thereof and located adjacent to said first-named ducts, means for supplying an evaporative liquid under pressure to the secondary ducts, and absorbent material entering and tightly filling said openings so as to be held firmly therein adapted to convey the confined evaporative liquid from said secondary ducts to said first-named ducts.

2. A cooler or condenser comprising in combination, pipes for conveying the fluid to be cooled, an envelop of absorbent filaments covering said pipes, tubes having an opening or openings along the lengths thereof and located above said pipes, means for supplying an evaporative liquid under pressure to said tubes and an absorbent material entering and tightly filling said openings so as to be held firmly therein and adapted to convey the confined evaporative liquid to said absorbent filaments.

3. A cooler or condenser comprising in combination, pipes for conveying the fluid to be cooled, an envelop of absorbent filaments covering said pipes, elongated tanks having an opening or openings along the lengths thereof located above said pipes and an absorbent material entering and tightly filling said openings and adapted to connect said troughs and filaments and means for supplying an evaporative liquid under pressure to said troughs.

4. A cooler or condenser comprising in combination, pipes for conveying the liquid to be cooled, an envelop of absorbent fabric covering said pipes, a secondary covering of absorbent or capillary material over said fabric, troughs located above said pipes, absorbent



or capillary material entering and tightly filling the upper portions of said troughs and adapted to connect said troughs and said coverings, and means for supplying an evaporative liquid under pressure to said troughs.

5 5. A cooler or condenser comprising in combination pipes for conveying the fluid to be cooled, envelops of metallic filaments covering said pipes, the interstices of said filaments having capillary action, troughs located above said pipes, absorbent or capillary material entering and tightly filling the upper portions of said troughs and adapted to connect said troughs and said metallic filaments and means for supplying an evaporative liquid under pressure to said troughs.

6. A cooler or condenser comprising in combination, pipes for conveying the fluid to be cooled, an envelop of dimity covering said pipes, a secondary envelop of wire-gauze over said dimity, troughs located above said pipes, absorbent or capillary material entering and tightly filling the outlets of said troughs and adapted to connect said troughs and said covering and means for supplying an evaporative liquid under pressure to said troughs.

7. A cooler or condenser comprising in combination a plurality of sections of pipe located one above the other for conveying the fluid to be cooled, absorbent envelops covering said pipe-sections, ducts located above said sections having openings in their upper portions, absorbent material filling said openings and connecting said ducts with said envelops, coverings for said material open at their upper portions to receive the drip from the adjacent pipe-envelops and means for supplying an evaporative liquid to said ducts.

8. A cooler or condenser comprising in combination, pipes for conveying the fluid to be cooled, an envelop of absorbent fabric covering said pipes, troughs located above said pipes, absorbent material connecting said troughs and said envelop, means for supplying an evaporative liquid to said trough and a covering and supporting means to prevent evaporation from the greater portion of said

last-named absorbent material, to hold the same in position and to allow the drip from adjacent pipe to be retained.

9. A cooler or condenser comprising in combination, pipes for conveying the fluid to be cooled, an envelop of dimity covering said pipes, a secondary envelop of wire-gauze partially covering said dimity, troughs located above said pipes, parallel strips adjacent said troughs and resting upon said pipes, means for retaining said strips and coverings in position, absorbent or capillary material connecting said troughs and said coverings and means for supplying an evaporative liquid to said troughs.

10. A cooler or condenser comprising in combination, pipes for conveying the fluid to be cooled, an envelop of absorbent fabric covering said pipes, a secondary envelop of wire-gauze partially covering said fabric, troughs located above said pipes, parallel strips adjacent said troughs and contacting with said wire-gauze, springs for retaining said strips and coverings in position, absorbent or capillary material connecting the interior of said troughs with said coverings and means for supplying an evaporative liquid to said troughs, substantially as described.

11. A cooler or condenser comprising in combination, pipes for conveying the fluid to be cooled, envelops of absorbent fabric covering said pipes, a secondary envelop of wire-gauze partially covering said fabric, troughs located above said pipes, parallel strips adjacent said troughs and contacting with said wire-gauze, horseshoe-shaped springs attached to said strips and inclosing said coverings for retaining said parts in position, absorbent or capillary material connecting the interior of said troughs with said coverings and means for supplying evaporative liquid to said troughs, substantially as described.

In witness whereof I have hereunto set my hand this 4th day of November, A. D. 1902.

WARREN H. MILLER.

Witnesses:

EDW. W. VAILL, Jr.,  
CHAS. K. BENNETT.