April 18, 1939. J. R. FELLOWS 2,155,120

DOWN-DRAFT BURNER

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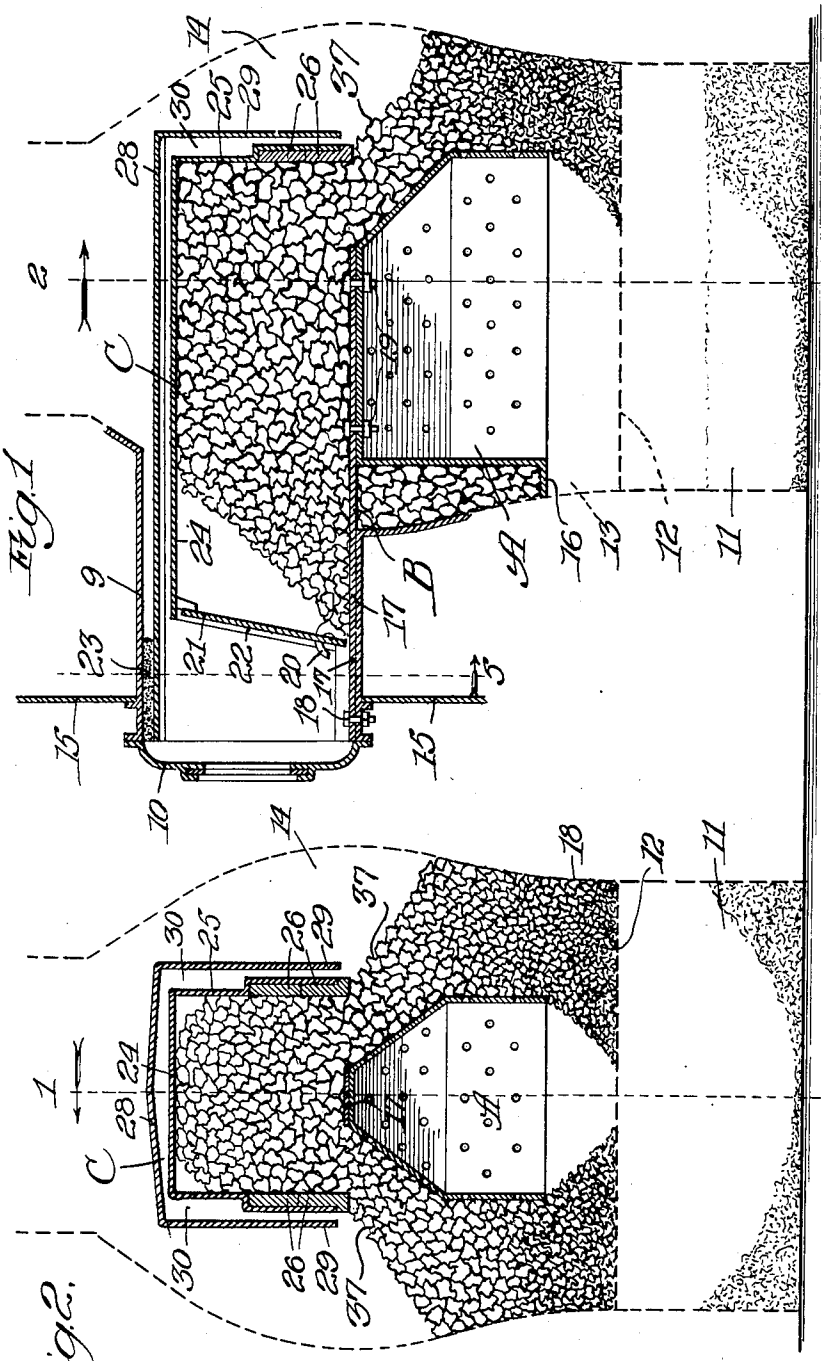


Fig. 1

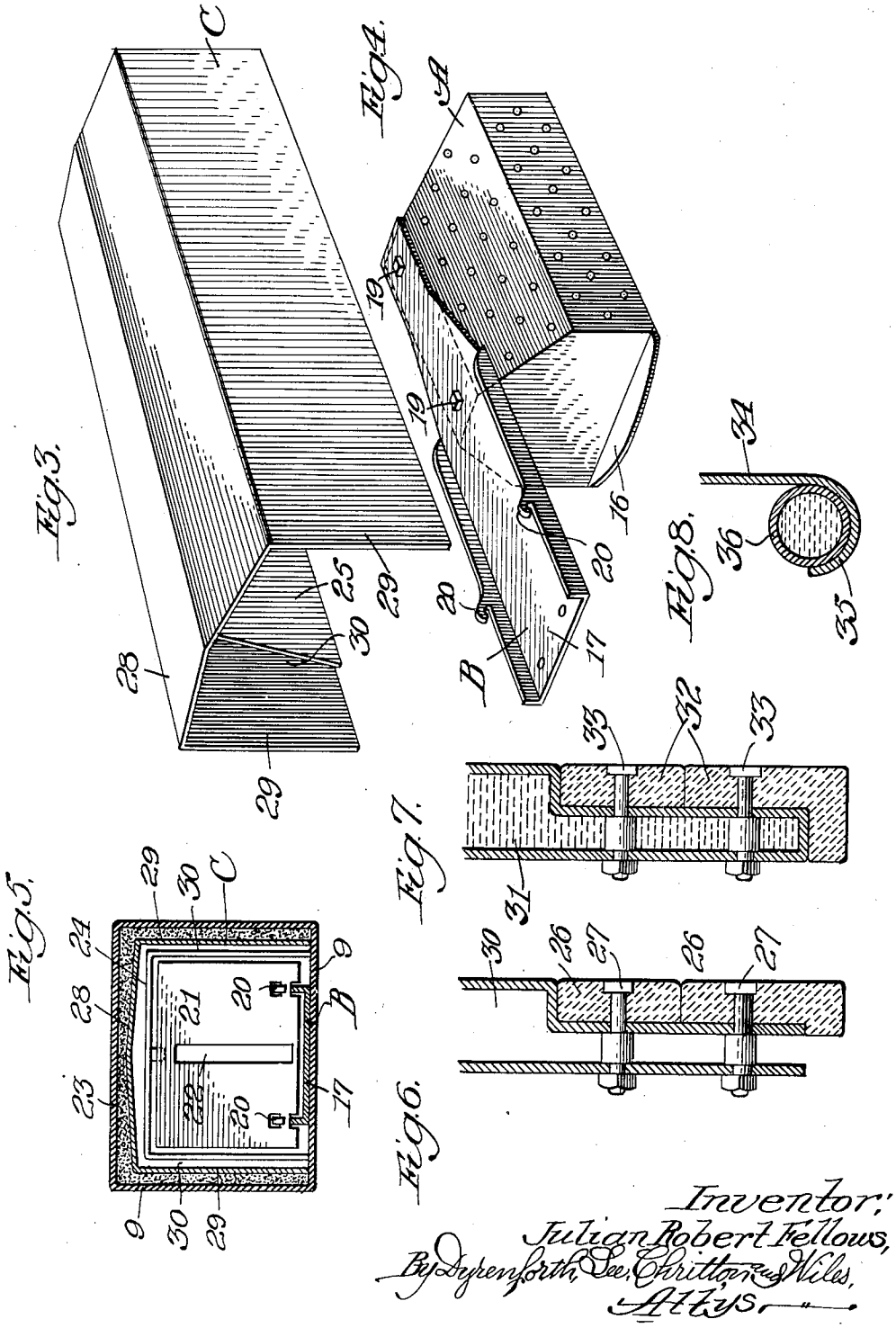
Fig. 2

Inventor:
Julian Robert Fellows,
By Dyer, Tyler, Brady & Thompson
Attys.

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DOWN-DRAFT BURNER

Julian Robert Fellows, Urbana, Ill.

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7 Claims. (Cl. 110—29)

This invention relates particularly to down-draft burners which will enable solid fuels such as bituminous coal and the like to be burned efficiently without appreciable smoke.

The primary object of the invention is to provide a down-draft coal burner which is adapted for use in small or domestic heating plants which may be warm air furnaces, steam or hot water boilers.

A further object of the invention is to provide an inexpensive burner which may be installed easily in existing plants with practically no change or destruction of the standard equipment heretofore used.

A further object of the invention is to provide an improved auxiliary grate onto which coal may be fed by gravity from a superposed charging housing.

Another object of the invention is to provide a charging housing having walls in the combustion chamber of the furnace which conducts air entering the furnace down through the green coal, said walls being protected by air or water cooling means.

It has been found that practically all domestic heating plants operate on the up-draft principle. This principle is not suited to the burning of bituminous coal because the gases in the coal are driven off at a much lower temperature than that required to burn them. As a result, a large amount of volatile gas, originally in the coal, passes into the atmosphere in the form of smoke. These losses not only reduce the efficiency of the heating plant but result in damage to property and health.

The invention is illustrated in a preferred embodiment in the accompanying drawings, in which—

Figure 1 is a longitudinal sectional view of the firing-neck and burner of a furnace (the furnace being shown diagrammatically) with the burner supported by said neck; Fig. 2, a vertical sectional view, taken as indicated at line 2 of Fig. 1; Fig. 3, a perspective view of the charging housing; Fig. 4 a perspective view of the auxiliary grate and its supporting arm; Fig. 5, a sectional view, taken as indicated at line 5 of Fig. 1; Fig. 6, a fragmentary sectional view showing one of the side walls of the charging housing; Fig. 7, a modification showing the wall of a housing provided with a water jacket; and Fig. 8, a further modification in which the charging housing has but a single wall whose lower end portion is protected by a cooling water pipe.

In the preferred embodiment illustrated in Figs. 1–6, inclusive, A designates an auxiliary grate; B, a cantilever supporting arm for said auxiliary grate whereby the grate may be suspended in the firing-pot from the firing-neck of the furnace; and C a charging housing for feeding coal by gravity to the auxiliary grate A.

For the purpose of illustration a conventional warm air furnace has been shown by dotted lines and is provided with a suitable firing-neck 9 whose outer end is provided with a firing door 10. A furnace of this character has an ash pit 11, a main grate 12, a fire-pot 13, a combustion chamber 14, and is usually enclosed by sheet metal shell 15.

The various parts of the present invention are designed so that they may be installed through the firing door without taking the furnace apart.

As shown in Figs. 1, 2 and 4, the auxiliary grate A is made of heavy perforated sheet metal and its walls taper downwardly and outwardly from the center of the combustion chamber so as to distribute the fuel towards the marginal edge portions of the fire-pot 13. The front lower edge portion is shown provided with a flange 16 which may bear against the front edge of the fire-pot to help the supporting arm B and protect it against bending.

The supporting arm B has a channel like front portion 17 which is adapted to be bolted to the firing-neck by means of stove bolts 18. Its rear end is tapered back and forms a cantilever support for the auxiliary grate A which may be suspended therefrom by means of stove bolts 19. As shown in Figs. 1 and 2, the arm may be provided with a pair of pivot brackets 20 upon which a smoke door 21 may be mounted. The door is provided with a vertical slot 22 to permit a rod or poker to be inserted into the charging housing without opening said door.

The charging housing C is an open bottom box-like member having an open front end which, after installation, is adjacent to the firing door 10. This housing may be supported by the firing-neck, above the auxiliary grate in a variety of ways but in the embodiment illustrated it is shown sealed in position by means of fireproof cement 23, as it is important in employing the down-draft principle that no air be admitted to the combustion chamber between the side walls or the top of the housing, and the firing-neck. If desired, the front ends of the housing may be flanged outwardly and secured to the front edge of the firing-neck so that no sealing cement is required. If the device is installed in this manner, the hinged brackets of the firing door must

be changed to allow space for a flange, or, the firing door may be mounted directly on the housing. The important thing, as mentioned above, is to prevent air from entering between the side walls or top wall of the housing and the firing-neck. The housing C has inner top walls **24** and side walls **25** which form a box-like structure to receive the coal through the doors **10** and **21**. As the lower edge portion of the housing is very close to the hottest part of the fire, it is desirable to protect it from burning. For this purpose blocks of refractory material **26** may be secured to an offset portion of the walls by means of bolts **27**, which may be made of stainless steel or other heat resistant material. In the preferred form illustrated, the coal receiving compartment walls are enclosed by an outer jacket having a top wall **28** and side walls **29**. The inner and outer walls are spaced to provide an air space **30** through which air is permitted to circulate from the firing door to the combustion chamber. The air thus admitted performs two functions, first, it cools the side walls of the housing and thereby itself becomes preheated, and second, it is introduced at the hottest point in the fire-pot and provides additional oxygen to burn the carbon monoxide to CO_2. However, in using the double wall construction with air cooling, the space should be sufficiently small that an excess of "over fire air" is not introduced, for that would result in reduced efficiency. The proper proportions are well-known by those skilled in the art. It may be noted in Figs. 1 and 3 that the inner walls **24** and **25** do not extend to the outer end of the firing-neck and accordingly the conduit **30** opens around the top and sides of the smoke door **21**. This feature minimizes the danger of any smoke coming back from the coal compartment, out through the firing door **10**, when a fresh charge of coal is being put in, as any smoke and gas driven off forwardly will be sucked into the conduit **30** and back into the combustion chamber. The smoke door **21** is designed to further prevent smoke from escaping into the furnace room, particularly while the coal is being poked, through the slot **22**.

In the modification shown in Fig. 7, a charging housing has its side walls in the form of a water leg **31**. The water, circulated through this leg or jacket, may be used for various domestic purposes. As the leg is kept comparatively cool by the water it is desirable to partially enclose it with refractory blocks **32** so that it will not chill the fire excessively. The refractory blocks may be held in position by suitable stay bolts **33** which may be made of stainless steel or the like.

In the modification shown in Fig. 8, a single wall charging housing is used and the lower leg **34** is turned outwardly, as indicated at **35**, to support a water pipe **36** and protect the housing from being burned. The water pipe may be welded to the leg **34** to insure good conduction.

In operation it will be understood that green coal is shoveled into the charging housing through doors **10** and **22**. The coal gradually drops down towards the fire-pot and the hottest part of the fire is in the vicinity indicated by numeral **37**. After the coal burns to ash the ashes drop down onto the main grate **12** and may be removed in the usual manner. Practically all of the air admitted to the combustion chamber enters through the door **10** and is drawn rearwardly and downwardly to the point of combustion. Most of the air travels through a fuel bed of the inner compartment and is thereby preheated before it reaches the combustion chamber. Some burning occurs within the charging housing and the charge is heated by conduction of heat from one particle of coal to another. The volatile part, of a charge of coal, is thereby driven off very much more slowly than in an up-draft combustion chamber and then carried by the incoming air through the hottest part of the fire where it is burned and not given an opportunity to pass off as smoke. An extremely small amount of air, preferably, is permitted to enter through the ash pit and is admitted to the combustion chamber through the auxiliary grate. This air is sufficient to cool the auxiliary grate and prevent its being burned. In cold weather, if it is desired to force the fire, more of the ashes are removed from the firing pot and this permits a large amount of burning coal to be exposed in the combustion chamber.

It has been found by careful tests that low grades of bituminous coal may be burned without smoke by utilizing the present burner. No serious difficulty has been encountered by clinkers. With some grades of fuel there is some tendency for the green coal to form coke in the housing C but coke is easily broken up by a poker inserted through the slot **22**. With free burning coals, of course, there is no difficulty in maintaining an even feed at all times.

It will be readily understood that the present invention is not only adapted to convert existing up-draft installations into down-draft burners but that new installations can be designed to utilize the down-draft principle. The burner has many advantages over an up-draft installation and has certain advantages over under-fed stokers. With the present burner the air and volatile gases are subjected to greater preheating than is the case in most underfed devices. For this reason there is less likelihood of smoke being given off and efficiency is somewhat improved. While the invention has been illustrated in connection with a warm air furnace, it will be understood that it is equally adaptable to hot water or steam boilers. Accordingly, in using the word furnace, I mean to use the word in its broader sense so as to include not only a warm-air furnace but also hot water and steam heating units. The device is intended to be used primarily with practically any grade of coal, but obviously it will burn other types of solid fuel.

The foregoing detailed description has been given for clearness of understanding only, and no unnecessary limitations should be understood therefrom, but the appended claims should be construed as broadly as permissible, in view of the prior art.

I claim:

1. In a furnace having a grate, and a fire-pot with a firing-neck and combustion chamber, a down-draft coal-burner comprising: an auxiliary grate mounted in said fire-pot above said grate, said auxiliary grate having perforate walls sloping downwardly and outwardly from the center of the combustion chamber; and a closed-top coal-charging housing having its top and lateral walls sealed in said firing-neck and extending horizontally into said combustion chamber, and having a rear wall and bottom opening above said auxiliary grate so that air entering the furnace through the firing-neck must pass through and beneath said housing.

2. A device as specified in claim 1, in which the housing is provided with inner walls extending towards the front of the firing-neck so as to pro-

vide a coal compartment with an air jacket, and a smoke door is hinged in said firing-neck to form an air regulator for the front end of said coal compartment.

3. A device as specified in claim 1, in which the housing is provided with inner walls extending towards the front of the firing-neck so as to provide a coal compartment with an air jacket, and a smoke door is hinged in said firing neck to form an air regulator for the front end of said coal compartment, said door having an opening to permit a rod to be inserted into the coal chamber when the door is in closed position.

4. A device as specified in claim 1, in which the auxiliary grate is suspended from an arm rigidly secured to said firing-neck.

5. In a device of the character set forth, apparatus for converting an up-draft heating furnace into a down-draft furnace, comprising: an auxiliary tapered grate adapted to be inserted into the combustion chamber of the unit through the firing-neck and be supported by said neck; and a coal-charging housing adapted to be inserted through said firing-neck, above said auxiliary grate, and supported by the firing-neck.

6. In a device of the character set forth, apparatus for converting an up-draft furnace, having a horizontal firing-neck, into a down-draft furnace comprising: a coal-charging housing provided with closed top, side, and rear walls and a bottom opening, said housing being insertable through said firing-neck and adapted to be permanently supported by and sealed within the firing-neck; and a coal spreader insertable through said neck, said spreader having a cantilever supporting arm fixed within said firing-neck so as to hold the spreader below and in spaced relation to said housing.

7. A down-draft coal-burner for a furnace having a grate and a firepot provided with a firing-neck and combustion chamber, comprising: a coal-charging housing adapted to extend horizontally into the combustion chamber and be supported by the firing-neck, said housing having a front opening through which coal may be introduced and a bottom opening from which fuel may be discharged from the housing into the firepot, the top, sides, and rear walls of said housing forming an air conduit for conducting "over fire" air from the front opening around fuel in the housing to the combustion chamber, and a smoke door hinged near the front of said housing to regulate air passing through the fuel in the housing.

JULIAN ROBERT FELLOWS.