

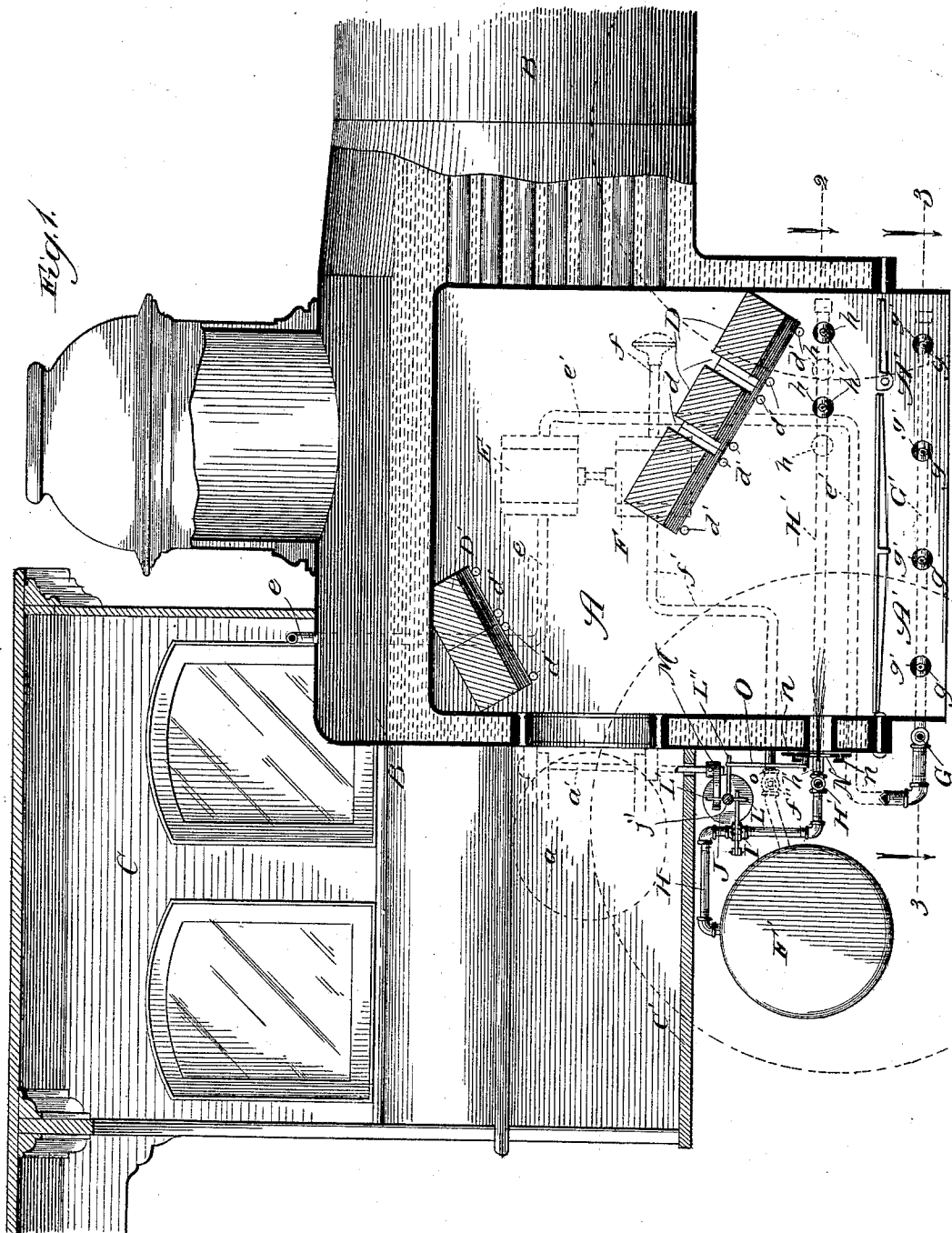
(No Model.)

3 Sheets—Sheet 1.

G. McDOWELL.
SMOKE CONSUMER AND FUEL SAVER.

No. 469,264.

Patented Feb. 23, 1892.



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Fig. 3.

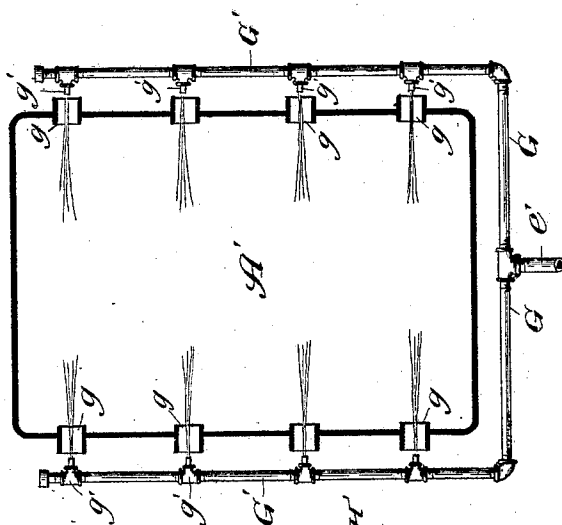


Fig. 2.

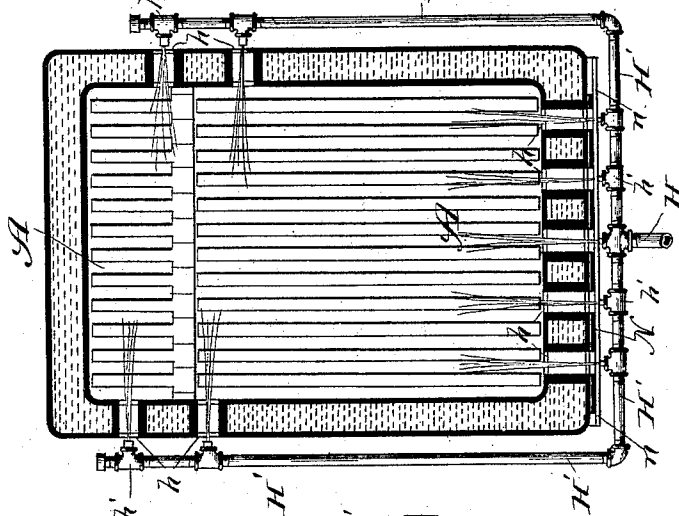
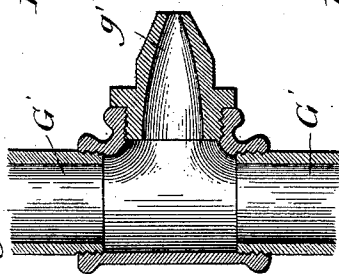


Fig. 1.



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(No Model.)

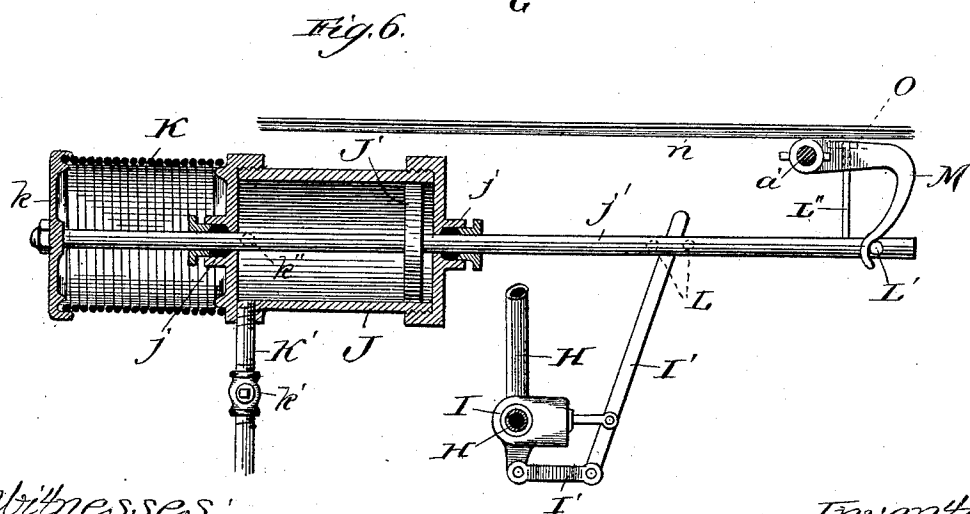
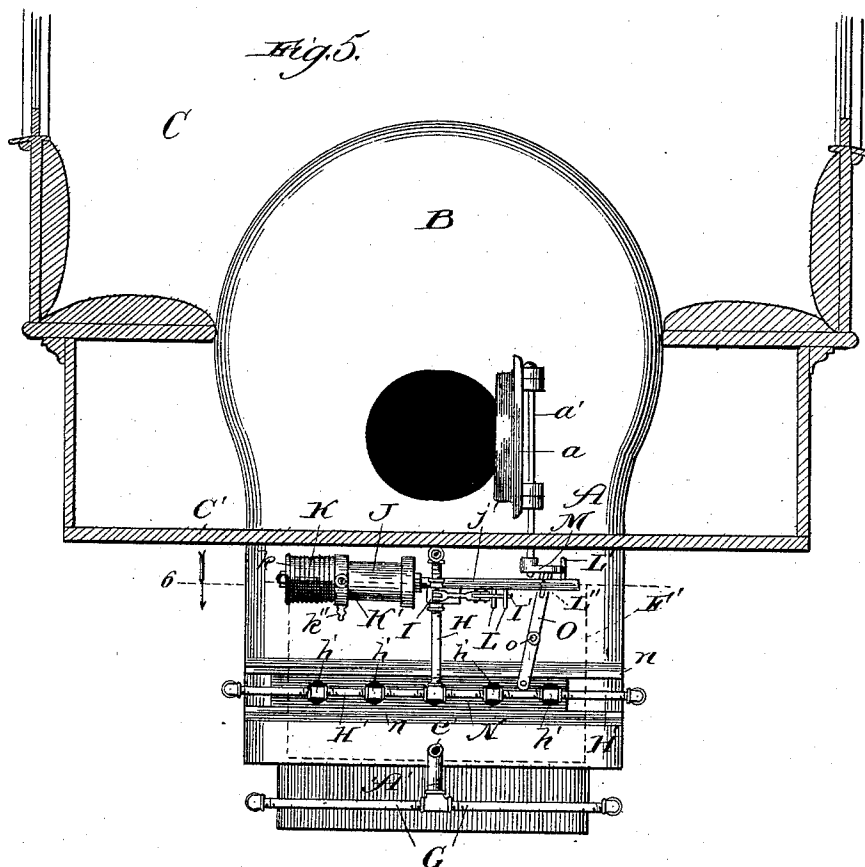
3 Sheets—Sheet 3.

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UNITED STATES PATENT OFFICE.

GORDON McDOWELL, OF EVANSTON, ILLINOIS.

SMOKE-CONSUMER AND FUEL-SAVER.

SPECIFICATION forming part of Letters Patent No. 469,264, dated February 23, 1892.

Application filed January 24, 1890. Renewed July 29, 1891. Serial No. 401,046. (No model.)

To all whom it may concern:

Be it known that I, GORDON McDOWELL, a citizen of the United States, residing at Evanston, Cook county, Illinois, have invented a new and useful Improvement in Smoke-Consumers and Fuel-Savers, of which the following is a specification.

The object of my invention is to provide a simple and effective means for promoting perfect combustion of the fuel, thereby preventing the formation of smoke and diminishing the amount of fuel used; and, stating it generally, my invention consists in certain devices and apparatus for feeding air into the fire above the grate and steam or steam and air below the grate, together with suitable mechanism for controlling the operation of these devices, and arches in the fire-box so situated as to give full effect to the air and steam feeding apparatus. More particularly my invention consists in the features and details of construction hereinafter described and claimed.

I shall herein illustrate and describe my improvements when applied to a locomotive; but inasmuch as they can be used advantageously and efficiently in connection with a marine or stationary boiler, and since I contemplate so using them, I do not intend to limit myself to their use in connection with a locomotive solely, but shall claim them, broadly, so as to cover my improvements to whatever form of boiler they may be applied.

In the drawings, Figure 1 is a vertical central section through the cab and fire-box of a locomotive equipped with my improvements, the air-pump and connections, the engine-drivers, and furnace-door being shown in dotted lines. Figs. 2 and 3 are horizontal sections taken on the line 2 2 and 3 3 of Fig. 1, respectively, looking in the direction of the arrows; Fig. 4, a horizontal section of one of the air or steam injectors on an enlarged scale; Fig. 5, a rear elevation of the boiler and cab, showing the furnace-door and the mechanism connected therewith for operating the air-injectors, &c.; and Fig. 6, a sectional view, on an enlarged scale, of a portion of Fig. 5, taken on the line 6 of said figure, looking in the direction of the arrow.

A is the fire-box of the locomotive; A', the ash-pit; a, the furnace-door; a', the hinge-pin

thereof; B, the locomotive-boiler; C, the cab; C', the cab-floor; D D', arches in the fire-box; E, the steam-chamber of an air-pump; e, the pipe for supplying steam thereto; e', the exhaust-pipe; F, the air-chamber of such pump; f, the pipe for supplying air to such chamber; f', a pipe leading from such chamber for conducting the air to the storage-reservoir F'; f'', a check-valve in such pipe; G, a pipe connecting with the exhaust-pipe e' and provided with branches G'; g, openings in the side of the ash-pit; g', injectors in the pipes G'; H, a pipe leading from the reservoir F' and connecting with branch pipes H' H'; h h, openings in the sides of the fire-box A; h', injectors in the pipes H' H'; I, a gate-valve in the pipe H, and I' a lever by means of which such valve is opened and closed; J, a cylinder attached to the outside of the fire-box; J', a piston; j', a piston-rod; K, a coiled spring around the piston-rod; k, a cap attached to the end of such piston-rod; K', a pipe for supplying water or steam to the cylinder provided with a check-valve k'; k'', a petcock attached to the cylinder; L L' L'', pins on the piston-rod j'; M, a bent lever attached to hinge-pin a'; N, a slide or damper; n n, ways or guides for the same, and O a forked lever fulcrumed at o and fastened to the slide N.

The various parts of my invention are constructed as follows:

The locomotive boiler, fire-box, cab, &c., to which my improvements are to be applied, are made, except as hereinafter pointed out, in the ordinary and well-known manner and require no further description.

An air-pump E F, of any of the well-known forms, may be attached to the frame of the locomotive, preferably between the drivers on the side opposite to that on which the pump for supplying air to operate the brakes is placed. This pump is shown in dotted lines in Fig. 1. Its steam-chamber E connects with the boiler or steam-dome by means of a suitable pipe e, and its air-chamber F is provided with a suitable pipe f, through which to obtain the necessary air. The exhaust from the steam-chamber is taken off through a pipe e', which preferably passes downward at the side of the fire-box, then backward to the end thereof, where it connects with a pipe G, running, preferably, horizontally along the back of the

boiler at a point opposite the ash-pit. This pipe G is provided with branches G', which run forward along each of the sides of the ashpan to the forward end thereof, where they are provided with caps or plugs or closed in any other suitable manner.

Holes *g* are drilled through the walls of the fire-box some two or three inches in diameter and suitable thimbles fastened therein. There may be any desired number of these holes or openings; but I consider that four along each side of the ash-pit, preferably arranged opposite each other, a preferable number. In the branch pipes G', I provide injectors *g'*, one of them being placed opposite to each of the openings *g*, the nozzle of the injector being placed a short distance, preferably from one-eighth to one-half of an inch, from the openings. The arrangement of these pipes, injectors, &c., is more fully shown in Fig. 3, and the construction of one of the injectors is shown on an enlarged scale in Fig. 4.

The air from the air-pump passes through a pipe *f'* into a reservoir F', placed, preferably, beneath the floor of the cab, as shown in Fig. 1. From this reservoir the air is drawn, as desired, by means of a pipe H. This pipe connects with two branch pipes H' H', running along the rear end and sides of the fire-box at a little distance above the grate-bars. Holes *h* are drilled, as above described, through the walls of the fire-box and provided with suitable thimbles, and injectors are placed in the pipes H' opposite to these holes, as above described, with reference to the pipes G'. There may be any number desired of these injectors *h'* and openings *h*; but I prefer to use five, placed, substantially, at equal distances apart along the back of the fire-box, and two at each side near the forward end of such box, the injectors at the sides being preferably arranged irregularly or breaking joints, as shown more particularly in Fig. 2, where this arrangement of pipes, injectors, &c., is illustrated. The air-injectors *h'*, made, substantially, as shown in Fig. 4, are placed with their nozzles a short distance away from the entrance into the openings *h*, say from one-eighth to one-half inch, though any other space may be left that will accomplish the purposes of my invention; or, if desired, the injectors may be inserted into the openings *h*. The same is true with reference to the injectors and openings *g'* and *g*.

The cylinder J, which, together with its parts, is more particularly shown in Fig. 6, is made of any suitable material and size, preferably about four inches in length and three inches in diameter, and may be attached in any suitable manner to the outside of the fire-box below the floor of the cab, as shown in Fig. 5, or in any other place that will allow it to operate, as hereinafter set forth. It is provided with a piston J' and a piston-rod *j'*. This rod passes out at both ends of the cylinder, which is provided with two stuffing-boxes *j*. Around the left-hand end, Fig. 6, of

this rod is placed a coiled spring K, preferably about four inches in diameter, one end of which abuts against the end of the cylinder J, the other end being confined by means of a cap *k*, bolted to the end of the piston-rod. In the drawings the piston is shown at the right-hand end of the cylinder and the spring is compressed. While the form of spring here shown operates efficiently, any other means for drawing back the piston and rod when released may be employed in its place.

The cylinder is provided with a pipe K', having a check-valve for the admission of water or steam and a petcock *k''*, by means whereof the escape of the water or steam is regulated.

The hinge-pin *a'* of the furnace-door extends down through the cab-floor and is provided at or near its lower end with a lever, preferably made in the form shown in Fig. 6, which engages with a pin L', attached to the upper side of the piston-rod *j'*.

The pipe H, which leads air from the reservoir to the injectors *h'*, is preferably provided with a gate-valve I, which is opened and closed by means of a lever I'. Two pins L extend, preferably, downward from the under side of the piston-rod *j'* and engage with the end of the lever I', as shown in Figs. 5 and 6.

To close the openings *h*, formed in the rear end of the fire-box, a slide N is provided, moving the guides *n* and provided with openings which coincide with the openings *h*. To this slide is attached a lever O, which is fulcrumed at *o* to the outside of the fire-box, and which extends upward and engages with the pin L'' on the piston-rod *j'*. (See Figs. 1, 5, and 6.)

The arch D' is made of fire-brick or other suitable material and extends across the rear end of the fire-box just above the door, and inclines upward and forward, as shown in Fig. 1. It is supported, preferably, by means of lugs *d'*. The arch D, made also of fire-brick, or other suitable material, is supported, preferably, in the position shown in Fig. 1. It is made, preferably, in three parts and is provided with openings *d*, through which the air can pass. These openings may be of any size and shape desired, but are made, preferably, as shown, and extend nearly the whole distance across the fire-box.

The operation of the device is as follows: I desire to call particular attention to the fact that no extra work whatsoever is thrown upon the fireman or engineer. When the door is opened to feed fuel into the furnace, the hinge-pin *a'*, which is squared into the door-lugs or otherwise rigidly attached thereto, is rotated, and the lever M, turning with the hinge-pin, acts by means of its engagement with the pin L' to move the piston and rod to the right, as shown in Fig. 6, compressing the spring K and drawing in water or steam through the pipe K', which is connected with any suitable

source. At the same time the slide is moved to the left by means of the lever I, engaging with the pin L', thus opening the holes h' in the rear of the fire-box, and the valve I is opened through the engagement of the lever I' and the pins L, thus admitting air to the injectors h'. Steam is meanwhile continuously injected into the ash-pit from the air-pump through the pipes e', G, and G'. When the door is closed, the pin L' is released from the lever M, and the resiliency of the spring K tends to move the piston toward the left, thereby forcing the water out of the cylinder. The speed with which it accomplishes this is regulated by means of the petcock k', from which the water escapes. As the piston and rod move toward the left, the valve I is closed and the slide N moved to cover the holes h by the reverse of the operations above described. As the steam enters the ash-pit through the openings g, it draws air in with it, and the mingled air and steam, striking against the grate-bars and bed of incandescent fuel, the steam abstracts heat therefrom and is decomposed into a fuel or water-gas, which is burned immediately above the fuel, thus heating the fire-box and arches D D' to a very intense degree. Now as fresh fuel is fed into the fire it has a tendency to deaden or chill it, thus creating smoke; but just before the fuel is fed in, compressed air is forced through the injectors h' above the grate into the fire-box, drawing in with it additional air through the openings h. The temperature to which the fire-box and arches have been raised by means of the combustion of water-gas, as above described, is so high that the introduction of fresh fuel and air cannot sufficiently reduce the temperature or deaden the fire to produce smoke, and the air being injected, as above described, at a point but a short distance above the grate mingles with the gases distilled from the coal. The mingled gases are carried by the force of the jets across the fire-box, and striking against the intensely-heated arch D are ignited, thus promoting perfect combustion. The products of combustion pass in part through the openings d, and in part are driven back around the rear end of the arch D, and striking against the arch D' pass out through the flues.

It will thus be seen that the steam injected below the grate transfers heat from the grate-bars to the arch D and heats it to such a degree that when the gases distilled from the coal are brought into contact with it they are instantly ignited, perfect combustion is promoted, and formation of smoke prevented.

When applied to a stationary or marine boiler, the construction and operation of the various parts of my device are substantially the same, although some of them—as, for instance, the air-pump and reservoir—may be differently located.

The automatic device has, of course, the

advantage that no extra work is thrown upon the fireman or engineer, the operation of the devices being insured by the opening of the door solely, which has to be done whenever fuel is fed into the furnace. I do not, however, intend to limit myself to these automatic devices solely, since they may be used or not, as found necessary or advisable.

I claim—

1. In a smoke-consumer, the combination of a jet of compressed air for injecting air above the grate, a jet of steam for injecting air below the grate, and an arch situated in the rear of the fire-box and inclined at an angle to the grate-bars for igniting the gases, substantially as described.

2. In a smoke-consumer, the combination of a pipe provided with jets for forcing steam into the ash-pit, a pipe provided with jets for forcing air into the fuel above the grate, and an arch D, placed above and at an angle to the grate-bars, substantially as described.

3. In a smoke-consumer, the combination of pipes provided with jets or injectors for forcing steam into the ash-pit and air into the fire-box above the grate, an arch D, having openings d, and an arch D', placed above the fuel-door, substantially as described.

4. In a smoke-consumer, the combination of a pipe provided with compressed-air injectors for forcing air into the fire-box above the grate and means whereby the admission of air to such pipe is automatically controlled, substantially as described.

5. In a smoke-consumer, the combination of the fuel-door, a hinge-pin d', lever M, fastened to such pin, cylinder J, piston J', rod j', engaging with lever M, spring K, pipe H, valve I, and lever I', engaging with rod j', whereby the opening of the fuel-door opens the valve and the spring closes the same after the door is closed, substantially as described.

6. In a smoke-consumer, the combination of an air-pipe H, provided with injectors h', openings L in the fire-box, a slide N, means whereby the opening of the fuel-door admits air to such pipe and moves the slide to uncover the openings L, and means whereby the air-supply is gradually cut off and the slide moved to cover the openings after the fuel-door is closed, substantially as described.

7. In a smoke-consumer, the combination of an air-pump, pipe G, connected with the exhaust-port thereof and provided with injectors g', reservoir F', connected with the air-pump, pipe H, leading from such reservoir and provided with injectors h', and means whereby air is automatically admitted to and shut off from such pipe, substantially as described.

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