Sept. 2, 1941. R. R. HARRIS 2,254,481

FURNACE

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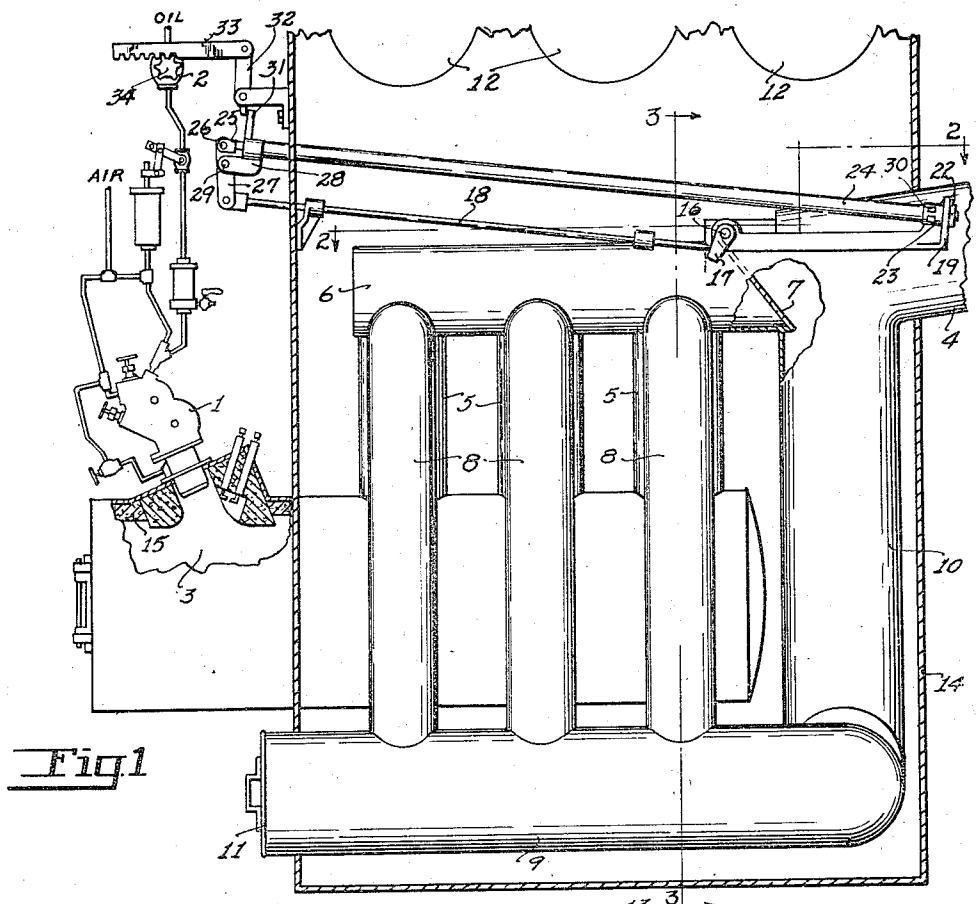

Fig. 1

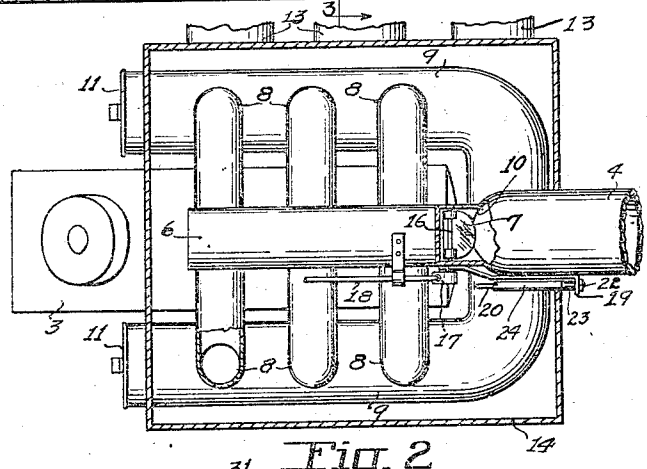

Fig. 2

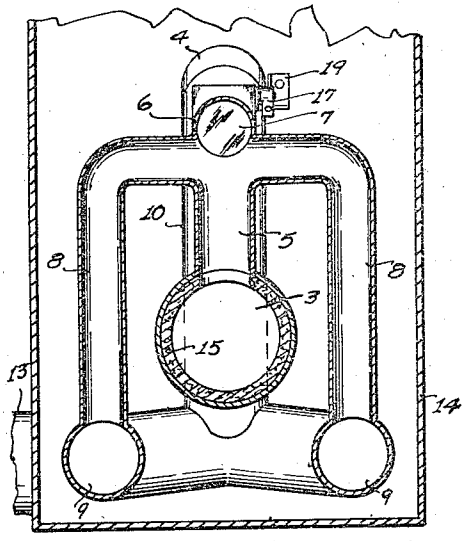

Fig. 3

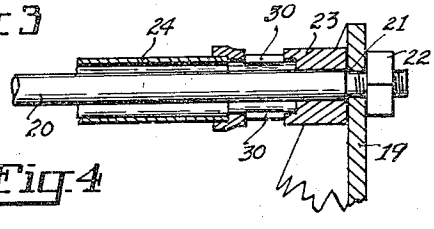

Fig. 4

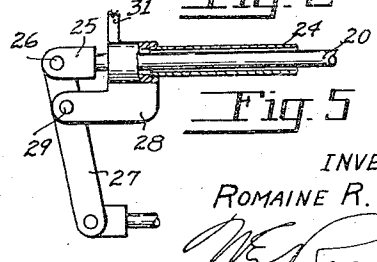

Fig. 5

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2,254,481

FURNACE

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Application March 24, 1939, Serial No. 263,862

1 Claim. (Cl. 236—15)

My invention relates to furnaces and to the control mechanisms therefor. It is particularly directed to the automatic burning of fluid fuels, although some features of my invention are useful when solid fuels are burned.

The transference of heat from the combustion chamber of a furnace to the circulating medium, which may be either a gas or a liquid, is a matter of difficulty particularly with the smaller furnaces such as are used in residences. For convenience, the discussion of this problem will hereinafter be confined to the case where air is used as the circulating medium, that is, to the hot-air type of furnace, although I do not wish my invention to be limited to this particular type inasmuch as the principles are applicable to furnaces in which other media are heated.

In a hot-air furnace, it is necessary that the products of combustion be confined within a conduit leading to a smokestack. All of the useful heat must pass through the walls of this conduit; the heat that remains in the products of combustion and passes up the smoke stack is wasted. For maximum efficiency, the temperature of the gases passing up the smoke stack must approach that of the air being heated. This requires that the aforesaid conduit be long and of a substantial area. However, when said conduit is made long, the difficulty is encountered that too much draft is required to draw the products of combustion through it. Although sufficient draft may readily be provided by means of a smokestack, this form of draft is not effective until the gases within the conduit become hot, and said gases cannot be heated without draft. This impasse tends to cause smoking of the furnace while it is heating up.

The foregoing exposition is elemental in the heating art, and it has heretofore been common practice to provide a short-cut, or by-pass, for the aforesaid conduit to permit the products of combustion to pass directly up the smokestack when the fire is first started. Thereafter, when the gases in the combustion chamber and in the smokestack have become sufficiently hot to provide a good draft, the aforesaid by-pass is closed by means of a check valve and the products of combustion then pass through the entire conduit and therein give up as much as possible of their sensible heat. An object of my invention is to provide a thermostat for automatically operating the aforesaid check valve, none heretofore being available that were sufficiently simple and cheap for use on small furnaces. The requirements of a satisfactory thermostat for this purpose are discussed more fully hereinafter.

The length of conduit through which it has heretofore been deemed feasible to pass the hot gases of a furnace has been limited by the danger of said conduit bursting due to a mild explosion within the firebox. Particularly when oil is burned, a condition occurs in which the firebox becomes partially filled with an unburned mixture of air and fuel. This condition may be caused by a momentary interruption of the fuel supply, resulting in a relatively thin stratum of pure air separating the flame from the succeeding combustible air-fuel mixture. When the flame is subsequently propagated back through said stratum of air, the combustible mixture burns rapidly and produces a sufficiently high momentary pressure to rupture its containing conduit if the length of said conduit be too great. A further object of my invention is to provide a by-pass and a check valve therefor which will relieve the aforesaid pressure due to a mild explosion, thus permitting the use of a longer conduit which will result in a more complete transfer of heat from the combustion chamber to the circulating air. For this purpose, a light weight valve that is free to open at all times is required. The inertia of the valve must be sufficiently low so that the valve can open quickly; otherwise the conduit will burst in much the same way that a gun barrel does if it is fired while obstructed by mud.

A further object of my invention is to provide a thermostatic control for a furnace wherein the effect of the differential expansion of two metals when their temperature changes is augmented by maintaining a differential temperature between said metals, the metal having the higher temperature coefficient of expansion being maintained at the higher temperature. I attain said object by so arranging the metal elements whose differential expansion is to be utilized that the one having the lower coefficient of expansion is exposed to a draft of relatively cool air while being protected from the actuating heat supply.

Other objects and advantages of my invention will be described with reference to the accompanying drawing in which—

Fig. 1 is a fragmentary vertical sectional view of a furnace embodying my invention;

Fig. 2 is a horizontal section taken substantially along the line 2—2 of Fig. 1;

Fig. 3 is a vertical section taken along the line 3—3 in Fig. 1;

Fig. 4 is an enlarged fragmentary detail view of one end of the thermostat shown in Fig. 1; and

Fig. 5 is an enlarged fragmentary detail view of the other end of said thermostat.

An oil burner adapted for use with a furnace embodying my invention is described more fully in my copending application for United States patent entitled Liquid fuel burning apparatus, Serial No. 268,653, filed April 19, 1939. Suffice it to say here that the magnitude of the flame produced by said burner is adjustable by means of valve 2. Said burner is adapted to produce a flame in combustion chamber 3. Two alternative paths for the products of combustion are provided between said chamber and smokestack 4. First, a direct path through risers 5 and manifold 6, said path being available when valve 7 is open. Second, when said valve is closed the hot gases will go from risers 5 to branch pipes 8, thence to main pipes 9, thence to riser 10, thence to smokestack 4. Thus, combustion chamber 3 is connected to smokestack 4 by a branched conduit comprising risers 5, branch pipes 6, main pipes 9, and riser 10.

Removable plates 11 may, if desired, be provided to facilitate cleaning soot or ashes from main pipes 9. Pipes 12 are adapted to conduct heat from the furnace to the rooms to be heated, and return pipes 13 to return said air thereto. If desired, a fan or blower might be used to circulate said air in which case a single duct might be interposed between said pipes 12 and the furnace to accommodate said fan; and fresh outside air may be admitted to the system by appropriate means. However, I deem it advisable to arrange said return pipes near the bottom of the furnace casing 14 in order that the relatively cool air therefrom shall be directed against main pipes 9. If the heat is to be thoroughly extracted from the products of combustion, it must be done gradually and the final portion of the conduit must be the coolest. It may be advisable to line said combustion chamber with Firecrete 15, or some similar heat resistant material, to prevent corrosion thereof and this will interfere somewhat with the flow of heat to the circulating air. Accordingly, the remainder of the conduit must be of substantial length to provide for said flow.

As mentioned, valve 7 is adapted, when closed, to divert the products of combustion from the direct path to the smokestack, causing them to flow through the longer conduit. Said valve may be fixedly secured to shaft 16 in such a way that it will tend to be closed by gravity, and so that it is free to swing open to relieve undue pressure in the combustion chamber, as hereinbefore described. Also fixedly secured to shaft 16 near one end thereof is arm 17 against which the end of rod 18 is adapted to bear, the longitudinal thrust of said rod opening valve 7.

A lug 19 extends outside casing 14 and there supports thermostat rod 20, which may, if desired, be provided with a shoulder 21 adapted to be drawn against said lug by nut 22 engaging the threaded end of said rod. Said lug extends within the furnace casing, and is provided with a hole near its inner end which serves as a bearing for shaft 16. An annular fitting 23 is press fitted on rod 20 near the end thereof, and said fitting is adapted to carry tube 24 which may, if desired, be press fitted into said fitting. The end of rod 20 opposite lug 19 carries threaded thereon a yoke 25 in which pin 26 is journaled. Pin 26 serves as a pivot for lever 27. A clamp 28 press fitted on the end of tube 24 is pivotally secured to said lever by pin 29. I propose to make tube 24 of some material, such as brass, which has a high temperature coefficient of expansion, and to make rod 20 of some material, such as steel, which has a lower coefficient. Thus, when said tube and rod are heated equally, they will react upon lever 27 to retract rod 18, which is pivotally secured to said lever, to allow valve 7 to close by its own weight.

However, I do not propose that tube 24 and rod 20 shall be heated equally; I prefer to arrange these elements in such a way that said tube will be heated to a higher temperature than said rod, thus augmenting the aforesaid differential elongation. To this end, I provide holes 30 in fitting 23 to admit cool air from outside the furnace to tube 24. Rod 20 within said tube is thus protected from the heat of the furnace by said tube, and it is cooled by said air. To provide draft to draw said air through said tube, I prefer to incline the latter at a substantial angle. Rod 18 and lug 19 may be made of some material having a low coefficient of expansion, if desired.

Clamp 28 may be provided with an ear 31 adapted to engage lever 32 operatively connected to rack 33. Said rack engages pinion 34 fixedly secured to valve 2. Said valve is adapted to regulate the flow of liquid fuel to burner 1, when said pinion is rotated, and the direction of rotation of said valve is such that expansion of tube 24 will close it, thus reducing the flame as the temperature within the furnace increases. Said valve may be designed and adjusted to reduce said flame to a negligible size when said temperature reaches a predetermined value.

The aforesaid thermostatic device, including tube 24 and rod 20, is adapted to exert an enormous force to operate valves 7 and 2, said force being limited only by the strength of the materials used. However, this force is effective over only a relatively small distance, which may be magnified by levers, as described. I deem it important that said levers be so arranged that a minimum of lost motion is permitted, thus conserving the effective thermal expansion.

I claim:

A furnace comprising a conduit for the products of combustion, a by-pass for a portion of said conduit, a valve for said by-pass, said valve being adapted to open freely under a predetermined gas pressure within said conduit, and a thermostat adapted to hold said valve open when said furnace is cold, said thermostat being adapted progressively to allow said valve to close when said furnace is heated above a predetermined temperature, said thermostat being adapted progressively to reduce the fuel supply to said furnace when the temperature of the latter increases beyond a predetermined value, said thermostat comprising an outer element having a relatively high temperature coefficient of expansion and an inner element having a relatively low temperature coefficient of expansion, said inner element being ventilated to maintain its temperature lower than that of said outer element, said outer element consisting of an inclined tube open at each end, each of said ends being outside said furnace.

ROMAINE R. HARRIS.