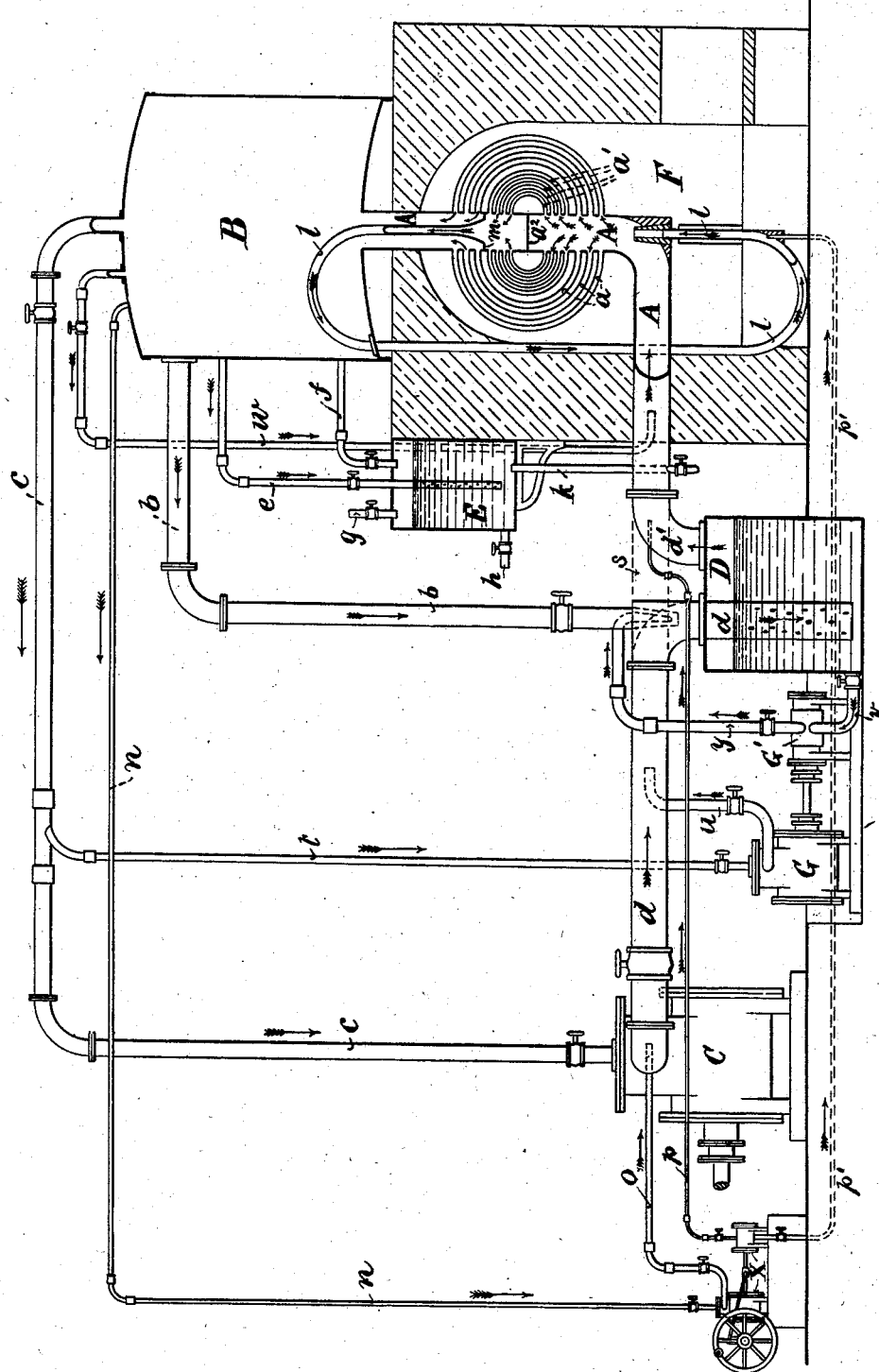


(No Model.)

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UTILIZING EXHAUST.

No. 260,033.

Patented June 27, 1882.



Witnesses

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# UNITED STATES PATENT OFFICE.

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## UTILIZING EXHAUST.

SPECIFICATION forming part of Letters Patent No. 260,033, dated June 27, 1882.

Application filed November 2, 1881. (No model.)

*To all whom it may concern:*

Be it known that we, HARVEY T. LITCHFIELD, of Hull, in the county of Plymouth, and DAVID RENSHAW, of Cohasset, in the county of Norfolk and State of Massachusetts, have invented a new and useful Improvement in the Process of Utilizing Exhaust, of which the following is a specification.

Our invention has for its object the utilization of exhaust issuing from engines worked by steam, air and steam, air, or other gases.

The invention consists in the production of a rapid circulation of the steam, gases, &c., under pressure, by means of a heater or superheater and jets.

The accompanying drawing represents an apparatus for carrying out our invention.

It represents a furnace, within which is placed a heater or superheater, connected with a steam reservoir, B, above the same. This heater or superheater is composed of a central pipe, A, provided with two series of semicircular tubes, *a a'*, one series of which is of larger diameter than the other series.

A is a pipe forming a part of the heater or superheater. In the pipe A is a partition, *a*<sup>2</sup>, so placed that the incoming steam shall be caused to pass through all the semicircular tubes. There is also in the pipe A, at a point between the two series, a partition, *m*, from which extends a pipe, *l*, (shown partly in section,) which pipe carries off the more highly-heated steam or gas, the steam or gas of lower temperature passing off from the upper portion of pipe A. The pipe *l* carries the more highly-heated steam again into the lower portion of pipe A, thus producing a circulation. This might also be accomplished by having two heaters or superheaters properly proportioned for the volume and heat of steam or gas to be used in each case. The steam passing through the pipes *a'* of larger diameter enters the reservoir B and passes through pipes *b c*, engine C, and through pipe *d* into tank D. The pipe *b* delivers steam from the reservoir B into the water-tank D until the heat and pressure in tank D is equal to that in reservoir B. When the engine is started, and the exhaust is carried into and through tank D

by the attained velocity of steam or gas passing through pipe *b*, the resultant steam or gas having a force due to the working pressures, completes the circulation. Should the resultant steam, in combination with the superheater alone be found sufficient to maintain said circulation, then the pipe *l* may be dispensed with and a single ordinary heater or superheater be used in place of the one shown.

*d* is the exhaust-pipe leading from the engine C into tank D or connecting directly with the heater A, but when leading into tank D the portion of pipe *d* below the water-line is perforated and closed at the lower end. *d'* is a pipe connecting the tank D with the pipe A. *e* is a pipe leading from reservoir B to engine C.

E is a reservoir partially filled with water, and is located above the level of the lower portion of superheater A and connected with the reservoir B by the pipes *e* and *f*. The pipe *e* extends to a point near the lower part of the reservoir, and is perforated below the water-line. The pipe *f* leads from the upper part of reservoir E into reservoir B. *g* is an air-supply pipe attached to the upper part of reservoir E. *h* is a water-supply pipe. *k* is a pipe connecting the lower portion of the reservoir E with the superheater A at its lower portion. By means of this arrangement water sufficient to fill the entire apparatus with steam can be forced into the lower portion of superheater A under all its conditions.

In making use of this apparatus to run engines with air alone we use an air-pump, X, worked by hand or other suitable means, with which to fill the apparatus to the desired working-pressure. This pump X exhausts into pipe *d* through pipe *o*, the air forced by such pump being delivered into pipe *d'* through pipe *p* or through pipe *p'* into pipe *l*. The air exhausted from engine C passes through the tank D, and is cleansed by its passage through the water. However, when this apparatus is used with air alone the tank D may be dispensed with and a pipe, *s*, made to connect pipe *d* with pipe A, and pipe *w*, extending from B to A, may be used to further assist the circulation.

G G' represent a pump, the steam end G of

which is provided with an exhaust-pipe, *u*, and is made very much larger than the water end *G'*, for the purpose of effecting delivery of the water under great pressure from the tank *D* through pipes *v*, *y*, and *b*, back into tank *D*, by means of which and the well-known affinity of water with steam and the attained velocity of steam or gas passing through pipe *b* the exhaust is forced into tank *D* without condensation, and from thence passes through the superheater into reservoir *B*.

In some cases the valve on pipe *b* may be closed, the action of the pump *G G'* being alone sufficient for the return of the exhaust.

15 In making use of this apparatus to run steam-engines with a mixture of air and steam (the steam being used for the purpose of lubrication) the apparatus may be used either way, as above described. In this case, as soon as 20 there is sufficient pressure—say five pounds—to work the air-pump the latter is started by means of steam carried through pipe *n* from reservoir *B*, and continues to deliver air into the apparatus until such time as the mixture 25 of steam and air has a density sufficient for the desired working-pressure.

The operation is as follows: A fire being started in the furnace, the valve in pipe *g* and valve in pipe *k* are immediately opened, and a 30 small quantity of water is let into the pipe *A*, sufficient, when generated into steam, to fill the entire apparatus with steam of the required working-pressure. Steam in passing through the superheater or heater is brought by the 35 same to two different temperatures, the steam of higher temperature passing through pipe *l* into the lower portion of the superheater, and thus by its greater rarity and action as a jet assisting the circulation. The valve in pipe *b* 40 is then opened, which allows the steam to pass from the reservoir *B* through the exhaust-pipe *d*, which is perforated below the water-line in tank *D*. When the water in tank *D* is brought up to the heat and pressure of the steam issuing from reservoir *B* the valves in pipe *c* are 45 opened, starting the engine. The exhaust of such engine being forced into pipe *A* by means of the jet from pipe *b*, the circulation is completed.

50 When the apparatus is worked with air or steam and air the exhaust may be carried through the tank *D*, as when working with steam alone; or it may be carried directly from the engine to the heater or superheater, as 55 above described.

What we claim as our invention is—

1. The process herein described of utilizing exhaust-steam by forcing the exhaust of an en-

gine into water of the temperature and pressure equal to that of the working-steam by a 60 jet of live steam, then conveying said exhaust and live steam into and through a superheater to be revived, when it is again in condition to be conveyed to the engine, substantially as 65 set forth.

2. The process herein described of utilizing exhaust-steam by forcing the exhaust of an engine into a tank of water of high temperature by a jet of live steam, then forcing the steam into a superheater from said tank to be revived, and there mixed with a jet of air from a pump, then passing it into the steam-receiver, 70 when it is in condition to be conveyed to the engine.

3. The process of utilizing exhaust, consisting in passing the exhaust-steam or steam and air through a superheater to a receiver, a portion of said exhaust being passed through the superheater two or more times, whereby it is more highly heated, substantially as and for 80 the purpose set forth.

4. In an apparatus for utilizing exhaust-steam, the combination of the superheater or regenerator with the cylinder of an engine, tank *D*, and exhaust-pipe *d* of the live-steam 85 jets *b* and *u*, arranged in such manner that the combined live steam and exhaust-steam is forced into the revivifying-vessel, substantially as set forth.

5. The combination, in an apparatus for utilizing exhaust-steam, of the superheater with the feeding-tank *E*, steam-pipes *e*, *f*, and *k*, and pipe *a*, for the supply of the superheater, and air-valve *g*, all arranged for joint operation for the starting of the apparatus and to supply 95 any loss from leakage during operation, in the manner shown and described.

6. The process herein described of utilizing exhaust, the same consisting in forcing the exhaust into water of the temperature and pressure 100 due to the working-steam by means of a jet of water of extraordinary velocity taken from the tank *D*, the said exhaust and water-jet being forced into tank *D*, and the resultant steam being carried into and through the superheater and revived, when it is again in 105 condition to be conveyed to the engine.

In testimony whereof we have signed our names to this specification in the presence of two subscribing witnesses.

HARVEY T. LITCHFIELD.  
DAVID RENSHAW.

Witnesses:

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