



No. 821,268.

PATENTED MAY 22, 1906.

R. L. WALKER.  
SMOKE CONSUMING FURNACE.  
APPLICATION FILED JAN. 14, 1902.

3 SHEETS—SHEET 2.

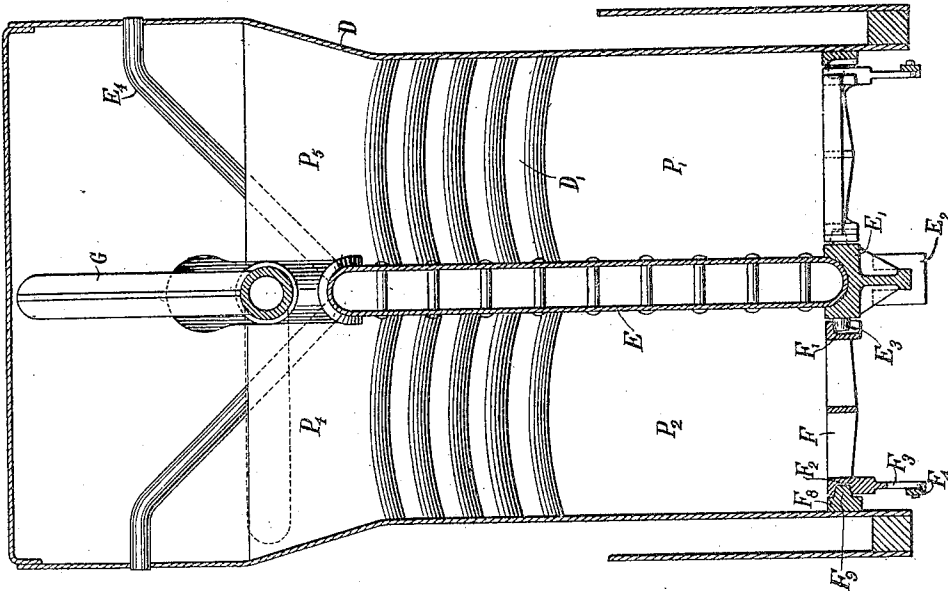


Fig. 3

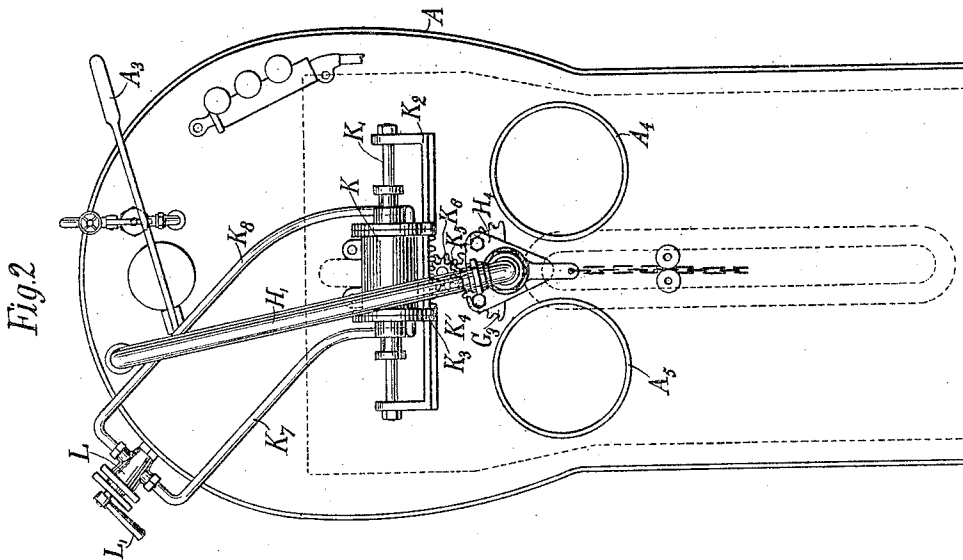


Fig. 2

Witnesses:

James H. Baelow  
Jessie B. Kay

by Robert L. Walker Inventor  
Frederick S. Hensen Atty

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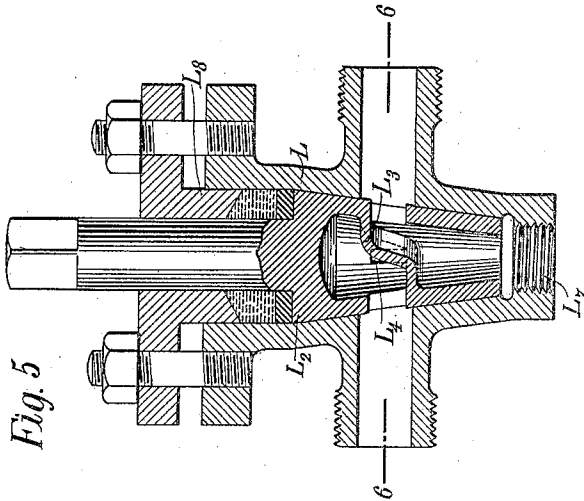


Fig. 5

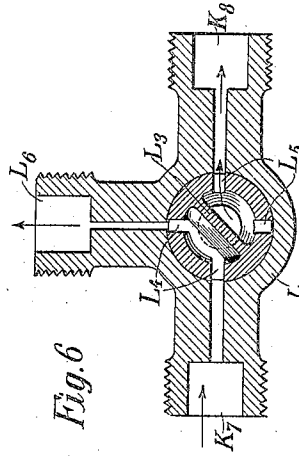


Fig. 6

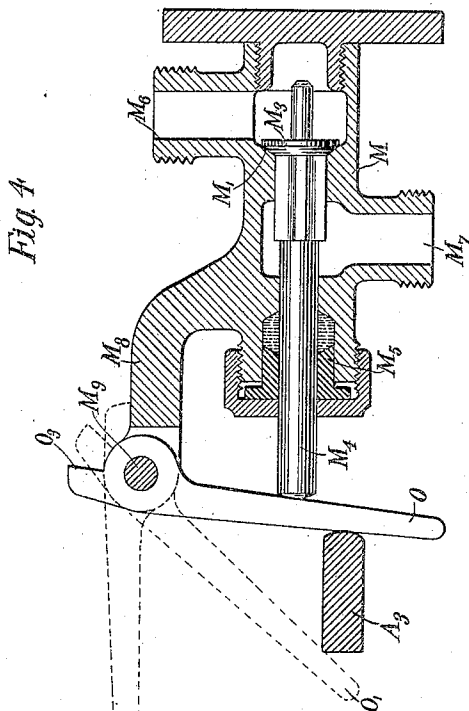


Fig. 4

Witnesses:

*Genned N. B. C. R. D.*  
*Jessie B. Kay.*

*Robert L. Walker* Inventor

*by Frederick S. Plummer* Atty

# UNITED STATES PATENT OFFICE.

ROBERT L. WALKER, OF BROOKLYN, NEW YORK.

## SMOKE-CONSUMING FURNACE.

No. 821,268.

Specification of Letters Patent.

Patented May 22, 1906.

Application filed January 14, 1902. Serial No. 89,647.

*To all whom it may concern:*

Be it known that I, ROBERT L. WALKER, a citizen of the United States, and a resident of New York city, borough of Brooklyn, county of Kings, and State of New York, have invented certain new and useful Improvements in Smoke-Consuming Furnaces, of which the following is a specification, taken in connection with the annexed drawings, forming a part of the same.

This invention relates to smoke-consuming furnaces, more especially adapted for use on locomotive-boilers.

In the accompanying drawings, in which the same reference characters refer to similar parts in the various figures, Figure 1 is a vertical longitudinal section through the furnace, parts being shown in elevation. Fig. 2 is an elevation of the rear of the furnace. Fig. 3 is a transverse section of the fire-box. Fig. 4 is a detail sectional view of the blast-valve. Fig. 5 is an axial section through the controller. Fig. 6 is a transverse section of the same, taken along the line 6 6 of Fig. 5.

The furnace is shown as used in connection with a locomotive-boiler A. This boiler is of the ordinary construction provided with the usual fire-tubes, and at the front end of the boiler is located the smoke-stack B with the exhaust-nozzle C below the same. The fire-box D is arranged at the rear of the boiler and is surrounded by suitable water-spaces A' A'. This fire-box is stayed and supported in any desired manner, as is well known in this art. The fire-box is divided by the vertical water-leg E, which extends nearly the whole length of the same and which is supported by the frame E', extending along the bottom of the fire-box. This frame is held at either end in the saddles or brackets E<sup>2</sup>, which are secured in any suitable way to the lining of the fire-box. A supporting-frame E' is formed at either side of the same with the projecting trunnions E<sup>3</sup>, and the bars F<sup>8</sup>, arranged on either side of the fire-box at substantially the same height, are provided with corresponding trunnions F<sup>9</sup>. These trunnions serve to support the pivoted grate-bars F, which are formed with the bearing F<sup>2</sup> in the outer ends of the same and with the bearing-slot F' in their inner ends, which may be readily slipped over the trunnion E<sup>3</sup>. Each of these grate-bars is formed with a downwardly-projecting arm F<sup>3</sup>, which is pivoted to the shaking-bar F<sup>4</sup>. This shaking-bar is operated through the connec-

tions F<sup>6</sup> F<sup>7</sup> to shake all of the grate-bars in unison.

At the front end of the fire-box there is arranged the combustion arch D', having a lower surface of suitable corrugated form, as indicated, and this arch extends entirely across the front end of the fire-box on both sides of the water-leg. In this way the passages P<sup>4</sup> P<sup>5</sup> are formed, as indicated in Fig. 3, on either side of the central water-leg, by which the products of combustion must pass out from the grate into the chamber P<sup>3</sup> at the upper part of the fire-box, and thus into the boiler-tubes. The water-leg is provided with the connections E<sup>4</sup>, which serve to support the front end of the water-leg, and the additional connections E<sup>8</sup> and E<sup>9</sup> are arranged to secure a sufficient circulation in the water-leg. The pipe E<sup>5</sup> connects with the upper end of the water-leg and also keeps the bearing E<sup>6</sup> for the grate cool.

The water-damper G is mounted to control the passages P<sup>4</sup> P<sup>5</sup>, the shaft G' of this damper being slightly inclined, so that the rear end G' of the damper is slightly higher than the front of the same. The trunnion E<sup>7</sup> at the forward end of this damper fits into the bearing E<sup>6</sup>, secured to the top of the water-leg, and the rear end of the damper-shaft is formed with a gland G<sup>2</sup>, screwed upon the end of the shaft G', which engages a suitable joint H<sup>2</sup> in the damper outlet-pipe H'. In this way the water-damper is allowed to turn through one hundred and eighty degrees, and at the same time a circulation is maintained from the damper inlet-pipe H, communicating with the water-space in the boiler, through the sinuous damper-passages indicated and out through the damper outlet-pipe H', which communicates with the steam-space of the boiler. It will be noted that the damper-passage formed by the partitions G<sup>7</sup> and G<sup>8</sup> gradually increases in cross-section from the end to the rear of the damper, so that the production of steam and the consequent greater volume of the fluid within the damper is more readily accommodated by the gradually-increasing size of the passage from G<sup>5</sup> to G<sup>6</sup>. The circulation of water and its evaporation in the damper serve to cool the same and also to utilize the steam thus produced. The shaft G' of the damper is supported in the bearing-sleeve H<sup>3</sup>, bolted to the shell of the boiler at this point, and the damper is held firmly against the front bearing, so as to make a tight joint by the spring

H<sup>5</sup>, which bears upon the damper-sector G<sup>3</sup>, secured to the shaft of the damper, and against the collar H<sup>4</sup>, which may be adjusted by appropriate screw-bolts indicated. This damper may assume the vertical position indicated in full lines in Fig. 3 or may be thrown over on either side into a horizontal position to close either the passage P<sup>4</sup> or the passage P<sup>5</sup>. For this purpose the cylinder K is used rigidly mounted on the rear of the boiler. This cylinder is provided with a suitable piston rigidly secured to the piston-rod K', and to either end of the piston-rod the rack-frame K<sup>2</sup> is secured, carrying at its lower portion the rack-teeth K<sup>4</sup>. This rack-frame is guided accurately in its movement by the guides K<sup>3</sup> on the cylinder-heads. The rack-teeth K<sup>4</sup> mesh with the teeth of the pinion K<sup>5</sup>, and the gear-wheel K<sup>6</sup>, rigidly secured to K<sup>5</sup>, since both are mounted to rotate freely about the bearing-stud indicated, meshes with and drives the damper-sector G<sup>3</sup>. The cylinder-pipes K<sup>7</sup> K<sup>8</sup> communicate with either end of the cylinder K, and these pipes are connected with the controller L, by which steam may be admitted to either side of the cylinder and discharged as desired, so that the movements of the damper are thus readily controlled by steam supplied from the boiler. The counterpoise is connected with the damper to compensate in some measure for the weight of the damper and also to control its movements. The arm G<sup>9</sup> is rigidly secured to the damper-shaft, and to the lower end of this arm is connected the counterpoise-chain H<sup>7</sup>, guided by suitable pulleys indicated and connected with the spring H<sup>6</sup>, which always exerts a considerable pull upon the chain.

The controller L is formed as is indicated in Figs. 5 and 6, the casing being connected with the cylinder-pipes K<sup>7</sup> and K<sup>8</sup>. The lower end of the controller-casing is rigidly secured to the boiler and is connected with the steam-space within the same, so that a supply of steam is constantly furnished to the lower end of the controller. The passage L<sup>6</sup> is connected with a suitable exhaust-pipe. The controller-valve L<sup>2</sup> is formed tapered, as indicated, and is held down on its seat in the casing by the suitable stuffing-gland L<sup>8</sup>. This valve is formed with a diaphragm L<sup>3</sup>, which divides the central chamber within the valve into two parts, the lower part communicating with the two steam-ports L<sup>5</sup> and the upper part serving to connect the two exhaust-ports L<sup>4</sup>. The handle L<sup>1</sup> is rigidly secured to the valve-stem to rotate the same. In the position indicated in Fig. 6 steam is supplied to the cylinder-pipe K<sup>8</sup> through the steam-port L<sup>5</sup> in the valve, and at the same time the steam is allowed to escape from the other end of the cylinder through the cylinder-pipe K<sup>7</sup>, and the exhaust-ports L<sup>4</sup> of the valve, so as to exhaust into the passage L<sup>6</sup>. In this way the piston

is moved in one direction and the grate is rotated correspondingly. By rotating the valve through a quarter-turn steam will be admitted to the other side of the cylinder, so as to cause the piston and the water-damper to move in the opposite direction. It is also apparent that by moving the controller-valve into an intermediate position there will be no steam admitted or discharged from the cylinder, so that the damper will in this way be held stationary.

In order to secure at all times a sufficient draft through the bed of fuel on the grate, it is desirable that when the engine is not being operated there shall be an induced draft maintained by other means than the steam-exhaust from the exhaust-nozzle. In order to automatically secure this result, the blast-pipe C<sup>2</sup> is formed at its open end within the exhaust-nozzle with the vertical end C', so that steam issuing from the end of this pipe will induce a draft in the stack. The blast-pipe C<sup>2</sup> is connected with the passage M<sup>7</sup> of the blast-valve M, and steam is supplied to this blast-valve through the passage M<sup>9</sup>, the cut-off valve M<sup>10</sup> being placed in this connection. The valve-plug M<sup>3</sup> operates in connection with the seat M' in the casing and is under ordinary conditions forced outward against the seat by the steam-pressure, although, if desired, a suitable spring may be employed to assist in closing this valve. The valve-stem M<sup>4</sup> passes out through a suitable stuffing-gland M<sup>5</sup> and is engaged by the latch O. This latch is loosely pivoted about the pivot M<sup>9</sup> upon the outer end of the arm M<sup>8</sup>, so that this latch is allowed a limited movement about the pivot. The latch can only be raised into the substantially horizontal position indicated in dotted lines, as O<sup>2</sup> in Fig. 4, since the foot O<sup>3</sup> of this latch engages the arm M<sup>3</sup>. The latch under all conditions therefore tends to fall into contact with the valve-stem M<sup>4</sup>. This latch is engaged by the throttle A<sup>3</sup> when the throttle is closed to shut off steam from the driving-cylinders, so that when the engine is stopped and the induced draft is no longer created by the exhaust from the engine the throttle, through the connections described, opens the blast-valve and allows steam to issue from the end C' of the blast-pipe and so maintain under these conditions an induced draft in the furnace. The force of this induced draft may be regulated by suitably manipulating the valve M<sup>10</sup> so as to regulate the amount of steam which flows through the blast-pipe. If desired, however, this blast may be thrown out of action by merely lifting the latch as the throttle is being closed. This raises the latch out of engagement with the throttle, and the blast-valve is not operated under these conditions. It will be noted, however, that as soon as released the latch will drop into the position indicated as O' in Fig. 4, so that as soon as

the throttle is opened the latch will again come into engagement with the valve-stem and be ready to operate automatically when the throttle is again closed.

5 The operation of this furnace in ordinary practice has been found to be very satisfactory in preventing smoke. The furnace is fed alternately through one of the fire-doors A<sup>4</sup> A<sup>5</sup>, and assuming that the fuel is to be  
10 added to the left side of the fire through the door A<sup>5</sup> the water-damper is thrown into the position shown in dotted lines in Fig. 3, so as to close the passage P<sup>4</sup>. Under these conditions, the new fuel naturally produces some  
15 unburned gases and considerable smoke within the chamber P<sup>2</sup>. The gases from this fuel cannot pass through the passage P<sup>4</sup>, but are compelled to pass through the throat P around the front of the water-leg and up  
20 through the passage P<sup>5</sup> into the chamber P<sup>3</sup> and thence through the boiler-tubes. In this way the unburned gases are brought into close contact with the highly-heated arch and, furthermore, are mingled with the gases  
25 which are produced by the other side of the fire, which under normal conditions contain an excess of oxygen. These unburned and smoky gases are in this way completely burned, and no smoke is produced by the  
30 furnace. When the side of the fire which has been supplied with fresh fuel comes into its normal condition and this arrangement is no longer necessary to prevent the production of smoke, the damper G is raised into  
35 the vertical position shown in full lines in Fig. 3, and then each side of the furnace acts independently, the gases rising on either side of the water-leg and passing directly into the chamber P<sup>3</sup> and thence through the boiler-tubes. The two sides of the furnace are fired  
40 alternately, and in this way the smoke produced by either side can always be burned by the excess of oxygen found on the other side of the furnace. The blast-pipe which  
45 has been described is useful in preventing the production of smoke when fresh coal has been added to the fire when the locomotive is not being operated, since under these conditions it is necessary in order to prevent the production  
50 of smoke that there shall be an excess of air supplied to the furnace, and this can only be accomplished by some form of induced draft, such as has been described.

Many modifications may be made in this  
55 invention by those skilled in the art. Furthermore, parts of this invention may be used without employing all of the same. I do not, therefore, wish to be limited to the exact disclosure which I have made in this case; but  
60 What I claim as new, and what I wish to secure by Letters Patent, is set forth in the appended claims:

1. In a locomotive-furnace, a fire-box provided with a centrally-arranged vertical wa-

ter-leg, a combustion-arch at the front end 65 of the fire-box, there being a passage around the front end of the water-leg under said arch, a movable water-damper revolvably mounted above said water-leg to close the passage on  
70 either side of said water-leg and behind said arch, said damper being formed with a sinuous tapering passage gradually increasing in cross-section from its inlet to its outlet, means to cause a circulation of water through  
75 said damper, a damper-sector secured to the shaft of said damper, a cylinder, a rack-frame actuated by said cylinder to operate said damper-sector, a controller to admit steam to said cylinder to operate said damper, said controller having a lower steam-in-  
80 let, opposite cylinder-pipes and an exhaust-pipe on the same level, a hollow tapered valve formed with a diagonal diaphragm, there being two exhaust-ports above said diaphragm and two steam-ports below said diaphragm to coact with said cylinder-pipes  
85 and said exhaust-pipe, a blast-pipe to cause an induced draft in said furnace, an automatic blast-valve to be operated by the throttle of said engine to increase the draft of  
90 said furnace when the engine is not running.

2. In a locomotive-furnace, a fire-box provided with grate-bars, a water-leg vertically arranged in the center of said fire-box, a frame upon which said water-leg is supported,  
95 said frame being mounted in brackets secured to said fire-box, trunnions formed on said frame to support said grate-bars, a combustion-arch in said fire-box extending across the forward end of the same, a water-cooled damper revolvably mounted in said  
100 fire-box above said water-leg to close the passage on either side of said water-leg, said damper being formed with a sinuous tapered passage gradually increasing in cross-section  
105 from the inlet to the outlet of said damper.

3. In a locomotive-furnace, a fire-box provided with a grate, a water-leg to divide said fire-box into two parts, a damper to close the passage on either side of said water-leg, a  
110 combustion-arch in said fire-box extending across the same in front of said damper, a blast-pipe to create an induced draft in said furnace and an automatic blast-valve normally operated by the throttle to admit  
115 steam to said blast-pipe when the engine is not operating, and means to prevent when desired the throttle operating the blast-valve.

4. In a locomotive-furnace, a fire-box provided with a grate, a water-leg to divide said  
120 fire-box into compartments, a movable damper mounted above said water-leg to close the top of one of said compartments while leaving a throat around said water-leg at the front of said fire-box and an automatic blast  
125 device normally adapted to cause an increased circulation of gases through said furnace when said engine is not running, and

manually-operating means to prevent when desired automatic action of the blast device.

5 In a locomotive-furnace, a fire-box provided with a grate, a water-leg to divide said fire-box into compartments, a movable damper mounted above said water-leg to close the top of one of said compartments while leaving a throat around said water-leg at the front of said fire-box, an automatic blast device  
10 normally adapted to cause an increased circulation of gases through said furnace

when said engine is not running, the throttle-lever, a lever normally adapted to engage with the throttle-lever and operate the blast device but so arranged that it can be swung upon its pivot out of the operating engagement with the throttle-lever, substantially as set forth.

ROBERT L. WALKER.

Witnesses:

HARRY L. DUNCAN,  
JOHN N. MOORE.