May 22, 1928. 1,670,295

E. G. BAILEY

FURNACE

Filed May 3, 1924

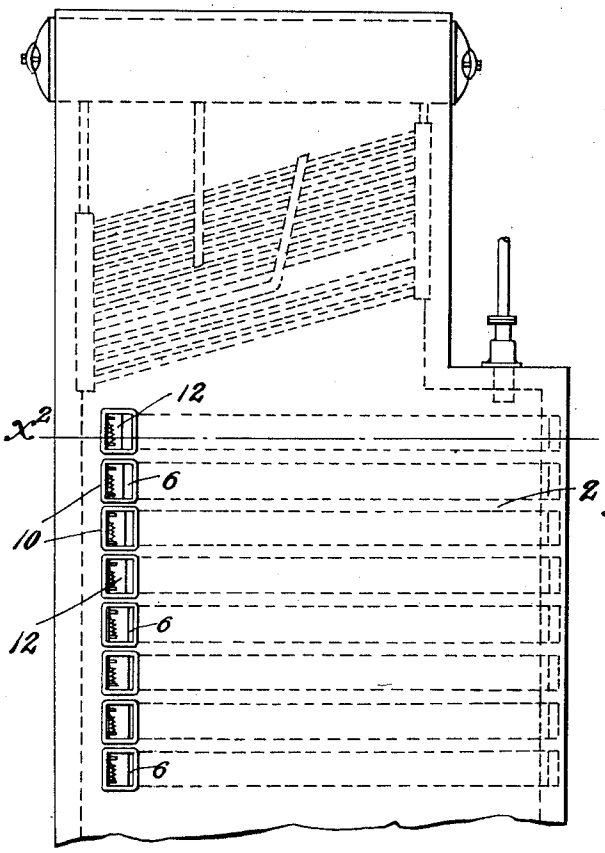


Fig. 1

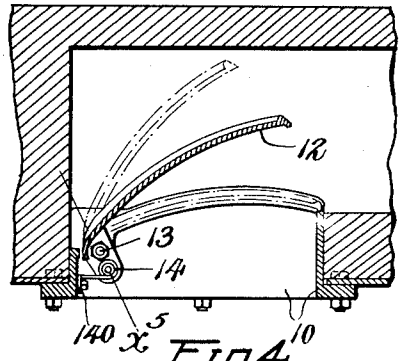


Fig. 4

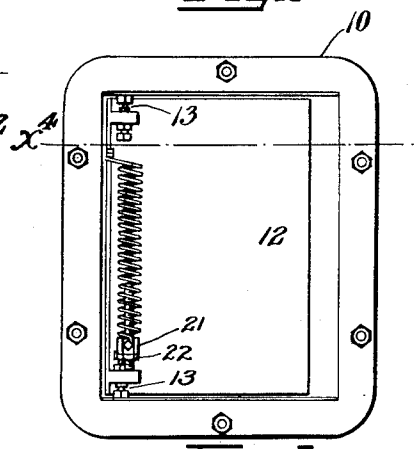


Fig. 3

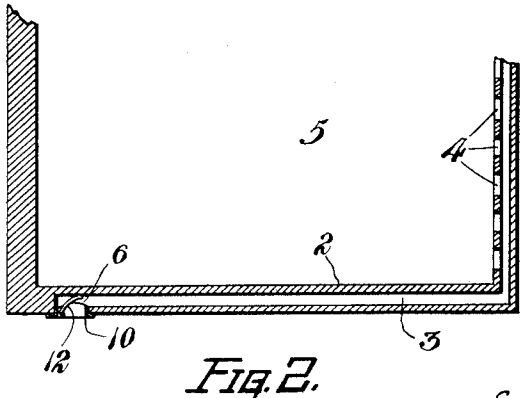


Fig. 2.

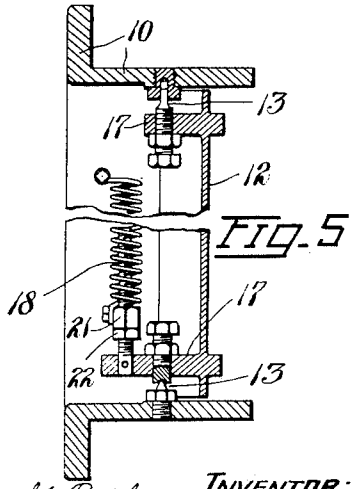


Fig. 5

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UNITED STATES PATENT OFFICE.

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FURNACE.

Application filed May 3, 1924. Serial No. 710,812.

This invention relates to furnaces and especially to the means for controlling the supply of air for combustion of the fuel in furnaces using powdered coal or fuel of similar nature.

In furnaces for burning powdered coal as now commonly constructed, the combustion chamber is relatively large and high as compared with that of a furnace in which the fuel is burned on a grate, and it is necessary for efficient operation that air, commonly called secondary air, should be admitted at numerous points to the combustion chamber, the inlets being distributed throughout the height of the combustion chamber.

Furthermore, it is necessary to control the admission at various levels separately or individually in order to effect the proper distribution of the incoming air as the draft pressure varies from top to bottom of the column of heated gases in the combustion chamber.

The inlet of air, or secondary draft control, is regulated by having separate independently operating valves, or doors, at the several air inlets, and the complexity of requirements, owing to variations in draft pressure at the different inlets when the furnace is working at any given combustion rate, and to variations in the total draft pressure according as the combustion rate is changed to meet the varying demands upon the furnace, is such that heretofore the draft doors have been controlled by hand operation, requiring careful and practically constant attention, and the exercise of a high grade of skill or judgment, in order to maintain the operation of the furnace at a high state of efficiency.

The purpose of the present invention is to provide for efficient control of the distribution of the air automatically, which is accomplished by the employment in connection with each draft inlet, of an automatically operating regulating device, or valve, with provision for adjustment of its action in response to the draft pressure, that is, to the difference between the external pressure at each inlet and the pressure in the combustion chamber at the place, or level, at which the air is delivered from said inlet into the combustion chamber.

The nature of the controlling means is such that when the several inlet valves, or doors, are properly individually adjusted, each with relation to the others, to effect the proper relative distribution of the air, the said valves will respond to variations in the aggregate or total draft of the furnace when the rate of the fuel supply is varied to meet the varying demands upon the power or output of the furnace, while retaining the proper relative action, so that after the proper initial adjustment has been made for a given furnace, air will continue to be admitted with proper distribution for efficient combustion without further operation or care on the part of attendants.

In the accompanying drawings

Fig. 1 is a side elevation of a sufficient portion of a boiler furnace, adapted for the combustion of powdered coal as its fuel, to illustrate an embodiment of this invention;

Fig. 2 is a fragmentary horizontal section on X^2 of Fig. 1 illustrating the character of one of the draft inlets;

Fig. 3 is an elevation of one of the automatic draft controlling devices or inlet valves;

Fig. 4 a sectional plan thereof on line X^4 of Fig. 3; and

Fig. 5 a sectional detail on line X^5 of Fig. 4.

Referring to Figs. 1 and 2 the furnace proper may be of usual construction, being shown as having its side wall, 2, provided with a number of draft, or air inlet, passages 3, shown in dotted lines in Fig. 1, each having its inlet opening, 6, near the rear of the furnace and each being continued across the front wall, as best shown in Fig. 2, in which front wall it is provided with a number of delivery openings, 4, into the combustion chamber, 5, or space in which the combustion of the fuel goes on.

This is a well known arrangement in furnaces of this nature, and it will be observed that the several passages are themselves horizontal and collectively form a vertical series extending from top to bottom of the combustion chamber, with the inlet openings, 6, standing in a vertical series, and each such opening has been provided with a door or valve to regulate the admission of air therethrough, which doors, so far as I know, prior to this invention, have had to be operated by hand in order to determine properly the amount of air admitted through each opening, and have had to be operated by hand from time to time accord-

ing as the total or aggregate draft of the furnace is varied to meet varying demands upon it.

It is required for efficiency that the proper relative amount of air should be admitted through the several passages when the furnace is operating at any given rate, and that the aggregate amount of air admitted through the entire series of ducts should be varied as the demand upon the furnace varies while still maintaining the proper relative distribution of the air delivered by the several passages.

These requirements are met, in accordance with the present invention, by the automatic air controllers, an effective embodiment of which is illustrated in Figs. 3, 4, and 5.

Each of the inlet openings, 6, (Fig. 1) is provided with a suitable frame, 10, supporting the draft regulator, shown as a door or flap valve, 12, mounted on a hinge or pivotal support, 13, near one side of the frame opening, and each being yieldingly impelled, as by the spring, 14, shown as a helical torsion spring, in the direction to close the opening and shut off and check, or wholly stop the admission of air.

The pressure of the external air on the valve, 12, however, tends to press it inward and thus to open the valve, and such action takes place, owing to the diminution of pressure in the duct, 3, due to the draft of the furnace.

As the spring action, tending to close the valve is yielding, and increases progressively as the door is opened owing to the increasing stress of the spring, it will be apparent that as the draft or reduction in pressure in the combustion chamber increases, the valve will be opened wider and will admit a correspondingly increased amount of air, so as properly to maintain the increased combustion, due to the added draft.

It is common to regulate the intensity of the fire, according to demands, by varying the draft, as for example, by a damper controlling the flow of the products of combustion from the furnace to the up-take or chimney, and by correspondingly varying the feed or supply of fuel and primary air, and it will be seen that such variation in draft will automatically effect the proper regulation of the admission of secondary air through the passages, 3, into the combustion chamber, by the above described controlling devices, thus requiring no attention of the operator to insure efficient action under the varying conditions requiring a more or less intense fire.

In order that the proper distribution of the air in the several passages, 3, may be secured, the springs, 14, are capable of minute adjustment and the spring for each valve will have to be adjusted at the outset, to effect a proper relative distribution, but once properly adjusted, will maintain the proper proportional admission of air under substantially all conditions of operation.

In order to provide for ready adjustment and efficient action of the valves, 12, the construction shown in detail in Figs. 4 and 5 is effective.

Said valves are shown as castings, the main portion of each of which is a curved plate as best shown in Fig. 4, which presents an effective surface to the pressure of the external air; and serves to deflect the air which is admitted to the direction of the duct, 3.

At the hinge edge, 16, said plate is provided at its upper and lower ends with lugs, 17, containing the pivot members at 13 which cooperate with corresponding pivot members secured to the frame, 10. The lower lug, 17, also has affixed to it a support or upright, 18, having provision for supporting one end of the spring, 14, and the means for adjusting its resilient action on the valve.

The said spring, 14, is shown as a helical spring having its upper end secured to the frame plate, 10, at 140.

The lower portion of said spring, 14, encircles the upright, 18, which is screw threaded, the end of the spring being fixed to an adjusting nut, 21, threaded on said upright, 18, together with a lock nut, 22, to prevent turning of said nut, 21, on the screw upright, 18, after it has been adjusted.

Thus the tension of the spring, and its resistance to the air pressure tending to force the valve inward and open the air passage, may be adjusted by turning the nut, 21, and fixing it in the new position by the nut, 22, and each door of the series may be adjusted individually, to afford the proper amount of opening relative to that afforded by the other valves for any given draft rate.

Once properly adjusted for the desired distribution of air, among the several passages, 3, at any given draft rate, substantially the same proportion will be maintained if the draft is increased or diminished, as the several valves will yield proportionately to an increase in draft pressure or will be closed proportionately by the action of the springs, upon diminution of the draft pressure, and thus, when once adjusted, will be self acting and will maintain the proper admission and distribution of air under practically all conditions of service of the furnace.

While the force of the springs may be adjusted throughout substantially the desired range, it may be desirable, or necessary, for the attainment of maximum efficiency, to use springs of different initial strength, and consequently of different rate of increase of force for a given movement for the doors at the different levels.

The curved shape of the doors, or valves, is such that the entering air is gradually de-

flected to the direction of the flue or air passage, 3, in the side wall, and reacts upon the door with a pressure increasing with the velocity of the air, with less impact, or rebound, than if plain surfaced doors were used.

The increase in reaction, due to the high velocity of the air when the door is nearly fully open, as shown in dotted lines Fig. 4, tends to compensate for the less effective reduction of back pressure, or draft pull, in the pocket at the rear of the door, which does not get the full effect of reduction of pressure in the combustion chamber and in the passage, 3, leading from the outside into the combustion chamber.

I claim—

1. A furnace the wall of which is provided with a plurality of air inlet ducts to the combustion chamber, combined with automatic valves in said ducts adapted to be opened by the pressure of the incoming air, and means for providing a predetermined yielding resistance to the opening movement of each valve proportioned relative to that of the other valves to effect a corresponding relative distribution of the air in the several ducts which is thus maintained substantially the same at all rates of air inflow.

2. The combination with an air inlet duct in the wall of a furnace having a laterally disposed inlet opening, of a valve for automatically controlling the admission of air to the duct consisting of a curved plate pivotally supported near one side thereof in the inlet opening and a spring which yieldingly impels said valve toward closed position, and means for adjusting the tension of said spring, said plate by reason of its curvature acting to deflect the air into the duct and being responsive to the reaction due to the change of direction in addition to the static pressure or the incoming air.

3. In a furnace, a wall having a plurality of air inlets into the combustion chamber, valves controlling the passage of air through said inlets, said valves being opened by air pressure, and means adjusted to resist the opening of different valves to different extents.

4. In a furnace, a wall having a plurality of air inlets into the combustion chamber, and automatically operated regulating devices for said inlets adjusted to permit air to flow through some of said inlets more freely than through others.

5. In a furnace, a wall having a plurality of air inlets into the combustion chamber, valves controlling the passage of air through said inlets, said valves comprising curved pivoted plates, yielding means to tend to keep said valves in their closed positions, and means to vary the pressure at which said yielding means yields.

6. In a furnace, a wall having a plurality of air inlets into the combustion chamber, valves controlling the passage of air through said inlets, said valves comprising spring closed concave plates, and means to adjust the tension of said springs.

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