April 24, 1928.

1,667,001

O. H. GRAY ET AL

FURNACE

Filed March 3, 1927

2 Sheets-Sheet 1

Fig. 1.

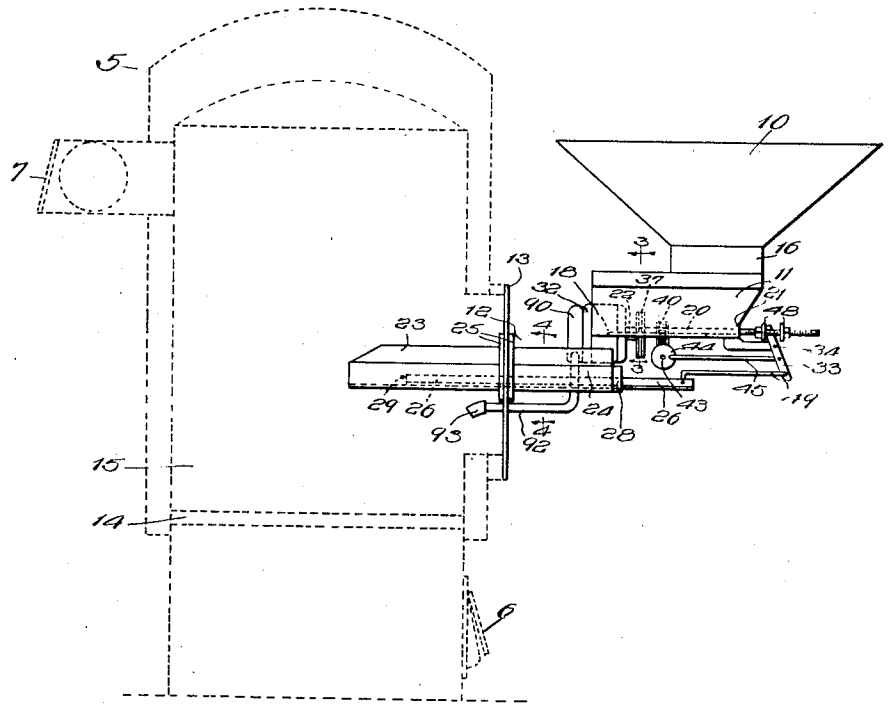
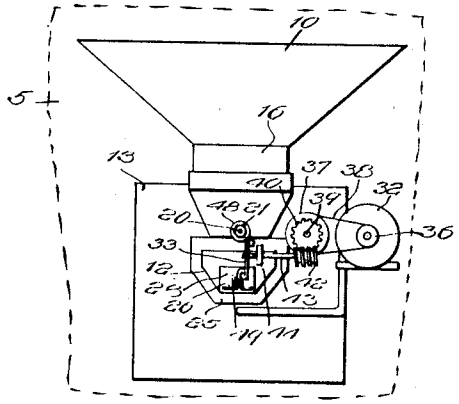


Fig. 2.



Witnesses:

William P. Wilson

Inventors:

Owen H. Gray

Charles P. Murdock

Brown, Boettcher & Dienner

Attys

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FURNACE

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Fig. 3.

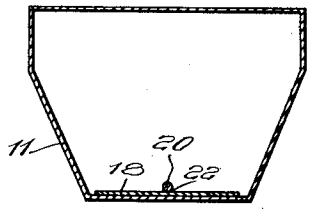


Fig. 4.

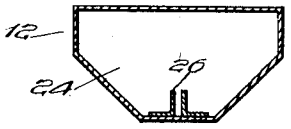


Fig. 8.

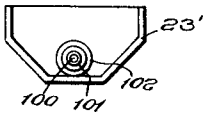


Fig. 7.

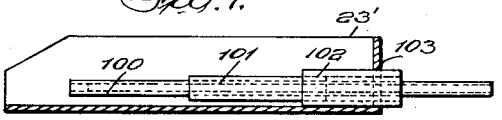


Fig. 5.

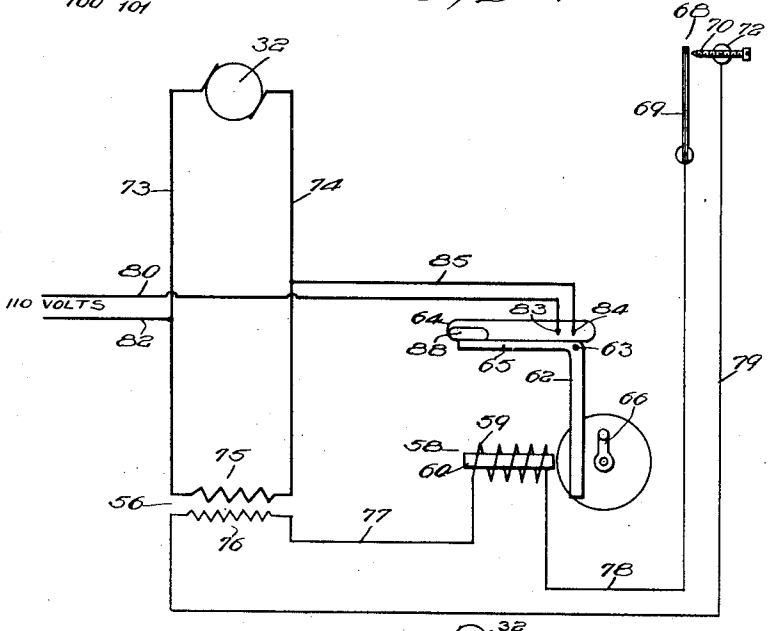
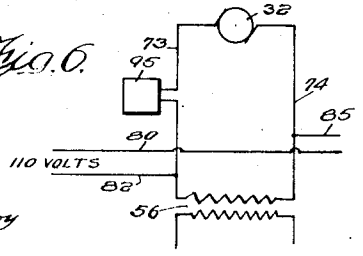


Fig. 6.



Witness:

William P. Kilroy

Inventors
Owen H. Gray
Charles E. Murdock
Brown, Boettcher & Sinnar
Attys

Patented Apr. 24, 1928. 1,667,001

UNITED STATES PATENT OFFICE.

OWEN H. GRAY AND CHARLES E. MURDOCK, OF SALT LAKE CITY, UTAH, ASSIGNORS TO GRAY & MURDOCK MFG. CO., OF SALT LAKE CITY, UTAH, A CORPORATION OF UTAH.

FURNACE.

Application filed March 3, 1927. Serial No. 172,260.

This invention relates to furnaces and more particularly to an improved automatic stoker and control therefor.

The present invention may be characterized as an improvement upon the automatic furnaces illustrated and described in Babcock United States Letters Patent Nos. 1,386,698 and 1,420,091, issued August 9, 1921, and June 20, 1922, respectively, and its objects are the provision of a generally improved and simplified stoker and control that may be economically produced and conveniently installed without altering the furnace and which is compact, simple, sturdy and reliable in operation.

While the particular embodiment which we shall hereinafter describe in connection with the drawings is particularly adapted for domestic use, it is to be understood that the invention is not limited to such use, but may be employed wherever found suitable or desirable.

We have found that the amount of heat given out by the furnace and, therefore, the temperature of the house, for example, being heated, can be controlled without opening or closing the dampers and that the complicated and delicate mechanical parts formerly used for that purpose may be entirely omitted without affecting the results.

According to our present invention, we obtain full and satisfactory control of the fire and temperature of the house automatically by the rate of fuel feed, the interval of time between feedings and the length of time that each feeding lasts, all as regulated by the clock mechanism and thermostat which form a part of our present stoker and control. We provide for leaving the check draft closed and the lower draft open to an extent which may be determined by a few tests, that is, opened sufficiently that the fire is not too sluggish and not so wide that the coal or fuel is entirely consumed and the fire extinguished between intervals of fuel feed.

The invention is illustrated in the accompanying drawings, in which

Fig. 1 is a side elevational view of an embodiment of our invention;

Fig. 2 is a front elevational view of the same;

Fig. 3 is a transverse section through the upper fuel chute and feed means taken on the line 3—3 of Fig. 1;

Fig. 4 is a similar view through the lower fuel chute and fuel feed means taken on the line 4—4 of Fig. 1;

Fig. 5 is a wiring diagram showing the electrical and thermostatic control for the fuel feeding means;

Fig. 6 is a fragmentary part of the diagram of Fig. 5 showing a safety device for stopping the fuel feed automatically when the pressure of the steam or temperature of the water reaches a predetermined point regardless of whether or not the air in the house has heated sufficiently to operate the thermostatic means;

Fig. 7 is a longitudinal section through the lower chute showing another form of slide; and

Fig. 8 is an end view of the chute and slide shown in Fig. 7.

Referring to the drawings, we have shown more or less illustratively at 5 the furnace, the amount of heat given out by which the present invention provides for controlling. Except with reference to controlling same without opening and closing the dampers, the details of the furnace 5, per se, form no part of the present invention which is equally applicable to various furnaces. The lower main draft is designated at 6 and the upper choke draft is designated at 7.

The stoker shown comprises a hopper 10 with two feed troughs or chutes 11 and 12, each having a slide in its bottom for moving the coal or other fuel forward through the fire door 13 of the furnace 5 and dropping it upon the grate 14 in the fire pot 15 within the furnace. The grate 14 may be of any standard or preferred form suitable for burning the fuel that is employed. The invention is adapted to use slack or small sized coal, although it is not limited to use with any particular sort of fuel.

The upper chute 11 underlies and receives the coal or other fuel from the outlet 16 from the bottom of the hopper 10. In the bottom of the chute 11 is a reciprocating slide 18. The slide 18 is reciprocated or moved back and forth to deliver the coal from the chute 11 to the chute 12, by a rod

20 which is preferably round or of circular section and passes through a circular opening 21 in the rear, with which opening it makes a snug fit. This snug fit prevents the coal dust from working out of the upper chute and dropping on the floor by the reciprocatory movement of the slide and rod. The rod 20 may be secured directly to the slide 18 in any suitable manner at 22.

The rear end of the chute 12 underlies the front end of the chute 11 and receives the coal therefrom as it is delivered by the slide 18. This lower chute 12 opens through the fire door 13 into the furnace and discharges the coal preferably at about the center of the fire box, although this may be varied. The chute 12 may, for example, be made up of two supplemental sections with the interior of one aligned with the interior of the other and in open communication therewith through an opening in the door 13. The adjacent ends of the sections 23 and 24 may be flanged at 25 and suitably joined with the door 13 secured between them. The inner section 23 is preferably formed of cast iron and constitutes a cast iron spout which is not readily burned off and is adapted for its disposition within the furnace and for delivering the coal thereto.

In the bottom of the chute 12 is a reciprocating slide 26. In Figs. 1, 2 and 4 this slide is shown as formed of cast iron angle bars secured back to back. The outer end of the slide 26 passes out from the outer end of the chute 12 through a stuffing box 28 which may be filled with cotton waste so that the spill of coal dust is practically if not entirely eliminated. The inner end 29 of the angle iron slide 26 never, in its reciprocating or back and forth movement, reaches the inner end of the chute 12. It preferably never comes closer than 3 or 4 inches from the end of the spout 23 and is therefore never exposed to the direct action of the fire. Thus we provide a spout construction which is adapted to be exposed to the fire within the furnace and we protect the improved slide 26 from exposure at all times by the spout 23. The fire door 13 is shown as being clamped between the two halves of the lower chute 12.

In Figs. 7 and 8 we have shown another form of slide for the lower chute. The slide in this instance comprises three pieces 100, 101 and 102 of standard iron or other suitable pipe. This round type plunger has certain advantages over the angle iron slide and when same is turned true on the outside and fitted accurately to a circular hold 103 in the back of the chute 23', allows practically no dust whatever to spill out through the back.

A motor 32 through suitable connections oscillates or rocks an arm 33 alternately in opposite directions about its pivot 34 (Fig. 1), the arm 33 being connected to reciprocate or move the slides 18 and 26 alternately in opposite directions, moving the slide 18 inwardly toward the furnace 5 when the slide 26 is being moved outwardly and vice-versa. The particular connections between the motor 32 and the arm 33 may be varied. Those shown comprise the speed reducing pulleys 36 and 37, belt 38, shaft 39, worm 40, worm wheel 42, shaft 43 and the eccentric 44 which is connected through a link 45 with the arm 33. The upper end of the arm 33 engages between a pair of nuts or abutments 48 threaded upon the outer end of the rod 20, these nuts or abutments 48 being adjustable upon the rod 20 to adjust the movement of the upper slide 18 and thereby the feed from the upper trough or chute 11. The lower end of the arm 33 on the opposite side of the pivot 34 is connected through a suitable link 49 with the lower slide 26.

We find a 1/12 horsepower motor suitable for domestic installations, as already referred to, but the particular motor may of course be varied.

The automatic motor control which controls the fuel feed and thereby the furnace without opening and closing the dampers, comprises (Fig. 5) a bell ringing transformer 56, electro-magnet 58 comprising a winding 59 and core 60, an inverted generally L-shaped bell crank lever 62 pivoted at 63 with the mercury tube or "mercoid" tube 64 mounted upon its generally horizontal arm 65, time or clock controlled cam 66 and the single contact thermostat 68 comprising the thermostatic leaf 69 of any suitable or preferred form and the cooperating contact 70 adjustably mounted at 72 for adjusting the space or gap between it and the leaf 69.

The motor 32 is connected through conductors 73 and 74 across the primary winding 75 of the transformer 56. One side of the secondary winding 76 is connected through a conductor 77 with one end of the winding 59 of the electromagnet 58 and the opposite end of the winding 59 is connected through a conductor 78 with the thermostatic leaf 69. The thermostat contact 70 is connected through a conductor 79 with the opposite side of the primary winding 76.

The circuit is supplied with current as from a suitable 110-volt source by suitable conductors 80 and 82. The conductor 80 extends to and terminates in a terminal 83 within one end of the tube 64. Adjacent the terminal 83 and within the same end of the tube 64 is a second terminal 84 connected by a conductor 85 with the conductor 74. The tube 64 contains a quantity of mercury 88 which immerses and electrically connects the terminals 83 and 84 when the tube is tilted by clockwise rocking of the bell

crank 62, but which leaves the terminals 83 and 84 unconnected when the tube is returned to the position shown.

The operation of the invention is as follows:—

At regular intervals of time, for example, once an hour or once every half hour, the cam 66 is rotated by suitable clock mechanism and engages the depending arm of the rocker or bell crank 62, pressing it to the left (Fig. 5) and thus tilting the "mercoid" tube 64 so that the mercury will roll down into contact with the terminals 83 and 84 connecting said terminals and closing the circuit from the 110-volt supply lines through the motor 32 which drives the coal feeding mechanism. The circuit through the secondary winding of the small transformer 56 is also closed, which causes the secondary of the transformer to impress a voltage of 12 volts, in a particular actual embodiment of the invention, on the circuit through the thermostat 68 and holding magnet 58.

The thermostat 68 is located, for example, in some room or other place to which heat is being supplied and the temperature of the air regulated and when the temperature is below the point for which the thermostat is set, this point being adjustable by adjusting contact 70, the thermostat contact will be closed so that current will flow through the electromagnet 58 and this magnet will then hold the rocker lever 62 in its tilted position even after the cam 66 has passed out of reach of the rocker lever. This keeps the main circuit closed through the "mercoid" tube 64 and therefore keeps the stoker feeding coal into the furnace until the air temperature at thermostat 68 rises and causes the contact at that point to be broken.

As soon as the contact at the thermostat 68 is broken, the electromagnet 58 releases the rocker lever 62 which then swings back to its normal vertical position and causes the mercury 88 to roll to the left and open the circuits through the motor and transformer. This stops the feeding of the coal and all flow of current in any part of the apparatus.

If the temperature of the air adjacent the thermostat 68 is up to or above the temperature for which the thermostat is set, the contact at the thermostat will be opened and no current will flow through the electromagnet 58 even though the main circuit is closed by the tilting of the "mercoid" tube 64 under the time action of the cam 66. In other words, when the house is warm enough, the motor circuit will be opened and closed and the fuel feed operated solely by the time controlled cam 66 and the duration of the periodic fuel feedings will be only so long as the cam 66 is in cooperation with the arm 62. The time mechanism will, for example, cause the stoker to feed fuel for say 10 minutes only once an hour, or five minutes only in a half hour. The amount of coal discharged into the furnace during each interval of feeding may be regulated so that it is just barely enough to keep the fire alive under the particular conditions in question.

With a rising outdoor temperature, it frequently happens that little or no heat is required from the furnace so that the thermostat contact 68 remains open and the time or clock mechanism operates to keep the fire alive. Whenever the temperature does drop, the thermostat 68 closes and the first time that the time mechanism tilts the tube 64 and starts the stoker operation, the electromagnet 58 will continue it in operation until the temperature is restored and the thermostat contact 68 opens. The time mechanism provides definite periodic fuel feedings, and as the temperature requirements demand, the thermostat increases the feedings and decreases the intervals between them.

Throughout the operation of the furnace, the main and check drafts 6 and 7 have fixed settings and the furnace is controlled solely by the control of the fuel feed thereto. The check draft 7 is closed and remains closed throughout the different conditions of operation and the main lower draft 6 is opened to an extent determined by a few tests. It is opened enough that the fire is not too sluggish and not so wide that the coal or fuel is entirely consumed and the fire extinguished between intervals of fuel feed and upon obtaining the proper opening to provide this condition that setting of the lower draft 6 remains fixed throughout the operation of the furnace. No further change in the draft is required.

We have also found that in some instances an improved combustion may be secured by means of a moderate blast of air directed onto the fire from above. For this purpose the motor 32 may drive a relatively small fan such as that employed in a vacuum cleaner. This fan is designated at 90 in Fig. 1 and furnishes air which is supplied or introduced into the furnace by means of a short piece of one and one-half inch hose connected through a piece of one and one-quarter inch iron pipe 92 which passes through the fire door 14 at a point immediately under the fuel feed spout 23 and terminates in an ordinary 45 degree pipe elbow 93. With this arrangement, every time fuel is fed into the fire, a moderate jet of air is thrown onto the fire at about its center, thus assuring a good supply of air for combustion, even though the grate below might be entirely clogged with ashes and cinders.

This air jet, while desirable in some cases,

may be omitted, and we therefore do not intend to be in any way limited to operation with such a jet.

In some instances, it may also be desirable to provide an automatic limit to the pressure of the steam or temperature of the water, whether the air in the house to be heated has reached the normal degree, or not. In that in some installations the pressure of the steam or temperature of the water may reach dangerous points before the air in the house has had time to warm up, we provide (Fig. 6) a device designated at 95, which may be operated by the temperature of the water or pressure of the steam to open the circuit of the motor irrespective of the thermostat 68'. This device is designated at 95 in Fig. 6 and is shown as connected by means of the conductor 73 in series with the motor 32. This device may be any one of several already on the market or of any other suitable type, and may be used in addition to the automatic control, as already described, so that when either the air in the house, or the water in the boiler gets too hot, the fuel feed is stopped.

We claim:—

1. In a furnace, the combination of a mechanical fuel feed, means for periodically operating said fuel feed independently of temperature requirements, and means for varying the duration of the periodic fuel feeding operations produced by said first means and the intervals between said operations with the temperature requirements of the furnace.

2. The combination, with a furnace, of a mechanical fuel feed thereto, time controlled means for operating said fuel feed to supply fuel to the furnace at periodic intervals, irrespective of temperature requirements, and a single contact thermostat controlling said fuel feed to vary the fuel supply according to the temperature requirements of the furnace.

3. The combination, with a furnace, of a mechanical fuel feed for feeding fuel into the furnace, electrically operating means for operating said fuel feed, time controlled means controlling the operation of said operating means to operate fuel feed periodically over definite intervals and thermostatically controlled means for varying the duration of the fuel feeding intervals and the duration of the intervals between said fuel feedings with the temperature requirements of the furnace.

4. The combination, with a furnace, of a mechanical fuel feed for feeding fuel into the furnace, a driving motor for said fuel feed, a motor circuit, a circuit having a thermostat, a bell ringing transformer having its primary in one of said circuits and its secondary in the other circuit, a mercury bulb contact device, a rocker arm pivotally mounted and adapted to tilt said bulb to close and open the motor circuit, a time control device for tilting said arm at definite periodic intervals irrespective of temperature requirements, and electromagnetic means controlled by the temperature requirements of the furnace through said thermostat and cooperating with said rocker arm to hold same tilted after tilting by said time controlled means for increasing the duration of the intervals of the fuel feed to the furnace.

5. The combination, with a furnace, of a mechanical fuel feed for feeding fuel into the furnace, a driving motor for said fuel feed, a motor circuit, a circuit having a thermostat, a bell ringing transformer having its primary in one of said circuits and its secondary in the other circuit, a mercury bulb contact device, a rocker arm pivotally mounted and adapted to tilt said bulb to close and open the motor circuit, a time control device for tilting said arm at definite periodic intervals irrespective of temperature requirements, electromagnetic means controlled by the temperature requirements of the furnace through said thermostat and cooperating with said rocker arm to hold same tilted after tilting by said time controlled means for increasing the duration of the intervals of the fuel feed to the furnace, and means operated by the pressure of the steam or temperature of the water for stopping the fuel feed independently of the thermostat.

6. In a furnace, the combination of a mechanical fuel feed, time controlled means for periodically operating said fuel feed independently of temperature requirements and temperature controlled means for varying the duration of the periodic fuel feeding operations produced by said time controlled means and the intervals between said operations with the temperature requirements of the furnace.

7. In a furnace, the combination of a mechanical fuel feed, time controlled means for periodically operating said fuel feed independently of temperature requirements, and temperature controlled means for varying the duration of the periodic fuel feeding operations produced by said time controlled means and the intervals between said operations with the temperature requirements of the furnace, said temperature controlled means being located outside the furnace and adjacent the place to which heat is supplied by said furnace.

8. In a furnace, the combination of a mechanical fuel feed, means for periodically operating said fuel feed and a second means operated to vary the operation of said first means with the temperature requirements of the furnace.

9. In combination, a furnace, a heat supply line therefrom, a mechanical fuel feed

device for said furnace, means for periodically operating said fuel feed device independently of temperature requirements, means for varying the duration of the periodic fuel feeding operations produced by said device and the intervals between said operations with the temperature requirements of the furnace and means operated by the temperature of the fluid in the heat supply line for stopping the fuel feed means at a predetermined limit.

In witness whereof, we hereunto set our hands this 23rd day of February, 1927.

OWEN H. GRAY.
CHARLES E. MURDOCK.