April 11, 1950 W. D. HALL 2,503,262

THERMOSTATIC AIR CIRCULATION FAN CONTROL FOR COMBUSTION HEATERS

Filed Dec. 12, 1947

FIG. 1.

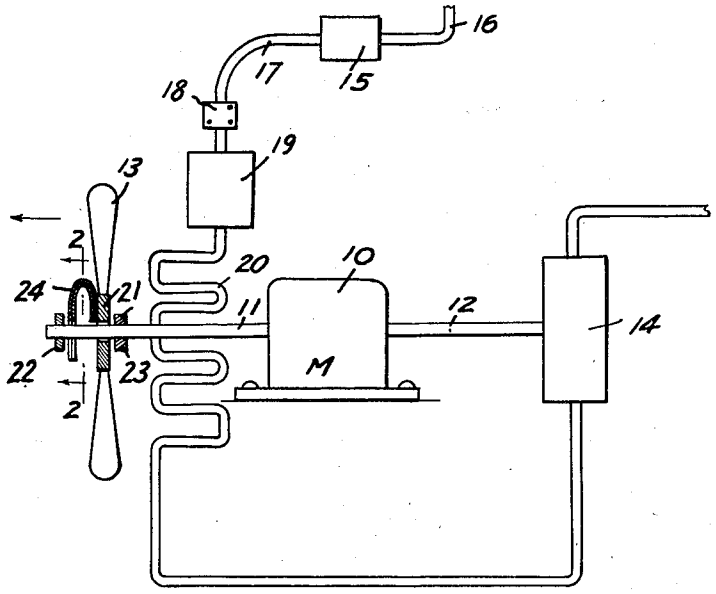



FIG. 2.

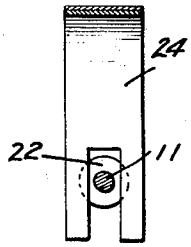
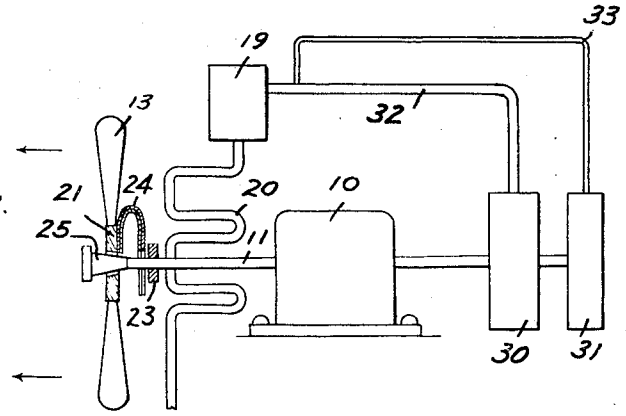



FIG. 3.

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2,503,262

## THERMOSTATIC AIR CIRCULATION FAN CONTROL FOR COMBUSTION HEATERS

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10 Claims. (Cl. 126—110)

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This invention relates to heating systems and more particularly to such systems that have a circulating fan or pump for circulating the heating medium. This application is a continuation in part of my prior copending application Serial No. 347,951, filed July 27, 1940, entitled Control systems, which application is now abandoned, and also a continuation in part of my prior copending application Serial No. 735,983, filed March 20, 1947, entitled Control system for heaters. The present invention is an improvement on a portion of the system of those applications when that portion is applied to certain types of small heaters.

The invention hereinafter to be fully described has for its primary object the provision of means for delaying the starting of the circulating fan of a hot air or hot water system until such time as the heater is warm. While the broad idea of starting the flow of circulating air only after the heater has become warm is not new, my invention resides in radically new and different means for accomplishing this end. Another and more detailed object of my invention resides in the provision of means for driving a fuel pump of a heater by the same motor as drives the fan and still delay the starting of the fan until the heater becomes warm.

My invention employs a motor mounted between the fan and the pump. The fan is loosely carried by its shaft so that it does not revolve at normal speed when the motor is started. However, when the heater becomes warm, a thermal element deflects and causes positive engagement between the fan and shaft thereby causing the fan to rotate at normal speed. In the description, I am setting forth the details of my invention and the best mode of applying it, but it is understood that the scope of my invention is being set forth in the claims.

In the drawings:

Figure 1 is a schematic diagram of the invention, except for the portion which shows the thermal clutch for the fan and this portion is shown in section.

Figure 2 is a sectional view taken along line 2—2 of Figure 1.

Figure 3 is a schematic diagram of a modified form of the invention, except that the portion which shows the thermal clutch for the fan is shown in section.

Referring to Figure 1, a main driving motor 10 has shafts 11 and 12 projecting therefrom in opposite directions, which shafts respectively drive fan 13 and fuel pump 14. The fuel pump 14 is a

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pump of the exhaust type and may be sufficiently powerful to suck fuel and combustion air into the system by its suction alone, or it may only be powerful enough to draw in the combustion air in which event it preferably should be supplemented by an additional pump 15 which may or may not be driven by motor 10. Fuel enters pipe 16, is forced through pipe 17 into mixer 18 where there are openings. The suction created by pump 14 causes combustion air to enter at mixer 18. The mixture passes into combustion chamber 19 and leaves through radiator 20 from whence it then passes to the exhaust pump 14.

The fan 13 is adapted to propel air toward the left, and is mounted on a hub 21 which hub has a center hole larger than shaft 11, whereby the hub 21 is free to move independently of shaft 11. The shaft 11 has collars 22 and 23 mounted on opposite sides of the hub 21. The bimetallic strip 24 of U-shape has its right end rigidly attached to the hub 21 and has its left end slitted so that it passes by shaft 11 without touching the latter.

The operation of the system of Figure 1 is characterized by starting motor 10 which in turn starts pump 14. The fuel then begins to flow into combustion chamber, but due to delays heat is not immediately generated in radiator 20. These delays are caused by delay in heating of the igniter as well as the usual delay in any heater in coming up to working temperature. Before the heater radiator 20 becomes warm the fan 13 is not rotated very fast inasmuch as it is only loosely mounted on shaft 11. Considerable torque is required to rotate fan 13 at high speed and the loose fit of hub 21 on shaft 11 is insufficient to provide that torque. However, as the heater becomes warm, the bimetallic strip 24 begins to expand and uncoil, whereby the ends of this strip move away from each other. When the heater is heating, the fan is rotating slowly and this moves some heat from the radiator 20 to the bimetallic strip 24. As soon as the heater radiator 20 is warm, the bimetallic strip 24 will have sufficiently expanded to force hub 21 into positive contact with collar 23, hence, the fan 13 will operate at the same speed as the motor M operates. If fuel is stopped and the flame is thereby extinguished, the fan 13 will continue to rotate until bimetallic strip 24 cools and disengages the hub 21 and collar 23.

Referring to Figure 3, the motor 10 drives the combustion air pump 30 and the liquid pump 31 (which feeds oil into the combustion chamber 19 through pipe 33). The oil is mixed with air

which flows through pipe 32. The left end of shaft 11 has a tapered portion 25 whereby the left end is larger than the remainder of the shaft. The hole in hub 21 is similarly tapered. In this device the fan 13 tends to propel air to the left, and hence when the fan is running at high speed the air leaving the fan exerts a force on the fan 13 tending to move hub 21 to the right. Therefore, the fan 13 will not attain substantial speed prior to a more positive engagement. When the radiator 20 becomes warm, bimetallic strip 24 uncoils and forces the hub into contact with portion 25 of the shaft. As the heater increases in temperature, the engagement of hub 21 and shaft 25 improves whereby the fan accelerates gradually to normal speed.

I have referred to exhaust pump 14 as a fuel pump, even though it is supplemented by a separate pump 15 (which may not even be rotated as a unit with pump 14) and even though pump 15 provides all of the force for moving the liquid fuel to the combustion chamber 19. This is true inasmuch as in a broad sense the pump 14 is necessary in order to deliver a combustible mixture to the chamber 19. Such a mixture is in the true sense "fuel" and the pump 14 is necessary in order to supply the combustion air thereof. In Figure 3, the motor drives air pump 30 and oil pump 31, either or both of which are, broadly speaking, a fuel pump.

In applicant's copending application S. N. 735,983 hereinbefore mentioned the broader aspects of the invention herein described and claimed are shown. That copending application illustrates one form of invention, in Figures 1, 2 and 5 wherein the fan and motor are on separate shafts and connected by a thermal clutch which responds to heater temperature. In Figure 8 of the copending application I illustrated a heater fan and motor on separate shafts connected by an electromagnetic clutch controlled by a thermal element that was responsive to heater temperature. While the broad aspects of these systems are the same and are herein claimed, it is emphasized that the present application discloses a single shaft for both the motor and fan, and the present system is far less expensive and compact than my earlier system. It is therefore ideally suited for small heaters.

I claim to have invented:

1. In a heating system, a heater, a fan for dissipating heat from the heater, a motor, thermostatic coupling means for automatically operatively coupling the fan to said motor when the heater is heated and uncoupling the fan from the motor when the heater is cooling, and a pump driven by said motor for effecting fuel flow to said heater.

2. In a heating system, a combustion heater, an exhaust pump for removing products of combustion from said heater, a fan for circulating air over said heater, a common motor for driving said pump and said fan, and thermostatic coupling means between the fan and motor for uncoupling the motor from the fan when the heater is cool and coupling the motor and fan when the heater is hot.

3. In a heating system, a combustion heater, a pump for effecting flow of combustion air into the heater, a fan for circulating air to be heated over the heater, a common motor for driving the pump and fan, and a thermal clutch interposed between the fan and motor for connecting the two



together without slippage when the heater is hot and for permitting slippage between them when the heater is cool, said thermal clutch including a thermal element subject to heat from the heater for controlling the thermal clutch.

4. The system defined by claim 1 in which the fuel pump is an exhaust pump adapted to exhaust the products of combustion and to cause combustion air to flow into the heater.

5. The system defined by claim 1 in which the fuel pump causes oil to flow into the heater.

6. The system defined by claim 1 in which the said fuel pump is an exhaust pump to draw in combustion air and to exhaust the products of combustion; and a separate fuel pump for causing oil to flow to the heater and being substantially the sole force for causing such oil to flow.

7. The heating system defined in claim 1 in which said motor has a shaft, in which the fan has a hub loosely mounted on the shaft, and in which the thermostatic coupling means effects a positive driving connection between the shaft and said hub in response to heat.

8. The heating system defined by claim 1; in which the thermostatic coupling means comprises: a hub carrying the fan, said hub defining a tapered axial hole therein, a shaft driven by the motor and tapered parallel to the walls of said hole, and a thermal element which when heated forces said tapered portions together; said motor including means to rotate the same in such direction as to tend to cause the fan to exert a force on the hub tending to cause said tapered portions to move away from each other.

9. The heating system of claim 8 in which the thermal element is located in the path of heated fluid from the heater and on the downstream side of said heater.

10. In a heating system, a combustion heater, a fan for dissipating heat from the heater, a motor, a thermal control element located in the path of heated fluid set up by said fan and on the downstream side of said heater, means operated by said thermal control element for controlling the degree of coupling between the motor and the fan to cause the fan to run at a speed substantially less than that of the motor when the element is cool and at motor speed when the element is hot, said means including means for providing sufficient coupling between the motor and fan when said element is cool to rotate the fan at sufficient speed as to move some heat from the heater to said element, and means driven by said motor for delivering fuel to said heater.

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