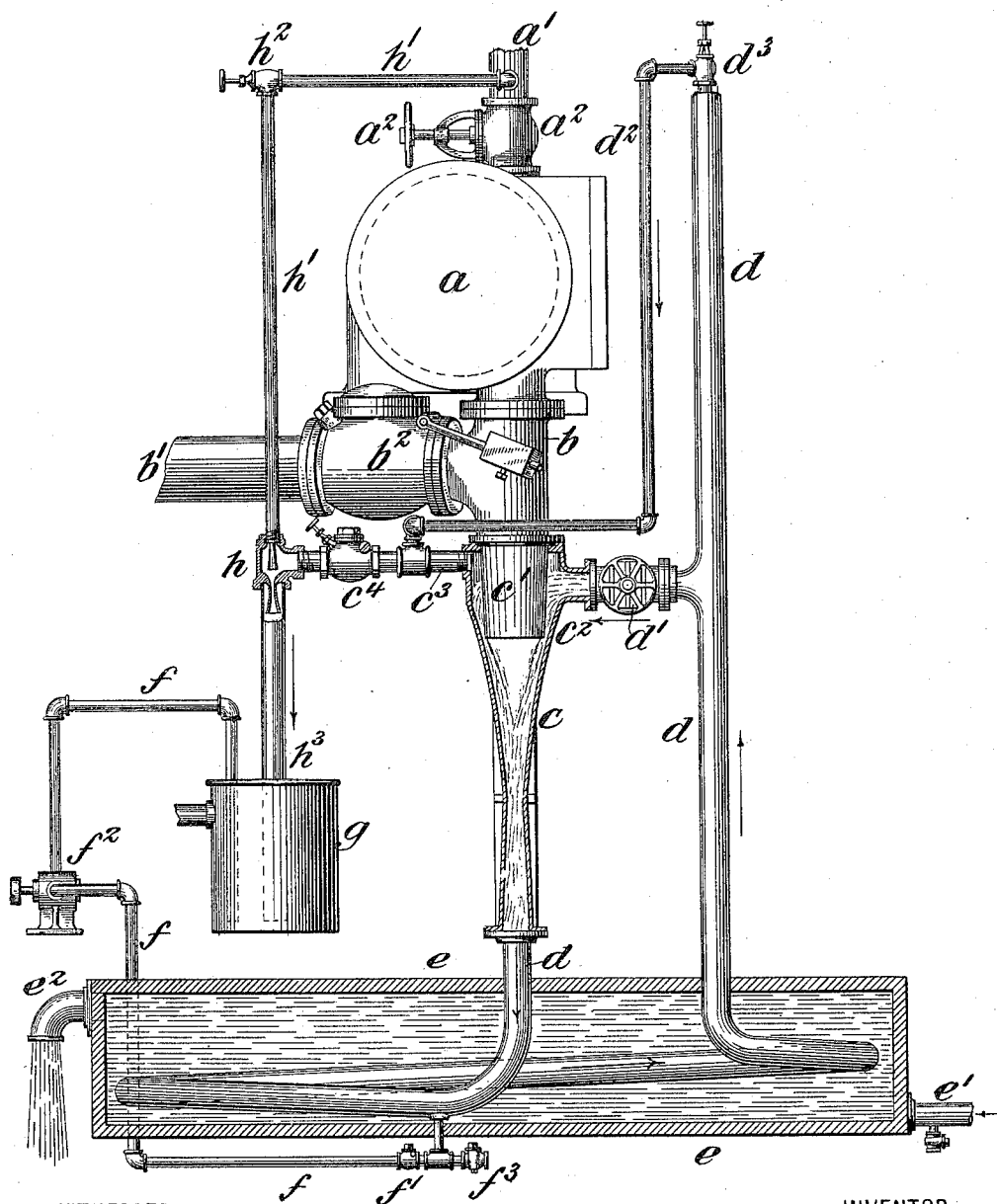


W. P. SKIFFINGTON.  
CONDENSING SYSTEM.

No. 585,365.

Patented June 29, 1897.

*Fig. 1.*



WITNESSES:

*R. H. Maynard*

*Ambrose R. Merrill*

INVENTOR

*William P. Skiffington*

BY

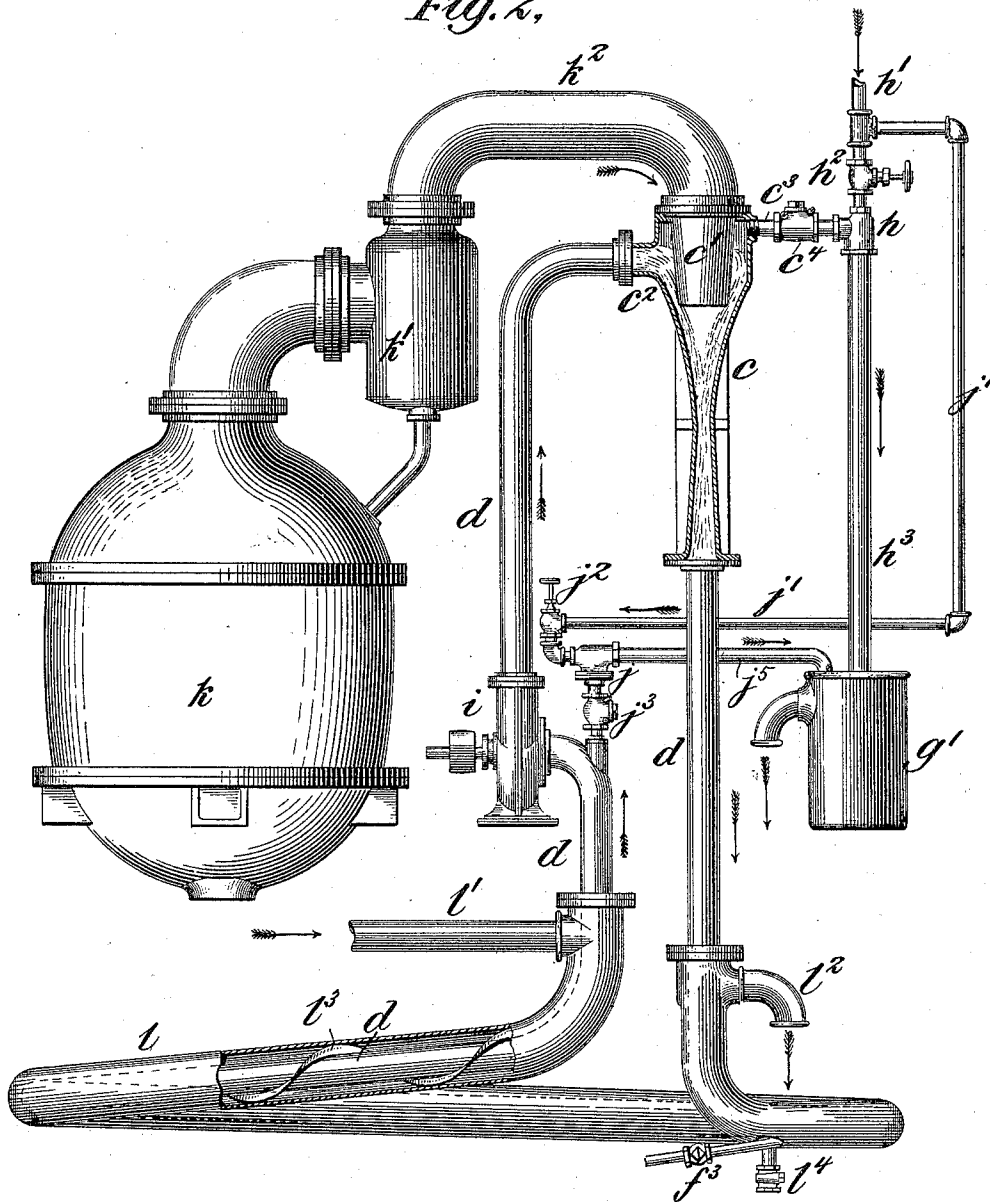
*Henry D. Williams*  
ATTORNEY

W. P. SKIFFINGTON.  
CONDENSING SYSTEM.

No. 585,365.

Patented June 29, 1897.

Fig. 2.



WITNESSES:

*R. H. Maynard*

*Andrew D. Merrill*

INVENTOR

*William P. Skiffington*

BY

*Henry D. Williams*  
ATTORNEY

# UNITED STATES PATENT OFFICE.

WILLIAM P. SKIFFINGTON, OF NEW YORK, N. Y.

## CONDENSING SYSTEM.

SPECIFICATION forming part of Letters Patent No. 585,365, dated June 29, 1897.

Application filed July 28, 1896. Serial No. 600,774. (No model.)

*To all whom it may concern:*

Be it known that I, WILLIAM P. SKIFFINGTON, a citizen of the United States, and a resident of New York, in the county of New York and State of New York, have invented certain new and useful Improvements in Condensing Systems, of which the following is a specification.

This invention relates to vapor-condensing systems, and to that class of condensing systems in which the vapors to be condensed are brought into direct contact with a condensing fluid.

One of the objects of my invention is the removal from the condensing fluid of the uncondensable gases that may be in solution therein. Another object of my invention is the circulation of said condensing fluid out of contact with the atmosphere to prevent the reëntance of air or other uncondensable gas into solution therein, and another object of my invention is the utilization of the force with which the vapor to be condensed enters the condenser for the purpose of maintaining or assisting to maintain the circulation of the condensing fluid or its motion in a closed continuous conduit.

My invention also has for its object the effective cooling of the condensing fluid and includes improved means to that end, and also includes means for regulating the supply of condensing fluid to the condenser.

The nature and objects of my invention will more particularly appear from the following description and claims, in connection with the accompanying drawings.

Figure 1 is a part sectional elevation representing my improved condensing system applied to a steam-engine. Fig. 2 is a part sectional elevation representing my improved condensing system applied to a vacuum-pan.

In Fig. 1 a horizontal steam-engine cylinder *a* is represented, supplied with steam through the steam-pipe *a'*, and a suitable throttle-valve *a<sup>2</sup>* is represented connecting the steam-pipe and steam-chest. The exhaust-steam passes out of the engine through the exhaust-pipe *b* and into the condenser *c*. The length of exhaust-pipe between the steam-chest and condenser is preferably as short as possible, and it is a material advantage of my invention that the condenser can be placed

in close proximity to the engine or other source of vapor to be condensed without regard to barometric heights. As shown, the exhaust-pipe is only of sufficient length to include a lateral opening and lateral pipe *b'*, having a balanced flap-valve *b<sup>2</sup>* interposed therein acting to automatically open and permit the escape of the exhaust-steam there- through whenever the exhaust-steam substantially exceeds atmospheric pressure, thus permitting the engine to be used as a non-condensing engine when desired.

The condenser *c* is shown in a form resembling the well-known injector-condenser, having an exhaust nozzle or cone *c'*, which forms the lower end of the induction-conduit for leading in the vapors to be condensed and extends into a casing of double conoidal form, said casing having a restricted neck located somewhat below its middle part. A restricted annular opening is formed at the mouth of the exhaust-cone *c'*, through which the condensing fluid enters the condensing-chamber in a thin sheet and at a high velocity and comes in contact with and condenses the exhaust-steam or other vapor to be condensed. Above this restricted mouth of the exhaust-cone is formed an annular chamber with an induction-opening *c<sup>2</sup>* for the entrance of the condensing fluid and a connection *c<sup>3</sup>* with an exhauster, to be hereinafter described.

It will be seen that the vapor to be condensed and the condensing fluid are moving in substantially parallel directions at the point of contact, so that the force with which the vapor enters the condenser will be effectively imparted to the condensing fluid for the purpose hereinafter described.

A pipe or conduit *d* extends from the lower end of the condenser *c* through a suitable cooler, shown in Fig. 1 as formed by a tank *e*, having induction and eduction openings *e'* and *e<sup>2</sup>*, respectively, for flowing a cooling fluid through the tank, said pipe *d* emerging from said cooler and extending vertically alongside of and, in the construction shown in Fig. 1, some distance above the condensing-chamber. If the engine is upon a boat, an out-board cooler may be used, the pipe *d* extending along outside the hull in contact with the fluid which floats the boat and the motion of the boat constantly bringing cool water in

contact with the cooling-pipe, so as to effectively cool the fluid flowing through the pipe, or in some cases the pipe  $d$  may be immersed in a moving stream of water in any suitable manner.

The length of the portion of the pipe  $d$  within the cooler would of course in each case be such as to bring about the desired cooling of the condensing fluid flowing therethrough. As shown, the portion of the pipe  $d$  within the cooler slopes gently downward toward its entering end, and means are provided connected to this end for removing the excess or increment of fluid produced by the condensation of the vapors, such means being shown as consisting of a connection  $f$ , having a check-valve  $f'$  therein (closing against pressure toward the closed conduit) and running through a fluid-moving device, as a rotary pump  $f^2$ , to the hot-well  $g$ . A cock  $f^3$  is also provided upon the connection  $f$  for use in cleaning or draining the condenser and connections.

The vertical portion of the pipe  $d$  is shown as connected to the induction-opening  $c^2$  of the condenser by a valve  $d'$ , whereby the inlet-opening for condensing fluid to the condenser may be adjusted as desired to regulate the rate of flow of the condensing fluid flowing to the condenser. The portion of the pipe  $d$  extending above this connection acts as a stand-pipe to receive any excess of condensing fluid beyond what will at once flow through the valve  $d'$  into the condenser in the event of a sudden impulse to the condensing fluid from the exhaust steam or vapor. As the exhaust steam or vapor is supplied to the condenser at times with considerable residual force and at other times with a comparatively slight impulse, and moreover this force with which the exhaust-steam enters the condenser is a quantity varying at different parts of the stroke of the engine, and this force maintains the circulation of the condensing fluid, it is desirable that these fluctuations of speed shall not be repeated in the supply of condensing fluid to the condenser, and therefore by the proper regulation of the valve  $d'$  the stand-pipe may be utilized to receive the excess of fluid and allow the excess of energy to be expended in lifting a column of fluid therein. This arrangement is practically automatic in action, as the column of fluid in the stand-pipe introduces a pressure upon the condensing fluid of increasing force as the height of the column increases, and this pressure will be effectively exerted through the induction-opening of the condenser in the event of a sudden diminution of speed in the condensing fluid flowing up the vertical portion of the pipe  $d$ , and therefore by a proper regulation of the valve  $d'$  a substantially uniform supply of condensing fluid may be obtained.

The upper end of the stand-pipe portion of the conduit  $d$  is shown as connected by a pipe  $d^2$ , having a suitable valve, as  $d^3$ , interposed

therein, to the connection or pipe  $c^3$  above described as running from the annular chamber at the top of the condenser  $c$ . The pipe  $c^3$  beyond the connection of the pipe  $d^2$  thereto has a check-valve  $c^4$  of suitable construction and closing against pressure toward the closed conduit and shown as a lock check-valve capable of being locked in closed position by a screw-stem, as well understood in the art, and beyond this check-valve the pipe  $c^3$  enters an exhaustor, shown as an ejector  $h$  of ordinary construction, the steam-nozzle of which is connected by a pipe  $h'$ , having a suitable valve  $h^2$  interposed therein, to the steam-pipe  $a'$  supplying the steam to the engine. From the lower end of the ejector  $h$  a pipe  $h^3$  extends into the hot-well  $g$ .

In the operation of the engine condensing system shown in Fig. 1 and above described the condensing fluid is circulated through a closed circuit out of contact with the atmosphere, and substantially the same fluid is used over and over again. The fluid when originally introduced into the system will contain, as do all fluids at atmospheric pressure, a large quantity of air or other uncondensable gas in solution therein, but upon lowering the pressure this uncondensable gas will escape from the fluid and rise to the top of the annular chamber in the condenser  $c$  and to the top of the stand-pipe of the conduit  $d$ , and at these places, as above described, connections are made with exhausting means, shown as a single ejector  $h$ , so that when the operation of the ejector is started by opening the valve  $h^2$  the reduction of pressure within the condensing system and the removal of the uncondensable gases from the condensing fluid will take place regularly and effectively. During the operation of the engine and condenser more or less of uncondensable gases will be carried into the condensing system with the exhaust steam or vapor and will at times leak in at the stuffing-boxes or other places by reason of the low pressure in this system, but these uncondensable gases will be removed by the continued action of the exhaustor and the condensing fluid will enter the condensing-chamber as free from uncondensable gases as is practicable, and inasmuch as the condensing fluid is continuously circulated out of contact with the atmosphere the amount of uncondensable gas to be removed during the operation is comparatively slight and a highly effective action of the condenser is assured. As the exhaustor is connected to the conduit in advance of the point of contact of the vapor and condensing fluid, there will be no withdrawal of uncondensed vapor by the exhaustor, and the withdrawal of uncondensable gases from the condensing fluid will properly precede the condensing operation. But a slight amount of live steam is used to work the ejector  $h$ , and after this steam has passed through the ejector it enters the hot-well and aids in heating the feed-water therein, and if any fluid is car-

ried out of the condensing system by the ejector this fluid is also delivered into the hot-well.

The inflow of exhaust-steam into the condenser constantly adds to the amount of fluid in the closed conduit, but this is provided for by the connection  $f$  and the rotary pump  $f^2$ , and the pump may be actuated in a suitable manner at such speed as to continuously remove fluid from the closed conduit in such quantity as to leave a substantially constant quantity of condensing fluid therein, or the pump may be actuated more rapidly for short periods whenever it is desirable to remove fluid from the closed conduit. It will be observed that this connection is in the neighborhood of the hottest part of the pipe  $d$ , so that in operation warm fluid will be removed and discharged into the hot-well, where it will aid in heating the feed-water of the boiler.

The application of my invention to a vacuum-pan is illustrated in Fig. 2,  $k$  representing the vacuum-pan,  $k'$  a drip or collecting chamber, and  $k^2$  the pipe leading to the condenser. The condenser is of the same construction as that above described and is similarly lettered. As the vapor from the vacuum-pan will not usually enter the condenser with sufficient force to maintain the circulation of the condensing fluid, I provide in this instance suitable means for maintaining the circulation of the condensing fluid, such means being shown as a centrifugal pump  $i$ , interposed in the conduit  $d$ . This pump may be continuously operated by any suitable means at such speed as to cause the condensing fluid to flow through the closed conduit at the desired rate of flow. In this drawing, Fig. 2, an ejector  $j$  is shown instead of the rotary pump  $f^2$  of Fig. 1, acting to remove the surplus fluid from the closed conduit, this ejector  $j$  being connected by a pipe  $j'$ , having a valve  $j^2$  interposed therein, to a pipe  $h$ , running from any suitable source of rapidly-moving fluid, as steam or water or air. The fluid carried out by this ejector passes through the pipe  $j^3$  into a suitable collecting-tank or hot-well  $g'$ , from which it may be drawn off as desired for use as a solvent for the substance to be evaporated. A check-valve  $j^3$ , closing against pressure toward the closed conduit, intervenes between the pipe  $d$  and ejector  $j$ .

The connection of the ejector  $j$  with the closed conduit is shown at a point in the vertical portion of the pipe  $d$  beyond the cooler and in advance of the condenser and immediately in advance of the centrifugal pump  $i$ , whereby the ejector receives the cooler fluid and is enabled to assist in charging the centrifugal pump. It is an advantage to use cool fluid in an ejector, and the cool fluid is a more concentrated solution of the solvent, such as sugar, which will usually be dissolved in the condensing fluid in a construction such as illustrated in Fig. 2, and it is of course desirable to draw out as much of the dissolved substance as possible. In some cases, how-

ever, it may be desirable to connect the fluid-removing device at some other part of the closed conduit.

The ejector for withdrawing uncondensable gases from the condensing fluid is of substantially the same construction as shown in Fig. 1 and above described and is similarly lettered, but in the construction shown in Fig. 2 the uncondensable gases are withdrawn only from the top of the annular chamber about the exhaust-nozzle  $c'$  of the condenser, that being the best place in the closed conduit here shown for obtaining such gases. This ejector  $h$  discharges into the collecting-tank  $g'$  through the pipe  $h^3$ .

The cooler for the condensing fluid as shown in Fig. 2 is of a special construction herein-after claimed. The lower portion of the pipe  $d$  is incased within an enveloping pipe  $l$ , and an induction-pipe  $l'$  and an eduction-pipe  $l^2$  are provided for this envelop and a suitable cooling fluid is caused to flow therethrough. The tendency of the fluid in flowing through such an annular space in the substantially horizontal portions of the pipes is for the hotter part to remain in contact with the upper part of the inner pipe, and the tendency in the inner pipe is also for the hotter portion to rise to the upper part of that pipe, and the effectiveness of the cooling action would therefore be impaired if this tendency were unrestrained. In vertical or substantially-vertical portions of the pipes the tendency of the cooling fluid is to move rapidly without bringing new portions of the cooling fluid in contact with the inner pipe. I effectively prevent gravitation of the cooling fluid into differently-heated layers and I also bring new portions of the cooling fluid into contact with the inner pipe and lengthen the path of the cooling fluid by causing it to move around the inner pipe as it flows longitudinally relatively thereto, the means shown for such purpose consisting of the helical partition  $l^3$ , of long pitch, located in the annular space between the inner and outer pipes, thus forming a helical passage for the cooling fluid around the inner pipe. The condensing fluid to be cooled in the inner pipe and the cooling fluid in the annular space surrounding it are caused to flow in opposite directions. As the cooling fluid approaches the hotter end its rate of flow is increased by narrowing the annular space between the inner and outer pipes toward the hotter end of the cooler, and, as shown, the outer pipe  $l$  is of gradually-diminishing diameter toward its eduction end.

The cooler slopes gently downward toward its eduction end, and at its lowest point is provided with a cock  $l^4$  for draining the outer pipe  $l$  and with a cock  $f^3$  for draining the inner pipe  $d$ .

It is well known that in the action of a vacuum-pan considerable portions of the substance dissolved, as the sugar in a sugar vacuum-pan, are carried over with the vapor into the vapor withdrawing and condensing appa-

ratus, and where the products of the condensation are wasted there is a considerable loss of the dissolved substance. As according to my invention substantially the same condensing fluid is used over and over again and the surplus is withdrawn and discharged into a supply-tank and the entire system may be drained at any time, all of the products of condensation are saved. For example, in a sugar-refinery, according to my invention, sweet water is supplied for dissolving fresh quantities of sugar to go through the refining processes and be again evaporated. It is also of material advantage that the condensing or cooling system may be located wherever desired without regard to barometric heights, and this is true in all applications of my invention.

In each of the two constructions shown and above described means are provided in addition to the exhauster for removing water from the closed continuous conduit. In some cases, however, the removal of water need not be effected except at long intervals, and this would be especially true with stand-pipes such as illustrated in Fig. 1, and the removal of water may be accomplished by the exhauster alone and could, in fact, be effected by the exhauster in the constructions shown in the event that the other means were out of repair and therefore ineffective or insufficient or were not operated, as the upper chamber of the condenser would be filled with water if the conduit were overcharged, and the exhauster would, if then operated, convey water out of the conduit.

It is obvious that various modifications may be made in the constructions above described within my invention and that parts of my invention may be used in connection with other parts of substantially different construction from that above described. I do not therefore limit my broad invention to the particular construction described and shown, but

What I claim, and desire to secure by Letters Patent, is—

1. The method of condensing a vapor which consists in circulating a condensing fluid in a closed circuit out of contact with the atmosphere, removing uncondensable gases from said condensing fluid and then leading the vapor to be condensed into contact with said condensing fluid and then cooling said fluid, substantially as set forth.

2. The method of condensing a vapor which consists in leading said vapor into contact with a condensing fluid flowing in a direction substantially parallel to the direction of movement of said vapor, whereby the movement of the vapor is imparted to the condensing fluid, and circulating said condensing fluid in a closed circuit out of contact with the atmosphere under the impulse of the vapor and cooling said fluid, substantially as set forth.

3. The method of condensing a vapor which consists in removing uncondensable gases

from a condensing fluid and then leading the vapor to be condensed into contact with said condensing fluid while the condensing fluid is flowing in a direction substantially parallel to the direction of movement of said vapor, whereby the movement of the vapor is imparted to the condensing fluid, and circulating said condensing fluid in a closed circuit out of contact with the atmosphere under the impulse of the vapor and cooling said fluid, substantially as set forth.

4. A condensing system comprising a continuous conduit for a condensing fluid closed from contact with the atmosphere and of sufficient surface to permit the cooling of the fluid therein, an induction-conduit opening into said continuous conduit for leading in the vapors to be condensed, and an exhauster connected to said continuous conduit away from the point of contact of the condensing fluid and vapor to be condensed, substantially as set forth.

5. A condensing system comprising a continuous conduit for a condensing fluid closed from contact with the atmosphere and of sufficient surface to permit the cooling of the fluid therein, and an induction-conduit for leading in the vapors to be condensed, opening into said continuous conduit in a direction substantially parallel to the direction of flow of the condensing fluid, whereby the force with which the vapor to be condensed enters the condenser is utilized to move the condensing fluid in its closed circuit and means for removing fluid from the conduit, substantially as set forth.

6. A condensing system comprising a continuous conduit for a condensing fluid closed from contact with the atmosphere and of sufficient surface to permit the cooling of the fluid therein, an induction-conduit for leading in the vapors to be condensed, opening into said continuous conduit in a direction substantially parallel to the direction of flow of the condensing fluid, whereby the force with which the vapor to be condensed enters the condenser is utilized to move the condensing fluid in its closed circuit, and an exhauster connected to said continuous conduit away from the point of contact of the condensing fluid and vapor to be condensed, whereby uncondensable gases are withdrawn from said fluid before it comes in contact with the vapor to be condensed, substantially as set forth.

7. A condensing system comprising a continuous conduit for a condensing fluid closed from contact with the atmosphere and of sufficient surface to permit the cooling of the fluid therein, said conduit including a stand-pipe, an induction-conduit opening into said continuous conduit for leading in the vapors to be condensed, said stand-pipe of the continuous conduit being located in advance of the point of contact of the condensing fluid and vapor, means for controlling the flow of condensing fluid, said controlling means

being located between said stand-pipe and said point of contact, and an exhauster for withdrawing uncondensable gases from said closed conduit, substantially as set forth.

5 8. A condensing system comprising a continuous conduit for a condensing fluid closed from contact with the atmosphere, an induction-conduit opening into said continuous conduit for leading in the vapors to be condensed, an exhauster connected to said continuous conduit in advance of the point of contact of the condensing fluid and vapor to be condensed, means for cooling said continuous conduit, and means for withdrawing the surplus fluid from said conduit, substantially as set forth.

9. A condensing system comprising a continuous conduit for a condensing fluid closed from contact with the atmosphere, an induction-conduit for leading in the vapors to be condensed, opening into said continuous conduit in a direction substantially parallel to the direction of flow of the condensing fluid, whereby the force with which the vapor to be condensed enters the condenser is utilized to move the condensing fluid in its closed circuit; means for cooling said continuous conduit, and means for withdrawing the surplus fluid from said conduit, substantially as set forth.

10. A condensing system comprising a continuous conduit for a condensing fluid closed from contact with the atmosphere, an induction-conduit for leading in the vapors to be condensed, opening into said continuous conduit in a direction substantially parallel to the direction of flow of the condensing fluid, an exhauster connected to said continuous conduit in advance of the point of contact of the condensing fluid and vapor to be condensed, means for cooling said continuous conduit, and means for withdrawing the surplus fluid from said conduit, substantially as set forth.

11. A condensing system comprising a continuous conduit for a condensing fluid closed from contact with the atmosphere, said conduit including a stand-pipe, an induction-conduit opening into said continuous conduit

for leading in the vapors to be condensed, said stand-pipe of the continuous conduit being located in advance of the point of contact of the condensing fluid and vapor, means for controlling the flow of condensing fluid, said controlling means being located between said stand-pipe and said point of contact, and an exhauster for withdrawing uncondensable gases from said closed conduit, means for cooling said conduit, and means for withdrawing the surplus fluid from said conduit, substantially as set forth.

12. A condensing system comprising the injector-condenser  $c, c'$ , the pipe  $d$ , an exhauster connected to the condenser by pipe  $c^3$ , means for cooling the pipe  $d$ , and means for withdrawing surplus fluid, substantially as set forth.

13. A condensing system comprising the injector-condenser  $c, c'$ , the pipe  $d$ , the valve  $d'$ , said pipe  $d$  having a substantially vertical portion forming a stand-pipe, an exhauster connected to the condenser by pipe  $c^3$  and to the stand-pipe by the pipe  $d^2$ , means for cooling the pipe  $d$  and means for withdrawing surplus fluid, substantially as set forth.

14. A condensing system comprising the injector-condenser  $c, c'$ , the pipe  $d$ , an exhauster connected to the condenser by pipe  $c^3$ , the pipe  $l$  enveloping the pipe  $d$ , and the helical partition  $l^3$  extending across the annular space between the pipes  $d$  and  $l$ , substantially as set forth.

15. A condensing system comprising the injector-condenser  $c, c'$ , the pipe  $d$ , an exhauster connected to the condenser by pipe  $c^3$ , a conduit for a cooling fluid enveloping the pipe  $d$  and means for causing the cooling fluid to move around the pipe  $d$  as it is moved longitudinally relatively thereto, substantially as set forth.

Signed at New York, in the county of New York and State of New York, this 27th day of July, A. D. 1896.

WILLIAM P. SKIFFINGTON.

Witnesses:

HENRY D. WILLIAMS,  
HERBERT H. GIBBS.