(No Model.) 2 Sheets—Sheet 1.

W. E. PRALL.

CONDENSER.

No. 457,791. Patented Aug. 18, 1891.

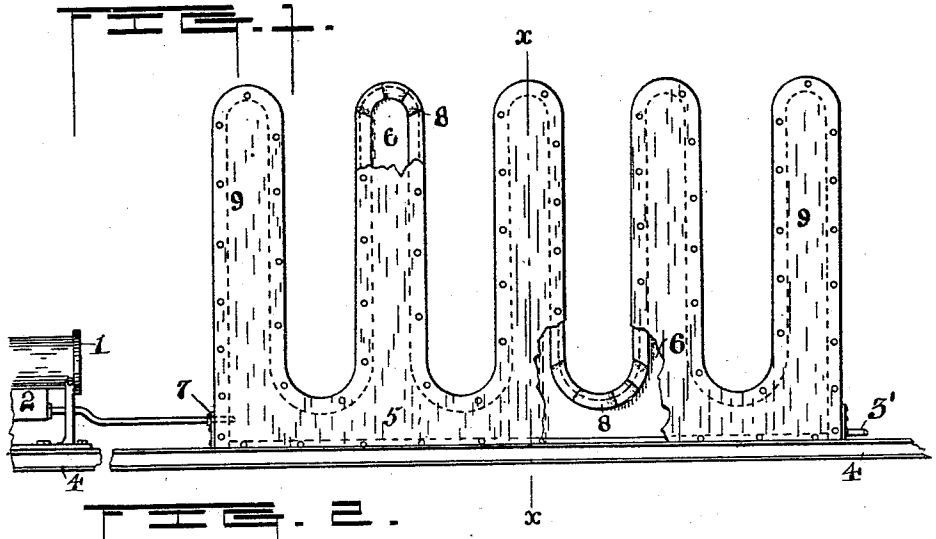


FIG. 2.

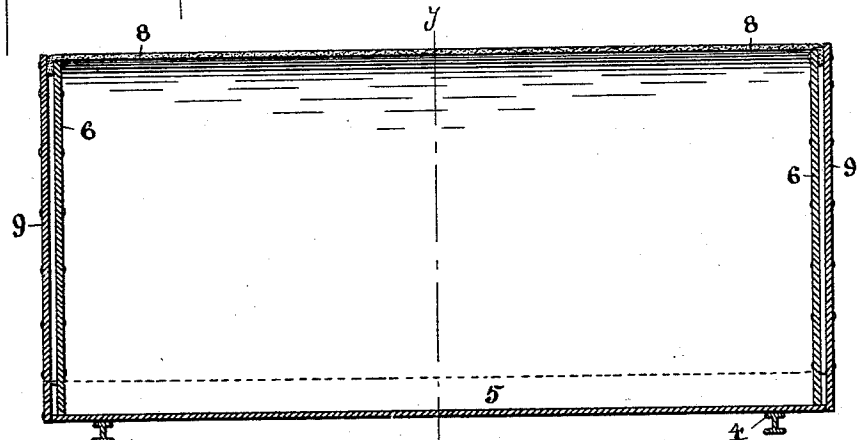
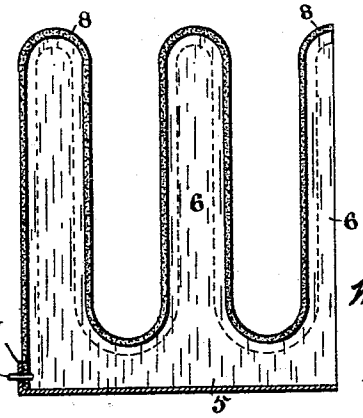


FIG. 3.



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(No Model.) 2 Sheets—Sheet 2.

W. E. PRALL.

CONDENSER.

No. 457,791. Patented Aug. 18, 1891.

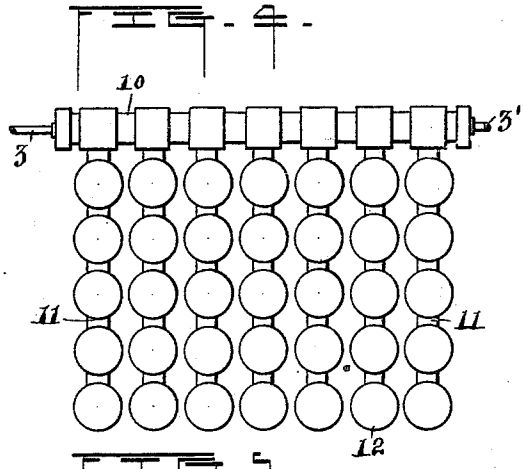


FIG. 5.

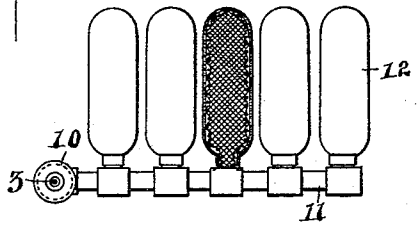


FIG. 6.

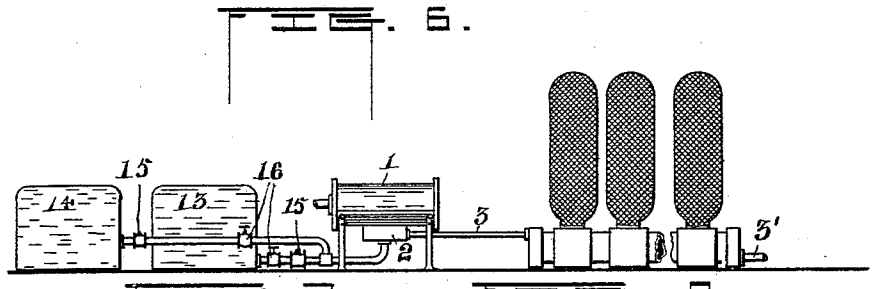


FIG. 7.

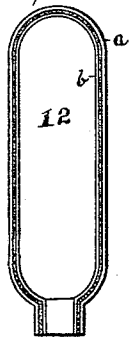
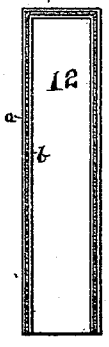


FIG. 8.



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UNITED STATES PATENT OFFICE.

WILLIAM EDGAR PRALL, OF WASHINGTON, DISTRICT OF COLUMBIA.

CONDENSER.

SPECIFICATION forming part of Letters Patent No. 457,791, dated August 18, 1891.

Application filed February 4, 1891. Serial No. 380,175. (No model.)

To all whom it may concern:

Be it known that I, WILLIAM EDGAR PRALL, a resident of Washington, in the District of Columbia, have invented certain new and useful Improvements in Condensers; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it pertains to make and use the same.

The invention has relation to steam-condensers, and, though primarily intended for use on street-cars, is capable of more general application; and the invention consists in the matter hereinafter described, and particularly pointed out in the claims.

In the drawings, Figure 1 is a side elevation, parts being broken away. Fig. 2 is a vertical section on line *x x* of Fig. 1. Fig. 3 is a vertical section of one-half the condenser on the line *y y* of Fig. 2. Fig. 4 is a plan of a modified form of the condenser. Fig. 5 is an end view, partly in section, of the same. Fig. 6 is a side elevation of a diagrammatic view of apparatus including air and water tanks, engine, and condenser, part of the latter being broken away. Figs. 7 and 8 are sectional views of details on an enlarged scale.

Let 1 indicate an engine, and 2 its valve-chest placed on the lower side thereof. This arrangement of the valve-chest is most suitable for the combined use of compressed air and highly-heated water, as set forth in my patent, No. 449,588, dated March 31, 1891.

3 is the exhaust-pipe.

4 indicates any convenient means of supporting a vessel 5, preferably in the form of a shallow pan. In Fig. 3 is shown at the bottom thereof a section of a part of such pan and a portion of the engine exhaust-pipe 3. From the sides of this pan rise the supports or posts 6 6, preferably integral with the pan, but not necessarily so. These posts or uprights are arranged in pairs, the two members of each pair being oppositely placed on the sides of the pan.

3′ indicates a water-discharge pipe.

The uprights above described are made to sustain a fibrous sheet or sheets in the following manner: A piece of coarse woolen cloth—for example, having a width a little larger than the distance between the uprights on opposite sides of the pan—has one of its ends secured in any convenient manner to the end 7 of the pan. The cloth is then arranged on the uprights in such manner that it extends between the opposite posts and from the top of said posts to a little below their junction with the sides of the pan proper. The edge of the cloth is folded over the posts and secured thereon by means of other similar posts or uprights, (denoted by 9,) which are applied upon the folded edges of the cloth, and then secured to post 6 by bolts or otherwise, so as to hold said edges of the cloth between them.

In Fig. 1 portions of the outer separable cloth-holding uprights are represented as broken away, showing the inner adjacent uprights and the folded edge of the cloth following the contour of said uprights. The manner in which these folded edges are clamped between the uprights 6 and 9 is indicated in Fig. 2. The cloth in Fig. 3 is represented as sectioned in a plane midway between and parallel to the uprights on opposite sides of the pan, the folded edge of the fabric being indicated by broken lines.

In Figs. 4 and 5 numeral 10 indicates a water-receptacle having an inlet 3, which may be the exhaust-pipe of an engine and an outlet 3′. The tube 10 has several branches 11, upon each of which are secured a series of domes or closed tubes 12, made of wire or perforated metal and covered with fibrous material, such as heavy woolen cloth.

Figs. 7 and 8 represent modifications of the tubes 12, in which two walls *a b* of wire fabric or perforated metal are made to sustain asbestus between them.

In Fig. 6 is diagrammatically represented an apparatus in which it is proposed to use the condenser, the form of the latter being in this instance that also shown in Figs. 4 and 5. A hot-water-storage tank is denoted by 13, and a tank for compressed air by 14. The valve-chest 2 is located at the under side of the cylinder to provide for easy discharge of water. 15 15 indicate check-valves, and 16 16 cocks to provide for the simultaneous admission of air and water to the cylinder. The design of this construction is to utilize com-

pressed air and highly-heated water in running the engine of a car or other vehicle by expanding the mingled air and water in the cylinder thereof. The water is used sufficiently hot to expand into steam in the cylinder, and the expansion of the air absorbs its heat, with the resulting effect of very largely increasing the work done by the air and at the same time lubricating the engine and discharging the steam or steam and water in a comparatively cool condition. In such apparatus it is desirable that the cylinder be capable of being freed promptly from water, and also that the exhaust-steam be at all times speedily and thoroughly condensed. For this reason the valve-chest is placed as indicated, and a condenser used of the general character herein set forth. In these condensers a water-receptacle is connected with an exhaust-pipe near its top and below the condenser proper and the water-outlet is placed as low as practicable, the arrangement being such that steam can be admitted and water drawn off without noise or interference of one with the other.

From the foregoing it will be understood that the pan is on its upper side inclosed by a textile cover arranged in folds or loops secured to the uprights and to the upper edge of the pan.

In operation steam and air are exhausted into the pan, and rising into the recesses or bays formed by the looped fabric the air passes out through its interstices, the steam accompanying it being rapidly condensed. This rapidity of condensation is insured by the final expansion of the air and by the fact that the air, which has free access to the exterior of the fabric, evaporates a part of the moisture, which is deposited by the steam in the interstices of the fabric, thereby reducing its temperature and maintaining its efficiency as a condenser. The main part of the water of condensation is deposited in the pan and may be discharged either at intervals or continuously and either upon the ground or into any desired receptacle.

It is characteristic of my improvement that the condenser is provided with an extensive surface of fibrous textile or equivalent capillary material, which will permit steam and air to come in actual contact, and will allow a substantial portion of the condensed steam to be evaporated from the exterior thereof. This effect may be secured by a great variety of open fibrous fabrics, textile, metallic, mineral, or vegetable, and by means of mechanical devices for supporting such fabrics other than the particular one illustrated, and the condenser can be varied in these particulars so long as substantially the same structure and the same principles of operation are preserved. Thus the particular form of the folds or convolutions are unessential and the sizes of the interstices thereof, provided they permit the escape of air and prevent any material escape of steam and have a capillary action sufficient to retain water until it is evaporated by the external air. The folds of cloth, when such are employed, will preferably be arranged in such manner as to promote the circulation of air on their exterior, and for this purpose they may be arranged in the direction of the motion of the car when used thereon.

I am aware that condensers have been made of wire-cloth, and also that fibrous materials have been used to aid the evaporation of water for refrigerating purposes, and such devices are not of my invention.

It is characteristic of my improvement that it brings air and condensed steam in contact in or upon fibrous or porous material, whereby the air aids in the evaporation of the water of condensation in or upon the wall of the condenser, the condensation of steam being aided by the evaporation of the product of previous condensation. It also provides for the free escape of air through the capillary passages in the material of the condenser, and it utilizes either the final expansion of air from the engine or external air, or both, to cool and condense the steam within the condenser by evaporation of water of condensation.

Having thus described my invention, what I desire to secure by Letters Patent is—

1. In combination with an engine and the exhaust-port thereof, a condenser inclosed by a textile fabric or the like, and a conduit leading from said exhaust-port to the condenser and adapted to conduct steam to the interior of the same, said condenser having no free outlet for steam and its fibrous or porous wall constituting its exterior being in free communication with air, whereby all of the steam is condensed and a part of the condensed steam is evaporated from the exterior of the condenser to reduce its temperature, substantially as set forth.

2. In combination with a steam-engine and the exhaust-port thereof, the water-holding receptacle having a convoluted cover of textile fabric or equivalent inclosing a chamber, and a conduit leading from said exhaust-port to the condenser and adapted to conduct steam and its fibrous or porous wall constituting its exterior being in free communication with air to the interior of the same, said condenser having no free outlet for steam, whereby all of the steam is condensed and a part of the condensed steam is evaporated from the exterior of the condenser to reduce its temperature, substantially as set forth.

3. In combination with a steam-engine and the exhaust-port thereof, the water-holding receptacle having oppositely-placed posts on its sides, and a fibrous covering secured in folds upon said posts and covering the receptacle, substantially as set forth.

4. The combination of the tanks and their respective pipes, supplying both air and water or steam to the engine, with said engine and with a condenser having a surface of ma-

terial provided with capillary interstices, said material constituting its external wall and being in free communication with the external air, and a pipe adapted to convey air and steam from the exhaust-port of the engine to the interior of the condenser, whereby provision is made for the free escape of air through the condenser and for the condensation of steam therein, substantially as set forth.

5. In combination with an engine, a condenser having a fibrous or porous wall, a pipe for introducing steam within the condenser, and means for bringing air in contact with said wall, substantially as set forth.

In testimony whereof I have signed this specification in the presence of two subscribing witnesses.

WILLIAM EDGAR PRALL.

Witnesses:
BENJ. R. CATLIN,
ARCH. M. CATLIN.