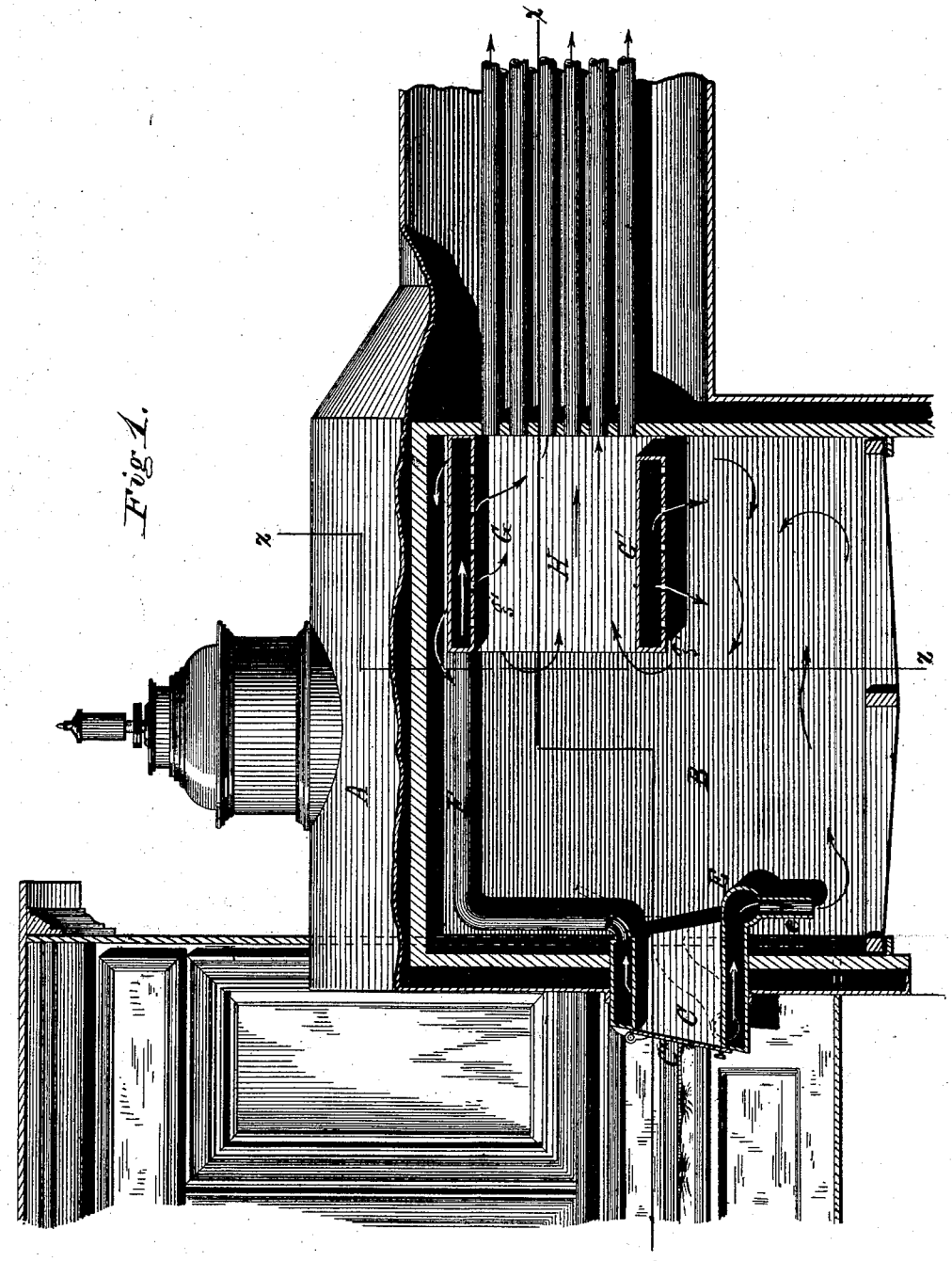
3 Sheets--Sheet 1.

H. F. HAYDEN.

Furnace for Locomotives.

No. 168,899. Patented Oct. 19, 1875.



WITNESSES

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Fig. 5.

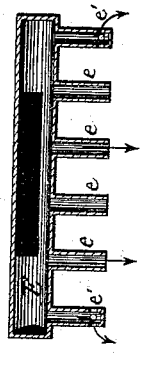


Fig. 1.

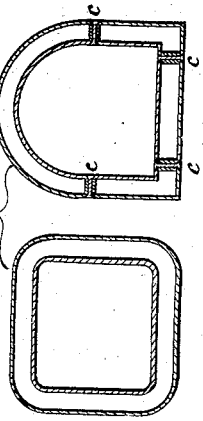


Fig. 6.

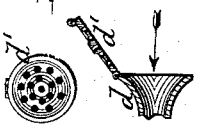
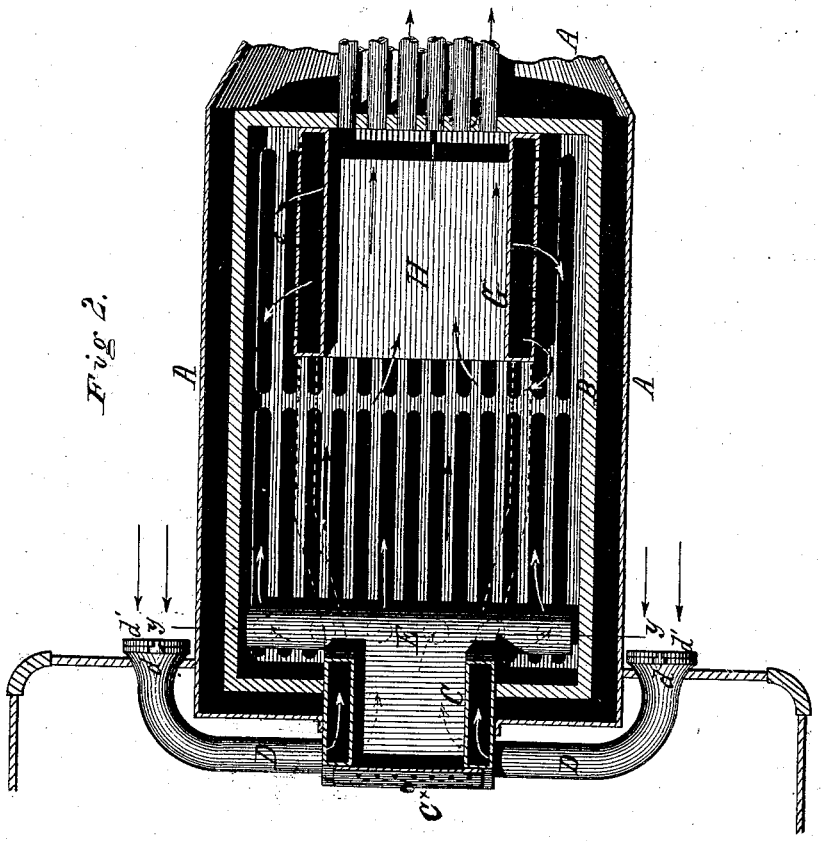


Fig. 2.



WITNESSES

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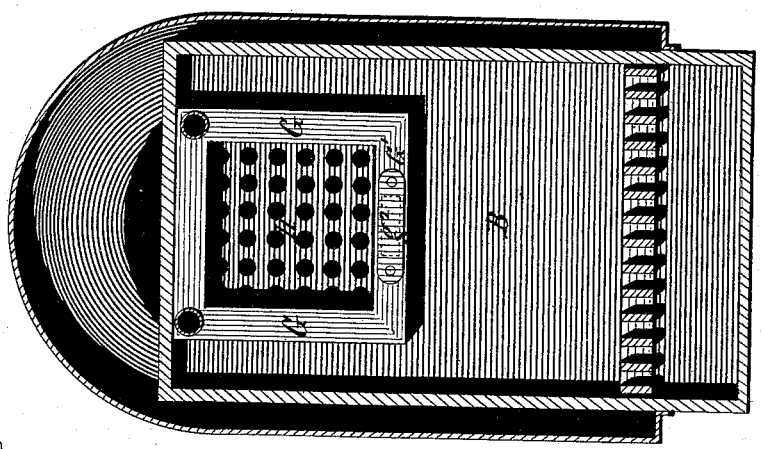

Fig 4.

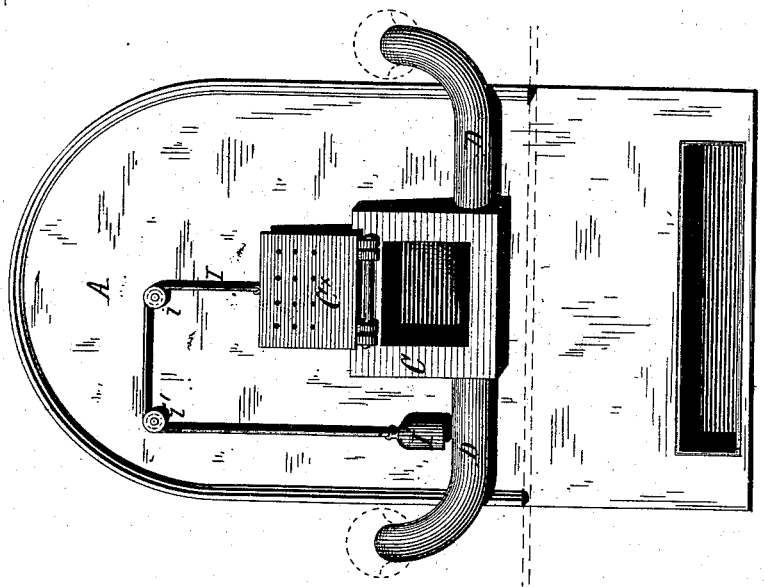

Fig 3.

WITNESSES

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UNITED STATES PATENT OFFICE.

HENRY F. HAYDEN, OF WASHINGTON, DISTRICT OF COLUMBIA.

IMPROVEMENT IN FURNACES FOR LOCOMOTIVES.

Specification forming part of Letters Patent No. **168,899**, dated October 19, 1875; application filed October 9, 1875.

To all whom it may concern:

Be it known that I, HENRY F. HAYDEN, of the city and county of Washington and District of Columbia, have invented certain new and useful Improvements in Doors and Attachments thereto for Locomotive and other Furnaces, of which the following is a full, clear, and exact description, reference being had to the accompanying drawings, making part of this specification, in which—

Figure 1 represents a vertical longitudinal section through so much of a locomotive as is necessary to show my improvements. Fig. 2 is a horizontal section of the same on the line *x x*, Fig. 1. Fig. 3 is a front elevation of the boiler and furnace-door. Fig. 4 is a vertical transverse section on the line *z z*, Fig. 1. Fig. 5 is a vertical section through the air pipe or tube and its branches connected with the furnace-door casing, taken on the line *y y*, Fig. 2. Fig. 6 represents a front elevation of, and a vertical section through, the mouth of one of the air-supply tubes; and Fig. 7 represents modifications in the form of the furnace-door or door-casing.

Similar letters of reference denote corresponding parts wherever used.

The invention relates to a novel means for supplying atmospheric air to various parts of the fire-box and combustion-chamber for promoting combustion at points where, as furnaces are ordinarily constructed, either dead spaces exist, or, from the lack of a sufficient supply of air, combustion is either retarded or suppressed; and, to this end, my invention consists, first, in the combination, with a double-walled door-casing, or one in which the air is admitted through ducts or passages outside of and around the coal-chute, of an air tube or pipe provided with pendent branches or short tubes, through which the air is conveyed to, and discharged in small jets at, the front of the fire, where, from the lack of such a supply of air, dead spaces are usually found in furnaces as ordinarily constructed. It further consists in the combination, with the fire-box, of a perforated annular or double-walled air-duct, surrounding, or nearly surrounding, the mouths of the tubes or pipes in the tube-sheet or point of exit of the products of combustion from the fire-pot, projecting from said tube-sheet into the fire-pot, and forming a combustion-chamber thereto. It further consists in combining the annular or double-walled air-duct and combustion-chamber with the annular or double-walled furnace-door by means of connecting air-supply tubes. It further consists in combining supply-tubes with the annular or double-walled furnace-door, and in certain details of construction and arrangement hereinafter fully set forth.

In speaking of the fire-pot, and the devices for supplying air thereto, that part of it to which the door is attached will be called the forward end, though in locomotive-furnaces, relatively, the said end will, of course, be really the rear end of said fire-pot.

In the accompanying drawings, A represents a locomotive-boiler, of any usual or preferred construction, within which is placed the fire-pot B, made in any desired form, and inclosed at the sides, top, and ends within a water-jacket in the usual manner. In the forward end of this fire-pot, and passing from the same through the water-jacket, is the annular or double-walled door-casing C, the construction of which is similar to that described in Letters Patent granted to me September 14, 1875, except that in the present instance the air-duct or double walls extend entirely around the door, opening at the top as well as at the sides and bottom, though of course they may be formed at the sides or top and bottom, or either only, as required; and, instead of being open in front, and provided with controlling-valves, as described in said patent, I prefer to close said air-ducts, and to connect them with air-supply tubes, as hereinafter explained, though of course the valves can be used either with or without the supply-tubes, as preferred. The door-casing is made to project outside of the fire-pot, and also through and outside of the water-jacket, where the latter is used, and the outer side walls of this projecting end, or the front walls, where it is preferred not to project the casing, have supply-pipes D D connected with them, extending laterally to the sides of the boiler, where they are turned forward and passed through the projecting forward walls of the engine-cab, as shown in Figs. 2 and 3, in such manner that the forward open mouth of the

pipe shall face the direction in which the engine is advancing. By this arrangement the air is forced into the tubes, and thence into the air ducts or spaces between the double walls of the door-casing, with a pressure proportionate to the speed at which the engine moves, and this pressure may be increased by giving to the open or receiving end of these pipes a bell-shaped mouth, as shown in Fig. 6 in section.

For controlling the amount of air admitted, the mouth *d* of each supply-pipe is provided with a pivoted valve, *d'*, arranged within convenient reach of the attendant, and adapted to be adjusted either directly by hand or by means of cords or chains extending within the cab, and held at any desired adjustment by means of hooks, buttons, or other suitable device for that purpose. These cords, chains, or levers for adjusting the valves *d'* may, if desired, be connected with the furnace-door in such manner that when said door is opened for putting on a supply of fuel, or for other purpose, the valves will be closed, cutting off the supply of air not required when the furnace door is open.

The valves *d'* may be provided with a series of small perforations, as shown in front elevation, Fig. 6, for admitting a limited quantity of air to the supply-tubes D D, when said valves are closed.

The lower horizontal duct of the door-casing has a tubular enlargement or transverse air-pipe, E, connected with its inner end, within the fire-pot, and extending horizontally across the forward end of the fire-pot, as shown in Figs. 1 and 2. This pipe E has projecting downward from it a series of small tubes, *e e'*, (see Figs. 1 and 6,) said tubes extending downward about one-half the distance, more or less, to the grate-bars, and either left open at their lower ends, as shown by *e*, or with said ends closed, and the tubes provided at and around said ends with a series of minute perforations, as at *e'*, by means of which the air received through the ducts in the furnace-door and pipe E is forced out in the form of minute jets or spray at the lower forward end and corners of the fire-pot for promoting combustion at these points.

At the rear end or wall of the fire-pot, or where the products of combustion pass out, ordinarily called the tube-sheet, and surrounding or partially surrounding the mouths of the tubes or exit-openings I place an annular or double-walled duct, G, its rear end resting against or in close proximity with said rear wall, and projecting thence forward into the fire-pot, and overhanging the rear end of the fire-grate, as shown by the drawings, the extent of its projection being governed by the form or construction of the furnace to which it is applied. This annular duct forms within itself a central combustion-chamber, H, open in front, and through which the products of combustion escaping from the fire-pot must pass, and is provided on its outer sides, and upon the lower walls of the top and bottom portions, with numerous small perforations, through which air is forced into the fire-pot around it, and into the combustion-chamber H itself.

Air is conveyed to the duct G through pipes F F, connecting it with the ducts through the double-walled door-casing C, and, through said casing, with the supply-pipes D D, and passing through the perforations *g g'*, around and inside of said duct and combustion-chamber in the form of numerous minute jets, is made to mingle with the products of combustion rising from the fire-pot around and passing centrally through said combustion-chamber, just at those points where, from the lack of a sufficient supply of air in furnaces as usually constructed, combustion is greatly retarded or entirely suppressed.

In practice the side and upper portions of the duct should be removed sufficiently from the adjacent walls of the fire-pot to permit the products of combustion to pass entirely around it, and the lower part G' should be shortened up, leaving a space between the end thereof and the adjacent rear wall or tube sheet of the fire-pot, as shown, through which the cinders and other unburned portions of the fuel drawn up into the combustion-chamber can escape again into the fire-pot, thereby preventing them from "banking-up" against said tube-sheet.

In some cases it may be found advisable or necessary, from the construction of the furnace, to omit the upper horizontal portion of said double-walled duct, leaving only the sides and lower portion, for affording the products of combustion free access to the upper wall of the fire-pot, said wall forming also one of the walls of the boiler; and in others it may be of service to give to the bottom portion of the duct a position inclining from front to rear, so that the products of combustion may more readily rise and pass forward to the mouth of the combustion-chamber H; but these, with other modifications in the form of the annular or double-walled duct and combustion-chamber, will readily suggest themselves to the skilled builders of the furnaces to which they are to be applied.

In most of cases the outer walls of said duct will be sufficiently removed from the adjacent boiler-walls to prevent any cooling action of the air thereon; but this will, in great measure, be obviated by the passage of the air through the furnace in the pipes F, in which it will be heated and prepared to combine readily with the escaping gases arising from combustion.

The duct can be bolted through flanges to the rear wall of the fire-pot, and may be supported at its forward end by angular straps or legs, if required.

In some cases it may be found desirable to connect the pipes F directly with the supply-pipes D D, leaving the pipe E to be supplied through valves at the forward end of the

door-casing, as explained; but for many purposes the construction above described is preferred.

A man-hole is provided at the forward end of the lower part of this duct, (shown at g^2,) through which obstructing matter that may accumulate therein can be readily withdrawn when required.

Any desired form may be given to the double-walled door-casing, (as also to the air-duct G,) modifications therein being indicated in Fig. 7. These walls may either be cast in one piece, with connecting front or rear walls, or they may be made separate, with intervening tubular stays and countersunk through-bolts, as indicated at *c*, Fig. 7, and the front and rear walls (either or both) may be bolted thereto through suitable flanges for that purpose.

The furnace-door $C^{\times}$ may be of any usual construction, either single or double walled, as desired, conforming to the shape of the casing, and hinged thereto in any usual manner; but I prefer to hinge it at its upper edge, as shown in Fig. 3, and to connect therewith a chain, I, running up and over pulleys *i i'*, and having its opposite pendent end connected with a weight, I', sufficiently heavy to counterbalance the weight of the door.

By this arrangement, when the door is closed, the weight having little or no leverage, the door will remain firmly closed until opened by the attendant; and vice versa, when the door is thrown up, as shown in the figure, it has little or no leverage upon the weight, and will remain open until it is moved by the attendant sufficiently far to give it leverage enough to continue its closing action automatically.

The form or direction of the supply-pipes D D is indicated in Figs. 2 and 3, and in dotted lines, Fig. 1, and, by preference, is such as to bring their mouths out above the cab-seats through the forward projecting walls or face of the cab; but this, of course, may be varied to suit the construction of the engine and cab, or the judgment of the builder.

The direction of the connecting-pipes F is shown in Fig. 1, and in dotted lines, Fig. 2, though, of course, the direction may be varied to suit the form or construction of the furnace.

The air tube or cylinder E, with its branches *e*, instead of extending along the front walls only of the fire-pot, and terminating at the side walls, may, in some cases, be turned and continued along the side or side and rear walls, and in other cases it may be found desirable to connect it at the rear with the duct G, thereby increasing the supply of heated air to said duct.

Under the arrangement of the double-walled duct G, at that portion of the fire-pot where it is exposed to intense heat it may be found necessary to provide it, on its outer exposed surface, with ribs, corrugations, or projecting points or spurs, and to coat said roughened surface with a cement of asbestus and fire-clay or other fire-proof material.

The arrows in the sectional views, Figs. 1 and 2, indicate approximately the direction of the currents of air supplied to the fire-pot and combustion-chamber through the arrangement of pipes and ducts described.

Having now described my invention, what I claim as new, and desire to secure by Letters Patent, is—

1. The combination, with the annular or double-walled door-casing, of the transverse air duct or tube E, arranged inside the fire-pot, and provided with the distributing-branches, substantially as described.

2. The annular or double-walled door-casing, in combination with the supply-tubes D, substantially as and for the purpose described.

3. The air-supply tubes D, arranged and operating, in connection with the double-walled door-casing, substantially as described, in combination with the valves for regulating and controlling the admission of air, as described.

4. The perforated annular or double-walled air-duct G, forming the combustion-chamber H in advance of and around the mouths of the exit-tubes or openings, substantially as and for the purpose set forth.

5. The annular or double-walled air-duct G, in combination with the supply-pipes F, connecting it with the double-walled door-casing, as described.

6. The double-walled air-duct and combustion-chamber, in combination with the supply pipes or tubes F and D, arranged and operating substantially as and for the purpose set forth.

H. F. HAYDEN.

Witnesses:
ALEX. MAHON,
JOHN G. CENTER.