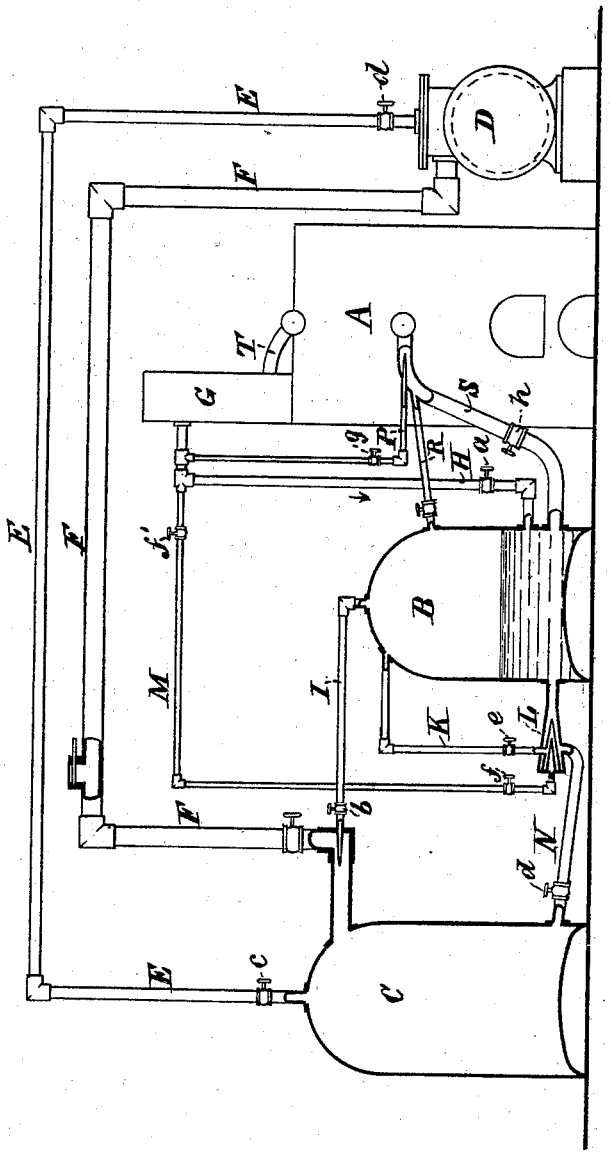
(No Model.)

H. T. LITCHFIELD & D. RENSHAW.

UTILIZING EXHAUST STEAM.

No. 262,959. Patented Aug. 22, 1882.



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UNITED STATES PATENT OFFICE.

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UTILIZING EXHAUST-STEAM.

SPECIFICATION forming part of Letters Patent No. 262,959, dated August 22, 1882.

Application filed September 9, 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-steam, revivifying the same, and controlling the pressure, of which the following is a specification.

The nature of our invention consists in maintaining three separate and distinct pressures in three separate and distinct vessels, one of which is to be a boiler and the others boilers or receivers, the several vessels being connected by pipes provided with jets and valves, all so arranged and operating as to produce said relative pressures, and by means of which the exhaust is first carried into the receiver of lowest pressure, and any surplus of steam or water arising therein is transferred to the receiver of the next highest pressure, and should greater pressure than desired be caused in such receiver, then such surplus of steam or water is further transferred to the water-body of the boiler of highest pressure, where it is again prepared for transferring heat to the vessels of lower pressure. By this means we are enabled to effect the utilization of exhaust-steam, control the pressure in the several vessels, and avoid all waste or loss of surplus steam.

Referring to the drawings, A is a boiler of extraordinary high pressure—say eight hundred to one thousand pounds.

G is a steam-drum connected to the upper part of boiler A by pipes T.

B is a vessel for receiving steam from the boiler A. It is shown in section, and contains a supply of water, which is heated by steam from boiler A until a pressure of, say, five hundred pounds, or such as would be sufficient for the purposes required, is produced.

C is a vessel connected with the vessel B by jet-pipe I, pipe N, and injector L. The vessels B and C are shown as receivers; but in the event of steam being required for other purposes than running an engine they may be steam-boilers.

D is an engine connected to the receiver C by steam-pipe E and exhaust-pipe F.

H is a pipe connecting the drum G with receiver B, and entering near the bottom of the same below the water-line.

I is a jet-pipe leading from receiver B into the exhaust-pipe F, leading into receiver C.

K is a pipe leading from receiver B to the injector L, which latter also connects with receiver B.

M is a pipe leading from the drum G to the injector L.

N is a pipe leading from receiver C to injector L.

P is a jet-pipe leading from drum G into pipe S, which latter connects receiver B with boiler A.

R is a pipe leading from the steam-room of receiver B into pipe S, which leads to the water-body of boiler A.

Suppose, for illustration, a pressure of eight hundred pounds on boiler A, and on receiver B five hundred pounds, and on receiver C eighty to one hundred pounds, if such should be the pressure desired for running the engine. Of course boiler A should be of sufficient capacity to furnish all steam required for the engine and the jets necessary for carrying out the process. In receiver B there is shown a water-body which has a temperature due to the pressure in such receiver, and thence becomes the regulator in this process both of volume and caloric without loss of heat. These conditions being understood, it is plain to see that the jets operating in injector L will force accumulating steam from receiver C into receiver B, where it is revivified for work; also, that the surplus of steam and water in receiver B is forced, as shown, into boiler A, from which it emanated.

The operation is as follows: Steam is first raised on boiler A to a very high pressure, and is then allowed to pass through pipe H, the valve *a* being opened into the receiver B at or near the bottom, where it continues to enter until the desired pressure is attained. Valve *b* in pipe I is then opened, which allows steam to pass from the receiver B to the receiver C, until the pressure in the latter necessary for the working of the engine is attained. Steam is then let on the engine by opening valves *c* and *d* in pipe E, and the exhaust entering pipe F is immediately acted upon by the jet of very high pressure steam issuing from receiver B and jet-pipe I, carrying along with it the exhaust-steam back to receiver C. The result of the continued flow of steam from receiver B is

a continued increasing pressure in receiver C, which is obviated by closing valve *a* in pipe H and opening valve *e* in pipe K and valve *d* in pipe N, which results in the overplus steam in receiver C being driven into the water contained in the receiver B when it is revivified. Valves *f* and *f'* in pipe M are then opened, allowing steam to pass from steam-drum G through the injector L into receiver B for the purpose of making good the heat lost by work done by the engine and by radiation. By this means it will be seen that the water and steam supply in boiler B is increasing when valve *g* in pipe P is opened, also valve *h* in pipe S, by which means water is injected from boiler B to pipe S into boiler A, thus furnishing the water-supply of boiler A. A pipe, R, leads from the steam-room of boiler B to pipe S near to the opening of jet-pipe G, whereby steam may be taken from boiler B and forced into the water portion of boiler A. Thus any excess of steam in boiler or receiver C is forced into boiler B, where it is revivified and acts as fuel. Should there be any excess of pressure caused in boiler B, it is forced into the highest-pressure boiler A as heat and feed-water, thus reducing the consumption of fuel to the least possible amount.

Pipe P and valve *g* on said pipe, pipe S and its valve *h*, and pipe R are for the purpose of establishing communication between boiler A and receiver B, should it for any purpose be necessary.

When there is an excess of pressure on boiler B, caused by steam passing from boiler A through pipe M into boiler B, and also a surplus of water, caused by radiation from the different pipes, the boiler C, and the engine, then valve *g* on jet-pipe P is opened, allowing live steam from boiler A to pass into the water-body of the same with great velocity, this condition being established when the valve in pipe R is opened, the pressure on boiler B forcing steam into contact with that issuing from the jet-pipe P, by which it is carried into the water-body of boiler A. Should there be more water in boiler B, caused by radiation from the exposed surfaces of the different pipes, the boiler C, and the engine, the valve *h* in pipe S being opened, the same action takes place as above stated, thereby controlling the pressure of steam and amount of water in boiler B.

In the ordinary method of injecting cold water into a steam-boiler when the supply of water is liable to be some ten feet lower than the boiler into which it is to be injected, the steam from the said boiler is carried into the water-body of the same with such force and velocity as to exhaust the air and raise the cold feed-water up to the jet-pipe before it can be forced into the boiler, and thus a vacuum of about five pounds has to be produced before the water can reach the steam to cause any condensation.

In our invention the steam is taken from boiler A through the steam-drum G and jet-pipe P into the water-body of the said boiler with such force and velocity as to insure the passage of the steam, also under pressure, from boiler B through pipe R into the water-body of boiler A, at the same time taking the water from boiler B through pipe S into the water-body of boiler A, by which it will be seen that the pressure from boiler B will assist the jet from pipe P, causing a positive action, and thereby dispensing with the necessity of creating a vacuum while forcing the water and steam of boiler B into the water-body of boiler A. In other words, the pressure on boiler B acts with and assists our process.

What we claim as our invention is—

1. The process herein described, consisting of first generating steam to an extraordinary high pressure, then conveying it to a lower-pressure vessel through a body of water in the latter, by means of which the water is raised to the temperature due to the steam, thence to still another receiver, under still lower pressure than either, from whence it is taken to the engine for work, the exhaust of which is forced back into the same vessel by a jet from the intermediate receiver, said jet also re-enforcing the pressure in the lowest-pressure receiver, as described.

2. The process of generating steam to a very high pressure, then transferring sufficient of it to vessels of varying pressures, and thence to the engine, the exhaust of which is forced into the vessel of the lowest pressure by means of a steam-jet from the intermediate vessel, the surplus steam of the said low-pressure vessel being first injected into a body of water in the intermediate vessel, and from it to the high-pressure boiler by means of jets from the high-pressure boiler.

3. In an apparatus for utilizing the exhaust of engines, the high-pressure boiler, the intermediate receiver or vessel, and the working-pressure receiver, with the pipe M and injector L, by which the high-pressure steam is forced through a body of water in receiver B, thus raising its temperature, and pipe I for injecting the exhaust-steam into the low-pressure receiver and revivifying the steam therein, substantially as described.

4. The combination of the high-pressure boiler and its steam-pipe M and nozzle L and receiver B, whereby the latter is made to govern the quantity of steam to the low-pressure receiver C, and the high-pressure steam-pipe M, nozzle L, and pipe P are made to force surplus water and steam from the low-pressure and intermediate vessel into the high-pressure boiler, in the manner set forth.

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

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Witnesses:
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