(No Model.)

R. D. BALDWIN, F. DOYLE & A. A. THOMAS.

FURNACE.

No. 374,285. Patented Dec. 6, 1887.

Fig 1.

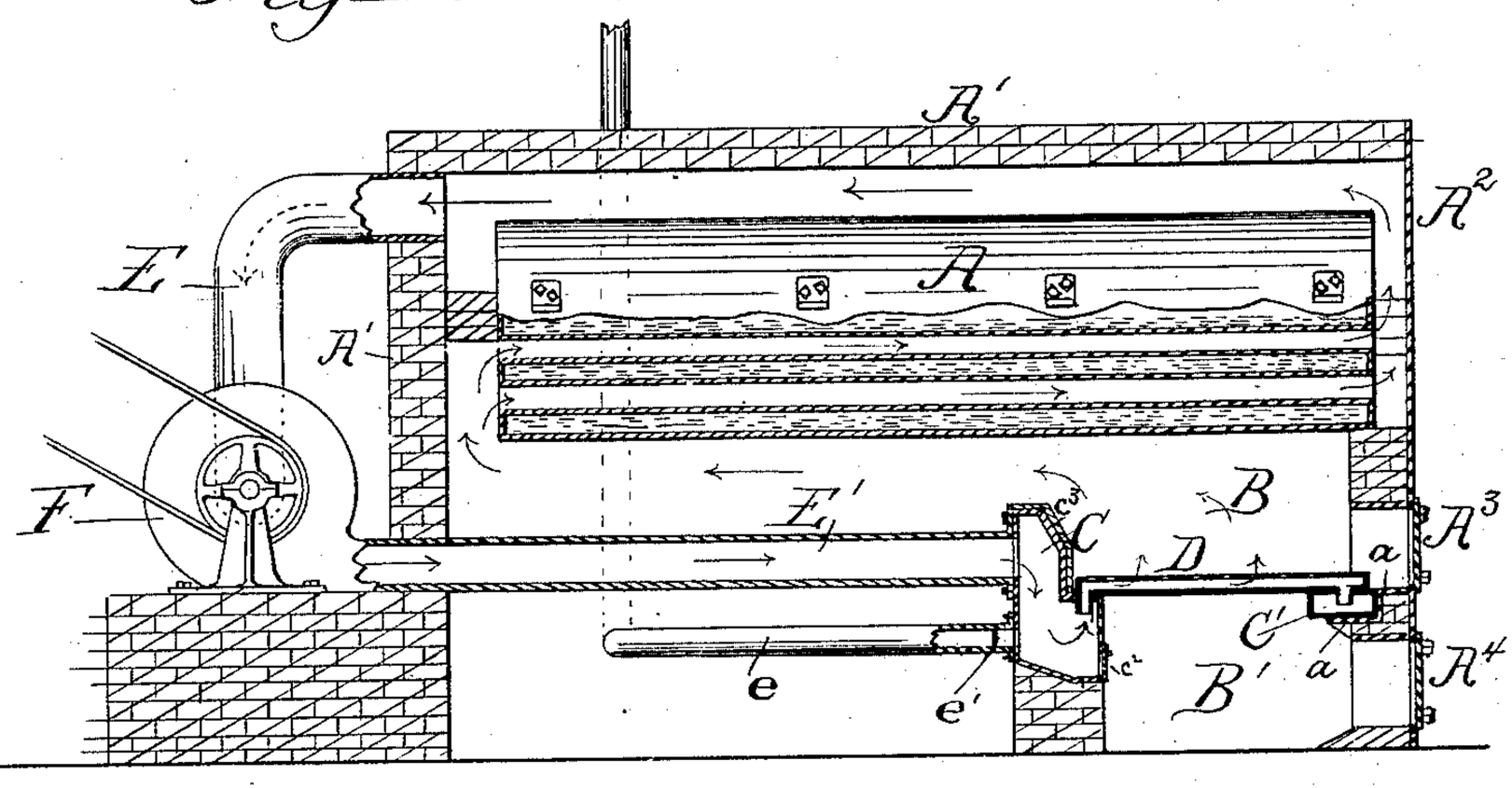


Fig 2.

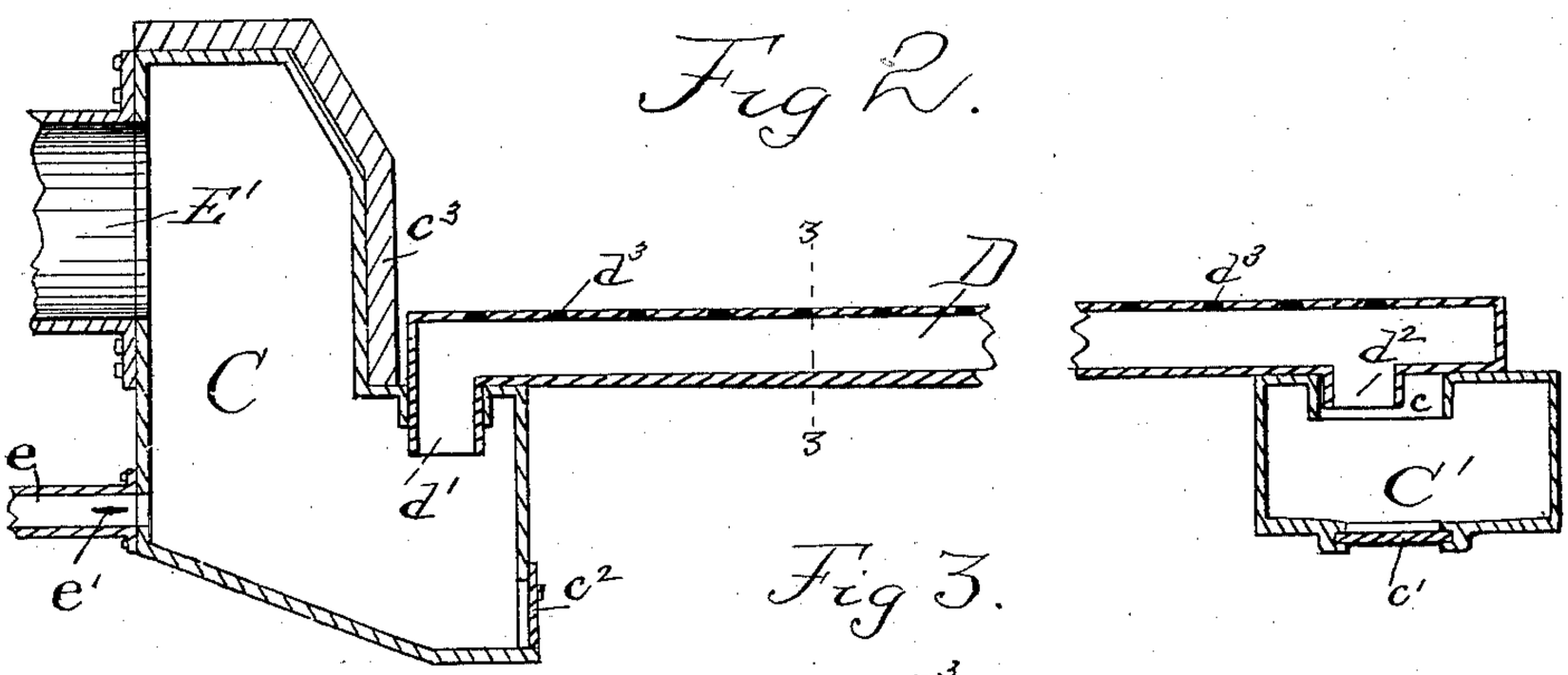
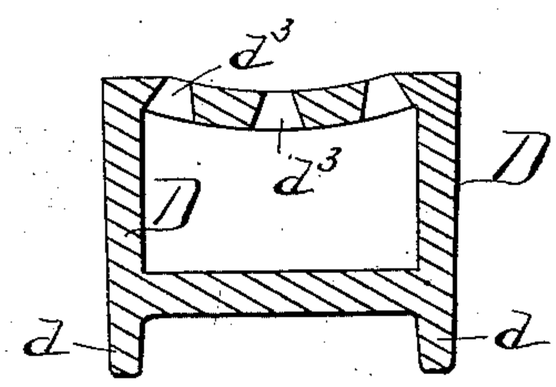


Fig 3.



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UNITED STATES PATENT OFFICE.

RICHARD D. BALDWIN, FRANK DOYLE, AND ADELBERT A. THOMAS, OF CHICAGO, ILLINOIS, ASSIGNORS, BY DIRECT AND MESNE ASSIGNMENTS, TO JOHN W. TRAER, OF CEDAR RAPIDS, IOWA, AND SAID RICHARD D. BALDWIN.

FURNACE.

SPECIFICATION forming part of Letters Patent No. 374,285, dated December 6, 1887.

Application filed September 6, 1886. Serial No. 212,863. (No model.)

To all whom it may concern:

Be it known that we, RICHARD D. BALDWIN, FRANK DOYLE, and ADELBERT A. THOMAS, citizens of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Furnaces, of which the following is such a full, clear, and exact description of the invention as will enable others skilled in the art to which it appertains to make and use the same, reference being had to the accompanying drawings, which form a part of this specification, and in which similar letters of reference indicate like parts throughout the several figures.

The object of the present invention is an improvement on the ordinary steam-boiler or other furnace that will secure by its use a large economy in the amount of fuel used and make available as fuel the lower grade of coal, coal-dust, and screenings not now generally used, and at the same time combine all the advantages of a spark-arrester and a smoke-consumer, and which will cause the fuel to be so perfectly burned as to reduce the quantity of ashes and cinder to a minimum. These objects, as well as other advantages, we obtain by the novel devices and combination of devices herein shown, described, and claimed.

In said drawings we have shown, in Figure 1, an ordinary steam-boiler furnace to which our invention has been applied; in Fig. 2, a somewhat enlarged view of a portion of the same, both being vertical longitudinal sectional views; and in Fig. 3, an enlarged transverse vertical sectional view of one of the grate-bars on line 3 3 of Fig. 2.

The letter A represents the boiler; A′, the usual masonry surrounding the same; A^2, the boiler-front, provided with fire and ash-pit doors A^3 A^4, which open, respectively, into fire-chamber B and ash-pit B′.

Upon the bridge-wall and extending across the width of the fire-surface is the receptacle C, in which one end of each of the grate-bars D is secured and supported. A second and somewhat smaller receptacle, C′, secured to a projection, *a*, of the boiler-front below the fire-door A^3, is provided with a number of openings or slots, *c*, corresponding to the number of grate-bars used, so that the forward end of each bar may rest upon said receptacle C′, as shown more clearly in Fig. 2. The receptacle C′ is provided at its bottom with an ordinary slide-opening, *c*′, by which the interior thereof may be reached and cleaned, as desired. A similar door or opening, c^2, is provided for the same purpose in the larger receptacle, C.

The grate-bars D are cast hollow throughout their entire length, and are provided with strengthening-ribs *d*, as shown. The grate-bars D are also provided with an extension at each end *d*′ d^2, the one to fit into an opening in the receptacle C and the other into the opening *c* in the receptacle C′. It will be noticed that this opening or slot *c* is somewhat larger than the extension d^2, thus allowing for any expansion or contraction which may take place in the grate-bars.

At suitable intervals in the upper surface of the grate-bars we provide a series of holes or openings, d^3, and we also prefer to make a portion of the fire-surface of said bars slightly concave, as shown.

The masonry A′ at the rear of the boiler A is so constructed that all the smoke, sparks, and flames of the burning fuel, after leaving the fire-chamber and passing to the rear beneath the boiler, are not allowed to escape, but are directed into and through the tubes or flues in the boiler, and thence, passing upward and to the rear over the boiler, as indicated by arrows in Fig. 1, enter the conduit E. This conduit or pipe E is connected to an ordinary rotary fan, F, which in turn connects with one end of another conduit or pipe, E′. This pipe E′ we usually place beneath the boiler, as shown, and connect its forward end to the receptacle C. The fan F is operated by any convenient means—as, for example, by a belt and pulley, as illustrated. The receptacle C has a smaller pipe, *e*, connected to it, as shown, for the purpose hereinafter to be explained, which pipe is provided with a damper, *e*′. The receptacle C may be provided with a lining of fire-clay, c^3, as shown.

The operation of this invention is as follows: The fire being built on the grate-bars in the fire-chamber, the smoke, sparks, heated air, &c., pass over the bridge-wall to the rear of the boiler, thence through the flues of the same out and over the boiler to the pipe E, thence through the fan F into the pipe E′, from whence they are forced into the receptacle C. As soon as this receptacle C becomes filled, the action of the fan F causes the smoke, sparks, &c., to seek outlet through the grate-bars, and the continued pressure forces the smoke, &c., into the fire through the number of small openings d^3, already mentioned. The ash-pit door A^4 may remain entirely open always, so as to admit fresh air to the fire through the interstices between the grate-bars, the latter being usually about one-half inch apart. The volume of fresh air is automatically regulated by the fan F, the fire drawing in more air or less, according as the blast is heavy or light. The portions of fuel which are not completely burned at first are thus returned to the fire in a number of small jets and impinge against the burning fuel remaining on the grates, become ignited and consumed, or are again caused to make the circuit through the boiler, fan, and receptacle C to the fire-chamber until entirely consumed or reduced to incombustible matter, such as a very fine ash or to clinker. With those fuels which evolve gases when burned in our furnace the results have proved very satisfactory, as such gases readily mingle with the smoke and make the circuit, passing out of the holes d^3 of the grate-bars, like so many gas-burners.

We have found by practical tests that furnaces equipped with our invention will completely burn or consume all the smoke and combustible matter in the fuel used in the furnaces, and completely arrest all sparks or cinders from escape, thus effecting a large saving in fuel used over other furnaces having a chimney or smoke-stack, whereby a large amount of combustible matter, as well as heat, escapes. Such incombustible gases as may sometimes be found in coal and other fuel are carried off by means of the small pipe *e* to a chimney or directly to the outer air.

We do not intend to limit ourselves to the precise mechanism herein illustrated, as many changes can be readily suggested by those skilled in the art, which changes and modifications may be used without at all departing from the spirit and principle of our invention. For example, we have shown the receptacle C as if made of cast metal; but it is obvious that the bridge-wall may be constructed into a receptacle, having proper openings for the pipes E′ and *e* and grate-bars D, instead of simply supporting the receptacle C, as illustrated in Fig. 1. The fan F and pipe E may be placed inside instead of outside the masonry A′, as shown, if preferred. The pipe E′ may be either a metal pipe or be built directly into the wall of masonry. In some cases it may not be convenient to pass the smoke and flames back over the top of the boiler, and in such cases we connect the conduit or pipe E to the front of the furnace immediately in rear of the boiler-front A^2. Where the fire-chamber is very large, requiring a wide grate-surface, we find it advantageous to divide or branch the pipe E′, so as to supply the receptacle C at two or more points, and thus more evenly divide the smoke and gases.

We have shown a stationary grate-bar; but it is obvious that a rocking grate-bar can be used with equal advantage.

We also do not wish to be limited to the use of our invention as applied to stationary-boiler furnaces, for it is equally applicable to locomotive and other portable boilers. The receptacle C′ receives such particles of cinders or sparks as do not find their way to the fire-chamber through the holes d^3.

In some cases where our invention is applied to furnaces already in use we may not conveniently construct the masonry at the rear end of the boiler, as shown at A′, and in such cases the ordinary damper is used, so as to permit the closing of the connection between the smoke-flues and the chimney or stack when the blast or fan power is applied.

Having now described our invention, what we claim, and desire to secure by Letters Patent, is as follows:

1. In a furnace wherein the products of combustion are returned to the fire-chamber, the hollow grate-bar D, having extensions $d' d^2$ at either end, and provided with a slightly-concave fire-surface having a series of small holes or openings therein, in combination with receptacles C and C′, substantially as shown and described.

2. In a furnace wherein the products of combustion are returned to the fire-chamber, the combination of the receptacle C, provided with pipe *e* and door c^2, and of receptacle C′, provided with door *c′*, with the hollow perforated grate-bars having extensions $d' d^2$ at either end, substantially as shown and described.

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