

(No Model.)

3 Sheets—Sheet 1.

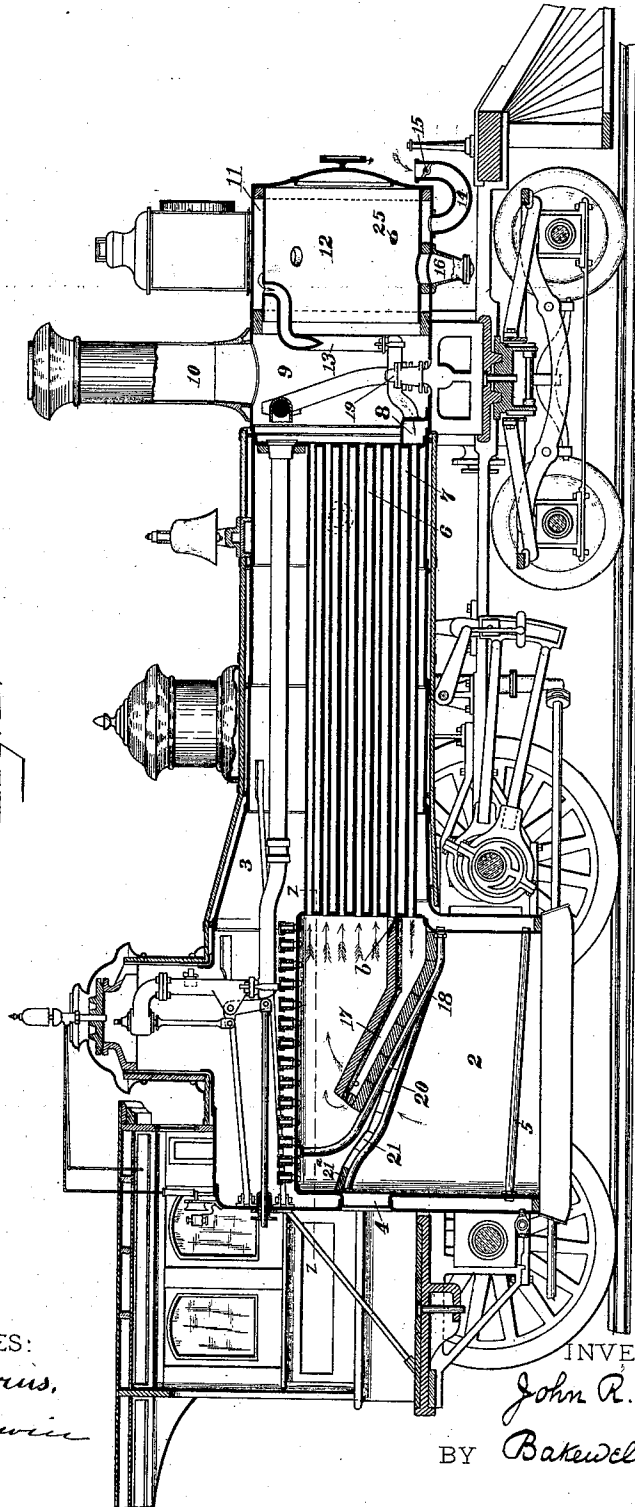
J. R. ALEXANDER.

LOCOMOTIVE FURNACE.

No. 352,217.

Patented Nov. 9, 1886.

Fig. 1.



WITNESSES:

J. A. Burns,
M. H. Corwin

INVENTOR,

John R. Alexander

BY

Bakewell & Kerr

ATTORNEYS

(No Model.)

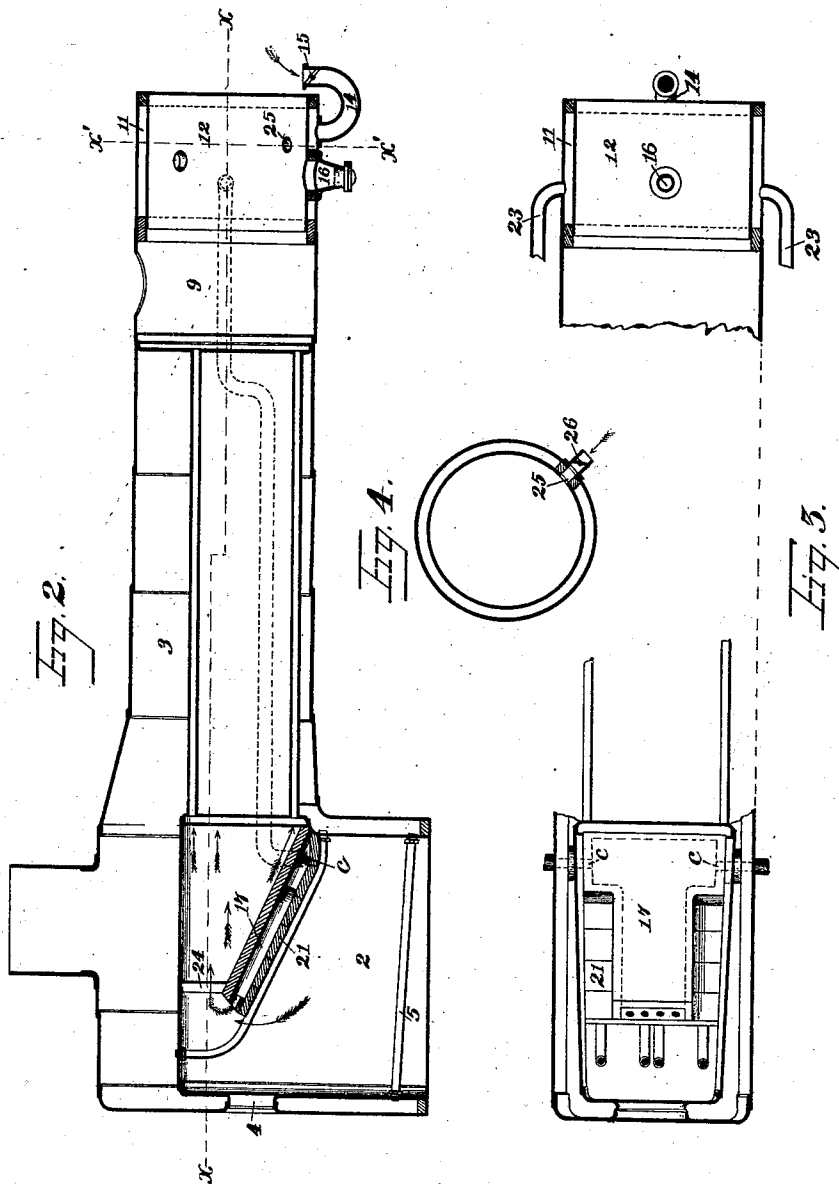
3 Sheets—Sheet 2.

J. R. ALEXANDER.

LOCOMOTIVE FURNACE.

No. 352,217.

Patented Nov. 9, 1886.



WITNESSES:

J. A. Burns,
M. F. Corwin

INVENTOR.

John R. Alexander

BY

Bakerell & Kern

ATTORNEYS.

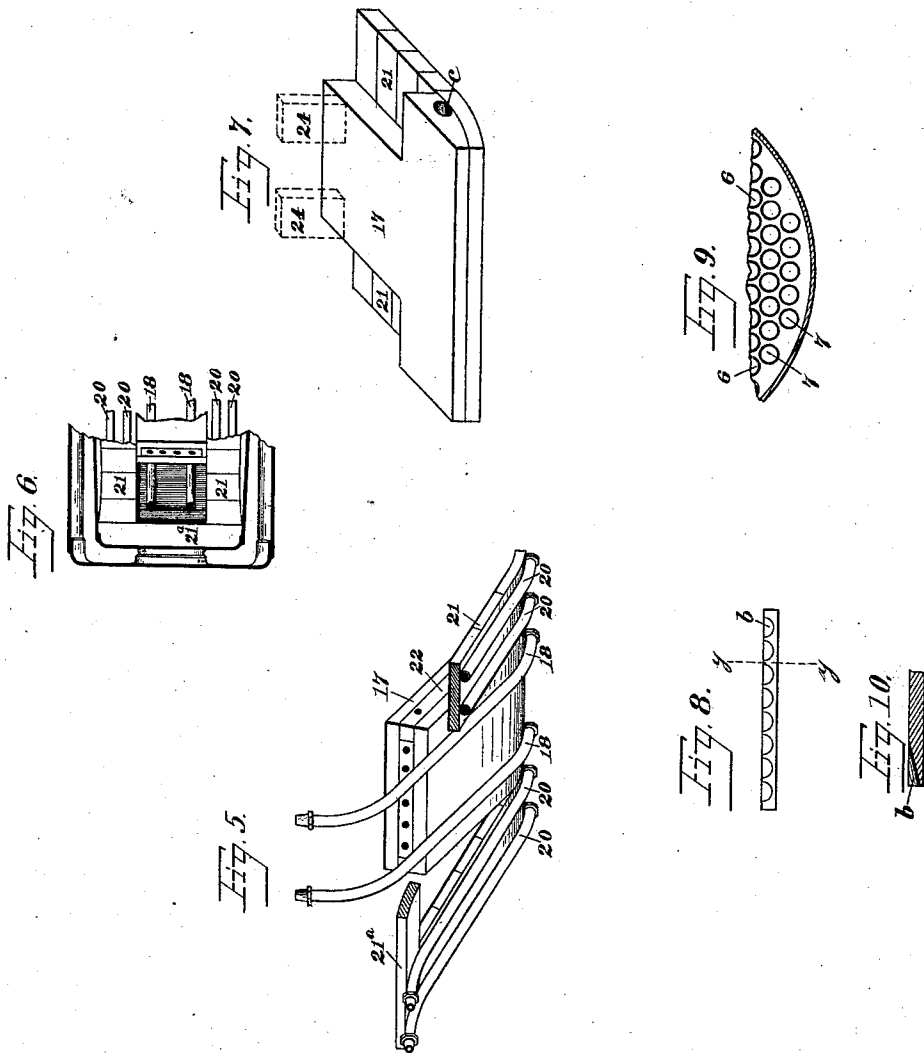
(No Model.)

3 Sheets—Sheet 3.

J. R. ALEXANDER.
LOCOMOTIVE FURNACE.

No. 352,217.

Patented Nov. 9, 1886.



WITNESSES:

J. A. Burns,
W. B. Corwin

INVENTOR,

John R. Alexander

BY *Bakewell & Kerr*

ATTORNEYS.

UNITED STATES PATENT OFFICE.

JOHN R. ALEXANDER, OF PITTSBURG, PENNSYLVANIA.

LOCOMOTIVE-FURNACE.

SPECIFICATION forming part of Letters Patent No. 352,217, dated November 9, 1886.

Application filed November 18, 1885. Renewed October 7, 1886. Serial No. 215,621. (No model.)

To all whom it may concern:

Be it known that I, JOHN R. ALEXANDER, of Pittsburg, in the county of Allegheny and State of Pennsylvania, have invented a new and useful Improvement in Furnaces for Locomotive-Engines; and I do hereby declare the following to be a full, clear, and exact description thereof.

The object of my invention is, primarily, to secure the perfect combustion of the smoke and gases generated in the use of bituminous coal and similar fuel, particularly in locomotive-engine-boiler furnaces.

In the tubular boilers of locomotives as generally heretofore constructed the flame enters the flues from the fire-box in a partially-consumed condition, and the cooler water surrounding the flues chills and extinguishes the flame, causing the gases to pass through the flues in the condition of hot smoke. In all cases where gases arising from burning fuel are allowed to come in contact with heat-absorbing surfaces or to mingle with air of lower temperature, the ignition of such gases will be prevented, or if ignited the flame will be slackened or extinguished; but if the air is first properly heated and then admitted to the furnace under proper conditions and in proper proportions a practically-perfect combustion will be obtained. It is also necessary, to secure the best conditions for generating heat, that the heated air for supporting combustion be introduced into the fire-box at the proper place. If it be introduced at a point near the entrance to the boiler-flues, it will escape directly thereinto without having opportunity to mix thoroughly with the gases and to produce the desired effect. It should be introduced at a point remote from the flues, and the fire-box should be provided with suitable deflectors, which will give an indirect course to the heated air and a better opportunity for its admixture with the gases; hence the value of a fuel does not alone depend on the quantity of the air supplied thereto, but also upon the condition of the air and the manner of its application.

With these considerations in mind I have constructed my improved locomotive-engine furnace so that the air is supplied to it in two volumes, one of which, entering the fire-box through the grate-bars, generates the gases from the coal, as in a gas-producer, and par-

tially consumes them, while the other volume of air, having first been heated by passage through a suitable regenerator or heating-chamber, enters the fire-box, preferably at a point near its rear end, and, mixing with the partially-consumed gases, completes their combustion and produces a very intense heat.

To enable others skilled in the art to make and use my invention, I will now describe it with reference to the accompanying drawings, in which—

Figure 1 is a vertical longitudinal section of a locomotive-engine to which my improvement has been applied. Fig. 2 is a similar section of the boiler and fire-box, illustrating a modification. Fig. 3 is a horizontal longitudinal section on the line xx of Fig. 2, shown partly separated or broken away for purpose of illustration. Fig. 4 is a vertical cross-section on the line $x'x'$ of Fig. 2. Fig. 5 is a perspective view of the form of arch in the fire-box shown in Fig. 1, viewed from the rear, which is the end most remote from the boiler-flues. The tile 21 and the deflecting-tile 21^a are shown partly broken away in this figure. Fig. 6 is a sectional plan view of the form of arch shown in Fig. 1, taken on the line zz of the latter figure. Fig. 7 is a perspective plan view of the modified form of arch shown in Fig. 2, viewed from the front of the fire-box. Fig. 8 is an end view of a tile shown in Fig. 5. Fig. 9 is a sectional end view of the boiler, showing the lower courses of flues. Fig. 10 is a vertical cross-section on the line yy of Fig. 8.

Like symbols of reference indicate like parts in each.

The locomotive-engine is of the usual construction, having a fire-box, 2, and a flue-boiler, 3. The fire-box has the usual fire-door, 4, for the supply of fuel, and grate-bars 5 at its bottom to support the latter. The boiler 3 is provided with tubes or flues 6 7, which need not differ in number, arrangement, or position from those in general use; but by means of a horizontal jacket or cover, 8, in the smoke-box 9 they are divided into two distinct series, the lower one, 7, of which comprises one or more of the lower rows of flues, while the other series includes the remaining upper flues. The jacket 8 is a simple box which cuts off communication between the smoke-box and the flues, whose ends it covers, while

these flues have free ingress into the box itself. The other flues, 6, open directly into the smoke-box 9 and into the fire-box 2, and serve to carry the flame and heat from the latter to the former. The smoke-stack 10 is directly above the smoke-box and communicates with it, and in front of the smoke-box and projecting forward beyond the situation of the stack is the usual smoke-box extension or drum, 12, which is simply a cylindrical prolongation of the smoke-box, and acts as a receptacle to catch sparks and cinders, which would otherwise pass out of the stack or accumulate in the smoke-box proper. I make this extension with double sides or walls in such manner as to provide an annular chamber, 11, surrounding it, and cut off completely from access to the interior of the extension-drum or the smoke-box. A pipe, 13, leads from the chamber 11 and opens into the jacket 8, which covers the lower series of flues, 7. This pipe is shown in Fig. 1, but not in Fig. 2, in which latter its use is supplied by other devices, hereinafter to be explained. The chamber 11 has communication with the open air through an adit-pipe, 14, which may be opened and closed by means of a valve, 15, arranged within it, as shown in Figs. 1 and 2, and preferably operated by a rod which extends to the cab.

16 represents the hopper or man-hole through which the cinders are removed from the drum 12.

Within the fire-box 2 there is an arch, 17, (see Figs. 1 and 5,) which is supported by hollow water-cooled bars 18, so that its front end may abut against the rear of the boiler at the adit of the lower flues, 7, while the rear of the arch extends somewhat past the center of the fire-box. The arch is upwardly inclined from the boiler, and, as shown in Figs. 1 and 5, is in the middle of the width of the fire-box, but does not extend entirely across it. The arch is hollow, and is constituted, preferably, by parallel tiles set transversely and separated by strips 22, so as to leave an intervening space, which is closed at the sides, but opens at the upper end into the fire-box, and at the lower end into the flues 7, against which it abuts. There is thus afforded an open conduit for free passage of air through the pipe 14 into the annular chamber 11, and thence through the pipe 13, jacket 8, flues 7, and hollow arch 17 into the rear part of the fire-box. In order that the tile which forms the surface of the hollow arch 17 may not obstruct the first row of flues above the series 7, I make the surface of its lower end grooved or scalloped, as shown at *b* in Figs. 8 and 9, so that the scallops may fit against the ends of these flues, and while completely cutting off direct access of the flues 7 from the fire-box the tile may not at all obstruct the entrance of the other flues, 6, thereinto.

Thus constructed, the operation of my improvement is as follows: The blast of steam into the smoke-box 9 from the exhaust-nozzle 19 induces a violent draft, which draws the flame

and gas from the burning coal in the fire-box upward around the arch 17, through the flues 6 into the smoke-box, and out of the stack. A considerable part of the heat and most of the cinders enter the drum 12 and heat it and its walls to an intense degree. If, now, the valve 15 be opened, the draft in the fire-box will draw a current of air through the pipe 14 into the annular chamber 11, and thence through the pipes 13 and flues 7 and hollow arch to the rear of the fire-box, where it will mingle with the volume of gases and flame about to enter the flues 6. In its passage through the chamber 11 the air will become highly heated by contact with the inner walls of the latter, and on emerging from the arch 17 a very vivid combustion will result from the admixture of the hot current with the already partially-burned gases. By means of this re-enforcement of the burning gases with heated oxygen combustion is promoted, and instead of the gases chilling during their passage through the flues 6 they will burn in their course and heat the water to a maximum degree. If at any time it should be desirable to dispense with this regenerating or air-heating apparatus, the valve 15 may be closed, in which case all the air of combustion will come through the grate-bars.

A novel and useful addition to my improvement is shown in Figs. 1 and 5, and consists in devices for causing the more thorough admixture of the heated air with the gases of the fire-box. As before stated, in the arrangement illustrated in Fig. 1 the hollow arch 17 does not extend entirely across the fire-box, but there is a vacant space on each side of it. By means of supporting-bars 20 I arrange tiles 21 at the sides of the arch, the front ends of the tiles abutting against the end of the boiler in the same horizontal plane with the front end of the arch. The rear ends of the tiles preferably extend to the back leg of the fire-box. The supporting-bars 20 are, however, more nearly horizontal than their counterparts 18, and the tiles 21 will therefore project at a different angle than the arch, and will leave intervening spaces between the sides of the arch and the tiles, through which the flame may pass. (See Fig. 1.) A convenient device is a tile, 21*, which extends across the fire-box, from one wing 21 to the other, over the fire-door, and at the rear end of the fire-box. The tiles 21 and 21* thus act as wings or deflectors, which will cause the flame from the fire-box to be centered upon the arch 17, and by acting as obstacles to the current of air will retard it and will create eddies, which materially expedite the admixture of the air with the gases. When the wings 21 are used, the sides of the arch 17 may be perforated to permit escape of the heated air, which will impinge upon the gases traversing the intervening spaces between the tiles and arch.

From the foregoing description it will be apparent that the arch 17 performs several functions. It deflects the flame to the rear of the

fire-box away from the boiler-flues, thereby increasing the distance of its travel, and giving it an opportunity to be thoroughly ignited before entering the flues. It also serves as a conduit to supply a re-enforcing current of air to the flame at the most desirable point, and, being itself exposed to the intense heat of the fire-box, will additionally heat the air which traverses it previous to mixing with the flame.

I will now describe the modification illustrated in Figs. 2, 3, 4, and 7, in which the principal difference is, that the air, instead of being conveyed from the chamber 11 to the fire-box through the flues of the boiler, is conveyed through pipes which are arranged on the outside of the boiler. I show two of these pipes, 23, leading from each side of the annular chamber 11 outside of the boiler directly back to the legs of the fire-box, where they are flexed and enter the hollow chamber of the arch 17 at points as near as possible to the front of the latter. In such case the arch may be constructed identically with the one shown in Fig. 1, except that the lower end should not be open, nor should it abut against the lower course or courses of flues. I have, however, illustrated a modification of the arch in the figures of the drawings last named. The lower tile or tiles of the arch extend entirely across the fire-box in the same plane, and the upper separated tile, forming the air-space, is set preferably at the middle of the lower tile, so as not to extend all the way across the chamber, though it may be made coextensive with the lower tile, if desired. The pipes 23 enter the cavity of the arch at points near its base, as shown in Figs. 2 and 3. Thus constructed, the lateral wings of the arch will act as deflectors to throw the flame to the rear end of the fire-box, but, being integral with the hollow part of the arch, they will not break up the current of flame, as do the corresponding parts shown in Figs. 1 and 5. To accomplish this latter result I set upright tiles 24 on top of the rear end of the arch, which, standing in the path of the current of flame and air, check it and break it up into eddies, which facilitate the proper mixture of the air with the gases.

Any one of the features of my invention shown in Figs. 2, 3, 4, and 7 may be substituted for the corresponding parts of Fig. 1, and vice versa, as may be suitable to the sort of locomotive to which it may be applied, or to the taste of the mechanic.

I do not desire to limit myself to the specific form of regenerating-chamber herein shown and described, because other forms may be used with good effect.

The construction of the smoke-box extension with double walls has special advantages which make it particularly desirable. The heat of the burning sparks and cinders in the drum 12 is very intense, and frequently burns out or injures the walls of the latter; but when the shell of the drum is made double, and a constant current of air is made to circulate through the annular jacket-space, as I have

described, the drum is kept comparatively cool, and may be used for a much longer time without repairs.

It will be found that even if care be had to mix the air and gas in the fire-box there will always be some of the fuel which will pass out of the stack unconsumed. I have devised a simple means for utilizing this fuel, and have shown it in Figs. 1, 2, and 4. A hole or flue, 25, is made through the wall of the smoke-box extension, so as to lead thereinto from the outer air, and is provided with a suitable valve, 26, for opening and closing it. On opening this valve a current of air will be induced into the drum, which on meeting the unconsumed gases therein will cause them to ignite. This device serves the double purpose of a smoke-consumer for lessening the amount of soot given out by the engine, and it also, by increasing combustion in the drum 12, raises the heat of the walls of the latter and correspondingly heats the air in the surrounding regenerator-space 11.

What I claim as my invention, and desire to secure by Letters Patent, is—

1. In a locomotive-engine, a deflecting-arch situate in the fire-chamber, extending from the rear end thereof toward the front wall, and having side wings, substantially as described, substantially as and for the purposes specified.

2. The combination, in a locomotive-engine, of a regenerator situate in the smoke-box, means for admitting air to the regenerator, a gas-producing fire-box, an arch in the fire-box extending partially across the same, a conduit pipe or flue leading from the regenerator through the arch into the fire-box, and a deflecting-wing, 21, projecting laterally from the arch, substantially as and for the purposes described.

3. The combination, in a steam-boiler furnace, of a regenerator, means for admitting air to the regenerator, a fire-box, an arch in the fire-box extending partially across the same, a conduit pipe or flue leading from the regenerator through the arch into the fire-box, and a deflecting-wing, 21, projecting laterally from the arch at a different level, substantially as and for the purposes described.

4. The combination, in a locomotive-engine, of a smoke-box, a regenerator-chamber surrounding the smoke-box, a gas-producing fire-box, and an air-flue discharging into the smoke-box, substantially as and for the purposes described.

5. The combination, in a steam-boiler furnace, of a regenerator-chamber in the smoke-box, a fire-box, an arch in the fire-box, and a conduit pipe or flue leading from the regenerator through the arch and discharging into the fire-box, substantially as and for the purposes described.

In testimony whereof I have hereunto set my hand this 29th day of October, A. D. 1885.

Witnesses: JOHN R. ALEXANDER.

W. B. CORWIN,
THOMAS W. BAKEWELL.