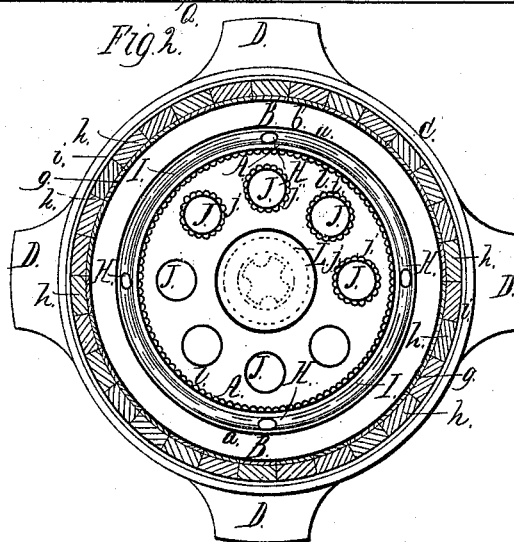
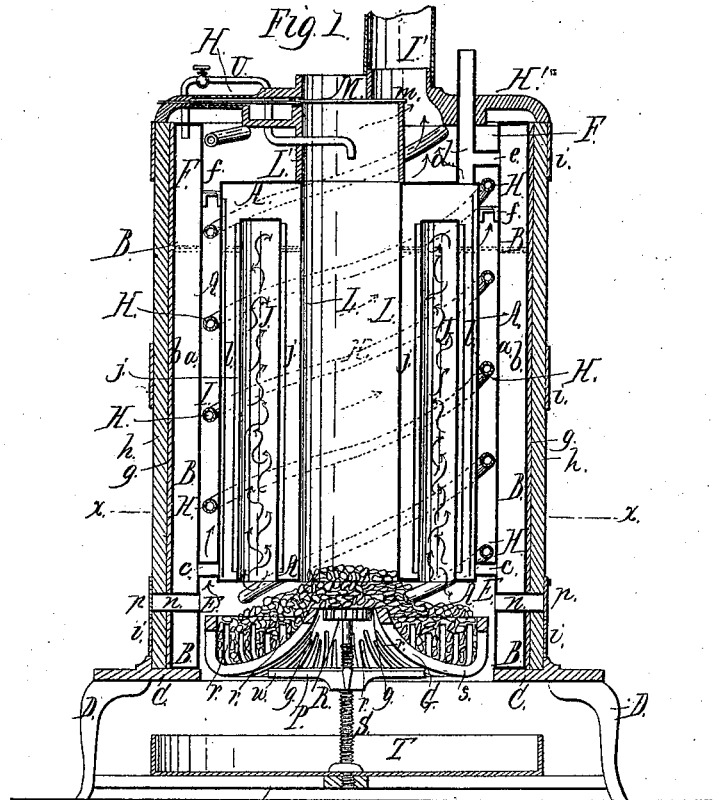


*R. W. & D. Davis,*  
*Steam-Boiler Fire-Tube.*  
*N<sup>o</sup> 54,063.      Patented Apr. 17, 1866.*



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# UNITED STATES PATENT OFFICE.

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## IMPROVEMENT IN STEAM-GENERATORS.

Specification forming part of Letters Patent No. 54,063, dated April 17, 1866.

*To all whom it may concern:*

Be it known that we, ROBERT WINSLOW DAVIS, of Flushing, in the county of Queens and State of New York, and DANIEL DAVIS, of Long Island City, in the same county and State, have invented certain new and useful Improvements in Steam-Boilers; and we do hereby declare the following to be a full, clear, and exact description of the same, reference being had to the annexed drawings, making a part of this specification, in which—

Figure 1 is a central vertical section of a steam-boiler constructed according to our invention. Fig. 2 is a horizontal section of the same in the plane indicated by the line *x x* in Fig. 1.

Similar letters of reference indicate corresponding parts in both figures.

Our improvements in steam-boilers relate to that class of boilers known as "upright boilers."

One feature of these improvements consists in the construction of such a boiler of an inner upright cylinder and a surrounding cylindrical water-jacket with an intervening annular flue-space, which is divided by means of spiral partitions into one or more spiral flues, through which the flame and gaseous products of combustion are caused to circulate circuitously around the said space, and so to remain longer in contact with the heating-surfaces of the said cylinder and jacket than if the said space were undivided, and are thereby made to yield up a greater portion of their heat to the water in the cylinder and water-jacket. These spiral partitions may be constructed of angle or plate iron, but we preferably make them of tubing, which, by communicating with the upper and lower parts of the said cylinder and shell, and thereby being always kept supplied with water and being exposed to the flame and gaseous products of combustion, are made to serve as a very effective means of generating steam.

Another feature of the invention consists in a novel arrangement within a so-constructed boiler, and in relation to the furnace-grate thereof, of a series of gas-mixing chambers, which are closed at the top but open at the bottom for the reception of portions of the gaseous products of combustion from the fur-

nace. The combustible gases eliminated from the fuel and undecomposed air, which pass through the fuel on the grate, rising together into the said chambers are mixed, and the ignition and combustion of the said gases thereby effected, and the heat thereby evolved in the said chambers, the exteriors of which constitute heating-surfaces, is thereby made instrumental in generating steam.

Another feature of the invention consists in providing the exteriors of the said gas-mixing chambers with coverings or shirts of corrugated sheet metal, between which and the exteriors of the said chambers the steam generated from the water in contact with the said chambers is allowed to pass upward into the steam-room in the upper part of the boiler without passing through the body of water in the boiler, and being thereby partly condensed.

Another feature of the invention relates to the use, in a steam-boiler, of a central fuel-supplying reservoir like that of what are known as "base-burning stoves." In this reservoir, though no active combustion takes place unless it be very near the bottom, the coal is to such extent heated that combustible gases are evolved from it, and these are carried off by a downward draft through and over the fuel in active combustion on the grate, and so burned. In order to obtain a very perfect combustion of these gases, as well as to avail ourselves to the fullest extent of the advantage of introducing steam among the fuel, we introduce a steam-pipe which supplies steam from the boiler to the upper part of the fuel-supplying reservoir, and this steam, being carried with the downward draft through the whole body of fuel in the reservoir, is caused to mingle thoroughly with the gases evolved therefrom, and is superheated preparatory to its arrival among the hotter fuel, and in consequence more easily decomposed and caused to enter into combustion.

To enable those skilled in the art to understand the construction and operation of our invention, we will proceed to describe it with reference to the drawings.

A is the inner or main upright cylinder of the boiler, and B is the surrounding upright cylindrical water-jacket. The water-jacket is com-

posed of two upright cylinders, *a b*, united at top and bottom, and arranged concentric with the cylinder *A*, and it extends upward some distance above, and downward some distance below, the cylinder *A*, with which it is connected near the bottom by the short water-pipes *c c*, and at the top by the steam-pipes *d e*, the pipe *d* being the pipe through which the steam passes to the engine or other apparatus where it is to be used. The water-jacket rests upon the horizontal base-plate *C*, which is supported upon suitable standards *D D*, and the cylinder *A* is attached to the jacket by angle-irons *f f*, or other suitable means, which are strong enough to bear the weight of the said cylinder and its contained water. The portion of the jacket *B* which extends downward below the cylinder *A* forms the sides of the furnace *E*, within which is arranged the circular grate *G*, and the portion of the jacket which extends upward above the cylinder *A* forms the sides of the smoke-box *F*, for the reception of the gaseous and fuliginous products of combustion which pass upward from the furnace through the annular space left between the cylinder *A* and water-jacket. The jacket and cylinder are covered by a plate, *H'*, which forms the top of the smoke-box, and on which is placed the chimney or uptake *I'*. The exterior periphery of the jacket *B* is surrounded with a casing of felt, *g g*, and wooden staves *h h*, which are held in place by hoops *i i*, the said casing serving to prevent loss of heat by radiation. There may be a further addition of one or more water-jackets of similar character to *B*, arranged outside of and surrounding it.

*H H* are pipes arranged spirally within the flue-space *I*, between the cylinder *A* and water-jacket *B*, to form partitions dividing the said space into a series of spiral flues, through which the flame and gaseous products of combustion from the furnace circulate around the boiler and gradually ascend to the smoke-box *F* and chimney or uptake. These pipes, in order to properly divide the flue-space *I*, it is obvious must be of a diameter to fit the said space snugly. Their lower ends are connected with the lower part of the water-jacket *B*, and their upper ends with the upper part of the same, so that they are always kept filled with water to the same level as the cylinder *A* and water-jacket. As the exteriors of the said pipes are exposed to the flame and heated gaseous products of combustion, the water in contact with the inner surfaces is rapidly converted into steam, which ascends into the steam-space in the upper part of the water-jacket *B*. Instead of these pipes *H H* spiral partitions, of angle or other iron, may be arranged in a similar manner to divide the flue-space *I* into a series of spiral flues; but the pipes are preferable, as, by forming a means of generating steam, they economize the heat from the ascending flame and gases of combustion.

*J J* are the gas-mixing chambers, of upright, cylindrical, or other suitable form, closed at

their upper ends and open at their lower ends, which are secured in openings in the bottom of the cylinder *A*, in which they are arranged in a circle, as shown in Fig. 2, at equal distances apart and at equal distances from the center of the cylinder. Portions of the gases arising from the fuel ascend into these chambers with air, which passes through the fuel without entering into combustion, and the said gases and air, mixing in the said chambers, enter into combustion, and as the exterior surfaces of the said chambers are heated by the combustion within them, steam is generated from the water in contact with them. The carbonic acid resulting from the combustion within the said chambers descends by its greater specified gravity and passes out from the said chambers to the flue-space *I*, and passes upward to the smoke-box and chimney or uptake.

*j j* are the shirts, of thin corrugated sheet metal, fitted to the exteriors of the chambers *J J* and extending from near the bottom up to the top of the said chambers. These may be made by rolling up a piece of corrugated sheet metal into the form of a tube of an internal diameter somewhat smaller than the exteriors of the chambers, so that when they are slipped over the chambers they will retain themselves thereon by their elasticity. The lines of the corrugations are lengthwise of the chambers, so that the corrugations form passages through which water may circulate upward over the hot surfaces of the chambers, and in which the water in contact with the chambers is insulated from that outside of the shirts, so that as it is converted into steam by the heat of the chambers such steam may circulate upward into the steam-room of the boiler without passing through the main body of water in the cylinder, and its place may be taken by water entering at the bottom of the shirts. The cylinder *A* is fitted with a lining of corrugated metal for the same purpose.

*L L'* is the central fuel-supply reservoir, all but the upper part of which consists of a vertical cylinder, *L*, open at top and bottom and extending right through the cylinder *A* and connected with the top and bottom thereof. The upper part of the said reservoir is composed of a short cylinder, *L'*, Fig. 1, which is attached to the top plate, *H'*. At the top of the cylinder *L* there is a tight-fitting horizontal slide, *M*, which is opened for filling up the reservoir with coal or other fuel, but closed at all other times. When this slide is open it opens a communication at *m*, Fig. 1, between the reservoir and the chimney or uptake *I*, in order that any gases or smoke rising from the furnace or the fuel in the reservoir may be drawn into the chimney by the draft, and so be prevented from entering the boiler-room. The bottom of this fuel-reservoir being always open, the grate is kept supplied with fuel, which descends by gravitation as fast as that on the lower part of the grate is consumed,

and that above descends to take its place. Active combustion of the fuel only takes place as far up as the bottom of the fuel-reservoir, as when the slide M is closed the only provision for the ingress of air is through the grate or by openings *n n* in the sides of the furnace just above the grate, the fuel in the reservoir being out of the draft. Any gases or vapors that might be generated by the heating of the fuel in the lower part of the reservoir would be caused by the draft to escape downward into the fire and be consumed. The openings *n n* aforesaid are provided with external shutters, *p p*, which may be partly opened, to a greater or less extent, to admit a regulated supply of air above the fuel on the grate for the purpose of inflaming the carbonic oxide. The said openings may be so large that when their shutters are wide open sufficient cold air may be admitted above them to check combustion whenever desired.

U is the steam-pipe for admitting steam among the fuel in the reservoir L L'. This pipe is connected with the upper part or steam-space of the boiler, and passes through the upper part, L', of the reservoir, and its extremity is formed into a nozzle, *v*, from which the steam issues in one or more jets among the fuel. In order to provide for the closing of this pipe while introducing fuel into the reservoir, or at any other time, a portion of the side pipe is brought through the plate H, to the exterior thereof, and this portion is furnished with a stop-cock, *u*. The steam issuing from this pipe among the fuel in the reservoir circulates among and through the said fuel, and

thus becomes superheated, so that on its issuing from the bottom of the reservoir into the furnace it is at once decomposed, and its elements—oxygen and hydrogen—enter into combustion with the fuel in the furnace and contribute to the heating of the boiler and the economy of fuel.

What we claim as new, and desire to secure by Letters Patent, is—

1. In combination with the upright inner cylinder and surrounding upright water-jacket, the spiral partitions dividing the annular space between such cylinder and water-jacket into spiral flues, substantially as herein described.

2. The arrangement of the gas-mixing chambers J J in relation with the cylinder A, the central fuel-supplying reservoir, L, and the grate G, substantially as and for the purpose herein specified.

3. The elastic corrugated shirts *j j*, in combination with the gas-mixing chambers J J, substantially as and for the purpose herein specified.

4. In combination with a fuel-supplying reservoir, so arranged in relation to the fire-grate or furnace and chimney of a steam-boiler that any draft in the said reservoir will be in a downward direction, a pipe or nozzle arranged to conduct steam from the boiler into the upper part of the said reservoir, substantially as herein specified.

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