

E. N. WOODRUFF.

CONDENSER.

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935,446.

Patented Sept. 28, 1909.

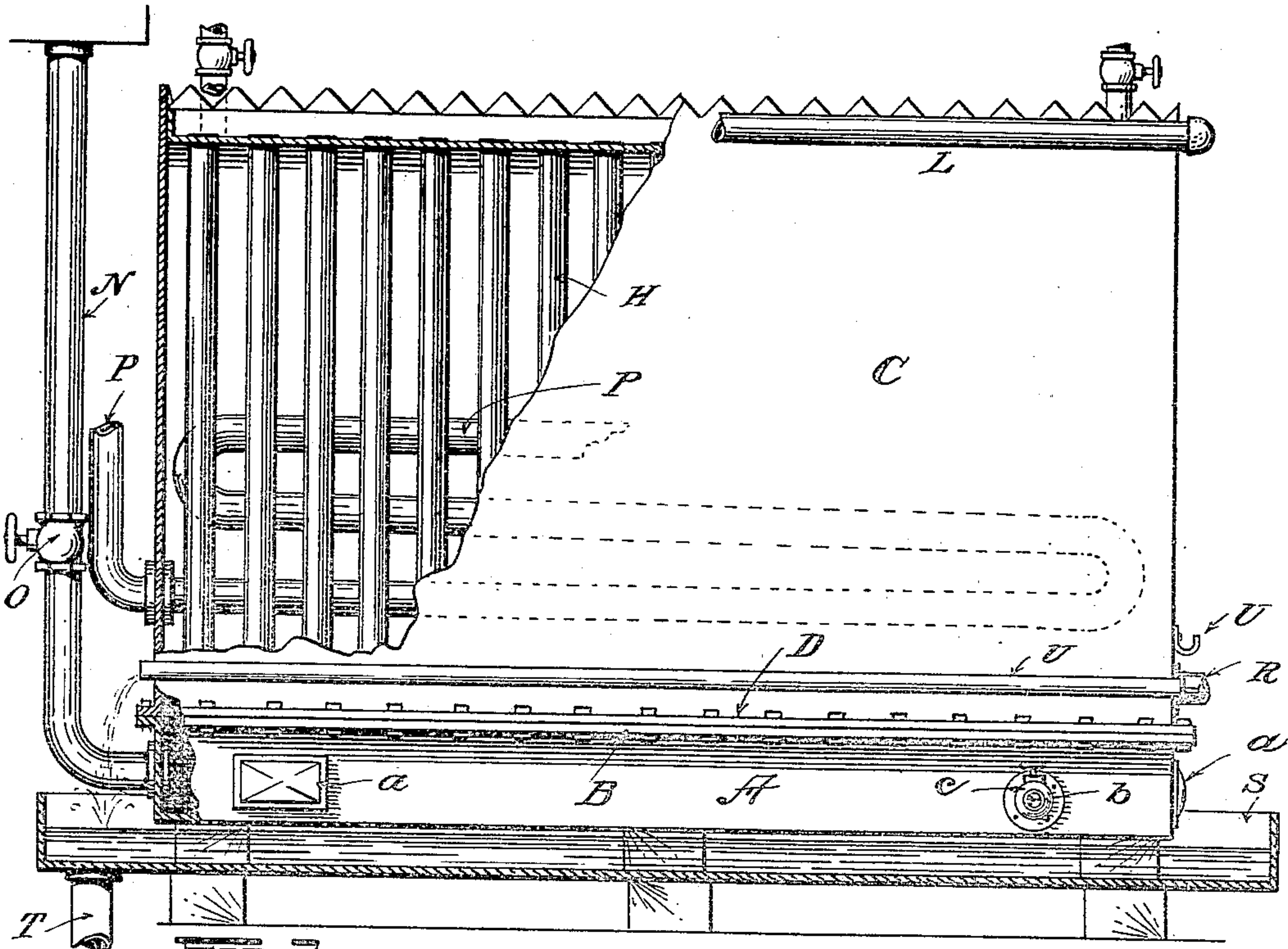


FIG. 1.

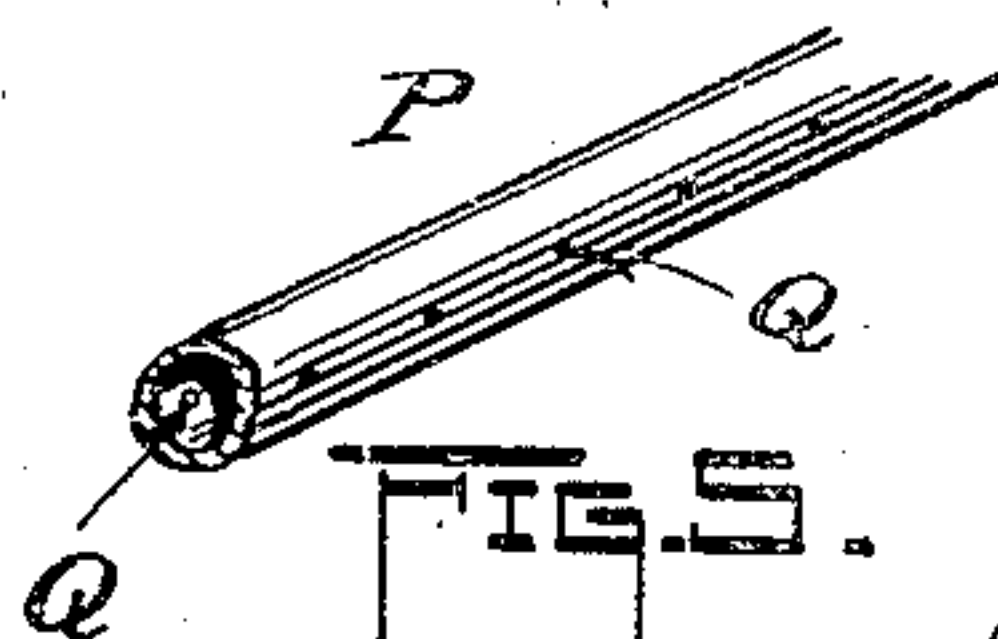


FIG. 5.

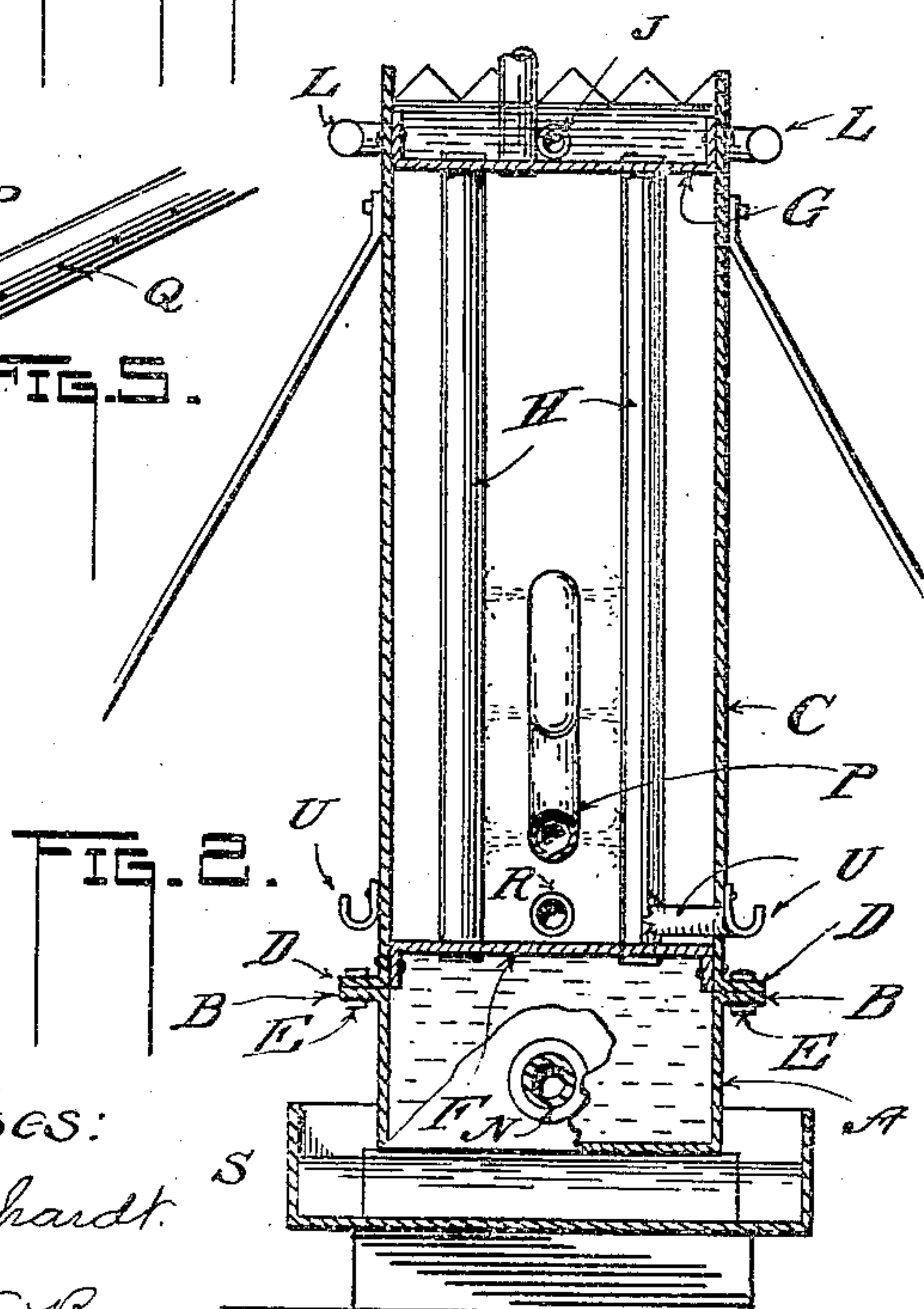


FIG. 2.

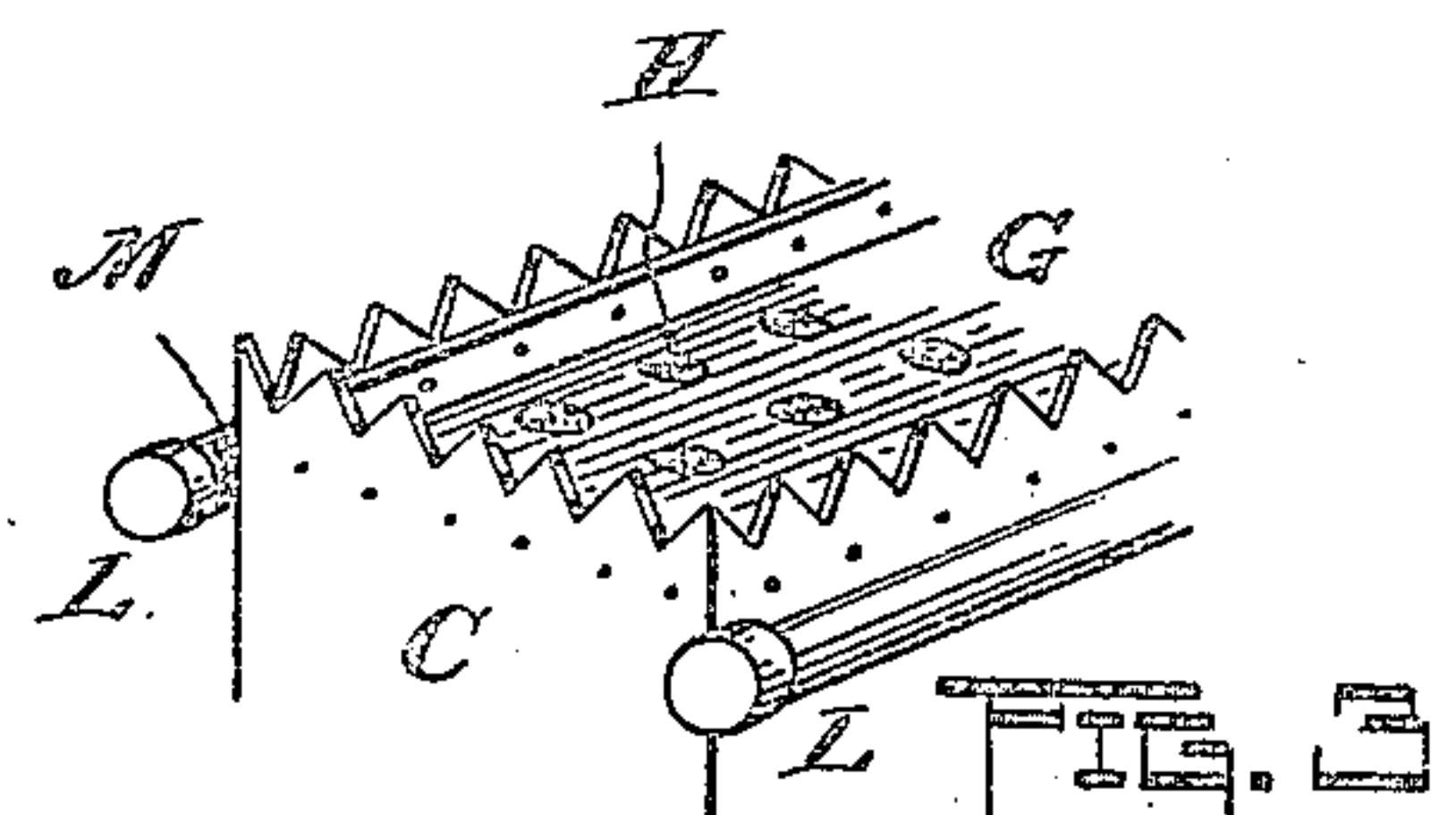


FIG. 3.

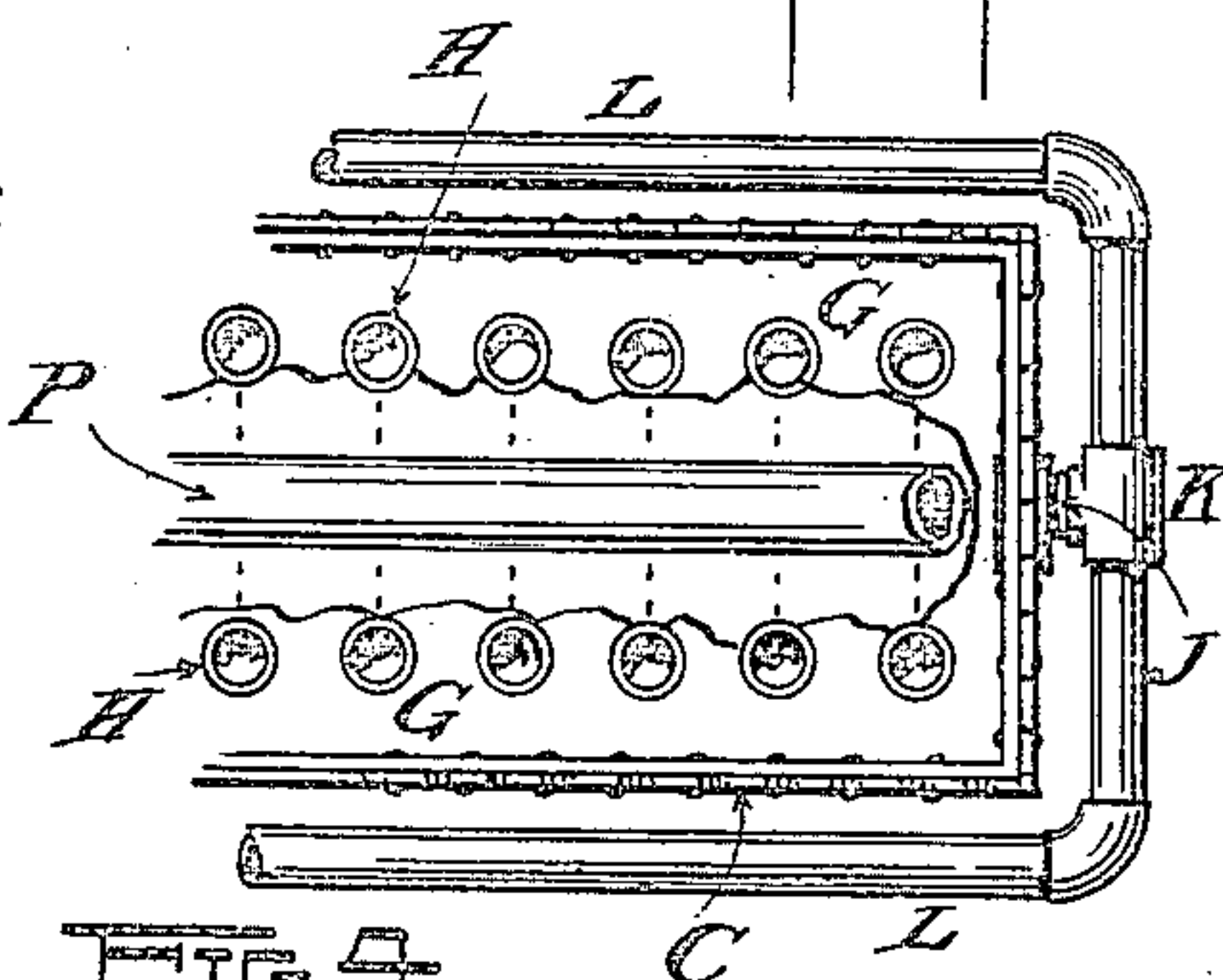


FIG. 4.

Witnesses:  
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# UNITED STATES PATENT OFFICE.

EDWARD N. WOODRUFF, OF PEORIA, ILLINOIS.

## CONDENSER.

935,446.

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Application filed December 23, 1908. Serial No. 468,906.

*To all whom it may concern:*

Be it known that I, EDWARD N. WOODRUFF, citizen of the United States, residing at Peoria, in the county of Peoria and State of Illinois, have invented certain new and useful Improvements in Condensers; 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.

This invention relates to condensers of the type adapted for condensing steam, or other vapors; the form to be described herein being particularly and peculiarly adapted for use in artificial ice plants where an apparatus that can be made to operate continuously and uninterruptedly is desired.

One of the objects of the invention is to provide a form of condenser in which vertically disposed pipes or tubes are used and up through which a cooling agent is made to flow and against which the vapor to be condensed is made to impinge.

Another object is to pass a cooling water up through the said pipes and then cause it to flow down over the outer surfaces of the walls of said chamber thereby using the said agent twice for cooling purposes.

Another object is to provide a condenser that may be quickly and thoroughly cleaned without stopping its action or closing down any part of the plant with which it is connected.

Preferably I use a supply reservoir placed higher than the condenser so that the water is made to rise through the vertically disposed pipes within the body of the condenser and then flow downward as described, the water being very evenly distributed over the condenser so as to run down its several walls in a sheet.

I am enabled by my construction to regulate the flow of the cooling water thereby making it possible in condensing the vapor to maintain it at a moderately high temperature when it is desired to employ it in that condition in further processes. My condenser also by the proper regulations has the advantage of permitting raising the temperature of the cooling water to a degree that a considerable quantity of lime and magnesia and such other minerals as are common to it will be deposited on the surfaces of the pipes or tubes whereby the water

will be better fitted as a feed water for boilers.

In the accompanying drawing Figure 1 is a side elevation of the condenser a portion of which is broken away to show the interior arrangement. Fig. 2 is a transverse sectional elevation of the same. Fig. 3 is a perspective view of a portion of the top of the condenser. Fig. 4 is a plan of a portion of the same. Fig. 5 is a perspective view of a portion of a pipe which conveys vapor into and throughout the condenser.

A indicates a receptacle for cooling water, preferably in the form of a pan, having a flange B around its upper edge. On this is mounted the condenser-body C also provided with a flange D which is secured to said flange B by means of bolts E. The said body C is merely a steam tight casing consisting of the side and end walls as shown and properly fitted with a bottom F and a top G. Erected within the casing is a series of vertically disposed pipes or tubes H arranged, in the present case, in two rows and whose ends extend through both the top G and the bottom F substantially as shown. The top G is placed below the top edges of the walls of the body so as to constitute a pan or container for water and the said walls above the pan are serrated so as to provide a series of notches preferably at regular intervals. Opening through one of the end walls into this pan is a pipe J which connects into a T-fitting K and connected to each end of the latter is a pipe L which is made to extend along the sides of the body C substantially parallel thereto and provided with perforations adjacent to the walls one of which perforations is shown at M in Fig. 3, the ends of the pipe L being capped as also shown in this figure. A pipe N is connected into the receptacle A and conveys water thereto, said pipe being provided with a valve O to regulate the flow of the water which is preferably fed by gravity from a source of water having a position above the condenser as already intimated. The said receptacle A is provided with clean out openings, not shown, and suitably covered at *a a* and has a pipe *b* controlled by a valve *c* through which the pan may be emptied and drained when desired. Connected into one of the end walls of the body C is a pipe P for the vapor to be condensed. This pipe extends between the two rows of



pipes H preferably the full length of the  
 body and it may be terminated at the oppo-  
 site side from which it enters or, as shown  
 in the drawing, it may be returned toward  
 the end at which it enters and then again  
 be carried to the opposite end and again  
 back as many times as may be desired. At  
 opposite sides of the pipes as shown in Fig.  
 5, are perforations Q opposite the several  
 tubes H so that the vapor projected there-  
 from will be made to impinge upon said  
 tubes or pipes. In the end wall of the body  
 C opposite that through which the pipe P  
 is entered is a pipe R constituting an outlet  
 for the fluid of condensation. Beneath the  
 condenser is a pan S for receiving the cool-  
 ing water discharged from the condenser,  
 there being a pipe T to conduct the water to  
 the sewer or to a suitable container for  
 further use.

In operation the cooling water enters and  
 fills the pan A through the pipe N and rises  
 through the pipes or tubes H into the pan  
 at the top of the condenser. The water  
 overflows from the upper pan runs out  
 through the notches or serrations before de-  
 scribed, and down the side and end walls of  
 the body C into the pan S. Preferably I  
 provide a trough U near the bottom of the  
 condenser body which extends entirely  
 around the latter and serves to catch the  
 water as it runs down the walls of the con-  
 tainer, said trough discharging the water into  
 the said pan S. But this trough is merely  
 a preferred way of catching the water so  
 that it will not flow over the flanges B D  
 and it need not be used. The vapor enters  
 the body C through the pipe P and is dis-  
 charged through the perforations Q against  
 the pipes H and the fluid resulting from  
 condensation flows down said pipes and  
 finally out of the body C through the escape  
 pipe R. The vapor within the body also  
 condenses upon the entire surface of the  
 pipes and upon the walls of the body C,  
 the combined cooling areas being sufficient  
 to thoroughly and continually carry on the  
 process of condensation. Since the flow of  
 the cooling water is from below it is coldest  
 at the lower ends of the pipes H and the  
 vapor entering at the bottom of the body C  
 is at its highest degree of heat and is made  
 to first impinge on the coldest part of the  
 pipes which result in rapid condensation and  
 since the body C becomes filled with the  
 vapor it must rapidly condense on all the  
 wall surfaces and the advantage of the dou-  
 ble use of the cooling water is thus apparent  
 making the condenser very economical and  
 effective. Evidently it is not necessary to pro-  
 vide a reservoir above the pipe H if proper  
 provision is made to distribute the water  
 evenly down the sides of the body C as it  
 leaves the said pipes. The minerals in the  
 cooling water will naturally be deposited in

the tubes and the said tubes can be readily  
 cleaned as thoroughly and as often as de-  
 sired by the use of any form of boiler tube  
 cleaner without interrupting the action of  
 the condenser. Since the pipes are entirely  
 open at the top the implement can be insert-  
 ed at any time and the entire series cleared  
 of deposits. Since the lower ends of pipes  
 open into the receptacle A below the de-  
 posits fall therein and from time to time  
 said receptacle may be cleaned out through  
 the openings provided for that purpose. In  
 addition to having the top edges of the wall  
 of the body C serrated I provide the per-  
 forated pipes L already described into which  
 the water flows from the pan and is dis-  
 charged through the perforations M upon  
 the wall of the body and I may use either  
 or both methods as I may see fit so as to  
 obtain the desired sheet of water upon the  
 walls.

Having set forth the construction and  
 particular advantages of my condenser, I  
 claim:—

1. In a condenser the combination of a  
 hollow body, a series of pipes erected therein  
 and extending through its top and bottom  
 and open at their upper ends above said top,  
 a receptacle for cooling water beneath the  
 body, means to cause the water to rise from  
 the receptacle into and through the pipes  
 and out at their upper ends upon the top of  
 the body, means to cause an even distribu-  
 tion of water flowing from the pipes upon  
 the outer surfaces of the walls of the body  
 of the condenser, and means connected with  
 the interior of the body through which vapor  
 is introduced into said body there being  
 a discharge opening in the body for the  
 water of condensation.

2. In a condenser the combination of a  
 hollow closed body, a series of open sub-  
 stantially vertically disposed tubes extend-  
 ing through the top and bottom of said  
 body, the walls of the body having vertical  
 extensions above the ends of the tubes to  
 form an open receiver above said tubes and  
 with which the latter communicate, there  
 being provision on the extensions of the wall  
 to provide for an even flow of water down  
 the outer surfaces of the walls of the body,  
 means to introduce water in the lower ends  
 of the tubes and compel it to flow up through  
 them, means to introduce vapor into the  
 body, there being an outlet in said body for  
 the discharge of the fluid of condensation.

3. In a condenser the combination of a  
 hollow closed body, having a horizontally  
 disposed division wall dividing it into two  
 compartments, an upper and a lower, a series  
 of vertically disposed open tubes extending  
 through the said division wall and thus com-  
 municating with the lower of the said com-  
 partments and extending also through the  
 top of the body, a receiver for water at the



top of the body, a conduit to introduce water into the lower compartment and cause it to ascend through the tubes into the receiver at the top of the body, and means to introduce vapor into the upper compartment, there being an outlet in the latter for the purposes set forth.

4. In a condenser the combination of a hollow closed body, having a horizontally disposed division wall dividing the body into two compartments, an upper and a lower, a series of vertically disposed open tubes extending through the top of the body and through the said division wall the said tubes communicating with the lower of the compartments, a receiver at the top of the body with which the tubes communicate, a conduit to introduce water into the lower compartment, there being provision at the top of the body to evenly discharge water from the receiver upon the outer surfaces of the walls of the body, and means to conduct vapor into the upper compartment and having provision for projecting the same against the tubes, there being an outlet for fluid in said body.

5. In a condenser the combination of a hollow closed body having a substantially horizontal division wall therein dividing said body into two compartments, an upper and a lower, a series of vertically disposed open tubes in said body extending through the top of the latter and said division wall said tubes being open at each end and communicating with the lower compartment, the walls of the body having vertical extensions above the upper ends of the tubes to constitute an inclosure, there being serrations in said extensions for the purposes set forth, means to introduce water into the lower compartment, and means to introduce vapor into the upper compartment, there being an exit in the latter for the fluid of condensation.

6. In a condenser the combination of a hollow closed body having a substantially horizontal division wall therein dividing said body into two compartments, an upper and a lower, a series of vertically disposed open tubes in said body extending through the top of the latter and said division wall, a receiver at the top of the body above the tubes, said tubes being open at each end and communicating with the lower compartment and the receiver, conduits connected with the receiver and extending along the walls of the body and having perforations adjacent to said walls, means to introduce water into the lowermost compartment, and means to introduce vapor into the upper compartment, there being an exit in the latter for the exit of the fluid of condensation.

7. In a condenser the combination of a hollow body for receiving the vapor to be condensed, a series of substantially vertically

disposed tubes opening through the top and bottom thereof, the same being free and open at each end, a receptacle on which the inclosure is mounted, a pipe connected into the receptacle for introducing water thereto, a conduit connected into the container for introducing vapor to the latter and an open receiver for water at the top of the container with which the tubes communicate.

8. In a condenser the combination of a hollow closed body, a series of open vertically disposed tubes therein extending through the top and bottom of said body, there being an open receiver at the top of the body with which the tubes communicate, a closed receiver constantly supplied with water and upon which the body is mounted, a conduit adapted for delivering vapor into the body and an outlet in the latter.

9. In a condenser the combination of a hollow closed body, a series of open vertically disposed tubes therein extending through the top and bottom of said body, there being an open receiver at the top of the body with which the tubes communicate, a closed receiver constantly supplied with water and upon which the body is mounted, a conduit extending into the body and having provision for discharging vapor against the said tubes, and an outlet in said body for the discharge of the fluid of condensation.

10. In a condenser the combination of a hollow closed body, a series of open substantially vertically disposed tubes therein and extending through its top and bottom, the walls of the body extending above the top of the condenser and above the upper open ends of the tubes to form an open receptacle, a receptacle constantly supplied with water and upon which the body is mounted and with which the tubes communicate, a valve controlled conduit connected into said receptacle, a conduit connected with and opening into the hollow body and having perforations therein opposite said tubes for the discharge of vapor against the latter, there being an outlet in said body.

11. In a condenser the combination of a hollow closed body, a series of open substantially vertically disposed tubes extending through the top and bottom of the body, the walls of said body having vertical extensions above the level of the upper ends of the tubes to form an open receptacle with which the said tubes communicate, the said vertical extensions having provision therein for the outflow of water, means to supply a flow of water into the lower ends of the tubes and up through the same, a conduit to discharge vapor into the body, and a discharge opening in the latter.

12. In a condenser the combination of a hollow closed body, a series of pipes therein for carrying a cooling-water, a vapor conducting pipe extending into the body among



the pipes and provided with discharge apertures opposite the several pipes for the discharge of vapor against the latter, there being a discharge opening in one of the walls  
5 of the body for the discharge of the water of condensation.

13. In a condenser the combination with a hollow closed body provided with a series of pipes for conveying a cooling-water, a vapor  
10 conducting pipe extending into the body between the pipes the same being returned upon itself in a series of substantially paral-

lel extensions provided with discharge apertures opposite the pipe through which vapor is discharged against the said pipes, there being an outlet from the body for the water of condensation. 15

In testimony whereof I affix my signature, in presence of two witnesses.

EDWARD N. WOODRUFF.

Witnesses:

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AUGUSTA BURKHARDT.