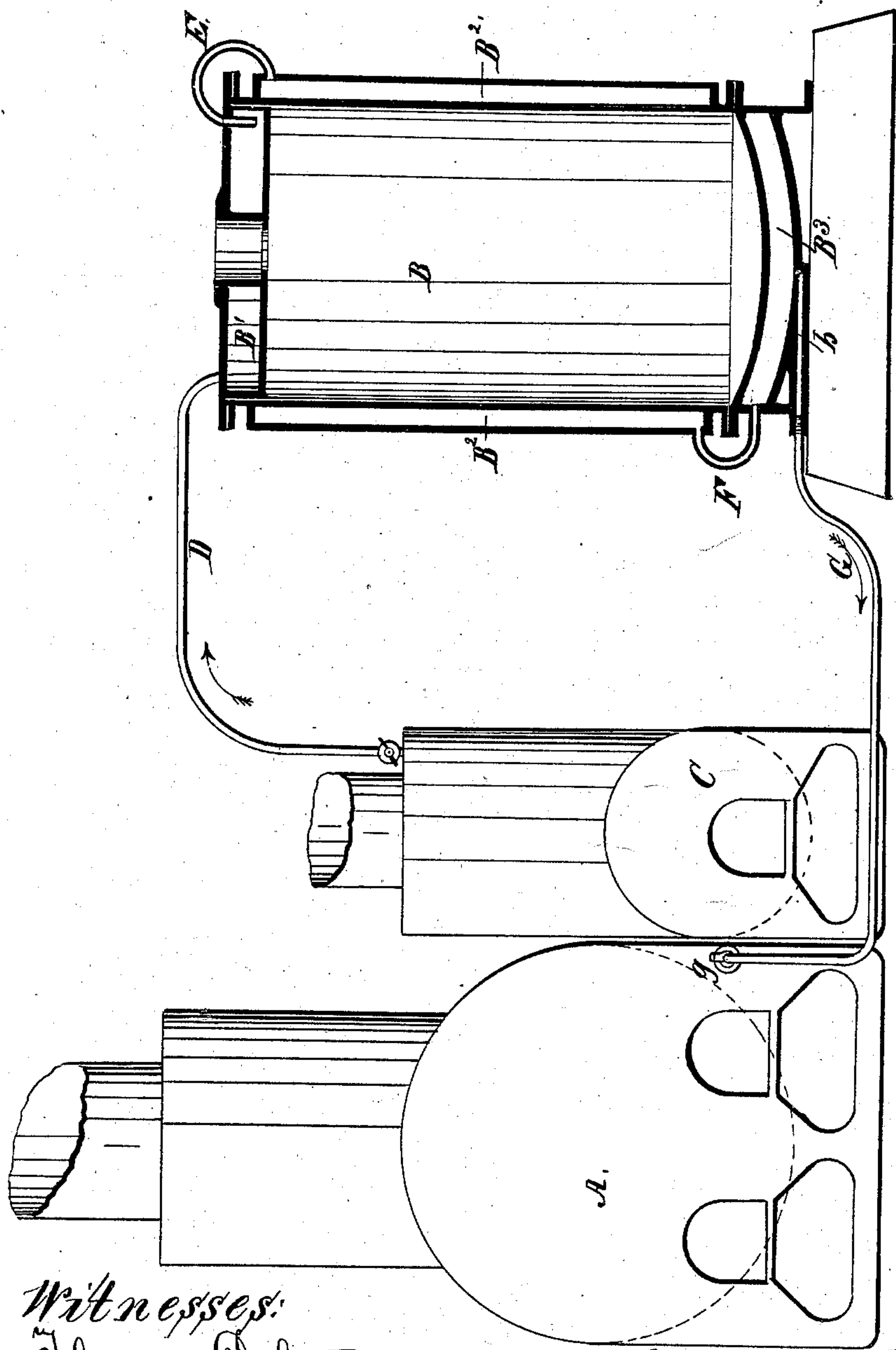


*E. W. Smith,*  
*Steam-Boiler Superheater.*  
*N<sup>o</sup> 32,538.      Patented June 11, 1861.*



*Witnesses:*

*Thomas D. Peterson*  
*Wm. B. Smith*

*Inventor:*

*E. W. Smith*



# UNITED STATES PATENT OFFICE.

ERASTUS W. SMITH, OF NEW YORK, N. Y.

## IMPROVEMENT IN STEAM-ENGINES.

Specification forming part of Letters Patent No. 32,538, dated June 11, 1861.

*To all whom it may concern:*

Be it known that I, ERASTUS W. SMITH, of New York, in the county of New York and State of New York, have invented a certain new and useful Improvement in Means of Drying or Superheating Steam; and I do hereby declare that the following is a full and exact description of the same, reference being had to the accompanying drawing, forming part of this specification, which is a vertical cross-section of the engine-cylinder and an end elevation of two of the boilers.

The advantages due to the use of steam which is slightly superheated are universally recognized, but the practical difficulties in the way of effecting this have prevented the general use of such steam. The incasing of a steam-cylinder partially or entirely within a jacket of steam from the same boiler which supplies the engine has been practiced previous to my invention; but inasmuch as the steam filling such jacket could not be hotter than the hottest steam admitted to the interior of the cylinder without involving serious practical disadvantages, which will be pointed out below, and as it is impracticable to perfectly and competely inclose the cylinder in any such jacket, the superheating of the steam cannot be practically effected by such means. In order fully to realize the benefits of superheating, a temperature must be applied somewhat higher than that due to the pressure of the steam admitted to the cylinder. In my invention the steam is superheated to a sufficient degree within the cylinder by means of heat received through the inner walls thereof from steam at a higher pressure outside. The transmission of heat through the inner walls of the cylinder, so as to heat more intensely the hottest steam which enters the cylinder, has been before proposed, but not under conditions which realize the advantages due to my invention.

The nature of my invention consists, first, in the heating of the cylinder of the engine to a temperature higher than the initial temperature of the steam worked within it by inclosing it in whole or in part in a jacket of steam which is generated separately from and is kept at a higher pressure, and consequently at a higher temperature, than that

used within the cylinder; second, in the combination and arrangement of the "donkey" or "nigger" boiler and the main boiler or boilers with their several passages and connections relatively to the cylinder of the engine and to the several parts of the jacket surrounding the same, in the manner and so as to cause a circulation from the donkey to the main boilers, as hereinafter described.

To enable others skilled in the art to make and use my invention, I will proceed to describe its construction and operation by the aid of the drawing and the figures of reference marked thereon.

A is a boiler, which either alone or in conjunction with another or others (not represented) supplies the steam to impel the piston. The steam from this boiler is conveyed to the interior of the cylinder B in the ordinary manner through a pipe and suitable steam chests and valves, (not represented,) and is discharged from the cylinder into the atmosphere or a condenser in any ordinary manner through valves or passages. (Not represented.)

C is a boiler separate from A and not connected therewith, except through the means hereafter described. It is adapted for use entirely independent of A or B when desired, as for working extra small engines in pumping, hoisting, &c., and is what is generally known as a "donkey-boiler" or a "nigger-boiler."

B is, as has been intimated, a cylinder, in which a piston (not represented) works in the ordinary manner. The cylinder cover is cast hollow, as represented. Its interior, B', is connected with the boiler C by means of the pipe D.

B<sup>2</sup> is a hollow space surrounding the cylinder. It is inclosed by a strong exterior shell, as represented, which may be cast with the cylinder or caused to form a steam-tight union therewith by any other convenient means.

E is a pipe connecting the lower portion of the cavity in the cylinder-cover with the upper portion of the space B<sup>2</sup>. The cylinder-bottom is cast hollow, as represented. Its interior B<sup>3</sup> is connected with the lower portion of B<sup>2</sup> by the pipe F. In the bottom plate of B<sup>3</sup> a passage, b, is formed, through which the



lowermost portion of the cavity is connected to the pipe G, which last communicates with the main boiler A through a cock, *g*.

Suitable means (not represented) are employed for supplying feed-water separately to the boilers A and C.

The pressure of steam in the boiler A is twenty-five pounds per square inch above atmosphere. It is admitted to the interior of the cylinder during a portion of each stroke and allowed to work therein expansively during the remainder of each stroke. The pressure of steam in the donkey-boiler C is one hundred pounds per square inch above atmosphere. The several pipes and cavities D, B', E, B<sup>2</sup>, F, B<sup>3</sup>, *b*, and G are of such capacity that a very violent flowage of steam from C to A through these would occur except for the obstruction offered by the stop-cock or valve, *g*. This latter must be open only to a small extent, so that the flow is moderate.

The temperature of steam at the pressure which obtains in A is 270°. The temperature due to the pressure of the steam within the interior or working portion of the cylinder B varies with its varying pressure, as is well known, its maximum being that due to the pressure in A, or 270° Fahrenheit.

The temperature of steam at the pressure of one hundred pounds which obtains in C is 342°. This is 72° Fahrenheit more than the maximum temperature due to the pressure of the steam in B. The pressure, and consequently the temperature, in the spaces B' B<sup>2</sup> B<sup>3</sup> is by reason of their free communication with C very nearly equal to that in C. The temperature of steam in its normal or saturated condition depends on its pressure, and the loss of any heat by the steam after leaving C results in condensing a portion and its existence in the form of water in the several cavities B' B<sup>2</sup> B<sup>3</sup>, while the temperature of the portion uncondensed remains the same as before.

The effect of my invention is as follows: The presence of the steam at a temperature of 342° Fahrenheit in the several cavities B' B<sup>2</sup> B<sup>3</sup> holds the temperature of the metal at nearly the same point. The steam in the interior of the cylinder, being at a lower pressure and temperature, absorbs a portion of the heat from the metal at each stroke, and thus becomes superheated to a proper extent, while the heat thus abstracted from the metal is replaced by heat received from the steam of higher pressure in the cavities. There is therefore a flow of heat through the inner walls of the cylinder, while the water produced by the condensation of the steam which supplies the heat trickles down to the lower portions of the several cavities, and is forced by the current of steam to travel into A, and is there allowed to expand into steam of the lower pressure which obtains therein. The several steps are as follows, viz: The water in B', so soon as it reaches its base, is taken

through E into B<sup>2</sup>; that in B<sup>2</sup>, so soon as it reaches its base, is taken through F into B<sup>3</sup>, and that in B<sup>3</sup> falls down into *b*, and, flowing moderately through the pipe G and violently through the cock or valve *g*, expands itself into A, where its peculiar action is finished, and, mingling with the other water and steam, it ultimately acts upon the piston as in other engines. The exterior surfaces of all the parts are protected from radiation by any ordinary means.

An effect analogous to that of my invention might be produced by superheating the steam flowing through D, so that the jacket B' B<sup>2</sup> B<sup>3</sup> would be filled with superheated steam instead of common steam. In such case the pressure in C and in the jacket might be as above proposed, or it might be the same or even less than that in A. I am not aware that any such plan has been before proposed; but should it be my invention is preferable thereto.

My invention is preferable to other means of superheating, because it exposes no steam-pipes or other steam-containing vessels to the risk of burning, and because as the donkey or nigger boiler is useful for other purposes it requires few extra parts and no unusual care or extraordinary knowledge or judgment on the part of the engineers. A partial jacket of steam from the same boiler which supplies the cylinder has been before applied around the ports only of steam-engines under such conditions that the steam being throttled between its passage into the jacket and its admission into the interior of the cylinder has thus been apparently able to impart heat to the contents of the cylinder in a manner analogous to mine; but such expedient is not equivalent to my invention, because, among other reasons, the water accumulating in the jacket by the abstraction of heat through the metal, as above described, must in such a method of superheating be discharged either into the cylinder, and thus defeat the object of the invention, or into the condenser or external air, with a loss of a portion or the whole of its heat. The main boiler or all the boilers must also in such a method of working be kept under a pressure higher than is necessary—a condition which involves a necessity for extra strength and expense, worse conduction of heat, and greater risk from explosion, &c.

Having now fully described my invention, what I claim as new therein, and desire to secure by Letters Patent, is—

1. Heating the cylinder of a marine steam-engine by inclosing said cylinder in whole or in part within steam which is generated separately from and at a higher pressure and temperature than the initial pressure of the steam admitted to the interior of the cylinder, substantially as and for the purpose herein set forth.

2. The employment of the donkey-boiler C



connections D, the steam-jacket or connected spaces B' B<sup>2</sup> B<sup>3</sup>, and the connection G, leading from the base of such connected spaces to the main boiler or series of boilers A, all combined and arranged substantially as and so as to operate together in the manner herein set forth.

In testimony whereof I have hereunto set my name in the presence of two subscribing witnesses.

ERASTUS W. SMITH.

Witnesses:

WM. B. SMITH,  
G. H. BABCOCK.