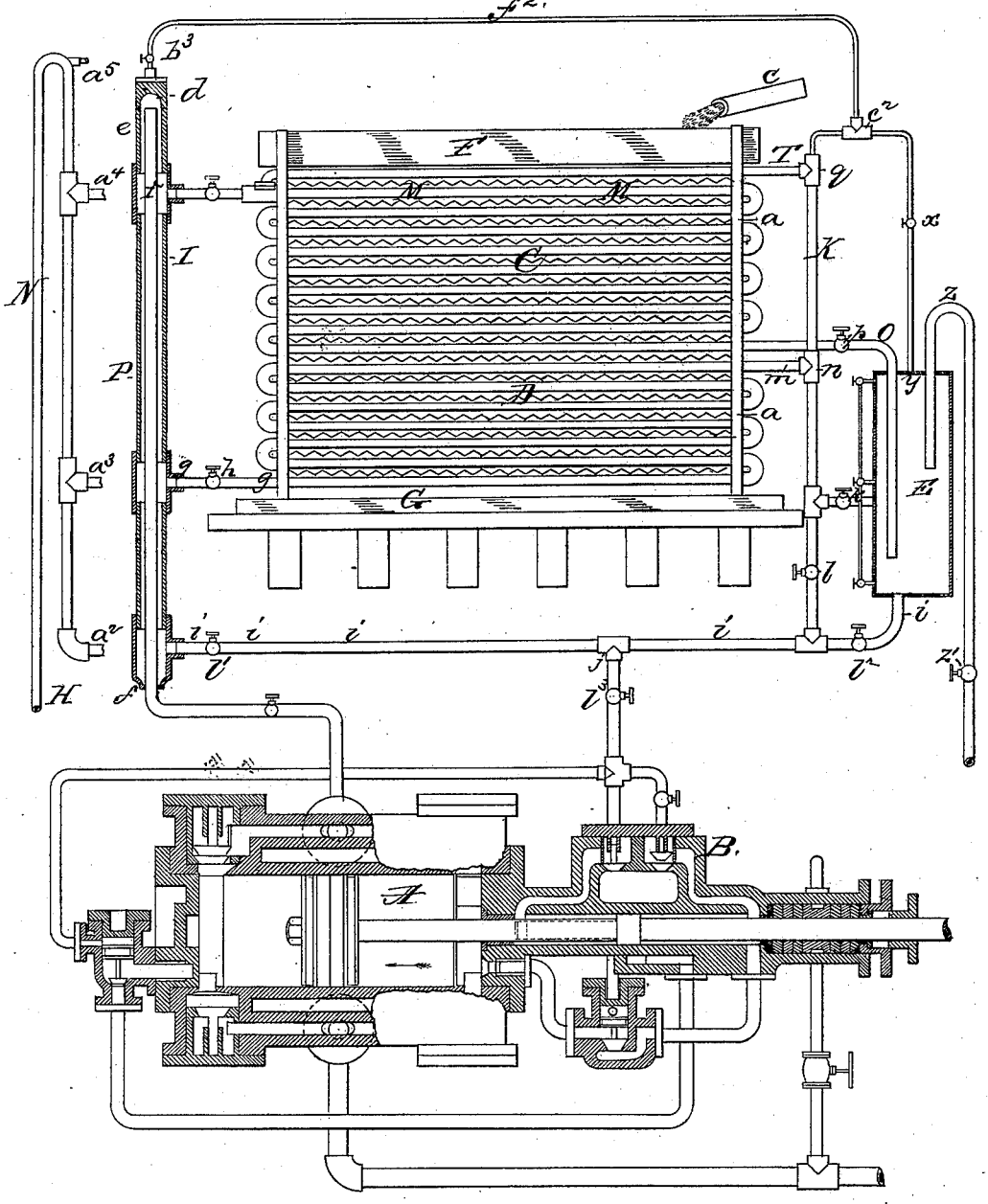
(No Model.) 2 Sheets—Sheet 1.

J. J. SUCKERT.

GAS CONDENSER FOR REFRIGERATING AND ICE MACHINES.

No. 302,361. Patented July 22, 1884.

Fig. 1.



Witnesses.
Thomas J. Hughes.
Paul M. Richards.

Inventor.
Julius John Suckert
by his atty.
W. L. Bennett

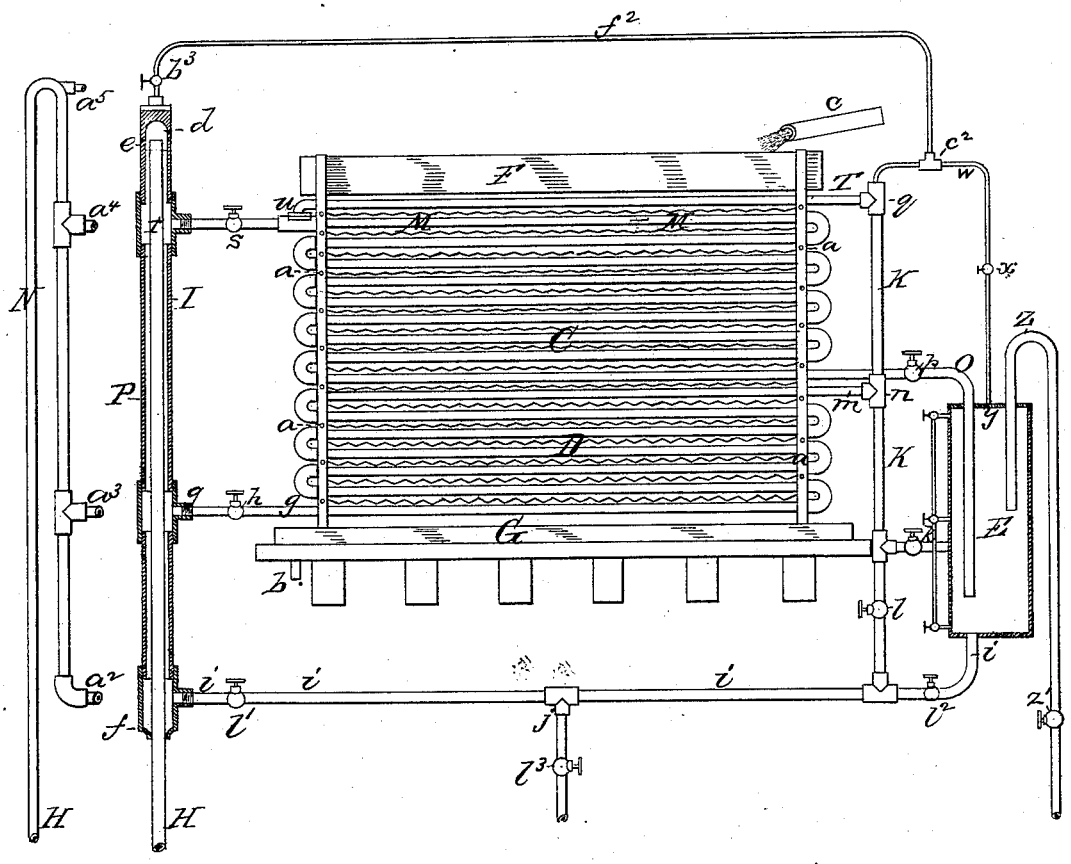
(No Model.) 2 Sheets—Sheet 2.

J. J. SUCKERT.

GAS CONDENSER FOR REFRIGERATING AND ICE MACHINES.

No. 302,361. Patented July 22, 1884.

Fig. 2.



Witnesses.
Thomas T. Hughes.
Paul M. Richards

Inventor.
Julius John Suckert
by his Atty.
W. L. Bennett.

UNITED STATES PATENT OFFICE.

JULIUS J. SUCKERT, OF RIDGEWOOD, NEW JERSEY.

GAS-CONDENSER FOR REFRIGERATING AND ICE MACHINES.

SPECIFICATION forming part of Letters Patent No. 302,361, dated July 22, 1884.

Application filed March 4, 1884. (No model.)

To all whom it may concern:

Be it known that I, JULIUS J. SUCKERT, a citizen of the United States, residing at Ridgewood, in the county of Bergen and State of New Jersey, have invented a certain new and useful Improvement in Gas-Condensers for Refrigerating and Ice Machines; and I do hereby declare that the following is a full, clear, and exact description of the invention, which will enable others skilled in the art to which it appertains to make and use the same.

My invention relates to a class of condensers used for the liquefaction of such gases or vapors as are utilized for purposes of refrigeration, and as are connected with refrigerating machinery; but they may be usefully applied in other ways.

Hitherto it has been the custom of those using open condensers, (or those not submerged,) and a sealing and lubricating liquid in their compression or vacuum pumps, to discharge the gas being compressed preparatory to liquefaction, mixed with the sealing or lubricating liquid, either into the condenser direct, without the interposition of a trap, or into a tank for the purpose of separating a part of the sealing or lubricating liquid from the gas prior to its passage through the condenser. In the latter case the lubricant thus collected was then forced through a separate cooling-coil to be cooled and deposited in another tank under a reduced pressure, involving a large and unnecessary expense in the construction of refrigerating machinery so built by the use of a surplus of costly tanks, pipes, fittings, and connections. Aside from the objection of cost, it has been found that when it was necessary to stop the compressors the gas under pressure in the condensers would liquefy and run back to the liquid tank or pump in sufficient quantity to congeal the lubricant held in either place when in contact with such lubricant under a reduced pressure, causing serious annoyance, great delay, and sometimes disaster. To avoid such difficulties a stop-cock has been inserted in the discharge-pipe, to shut off and prevent the return of such liquid. Depending upon labor not entirely familiar with the entire plant, and the stop-cocks being so numerous, this was frequently omitted, or the wrong cock was turned. Again, in using what is known as the "direct" expansion system, or the direct absorption system, it becomes necessary at times to draw the liquefied gas away from the expansion-coils, that they may be overhauled and repaired. It is advisable under such conditions to have an air-tight reservoir wherein such liquefied gas may be stored with safety. Under the old system it was thought advisable to introduce the lubricating and sealing liquid into the compressors under a pressure only equal to that of the suction side of the machine. This it has been proved was a mistake, as it reduced the efficiency of the compressors.

The object of my invention is to simplify and cheapen this character of apparatus, at the same time making it more effective and easier to handle; to be able to circulate the entire volume of sealing and lubricating liquid through the condenser in the presence of gas or liquefied gas under the liquefying pressure, and then separate them in the separating-tank preparatory to the introduction of the sealing and lubricating liquid into the compressors when fully charged with gas, and at a pressure in excess of the pressure on the suction side of the machine, to combine and so arrange the traps, inlet and outlet pipes, and stop-cocks that the condenser may be used as a reservoir for the storage of liquefied gas, in case it should be necessary to remove such liquefied gas from an expanding-coil or from other pipes or tanks connected with the condenser; to prevent the gas in the condenser from returning to the pump in liquid form, or to any tanks that may be placed between the compressors and the condensers, when the pumps or compressors are at rest; to be able to utilize the same water for cooling the lubricant and for condensing the gas used as a refrigerant; to arrange the condenser in such form and with relation to its connecting-pipes that either a warm or a cold lubricant may be drawn therefrom and be injected into the compressors; to arrange the condenser in such form and with relation to the separating or storage tanks, compressors, and their intermediate connecting-pipes, as to simplify the the entire apparatus when combined with the several parts specified, and dispense with the constant adjustment and regulation of the stop-cock permitting the lubricant to flow to

the compressors to liquefy the gas and be enabled to draw such liquefied gas away from the condenser without bringing it in contact with the heat of the gas passing in to be liquefied; and to this end my invention consists in combining and so arranging one or more coils of pipe in a vertical unsubmerged gas-condenser, with suitable traps, stop-cocks, and connecting-pipes, that the said condenser may form and serve as a reservoir or receptable for holding a liquefied gas or other liquid, if occasion should so require, as will hereinafter appear.

The invention also consists in combining one or more coils of pipe in a vertical condenser with a suitable trap interposed between the said condenser, and the means of compressing the gas to be condensed, which shall form a part of the condenser, and arranging the said coils and trap with intermediate connecting-pipes, in such a manner that any gas condensing or liquefying in the condenser is prevented from returning in the opposite direction through the inlet-pipe of said condenser, as will hereinafter appear.

The invention also consists in combining the coil for cooling the sealing and lubricating liquid of a refrigerating apparatus, with the coil or coils used for liquefying the gas or vapor used to absorb the heat, and in arranging and connecting the said coils in a vertical condenser, in such a manner that the water used for condensing the gas is also used for cooling the sealing and lubricating liquid, as will hereinafter appear.

The invention also consists in combining in a vertical condenser a coil of pipe for condensing a liquefiable gas, a coil of pipe for cooling a sealing and lubricating-liquid, a trap, separating-tank, stop-cocks and connecting-pipes, when so connected and arranged that the lubricating and sealing liquid may be drawn either from the said trap prior to its passage through the condenser, or the said liquid may be draw from an outlet-pipe of the condenser or cooling-coil prior to its admission to the separating-tank; or, the said liquid may be drawn from the separating-tank after its passage through the condenser or cooling-coil, as occasion may require, as will hereinafter appear.

The invention also consists in combining, in a vertical condenser, two or more coils of pipe provided with means of showering water upon the surface of said pipes when so constructed and arranged that a gas or a gas and liquid admitted to the inlet pipe or pipes of said condenser may pass in an upward direction through one of the said coils, and be deprived of its sensible heat, or a greater part thereof, and the liquid then be drawn away through an outlet of said coil from the unliquefied gas, and the unliquefied gas may then pass into another coil, follow the course of said coil in a downward direction, and be liquefied and drawn away from the said coil through another outlet without coming in contact with the warm incoming gas, as will hereinafter appear.

The invention further consists in combining with a vertical condenser a trap, which is connected with the inlet-pipe of said condenser, forming a part of the condenser, and so arranged that a separation or partial separation of the sealing or lubricating liquid and the gas about to enter the condenser to be liquefied may be effected, as will hereinafter appear.

The invention further consists of the coils of pipe, traps, stop-cocks, and intermediate connecting-pipes forming a vertical condenser, and the separating-tank and connecting-pipes, all in combination, when the said condenser is provided with means for showering water upon the surface of said coils, as will hereinafter appear.

The invention also consists in so arranging and connecting a condenser with a trap, or with a trap and a reservoir or separating-tank, as to prevent the liquefied gas within the said condenser from being siphoned out, as will hereinafter appear.

Reference being made to the drawings, a full explanation will be given.

Similar letters represent similar parts.

Figure 1 represents the condenser connected with a compressing-pump to show more clearly its full application. Fig. 2 represents the condenser and its incidental connections.

A, Fig. 1, is the compression-pump.

B is the auxiliary-pump for injecting the sealing and lubricating liquid into the compressor.

C, Figs. 1 and 2, is the coil of the vertical condenser, in which the greater part of the gas is condensed.

D is the coil in which the greater portion of the sealing and lubricating liquid is cooled.

F is a V-shaped trough with a perforated bottom to permit the water to shower or trickle over both coils C and D. It is held in position by small cast frames, which fit the trough and are secured to the clamps *a a* by bolts. The clamps *a a* are cut out or shaped to fit the corrugated surface of each side of the coils C and D, and are bolted firmly together, thus forming a frame or support for the coils, the feet resting upon the inside of the water-pan G. This pan rests upon the floor of the building and is to catch the water used for condensing and cooling, which is conveyed away by the waste-pipe *b*.

c is the water-pipe which supplies the trough F.

H is a continuation of the discharge-pipe of the pump or compressor, and is the inlet-pipe to the condenser. It terminates at a point, *d*, which should be higher than the uppermost pipe of the condenser, to prevent any return of the gas when liquefied.

e is a cap or shield placed over the top of the pipe H, to divert the flow of any liquid that may be discharged therefrom. The sides of the cap are perforated to permit the gas to

pass through readily. The pipe I is placed concentric with the pipe H, and has at its lower end a reducing-T, *f*, by which it is connected to the inlet-pipe H, forming when combined a trap, which we will designate as P. One pipe being much smaller than the other, the space between fills with the sealing and lubricating liquid to be cooled in the coils D.

g is the outlet-pipe from the trap, through which the lubricant passes to the coil D.

h is a stop-cock in the pipe *g*.

i is the pipe connecting the trap P with the separating-tank E, having a branch pipe, J, leading to the auxiliary pump B, and to some of the valves of the compressor. The stop-cock l' is to admit the hot lubricant or to shut it off, as desired. The stop-cock l^2 is to admit the cold lubricant to and from the separating-tank or to shut it off, as desired.

l^3 is to shut off or regulate the entire supply of lubricant. The stop-cock *l*, on the pipe *k*, is to admit or shut off the cooled lubricant from the condenser when you wish to draw from some other source. k' is the inlet-pipe to separating-tank for cooled lubricant.

m is the end of the upper pipe of the coil D, connecting with the pipe *k* by means of the T *n*.

O is an extension of the lower pipe of the coil C, and empties into the separating-tank near its bottom, to avoid making unnecessary disturbance of the liquid in the tank.

p is a stop-cock on the pipe O, to shut in case it be necessary to disconnect or to stop the flow of the liquid into the separating-tank.

M is the upper pipe of the coil C, and connects with the inlet-pipe H and the trap P by means of the T *r*, stop-cock *s*, the T *u*, and intermediate connecting-pipes.

T is a pipe connecting with the pipe M of the coil C at *u*, and forms a part of the coil for condensing. The other end of T connects with the pipe *k* by means of the T *o*, affording a passage or communication between the two coils on the side of the condenser opposite to the trap and the inlet-pipe.

w is an equalizing-pipe connecting at *q* with the pipes *k* and T, and with the separating-tank at *y*. It also connects by the T c^2 with another equalizing pipe f^2 with the top of the trap P.

b^3 is a stop-cock on said pipe.

x is a stop-cock on the pipe *w*.

z is the liquefied-gas pipe which conveys the liquid from the separating-tank to the expansion or heat-absorbing coils.

z' is a shut-off cock on the liquefied-gas pipe.

N is another form of trap used, which may be substituted for P. It has three openings, a^2, a^3, and a^4, which correspond with the three pipes *i*, *g*, and M, and one, a^5, which may connect with the pipe f^2.

Having described the several parts of the condenser, I will now describe its operation. A quantity of the gas to be condensed is discharged from the compressor or pump at each stroke of the piston, and with it the amount of lubricating liquid supplied to the pump during each act of compression. This liquid and the gas are forced onward through the inlet-pipe H until it dashes against the cap or bend in the top of the pipe of the trap P, and then falls and fills the lower part of the trap up above the outlets at a^3 and *g*. The continued action of the pump keeps up a constant supply of such liquid, which follows the course of the coil D in the condenser, is cooled by the water from the pipe *c* and trough F, and is discharged at *m* into the pipe *k*, and thence to the separating-tank E by the pipe *k* and k', or back through the pipe *i*, for reintroduction to the pump. This lubricant, being circulated with the gas and constantly under the working pressure, is more or less charged with gas or liquefied gas, and is so introduced to the pump when required. The gas entering the inlet-pipe H of the condenser separates from a large body of the lubricant, and passes, if the stop-cock S be open, through the openings a^4 or *u* of the traps into the pipe M of the coil C, and thence following the course of the coil is condensed by the trickling water passing over it, and is discharged through the pipe O into the separating-tank E. Some of the lubricating liquid, owing to the heat of compression and the force exerted upon it during compression, is driven from the compressor with the gaseous refrigerant in the form of gas, froth, or in minute separated particles, which are carried on mechanically, and pass with the refrigerant into the coil C of the condenser. The heat of compression being extracted, condensation or liquefaction takes place, and the vaporized lubricant returns to its normal condition, and in consequence of the difference in specific gravity the lubricant settles to the bottom of the separating-tank, while the refrigerant remains on the top. Should the reverse be the case, it would be necessary to change the pipes leading from the separating-tanks. Another and a better way of operating the condenser is to shut the stop-cock S and direct both the lubricant and the gas down the trap P or N, and out of the outlet a^3 or *g*, as the case may be, into the bottom pipe, *g*, of the bottom coil, D. It is then forced upward, following the course of the coil, and having the heat of compression constantly abstracted by the showering water upon the pipes through which it passes until it passes into the pipe K. By this time the sensible heat is absorbed from the lubricant, and it follows the middle section of the pipe K to K', and thence into the separating-tank.

It is evident that the heat developed by the compression of the gas is imparted to it, as well as to the lubricating-liquid. In fact, the gas, before entering the condenser, is in a superheated condition. In other words, its temperature is above that which the temperature of its vapor would represent at corresponding pressure. The gas is deprived of a portion of

its heat in passing through the lower coils of the condenser; but before liquefaction can take place its temperature must be reduced to that corresponding with the pressure of its saturated vapor. To effect this the gas is driven upward through the upper section of the pipe K into the pipe T, and thence through the T *u* to the pipe M of coil C, wherein it is cooled and liquefied, and then follows the coil C out through the pipe O into the separating-tank. The upper coil might have been connected with the pipe K at the bottom of the coil instead of the top; but in that case the liquefied gas running back would come in contact with the warm incoming gas, and would re-expand, producing unnecessary pressure. To avoid this the connection is made as shown. If this latter plan be preferred, the stop-cock S may be removed and the pipes be plugged. As a matter of convenience I make them as shown, but use the latter plan of working.

It will be observed that the auxiliary pump with which the lubricating-liquid pipe *j* is connected, is a piston-pump, and with the valve or stop-cock *l*³ wide open, it can only supply a given quantity of the lubricant at each stroke. If the valve is large enough to furnish a maximum supply, it will be an easy matter to lessen the quantity and the pressure by turning the cock; but when the quantity required is once known no further attention is required.

As before explained, the pipe f^2 is an equalizing-pipe, connecting the inlet side of the condenser with the discharge side, and is placed there to use when the machine may be at rest in case the conditions might be such as to siphon the liquefied gas out of the condenser in case it were not there and the valve open.

Having fully explained my invention, what I claim as new, and desire to secure by Letters Patent of the United States, is—

1. A condenser having one or more coils of pipe placed in line vertically, and provided with means for showering or sprinkling water upon the surface of said pipes, in combination with a liquid-trap attached to and forming a part of the said condenser when the said trap is interposed between the condenser and the pump, still or other source from which the gas or vapor comes and with which the condenser is connected, substantially as described.

2. A condenser having one or more coils of pipe placed in line vertically, and provided with means of showering or sprinkling water upon the surface of said pipes, in combination with a liquid-trap connected with the inlet pipe or pipes of said condenser when the said trap is so constructed, placed, and arranged that any liquid passing through the trap to the condenser is prevented from returning or passing from the condenser in the contrary direction through the said trap, substantially as described.

3. A condenser having two or more coils of pipe for condensing or cooling placed in line vertically, with means of showering or sprinkling water upon the surface of said coils, and a liquid trap connected to the inlet pipe or pipes of the condenser when the said trap has an outlet for the passage of gas and one or more outlets for the passage of liquid, substantially as described.

4. A condenser having one or more coils of pipe placed in line vertically, and provided with means for showering or sprinkling water upon the surface of said pipes, a liquid-trap, and intermediate connecting-pipes and cocks when the said trap is connected with and forms a part of the condenser, and the whole is so constructed and arranged that the said trap is connected with and forms an inlet-passage, or a part of said passage, to the condenser, substantially as described.

5. A condenser having two or more coils of pipe placed in line vertically, and provided with means for showering or sprinkling water upon the surface of said pipes, a trap connected with and forming an inlet-passage to the condenser, intermediate connecting-pipes and cocks, all in combination when so constructed and arranged that a gas or gas and liquid upon being admitted to one of said coils may pass in an upward direction and be cooled, and the unliquefied gas may then pass into another coil and follow the course of the said coil in a downward direction and be liquefied, substantially as described.

6. A condenser having two or more coils of pipe placed in line vertically, and provided with means for showering or sprinkling water upon the surface of said pipes when so constructed and arranged that a gas, or a gas and liquid, upon being admitted to one of said coils may pass in an upward direction and be cooled, and upon being cooled the liquid may be drawn away from the unliquefied gas through an outlet from said coil, and the unliquefied gas may then pass into another coil, follow the course of said coil in a downward direction and be liquefied, and then pass out through another outlet, substantially as described.

7. In a vertical condenser, the coil D and coil C, with means of showering or sprinkling water over them, the stop-cock S or its equivalent for closing an aperture, the frames *a a*, and the pipes T and K K with intermediate fittings, all in combination substantially as described.

8. A vertical condenser having the coil D, coil C, frames *a a*, and pipes T, O, and K K, in combination with a trap connected with an inlet-pipe of the condenser, and the stop-cock S or its equivalent for closing an aperture, all in combination when so constructed and arranged that water may be showered or sprinkled over the coils C and D, substantially as described.

9. A vertical condenser having one or more coils of pipe placed in line vertically, and provided with means for showering or sprinkling water over said pipes, in combination with a

trap formed of pipes concentric with each other, and intermediate connecting-pipes, substantially as described.

10. A condenser having the coils C and D, means of showering water upon the surface of said coils, a liquid-trap connected with the inlet-pipe *g* and pipe *i*, a pipe connecting the coils C and D on the discharge side of the condenser with the pipe *i*, pipe *j*, and stop-cocks l' and l^3, all in combination, substantially as described.

11. A condenser having the coils C and D, means of showering water over said coils, a pipe connecting the coils C and D on their discharge side with the pipe *i*, the pipes *o*, *i*, and *j*, and stop-cocks l' and l^3, in combination with a separating-tank and intermediate connecting-pipes, substantially as described.

12. A condenser having the coils C and D, with means of showering water upon the surface of said coils, in combination with the trap P, a separating-tank, a pipe connecting the coils C and D with the said pipe *i* on the discharge side of said coils, the pipes *o*, *i*, *j*, and *w*, the stop-cocks S, *h*, *l*, l', l^2, l^3, *p*, and *x*, and the intermediate connecting-pipes, substantially as described.

13. A condenser having one or more coils of pipe placed in line vertically, with means of showering water upon the surface of said coils, in combination with a trap connected with the inlet pipe or pipes of said condenser when the said trap is constructed and arranged to trap a liquid up to or above the level of the highest pipe of said condenser, substantially as described.

14. A vertical condenser having in line vertically one or more coils of pipe, in combination with a liquid-trap connected with the inlet pipe or pipes of said condenser, and an equalizing-pipe, which connects the said trap with the discharge side of said condenser, substantially as described.

15. A vertical condenser having in line vertically one or more coils of pipe, in combination with a liquid-trap, and an equalizing-pipe connecting with the inlet and discharge sides of said condenser, substantially as described.

16. A vertical condenser having a liquid-trap and an equalizing-pipe to prevent siphoning and drawing away liquid from said condenser, all in combination, substantially as described.

17. A vertical condenser having a liquid-trap, in combination with an equalizing-pipe, as f^2, a stop-cock, b^3, and intermediate connecting-pipes, substantially as described.

Witness my hand this 1st day of March, A. D. 1884.

JULIUS J. SUCKERT.

Witnesses:

JOSIAH H. MACY,

W. L. BENNEM.