(No Model.)

2 Sheets—Sheet 1.

S. BISSELL.

FURNACE.

No. 335,558.

Patented Feb. 9, 1886.

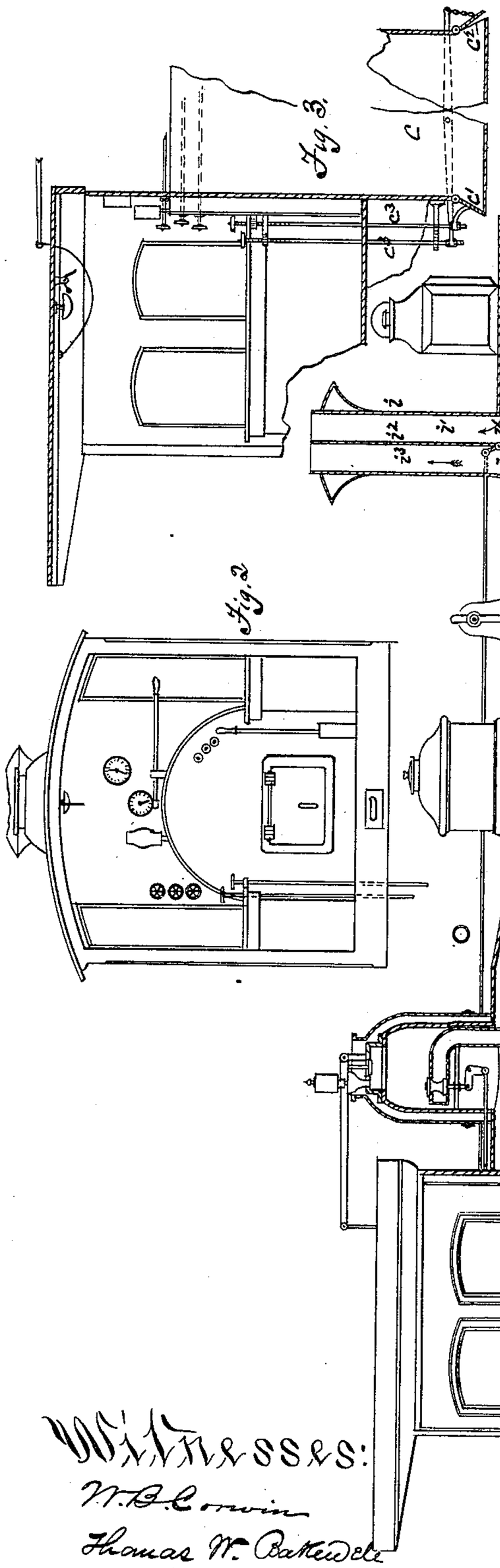

Fig. 2.

Fig. 3.

Fig. 1.

Witnesses:

W. B. Corwin

Thomas W. Bakewell

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(No Model.)

2 Sheets—Sheet 2.

S. BISSELL.

FURNACE.

No. 335,558. Patented Feb. 9, 1886.

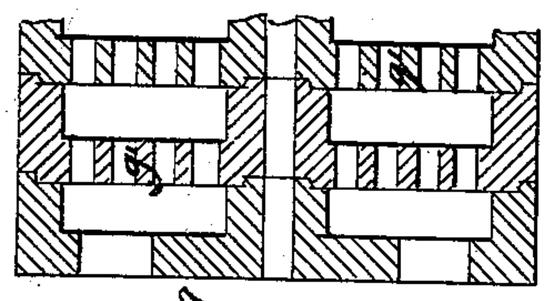

Fig. 8.

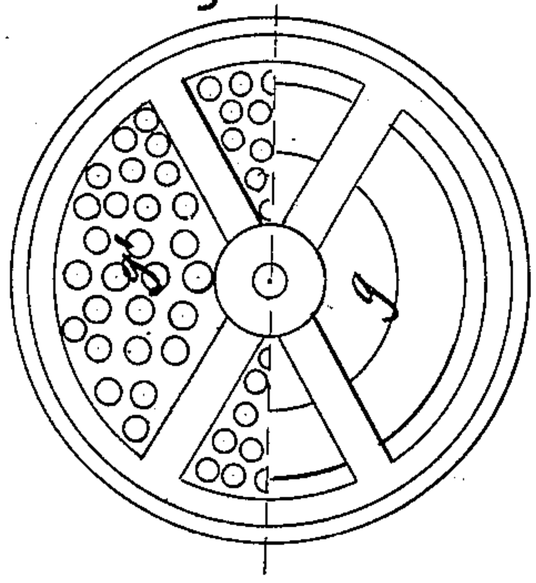

Fig. 7.

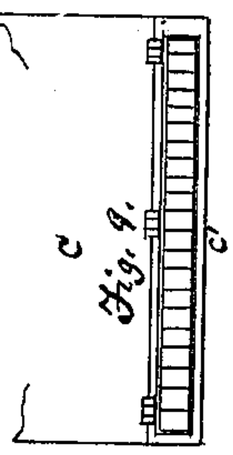

Fig. 9.

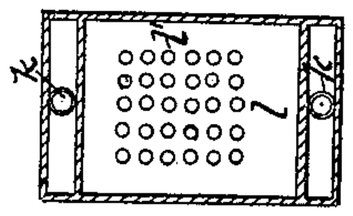

Fig. 10.

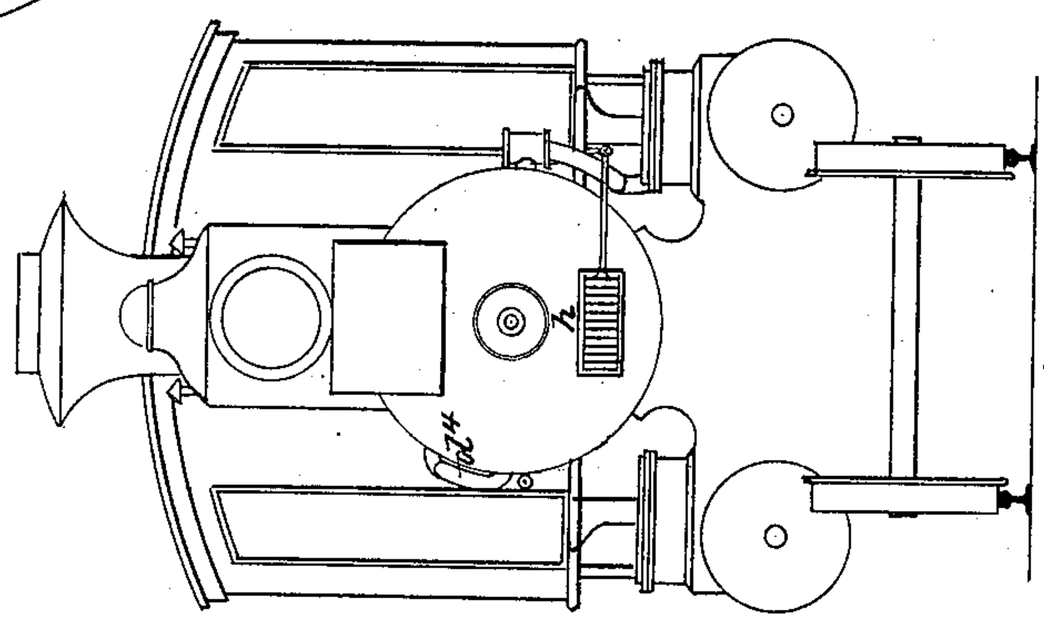

Fig. 5.

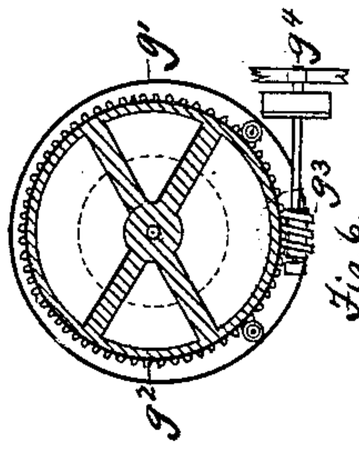

Fig. 6.

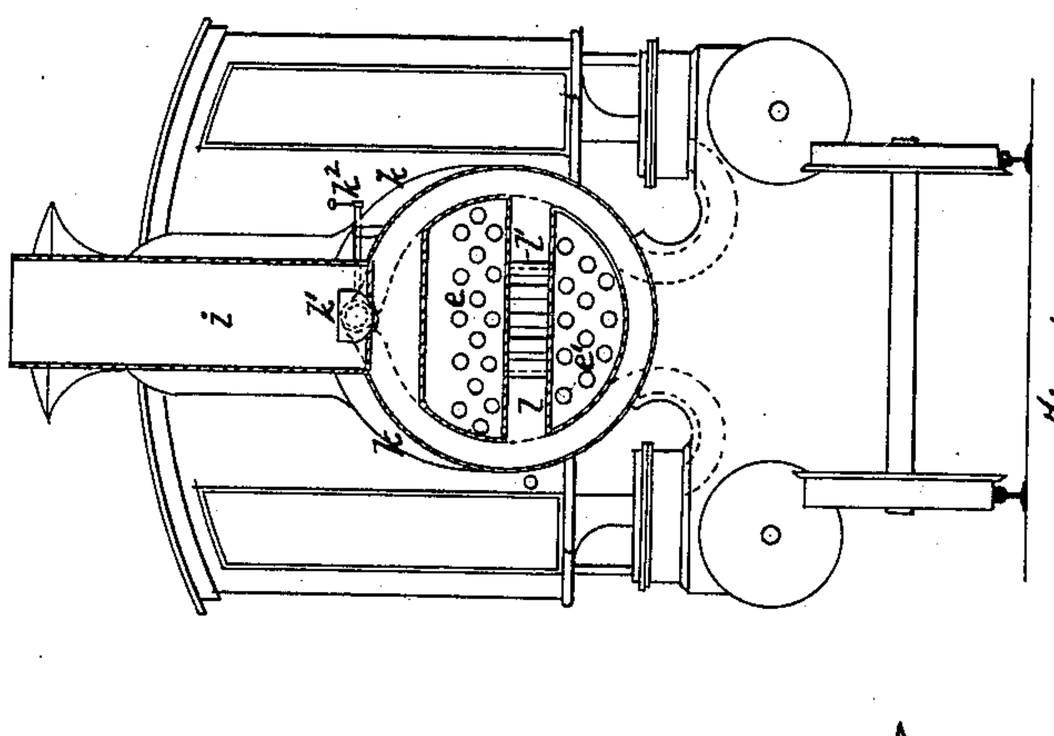

Fig. 11.

Witnesses:

W. B. Corwin

Thos. W. Bakewell

Inventor.

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by his attys.

Bakewell & Kerr

UNITED STATES PATENT OFFICE.

SIMEON BISSELL, OF PITTSBURG, PENNSYLVANIA, ASSIGNOR OF ONE-HALF TO JOHN R. ALEXANDER, OF SAME PLACE.

FURNACE.

SPECIFICATION forming part of Letters Patent No. 335,558, dated February 9, 1886.

Application filed October 25, 1883. Serial No. 110,019. (No model.)

To all whom it may concern:

Be it known that I, SIMEON BISSELL, of Pittsburg, in the county of Allegheny and State of Pennsylvania, have invented a new and useful Improvement in Furnaces; and I do hereby declare the following to be a full, clear, and exact description thereof.

My invention relates, primarily, to securing the perfect combustion of the smoke and gases generated in the use of bituminous coal and similar fuel, and particularly to its application to a boiler-furnace. In tubular-boiler furnaces as heretofore constructed the heat is entirely generated in the fire-box, and the flame passes thence directly into the flues, which, being surrounded by the colder water, chills and extinguishes the flame, causing the gases to pass through the flues in the condition of a hot smoke or gas. If this gas, on coming in contact with the air, is consumed, its useful effect is as certainly lost as if it had passed off unconsumed. 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 a 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; hence the value of a fuel does not depend alone on the quantity of the air supplied thereto, but also upon the condition of the air and the manner in which it is supplied. To obtain proper power, an intense heat is generated in the fire-box of an engine, for the reason that the steam-producing power is confined to that end of the boiler. This heat is often injurious to the plates and flues, and causes their rapid destruction.

With these considerations in mind I have constructed my improved furnace so as to divide the air and regulate its admission. The air is divided into three volumes, which are supplied, one to generate gas from the coal, the second to produce and support a semi-combustion of the gas in the fire-box, and the third for completing the combustion in the smoke-box, where the heat produced is utilized not only in generating steam, but in raising the temperature of the air, which is the main supporter of the combustion. By this arrangement I am enabled to reduce the degree of heat at the fire-box, because I utilize both ends of the furnace for generating steam, and am therefore able to obtain a larger quantity of steam with a lower degree of heat, which has the further merit of being uniform throughout.

In carrying out my invention I convert the fire-chamber into a kind of a gas-producer, receiving the air necessary for the distillation of the gases through the ash-box, where its admission is controlled by means of suitable valves. Thus I obtain a slow combustion and a regular and uniform distillation of fuel-gases.

To enable others skilled in the art to make and use my invention, I will now describe it as applied to a locomotive-engine, by reference to the accompanying drawings, in which—

Figure 1 is a longitudinal vertical section of the fire-box and boiler of a locomotive-engine. Fig. 2 is a rear elevation of the cab. Fig. 3 is a vertical section of the cab and ash-box. Fig. 4 is a vertical cross-section of the engine on the line *x x* of Fig. 1. Fig. 5 is a front elevation of the engine. Figs. 6, 7, and 8 are detail views of the regenerator. Fig. 9 is a view of the valve *c'*. Fig. 10 is a plan view of the upper flue-sheet in the air-combustion chamber.

Like letters of reference indicate like parts in each.

The locomotive-engine is of the usual construction, having a fire-box, *a*, and a flue-boiler, *d*. The fire-box *a* is provided with an incline or chute, *b*, for supplying the fuel, (usually coal-slack,) and is fitted with doors *b b*, to prevent the escape of gas and the ingress of air. The fire-box has suitable grate-bars, *a'*, which I prefer should be provided with a shaking device of any of the ordinary constructions, as will be understood. The ash-pit *c* is made tight, to prevent the ingress of air, except through the valves or dampers c' c^2, which are operated by suitable rods, c^3, extending up into the cab of the engine. There are two dampers, c' c^2, so that the one which is forward, as the engine moves, may be opened to admit the draft. The boiler *d* is provided with tubes or flues *e e'*, a steam-pipe, *d'*, and a feed-water

pipe, d^2. The flues of this boiler nowise differ either in number, arrangement, or position from those in general use, and no change in that respect is required or desirable; but by means of a horizontal partition, *l*, in the smoke-box *d* they are divided into two distinct series, *e e'*, constituting upper and lower tiers, and at the end of the smoke-box most remote from the boiler is a revoluble regenerator, *g*, the shell of which is constructed of iron plates, so riveted together as to form a drum-shaped vessel, through each head of which are a number of holes. This regenerator is divided into four segmental compartments, each lined and filled with fire-brick, *g'*, so arranged, in checker-work, as to leave between them a multitude of sinuous and tortuous passage-ways throughout. These bricks can be so molded as to fit perfectly into each other, making it impossible for them to move out of their places. When thus constructed, and when properly applied, some of the holes in the adjacent head will be opposite and coincide with the flues leading from the upper portion of the smoke-box, and other holes in like manner with the lower flues.

That portion of the smoke-box, d^3, which is situated between the forward ends of the flues and the regenerator is divided by the partition *l*, so as to form a passage, *f'*, through which the air from the lower chamber of the regenerator passes into the flues *e'*. The chamber d^3 is traversed by a pipe or flue, *f*, which connects the flues *e* with the upper chamber of the regenerator *g*. That portion of the chamber d^3 which is between the flues *f f'* constitutes the feed-water heater, the pipe d^2 discharging therein. It communicates with the water-space of the boiler which comes in contact with the flues *e e'* by means of a pipe, d^4. Extending vertically through the chamber d^3 from the flue *f'* to the flue *f* is a series of vertical pipes, *l'*, the purpose of which is to admit air from the flue *f'* into the flue *f*. Opening into the lower chamber of the regenerator through the front end of the engine is an air-port, *h*, provided with a suitable valve, *h'*, operated by a rod, h^2, in the cab, for regulating the admission of air to the regenerator, and opening out of the upper chamber of the regenerator is a flue, *i'*, which leads to the stack *i*. The stack *i* is provided with a damper, *k'*, and with a central vertical partition, i^2, dividing the interior of the stack into two passages, *i'* i^3. Opening into the stack below the damper *k'* are the exhaust-pipes *k*, which lead up from the cylinders of the engine. The damper *k'* is connected to and operated by a rod, k^2, extending to the cab of the engine, and so arranged that the exhaust may be caused to pass through either of the flues *i' i*³ at pleasure. When turned into the flue *i'*, it acts upon the flues of the engine through the regenerator, giving an increased draft to the fire-box. The regenerator-shell *g'*, Fig. 6, is provided with a rack or series of cogs, g^2, into which meshes a worm, g^3, mounted on a suitable shaft, g^4, and operated by any suitable means, so as to cause the slow but continuous revolution of the regenerator, in order that its chambers may be shifted, so as to be alternately the channels through which the outgoing hot gases and the ingoing cold air pass.

Thus constructed, the operation of my improvement is as follows: A sufficient quantity of slack or other suitable fuel having been placed in the fire-box *a*, the proper quantity of air is admitted through the ash-box and grate-bars to cause a slow but continuous distillation of the gas therefrom. The flame and other products of combustion from the fire-chamber *a* pass through the upper flues, *e*, flue *f*, upper regenerator-chamber, and out by the flue *i'*. As they enter the flues *e*, the flame becomes extinguished, and the hot unconsumed gases pass through the flues, and, entering the flue *f*, are there met by a volume of air rising through the tubes *l'*. This air, having entered through the lower regenerator-chamber, which was previously heated by the outgoing hot gases or waste products of combustion, is of the proper high temperature to cause an intense and thorough combustion of such unconsumed gases coming from the flue *e* into the flue *f*. This combustion takes place in the flue *f* and in the upper chamber of the regenerator. The heat thus generated, coming upon the water in the chamber d^3, raises the temperature of the latter, so that when it passes into the boiler proper it is almost in a vaporized condition. A portion of this heat is also absorbed by the brick-work of the upper regenerator, so that when, by the rotation of the shell, it is brought into the lower position, it will heat the incoming air up to the proper temperature. That portion of the incoming air which does not pass through the pipes *l'* passes back through the flues *e'* and enters the fire-box *a* above the surface of the fuel, where it comes in contact with the gas generated from the latter, and causes a vivid combustion in the fire-box. The temperature of the inflowing air, after passing through the hot regenerator-chambers, is so great that it raises that of the water in the boiler during its passage through the flues, and aids in vaporizing the same. Thus the heat which is applied to the generation of steam is equalized at the opposite ends of the boiler, and a very much larger surface of the latter is utilized for the purpose of generating steam than in the former construction of such furnaces. It will be noticed that the air is supplied for the purpose of combustion in three separate volumes—first, that which enters through the ash-box and grate-bars; second, that which passes through the flues *e'* and meets the gas in the upper part of the fire-box, and, lastly, that which passes through the pipes *l'* and meets the unconsumed gases in the flue or chamber *f*. These supplies of air being regulated, a perfect combustion can be effected and all the useful elements of the fuel utilized.

While I prefer to use the revoluble regenera-

tor described, I do not limit myself thereto, except as stated in the claims, because in a locomotive-engine it is new to use a regenerator in the smoke-box, and an ordinary flue-regenerator may be used instead of the revoluble one, as will be readily understood.

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

1. The combination, in a locomotive-engine, of a regenerator situate in the smoke-box, means of admitting air to a portion of the regenerator, gas-producing fire-box, and a flue-boiler interposed between the regenerator and the fire-box, one part of the flues of which conduct air from the inlet-chamber of the regenerator to the fire-box, and the other part convey the waste gases from the fire-box to the outlet-chamber of the regenerator, substantially as and for the purposes described.

2. In combination with a gas-producer and revoluble regenerator, an interposed flue-boiler, one portion of the flues of which conduct the waste gases to the outlet-chamber of the regenerator, and the other the air from the inlet-chamber of the regenerator to the furnace, substantially as and for the purposes described.

3. In combination with a gas-producer and regenerator, an interposed flue-boiler or other part, and a combustion chamber or flue placed between the boiler and the regenerator, wherein combustion of gases from the furnace is caused to take place by means of a current of heated air entering through the inlet-chamber of the regenerator, substantially as and for the purposes described.

4. In a locomotive-engine, the combination of a gas-producing fire-box, a revoluble regenerator in the smoke-box, an interposed flue-boiler, one part of whose flues admit air from the inlet-chamber of the regenerator to the fire-box, and the other convey the waste gases from the fire-box to the outlet-chamber of the regenerator, and means of admitting air to the waste gases as they pass from the boiler to the regenerator, substantially as and for the purposes described.

5. In a boiler-furnace, the combination of the boiler, a revoluble regenerator heated by the waste products of combustion, and a feed-water heater interposed between such boiler and regenerator, substantially as and for the purposes described.

6. The method herein described of utilizing waste gases of combustion in furnaces and other places where they are caused to pass over or in contact with cooler surfaces, which consists in reigniting them by mingling the same with a volume of highly-heated air in a revoluble regenerator after they have passed such cooler surfaces, whereby the bricks in the revoluble regenerator are kept at a high temperature for heating the air in its passage to the combustion or fuel chamber, as set forth.

In testimony whereof I have hereunto set my hand this 22d day of October, A. D. 1883.

SIMEON BISSELL.

Witnesses:
W. B. CORWIN,
T. B. KERR.