

(No Model.)

2 Sheets—Sheet 1.

F. W. SMITH.  
SMOKE CONSUMER.

No. 577,372.

Patented Feb. 16, 1897.

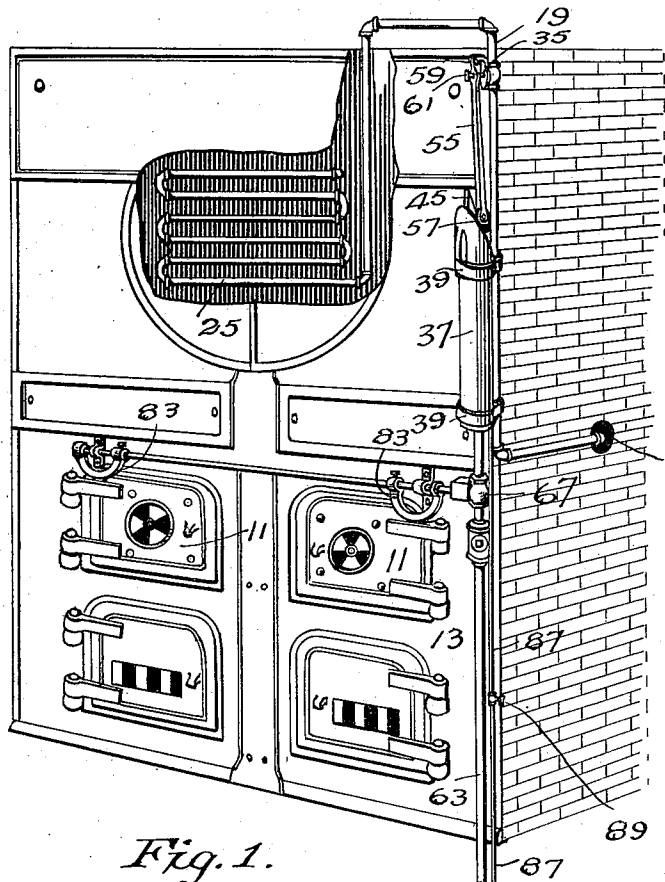


Fig. 1.

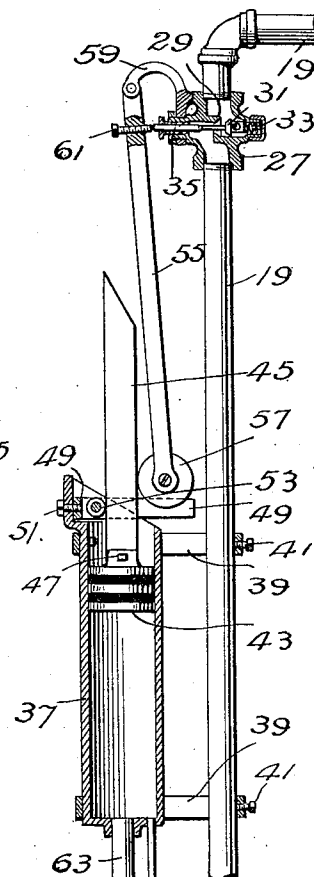


Fig. 4.

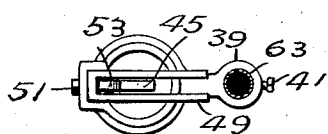


Fig. 6.

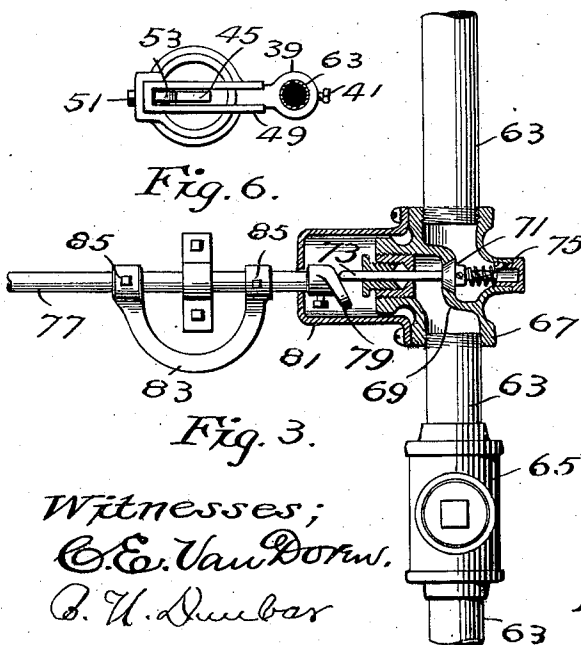


Fig. 3.

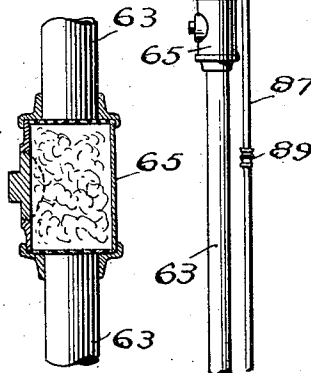


Fig. 5. Inventor,  
Fred W. Smith,

By Paul Hawley  
his Attorneys.

Witnesses;  
C. E. Van Dorn,  
G. H. Dumble

(No Model.)

2 Sheets—Sheet 2.

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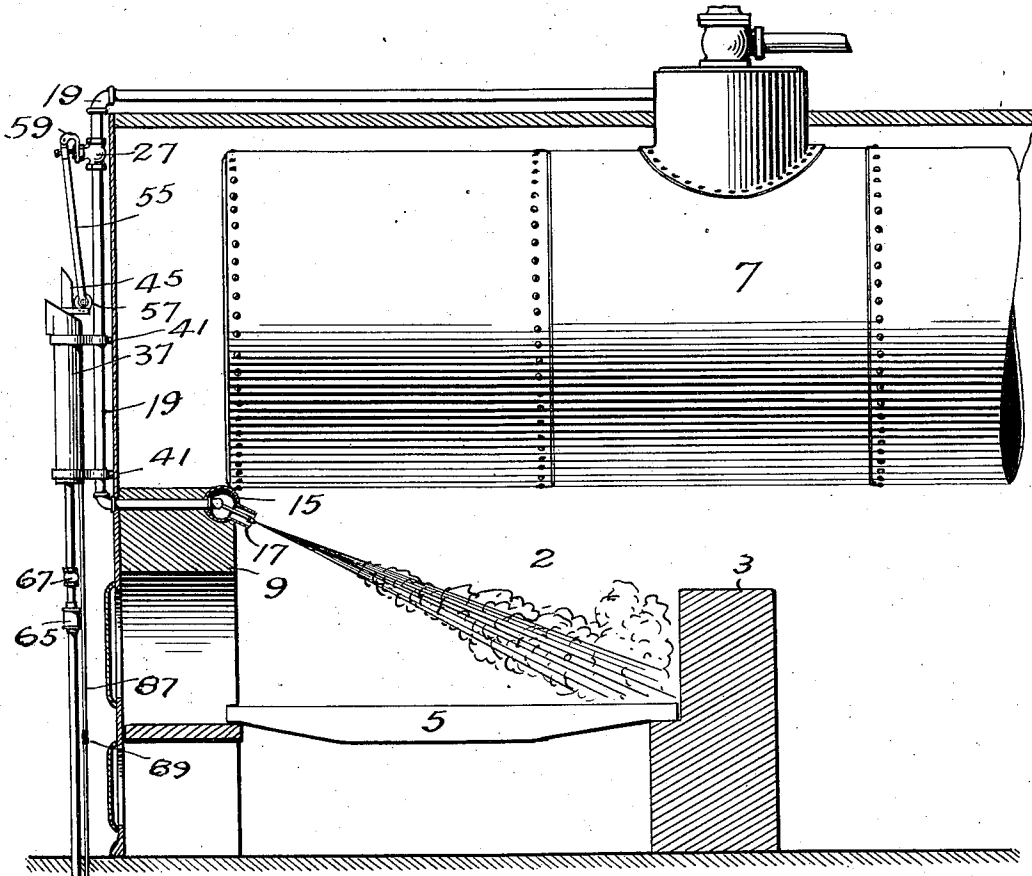


Fig. 2.

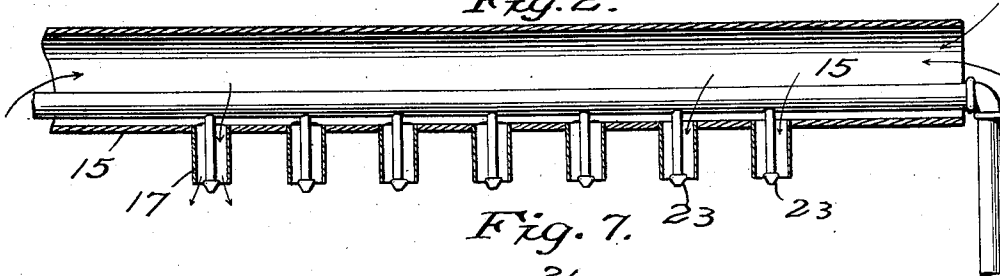


Fig. 7.

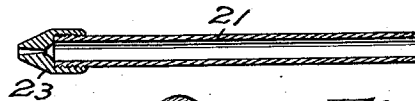


Fig. 8.

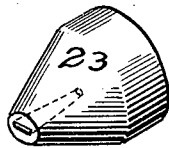


Fig. 9.

Witnesses;

C. E. Van Doren

A. H. Dumbor

Inventor;

Fred W. Smith.

By Paul Hawley  
his Attorneys.

# UNITED STATES PATENT OFFICE.

FRED W. SMITH, OF MINNEAPOLIS, MINNESOTA, ASSIGNOR OF THREE-FOURTHS TO NEWTON T. HUME AND WILLIAM H. DAVIES, OF SAME PLACE, AND SUMNER W. HUME, OF CHICAGO, ILLINOIS.

## SMOKE-CONSUMER.

SPECIFICATION forming part of Letters Patent No. 577,372, dated February 16, 1897.

Application filed August 3, 1896. Serial No. 601,407. (No model.)

*To all whom it may concern:*

Be it known that I, FRED W. SMITH, of the city of Minneapolis, county of Hennepin, State of Minnesota, have invented certain new and useful Improvements in Smoke-Consumers, of which the following is a specification.

This invention relates to improvements in devices designed for application to stationary, marine, or locomotive engine furnaces for the purpose of causing a substantially complete combustion of the fuel that is applied thereto.

It is well known that when a fresh supply of fuel is put into a furnace that a large amount of gas will be immediately thrown off therefrom. Considerable quantities of unconsumed carbon will be carried off by this gas and the whole will pass out of the furnace in the form of a dense black smoke, which will be emitted from the chimney. As the fuel becomes partially consumed a less amount of such gases will be thrown off, and after a time with the natural draft of the furnace there will be a very nearly complete combustion of fuel. It has been customary heretofore, in some instances, to provide devices generally called "smoke-consumers," which consist in some means for providing an increased supply of air above the fire of the furnace for the purpose of supplying oxygen in larger quantities and thereby obtaining a more complete combustion of the fuel. This is, however, objectionable, as after a time when the fuel has become partially consumed this additional supply of air is unnecessary and simply retards the combustion of the fuel in the furnace. I propose to obviate these objections by providing means which, when the door of the furnace is opened, will substantially supply to the furnace, above the fuel, a current of highly-heated air and steam, and will continue to supply such current for a predetermined length of time after the furnace-door has been opened. This means may be regulated by the fireman or engineer according to the quality of fuel he is using, so as to have the current of steam and heated air supplied long enough to burn off all of the gases that are

driven off from the fuel when it is first applied to the fire.

My invention consists generally in the constructions and combinations hereinafter described, and particularly pointed out in the claims.

In the accompanying drawings, Figure 1 is a perspective view, partially broken away, of a stationary-engine boiler having my invention applied thereto. Fig. 2 is a longitudinal vertical section of the furnace, showing the arrangement of the hot-air flue and of the steam-jets therein. Fig. 3 is a side elevation and partial section of the valve through which the water is supplied to the regulator each time that the door of the furnace is opened. Fig. 4 is a vertical section of the cylinder of the regulator, showing its connection with the steam-valve and showing also the waste-pipe connected therewith. Fig. 5 is a detail showing the filter that may be applied in connection with the water-pipe through which water is supplied to the regulator. Fig. 6 is a top view of the water-cylinder and section of the steam-pipe. Fig. 7 is a transverse section of the hot-air flue, showing the air-pipes connected therewith and showing also the steam-pipe passing through said flue with a series of steam-jets arranged in said air-pipes. Fig. 8 is a longitudinal section of one of the steam-jets and the steam-pipe connected thereto. Fig. 9 is a perspective view of one of the steam-jets or nozzles.

The present invention is applicable to stationary, locomotive, or marine engines. While I have shown it in the drawings and shall describe the invention as particularly applicable to a stationary-engine boiler, it will be understood, however, that the same device is applicable, without material alteration or reconstruction, to marine or locomotive engine boilers.

In the drawings, 2 represents the fire-box of a boiler-furnace, which, as before stated, may be of any ordinary or preferred construction.

3 represents the bridge-wall, and 5 the grate thereof, and 7 represents a boiler arranged in any suitable setting in said fur-

nace. As here shown, at the forward end of the grate is a suitable arch 9, preferably one at each side of the furnace, forming a fuel-opening through which fuel may be supplied to the grate as needed, each of said openings being provided with a suitable door 11, preferably hinged in a suitable manner to the head-plate 13 of the furnace.

At some point between the forward end of the furnace and the bridge-wall 3 I provide a transverse flue 15. Said flue may be in the form of a cast-iron pipe or a pipe of any other suitable material, or it may be formed in the brickwork or masonry that constitutes the boiler-setting. I have here shown this flue in the form of a pipe arranged in the upper part of the arch 9 and having a series of short pipes 17, connected thereto and extending into the upper part of the fire-box, and, as here shown, arranged upon an angle, so that a current of air passing therethrough would be directed backward and downward into the central part of the fire-box. A steam-pipe 19 preferably extends through this flue, and said steam-pipe is provided with a series of short pipes 21, preferably arranged centrally in the pipes or tubes 17, leading out from the flue 15. The ends of the pipes 21 are provided with nozzles 23, (see Figs. 8 and 9,) said nozzles preferably having openings through them that are spread out or fan-shaped to a certain extent, but of substantially the same area throughout, so that a current of steam passing through each of said nozzles will, as it emerges therefrom, be spread out in the form of a flat sheet.

The flue 15 is preferably open at both ends, so that the air has free access thereto, and as this is arranged substantially over the furnace on the fire-box the air that passes into it will become very highly heated, and when steam is supplied to the pipe 19 and nozzles 23 the heated air from the flue 15 will be drawn out through the pipes 17 and will be immediately mingled with the steam passing through the steam-pipe 19 and the jets 23.

While I prefer to use the steam jets or nozzles having their openings of the flattened form shown in Figs. 8 and 9, I do not wish to be limited to this form of opening, nor do I wish to be limited to the use of any particular material for the construction of said nozzles. I have used nozzles constructed of brass and have found this material desirable for the purpose; but I may prefer to construct such nozzles of cast-iron or other suitable material.

The steam for supplying the pipe 19 may be drawn directly from the steam-dome of the boiler, as shown in Fig. 2, or I may provide a steam-coil 25, that is connected to the steam-pipe 19, as shown in Fig. 1, this steam-coil being arranged within the furnace so that the water passing therethrough will be converted into steam, which will then be supplied to said pipe 19. I arrange in the pipe 19 a suitable valve with means for regulat-

ing the passage of the steam through said valve, as hereinafter described. Any suitable valve may be used for this purpose. I prefer to provide an ordinary steam-valve coupling 27, that is arranged between two parts of the pipe 19 and is suitably connected thereto. Within this coupling is a suitable valve-seat 29, a valve 31, adapted to fit upon said seat, and a spring 33, adapted to hold said valve upon its seat and thereby cut off the passage of steam from said pipe. This valve is provided with a valve-stem 35, which passes through a suitable stuffing-box in the coupling 27, so that by moving said valve-stem the valve 31 may be opened when desired.

A cylinder 37 is mounted upon a suitable support, preferably being connected to the pipe 19 by suitable straps or bands 39 and set-screws 41. Within this cylinder is arranged a piston 43, having pivotally connected thereto the piston-rod 45. Said rod is preferably in the form of a flat strip secured to the piston by the pivot 47, and the upper end of said piston-rod is cut off at an angle, as shown in Figs. 2 and 4. Above said cylinder I preferably provide a yoke 49, suitably supported, as by being secured to the top of said cylinder by a screw 51. Said piston-rod 45 passes through said yoke and is prevented from turning thereby, and the edge of said piston-rod rests upon a roll 53, that is mounted in said yoke. (See Fig. 4.) An arm 55 carries a wheel 57, that bears upon the opposite edge of said piston-rod 45, and said arm 55 is pivoted to a suitable support 59, and said arm carries a set-screw 61, adapted to engage the end of the valve-stem 35.

A suitable water-pipe 63 is connected to the cylinder 43 and extends to a tank or other source of water-supply. A suitable filter 65 (see Figs. 4 and 5) may be arranged in this pipe so as to remove any impurities from the water before it passes into said cylinder. A suitable valve is arranged also in the pipe 63, by means of which the supply of water to said cylinder may be regulated. As here shown, a valve shell or body 67 is coupled to the pipe 63. Said valve-shell is provided with a suitable valve-seat 69 and with a valve 71, mounted upon a suitable valve-stem 73. A spring 75 is arranged to engage the lower end of said valve-stem and to hold said valve normally closed. Arranged above the doors of the furnace is a suitable rock-shaft 77, having the cam 79 upon the end thereof, and I preferably arrange one of said cams upon each end of said shaft. This cam is in position to engage the valve-stem 73 of the valve 71. A casing 81 is preferably arranged to cover said cam and the ends of said valve-stem, as shown in Fig. 3.

Secured upon the shaft 77 are the curved bars 83, preferably secured in position by means of set-screws 85, so as to be adjustable upon said shaft. These arms extend down close to the outer surface of the furnace-door,

preferably near the upper edge thereof, in such position that said arms are encountered by the opening of said doors, whereby the shaft will be rocked and the valve 71 will be opened whenever either of said doors is open. Upon the opening of said valve water will pass through the pipe 63, thereby raising the piston 43, and the wheels 57 will be forced down over the inclined surface of the upper end of the piston-rod 45 into the position shown in Fig. 4, thereby opening the steam-valve 31 and permitting the steam to pass into the pipes 19 and through the steam jets or nozzles 23 into the fire-box. The closing of the furnace-doors will permit the valve 71 to be closed by the spring 75. A waste-pipe 87, provided with a valve 89, is connected to the cylinder 37, and the water from said cylinder gradually passes out through said pipe 87. The rapidity with which said water will pass out through the said pipe may be regulated as desired by means of the valve 89. As the water passes out of said cylinder the piston will slowly fall therein until the wheel 57 passes back over the inclined upper surface of the piston-rod 45, which will carry the end of the screw 61 out of contact with the end of the valve-stem 55 and permit the valve 31 to be closed by the spring 33, thereby shutting off the supply of steam from the nozzles or steam-jets. It will be seen that with this mechanism when the furnace-door is opened for the purpose of supplying fuel to the fire-box the steam-supply is automatically turned on through the steam-jets and is continued for a predetermined time after said door is opened. The air passing through the air-flue will at all times be heated, and the action of the steam-jets will be to draw said air out of said flue through the pipes 17 and into the fire-box of the furnace. The steam and heated air will together mingle with the gases and unconsumed carbon thrown off from the fuel, and the oxygen from said steam and air uniting with said gases will produce substantially complete combustion thereof, and this action taking place in the fire-box and before the gases have passed over the bridge-wall of the furnace will be complete before the gases have passed to a point where the temperature will be lowered by coming in contact with the flues of the boiler. This will prevent the passage of the unconsumed gases and black smoke out of the chimney or smoke-stack and will in fact produce a substantially complete combustion of the fuel, thereby securing a very large economy in the consumption of the fuel and a consequent saving in the cost of producing the necessary amount of steam for the operation of the engine that is connected to the boiler. The cutting off of the supply of steam will be a gradual operation, and thereby the amount of steam and air forced into the furnace will be gradually reduced and will finally cease. Where the device is applied to a locomotive-engine, it will, by the same process, prevent the throwing out of

sparks and cinders from the smoke-stack of the locomotive.

While I have described the regulator by which the steam-valve is controlled as operated by water let into the cylinder each time the door of the furnace is opened, it will be obvious that I might operate the piston in this cylinder by means of compressed air controlled in the same manner and obtained from a suitable source of supply, or this piston might also in some instances be operated by steam in place of water. I consider, however, that the water is preferable where it can be directly obtained for the purpose.

Having thus described my invention, I claim as new and desire to secure by Letters Patent—

1. The combination, with a furnace having an air-passage to the fire-box, of a valve whereby the passage of air to the fire-box is controlled, a cylinder, a piston provided therein, the piston-rod disconnected from said valve and whereby said valve is actuated and held open during the greater part of the movement of the piston, and from which the valve is liberated upon the complete return of the piston within the cylinder, a supply-pipe leading to said cylinder, a valve provided therein, means in connection with the furnace door or doors for opening said valve upon the opening of said door or doors, and a waste-pipe leading from said cylinder, for the purpose specified.

2. The combination, with a furnace, of an air-passage provided in the wall thereof, ducts leading from said air-passage into the fire-box of the furnace, siphoning pipes or nozzles provided therein, a pressure-pipe connected therewith, a valve provided in said pipe, a lever for actuating said valve, a cylinder, a piston therein, a piston-rod disconnected from and engaging said lever to open said valve, and to hold the same open during the greater part of the movement of said piston within the cylinder, a supply-pipe leading to said cylinder, a waste-pipe leading from said cylinder, a valve provided in said supply-pipe, and means whereby upon the opening of the furnace-door said valve is operated, substantially as described.

3. The combination, with the furnace, of the air pipe or duct arranged in the front of the fire-box, openings leading therefrom into the fire-box, nozzles provided therein, a steam-pipe for supplying steam thereto, a valve provided in said steam-pipe, a lever for operating said valve, the cylinder 37, the piston, the piston-rod 45 adapted to engage said lever said rod having a beveled end, the inlet-pipe and the waste-pipe connected to said cylinder, the valve 67 provided in said inlet-pipe, the furnace door or doors, the rock-shaft, the arm or arms provided thereon to engage the said door or doors, and means operatively connecting said shaft and the stem of said valve to operate the same, substantially as described.

4. The combination, with the furnace, having air and steam inlet openings in its fire-box, of the steam-pipe, the valve 27 provided therein, the lever 55 for operating said valve, 5 the cylinder 37, the piston therein, the piston-rod 45 having a beveled end, said rod adapted to actuate and hold said lever 55 during the greater part of the movement of said piston, the furnace door or doors, the rock-shaft, the 10 curved arm or arms 83 thereon to be operated by the opening of the furnace-door, an inlet-pipe leading to said cylinder, a valve therein, a cam upon said rocking shaft to operate said valve, whereby upon the opening of the fur- 15 nace-door said valve is opened to permit the filling of the cylinder to raise the piston, and a smaller waste or drain pipe leading from the cylinder and by which the cylinder is slowly emptied, substantially as described.
- 20 5. The combination, with the boiler and the fire-box, of a steam-jet pipe, a valve provided in said pipe, means for automatically closing said valve, a lever for opening the same, a cylinder and a piston, said piston provided 25 with a rod disconnected from and arranged

to engage and hold said lever, inlet and outlet pipes connected with said cylinder, and a valve in said inlet-pipe arranged to be operated by the opening of the furnace-door, substantially as described. 30

6. The combination with the furnace, of steam-jet pipes leading into the fire-box thereof, a steam-pipe connected therewith, a valve in said pipe, means to automatically close the valve, a cylinder 37 provided with inlet or sup- 35 ply and waste pipes, a piston in said cylinder, the piston-rod 45 preferably held in suitable guides and having a beveled upper end, means whereby on the opening of the furnace-door the cylinder is filled to project said 40 piston, said valve, being opened and held open by said piston-rod during the greater part of the movement of said piston in both directions, all as and for the purpose specified.

In testimony whereof I have hereunto set 45 my hand this 29th day of July, A. D. 1896.  
FRED W. SMITH.

In presence of—  
A. C. PAUL,  
N. T. HUME.