March 7, 1939. T. A. MARSH 2,149,740

DRAFT REGULATOR FOR FURNACES

Filed July 23, 1934

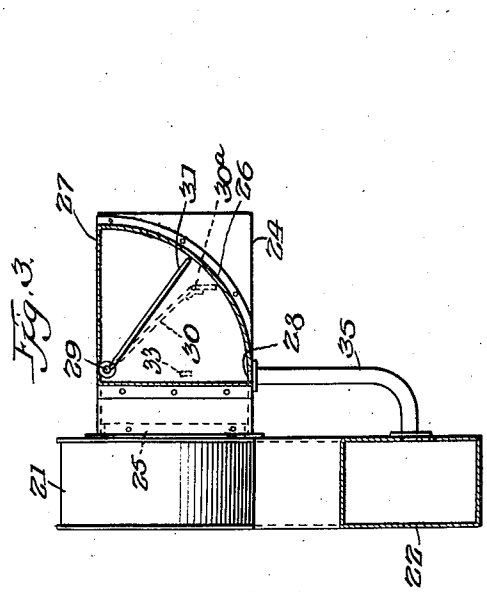


Fig. 3.

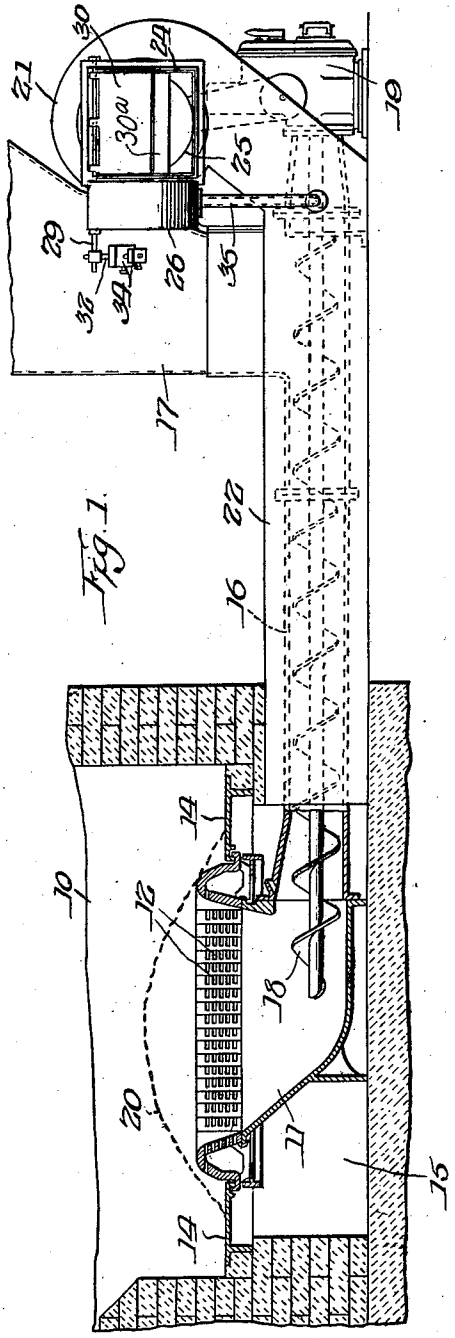


Fig. 1.

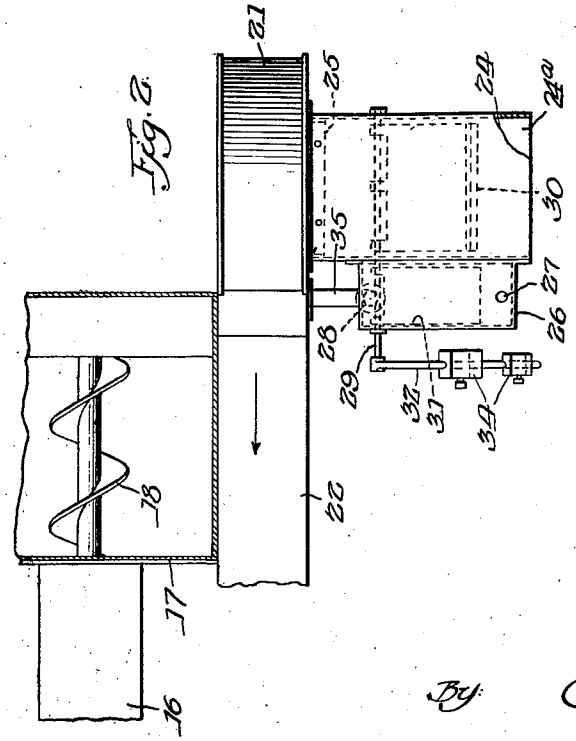


Fig. 2.

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Patented Mar. 7, 1939 2,149,740

UNITED STATES PATENT OFFICE

2,149,740

DRAFT REGULATOR FOR FURNACES

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Application July 23, 1934, Serial No. 736,471

6 Claims. (Cl. 110—69)

This invention relates to furnaces for the burning of fuel for production of heat and relates more particularly to automatic regulation and control of the volumetric rate of air supply for combustion.

There are various forms of furnace or fuel-burning equipment which include automatic stoking or fuel feeding apparatus together with apparatus for supplying combustion air by forced draft. Some of these are equipped with "on and off" control means whereby the operation of the fuel feeding and/or air feeding devices is started automatically when the temperature or steam pressure falls to some minimum, and stopped when the temperature or steam pressure reaches some maximum point. During continuous operation of the fuel feeding mechanism, the portion of the fuel bed through which the combustion air is forced may be maintained at a fairly consistent depth and density by keeping the rate at which the fresh fuel is supplied substantially equal to the rate at which the fuel is burned. However, after an "off" period, during which the fuel feeding apparatus has been inactive but the fuel in the furnace has continued to burn, the thickness of the fuel bed may become very substantially reduced. Since the rate at which the fuel burns is also dependent on the rate at which draft air is supplied, variation in the thickness of the fuel bed may occur also during periods of continuous operation if there is variation in the proportion of air actually available in the combustion zone.

The thickness, hence the resistance to air flow, of the fuel bed through which the draft air must be forced in order to reach the burning fuel has a very important bearing on the efficiency of operation of the furnace. If the draft air is delivered by the forced draft apparatus at an approximately constant volumetric rate and pressure, its passage through a thin fuel bed will be at a much higher volumetric rate than will its passage through a thick fuel bed. Consequently, with a thin fuel bed there will be an excess supply of air to the burning fuel and a great increase in the amount of fine or "fly" ash carried out in the stack gases; whereas with a thick fuel bed there may be a deficiency of air supply to the burning fuel, resulting in a reduced rate of combustion and a further increase in the thickness of the bed. Moreover, if the air is supplied at such a pressure and passes through the fuel bed at such a rate as to produce a pressure in the combustion chamber above the fuel bed, it may force smoke back through the fuel feeding means and into the room in which the latter is located.

A general object of the present invention is the provision of automatically operating apparatus whereby a proper ratio between the fuel being burned and the draft air supplied thereto may be maintained under all operating conditions.

Another object is the provision of such an apparatus which is simple in construction and operation, which may be supplied at low cost and which is adaptable to use with various forms of fuel and air feeding devices now on the market.

Another object is the provision of such apparatus which will function automatically in response to variations in the resistance of the fuel bed to passage of air, to keep the burning fuel supplied with the proper amount of air.

An important object of the invention is the provision of such apparatus wherein the ingress of air below the fuel bed is completely and automatically stopped when the forced draft apparatus is at rest, and wherein, when said apparatus resumes operation, the supply of draft air is gradually increased, so that the fuel bed is not subjected to a sudden blast or pressure of draft air such as would be likely to carry away quantities of "fly" ash.

Yet another object is the provision of such apparatus which will minimize "windage" noise incident to operation of the forced draft apparatus.

Another object is the provision of such apparatus which is certain in operation and which is not subject to deterioration or disablement from use under the conditions normally encountered in furnace operation, and which is not dependent on delicate adjustments for its effectiveness.

Other and further objects will be pointed out or indicated hereinafter, or will be apparent upon an understanding of the invention or its employment in use.

For the purpose of aiding in an explanation of the invention I show in the accompanying drawing and hereinafter describe one practical embodiment of it. It is to be understood, however, that this embodiment is presented merely by way of illustration and that the specific showing and description of it are not to be construed in any fashion as limiting the appended claims short of the true and most comprehensive scope of the invention in the art.

In said drawing,

Fig. 1 is a side view, partly in elevation and partly in sectional elevation, of a furnace instal-

lation containing one embodiment of the invention;

Fig. 2 is a top view illustrating a portion of the installation; and

Fig. 3 is a rear elevational view, partly in section, of a portion of the installation.

The nature of the invention may be ascertained most readily from a detailed description of the illustrative embodiment here presented.

The reference numeral 10 designates generally the combustion chamber of a furnace in which the solid fuel (e. g., coal) is burned. In the fuel chamber is located the fuel support which is in the nature of a retort or fuel pot 11 which has its upper portion provided with air ports or tuyères 12. Surrounding said upper portion of the fuel support is a platform 14 which closes off the space around the lower portion of the retort from the combustion chamber, to form an air distribution chamber which is designated generally by the reference numeral 15. Air passes from this air distribution chamber into the upper portion of the fuel pot through the tuyères 12.

A fuel conduit 16 communicates with the retort below the tuyères and with a fuel hopper 17 disposed outside the furnace chamber, and a suitable conveyor 18 is operable by a motor through a suitable drive gear mechanism 19 to feed coal from the hopper through the fuel conduit and into the fuel pot. As the coal is thus fed into the fuel pot, that ahead of it is crowded upwardly therein past the tuyères and may form a fuel bed having a surface contour approximately as indicated at 20. Having been ignited, the fuel normally burns in the surface portion of this bed, said surface portion being kept supplied with fresh fuel from below as described above.

A blower or compressor 21 is arranged to be operated concurrently with operation of the fuel feeding mechanism, the outlet of said compressor being connected by an air conduit 22 with the air distribution chamber 15, thus to supply air to said chamber at a pressure such as to force it through the tuyères and through the portion of the fuel bed thereabove.

A damper box 24 surrounds the inlet 25 of the compressor and extends outwardly therefrom, the outer end of said damper box being open to atmosphere, as indicated at 24a. A regulator casing 26, of sectoral form, is conjoined to the side of the damper box, forming a chamber which is closed excepting for an opening 27 at the top and an opening 28 at the bottom. A regulator shaft 29 extends through the regulator chamber and the damper box, being journaled in the walls thereof. A damper 30 is fixed on the shaft 29 for swinging movement in the damper box. This damper spans the passage within the damper box and is adapted to vary the size of said passage effective for admission of air to the compressor inlet. The damper closes toward the fan inlet against a stop 33 and opens by swinging movement toward the outer end of the damper box. A regulator vane 31 is fixed on the shaft 29 for swinging movement within the regulator compartment, said vane spanning the width of said compartment and its free end traveling in close proximity to the curved wall thereof. A lever arm 32 is fixed to the shaft 29 and carries regulator weights 34 which are adjustable longitudinally thereon. With this arrangement of parts, gravity tends to swing the damper to closed position and to swing the vane 31 toward the opening 28. This opening 28, which will be referred to as back pressure opening, is connected by a conduit 35 with the air supply conduit 22, whereby air may pass from the conduit 22 into the regulator chamber behind the vane 31.

In operation of the apparatus, the blower being actuated at a constant rate, it will propel air through the air supply conduit 22 into the air distribution chamber 15 and tend to build up a pressure in said chamber. Since the air in chamber 15 finds outlet through the tuyères 12, the degree of pressure which will be attained in chamber 15 will depend, among other factors, upon the resistance offered by the fuel bed to the passage of air therethrough from the tuyères. Hence, if the fuel bed is burned down thin, as it may be after an "off" period during which the fuel feeding apparatus has been inactive but the fuel is burning, the pressure in chamber 15 would not attain the degree, or build up at the rate, that it would if the fuel bed were thick, provided the air were supplied to chamber 15 at the same volumetric rate under both conditions of the fuel bed. The air supply regulator operates automatically to vary the volumetric rate of air supply in accordance with the pressure in chamber 15 and hence in accordance with the thickness or resistance of the fuel bed to the passage of air therethrough. The pressure in chamber 15 is effective as back pressure in air supply conduit 22 and, through conduit 35, in the regulator chamber 26 behind vane 31. Consequently, as pressure in chamber 15 builds up, the back pressure in regulator compartment 26 behind vane 31 will build up, and said vane will be lifted against gravity, thereby rotating regulator shaft 29 and giving damper 30 an opening movement. This increases the supply of air to the blower and hence enables it to increase the volumetric rate of air supply to chamber 15 and hence increase the pressure in said chamber. The desired ratio of back pressure to air admission is established by adjustment of weights 34.

It will be apparent from the foregoing explanation that the volumetric rate at which the air is supplied to chamber 15 is rendered dependent on the resistance of the fuel bed to the passage of air therethrough. By virtue of this regulation, the volumetric rate of air supply to the burning fuel may be maintained approximately at a constant ratio, inasmuch as when the fuel bed is thick it requires a higher pressure to force the air to the burning surface portion of the bed than is required when the fuel bed is thin. Upon resumption of operation after an "off" period, during which the fuel bed may have been thinned by continued burning at a reduced rate, the volumetric rate of air supply to chamber 15 will be at a minimum and the operation of the fuel feeding apparatus will gradually increase the thickness of the bed. With such increase in the thickness of the fuel bed, the volumetric rate of air supply to chamber 15 will be automatically increased until the quantity of air supplied to the burning fuel reaches the desired ratio.

The damper preferably is arranged so as to completely close the inlet to the blower when the apparatus is inactive. With such arrangement the blower and conduit 22 may be completely closed against ingress of air, to avoid the induction of air through the fuel bed by the natural or stack draft of the furnace. With such arrangement it is desirable to hinge the lower portion of the damper as indicated at 30a, so that when operation is started the suction of the blower may swing the hinged portion inwardly to a limited extent so as to admit a minimum volume

of air for the building up of back pressure sufficient to open the damper upon increase in the thickness or resistance of the fuel bed. Thus, when operation is resumed after an "off" period, the fuel bed is not subjected to a sudden blast or excessive pressure of air from the blower, and the opening of the damper is accomplished gradually and incrementally in response to increase of the resistance of the fuel bed. This limitation on the admission of air at the starting of the apparatus has a very desirable result in preventing the blowing out of "fly" ash from a bed which has burned down during an "off" period. Sudden or excessive opening of the damper is avoided also by the arrangement of the weight lever 32, which is such that the effectiveness of the weights increases as the damper and weight lever arm move upwardly from the closed position, and sudden opening of the damper is furthermore opposed by the air pressure on the outer side of the damper, which is higher than that on the blower side, and by the kinetic effect, or momentum force, exerted upon the damper by the incoming air in damper box 24.

What I claim is:

1. In fuel burning apparatus having a fuel support and an air chamber for supplying air thereto, the combination of a blower operable to feed air into said chamber, a damper for controlling volumetrically the admission of air to the blower, said damper tending normally to assume a closed position, a movable regulating device disposed outside the air chamber and operatively connected with the damper, and means for rendering air pressure from said chamber effective on said movable regulating device to move said damper to open positions.

2. In fuel burning apparatus having a fuel support and means for feeding fuel thereto, the combination of a blower, a conduit for conducting air from the blower to the fuel support, a damper for controlling admission of air to the blower, said damper tending to assume a closed position when the blower is not operating, and regulating means operable by air pressure in the conduit to give the damper an opening movement.

3. In fuel burning apparatus, a combination as specified in claim 2 and wherein said regulating means is disposed entirely outside said conduit.

4. In fuel burning apparatus having a fuel support and means for feeding fuel thereto, the combination of a blower, a conduit for conducting air from the blower to the fuel support, a damper operable to vary admission of air to the blower, said damper being biased to assume its closed position, a regulator chamber outside of but in communication with said conduit, and regulating means operable in said chamber by air pressure from said conduit to vary the position of said damper.

5. In fuel burning apparatus having a fuel support and means for supplying fuel thereto, the combination of a blower, a conduit for conveying draft air from the blower to the fuel support for passage through a bed of fuel thereon, a damper for shutting off supply of air to said blower, and regulating means operable by air pressure from said conduit to sustain said damper in various open positions, said damper having a portion operably responsive to operation of the blower when the damper is in closed position, to admit a restricted feed of air to the blower.

6. In fuel burning apparatus having a fuel support and means for supplying fuel thereto, the combination of a conduit for conveying draft air to the fuel support for passage through a bed of fuel thereon, a blower for supplying air to said conduit, a damper for varying admission of air to said blower, said damper being biased to assume its closed position and having a portion operable by the suction of the blower to admit a restricted feed of air to the blower, and means operable by air pressure in the conduit to sustain the damper in various open positions related to the degree of such air pressure.

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