July 7, 1942. W. W. HALLINAN 2,289,287

HEATING SYSTEM

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Fig. 1.

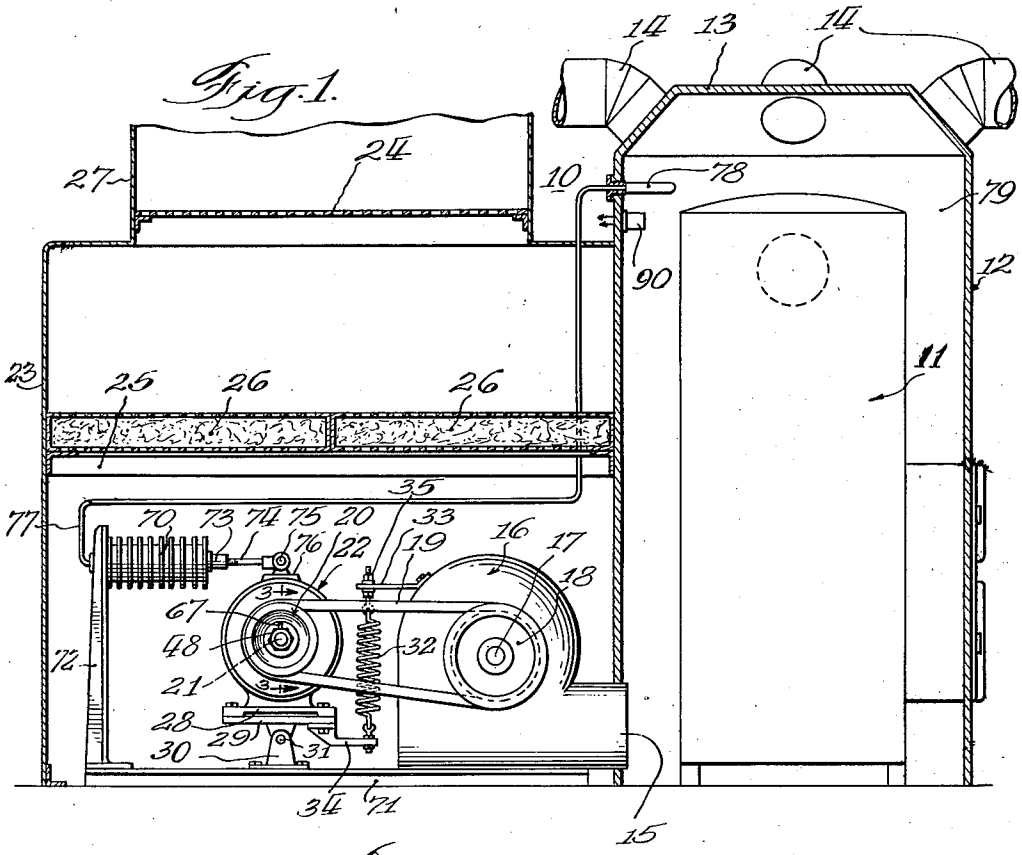


Fig. 3.

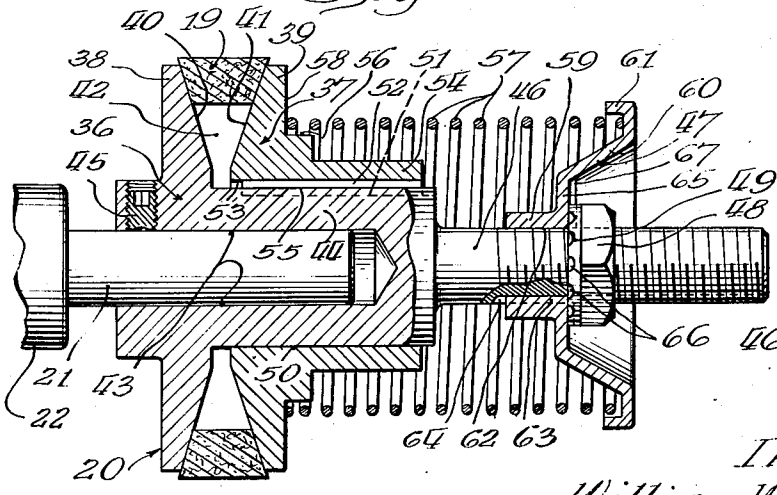
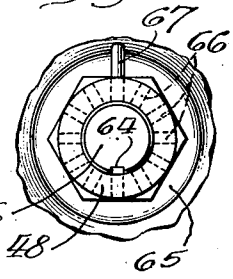


Fig. 4.



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Fig. 2.

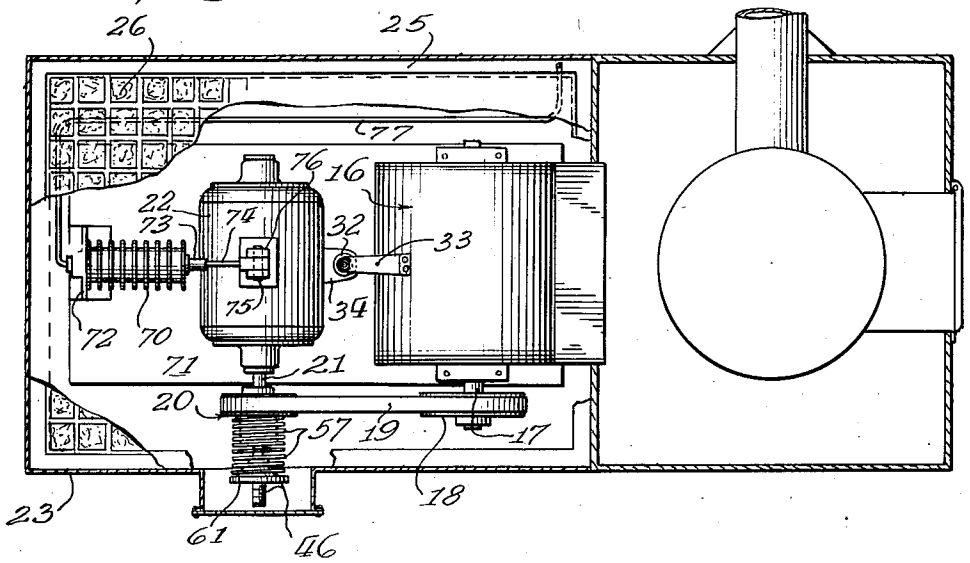
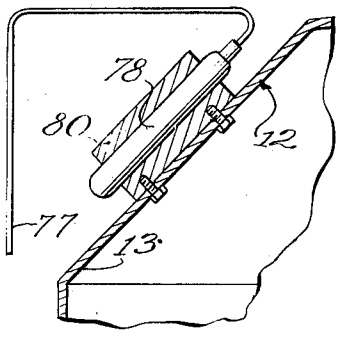


Fig. 5.



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HEATING SYSTEM

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Application October 16, 1939, Serial No. 299,616

4 Claims. (Cl. 236—10)

The present invention relates to heating systems, and is particularly concerned with heating systems of the type having a hot air furnace and an air blower for moving the air from the furnace to the rooms to be heated.

The present invention is related in subject-matter to my prior application, Serial No. 196,003, filed March 15, 1938, for Variable speed pulleys, Patent No. 2,210,976, issued August 13, 1940.

The heating systems of the prior art of this character are subject to the disadvantage that they are either complicated or they are so constructed that the volume of air circulated by the blower or fan must be adjusted to take care of the maximum heating load, which inevitably results in a higher operating temperature for the furnace, too great a volume of air put out by the fan when there is but a little demand for heat, and a blast of cold air from the furnace soon after the fan begins to operate, when the furnace is not operating at maximum heating load.

One of the objects of the invention is the provision of an improved heating system in which the fan may be operated continuously, or it may commence its operation at a relatively low temperature, and in which the speed of operation of the fan is continuously modulated from low speed at small furnace output to maximum speed at maximum furnace load.

Another object of the invention is the provision of an improved heating system of the class described, in which the operating temperature may be reduced to a lower value than the devices of the prior art, thus reducing the furnace losses at the stack and losses in the cellar, and providing a more efficient heating system.

Another object of the invention is the provision of an improved heating system of the class described, which is adapted to operate within a smaller range of temperature variation for the purpose of maintaining a more uniform temperature in the rooms to be heated, and for the purpose of eliminating any possibility of a blast of cold air.

Another object of the invention is the provision of an improved heating system of the class described, by means of which the volume of air circulated in the system is dependent upon the temperature of the circulating air or of the air in the plenum chamber in the furnace, so that a maximum efficiency of distribution of heat from the furnace is achieved and the circulating system is adapted at all times to circulate a volume of air which is required to carry away the heat from the furnace.

Another object of the invention is the provision of an improved variable speed driving system for air circulating fans, which is efficient, economical, and capable of manufacture and installation at a reasonable cost.

Other objects and advantages of the invention will be apparent from the following description and the accompanying drawings, in which similar characters of reference indicate similar parts throughout the several views.

Referring to the two sheets of drawings.

Fig. 1 is a diagrammatic vertical sectional view of a hot air furnace embodying the present heating system;

Fig. 2 is a diagrammatic top plan view in partial section, showing a part of the filters;

Fig. 3 is an axial sectional view, taken on the plane of the line 3—3 of Fig. 1, looking in the direction of the arrows, showing a spring pulley adapted to be used in the present invention;

Fig. 4 is a fragmentary end elevational view of the embodiment of Fig. 3;

Fig. 5 is a fragmentary view showing the installation of the thermally responsive bulb on the outside of a plenum chamber, but attached to the metal of the plenum chamber.

Referring to the drawings, 10 indicates in its entirety the installation which includes the furnace 11, such as a gas furnace, an oil burner, or a coal stoker type, controlled by room thermostats and auxiliary equipment so as to be turned on responsive to the heat demand in the rooms.

The furnace casing is indicated at 12, and it is provided with the usual bonnet 13, having hot air outlets to the rooms at 14.

The cold air inlet to the furnace casing is at 15, the outlet of a fan or blower 16 preferably of the centrifugal type, having a suitable centrifugal impeller shaft 17, which is provided with a V pulley 18.

The discharge pipe from the blower 16 passes through a hole in the wall of the furnace housing. The blower, of course, takes in air within the chamber where it is located, through intake apertures at the end of the shaft 17. Thus the only cold air inlet to the furnace is through the blower 16, which takes its cold air in from the upper conduit 27.

The blower 16 is adapted to be driven by means of a V belt 19 of constant width, which is driven by a variable diameter pulley 20 carried by the shaft 21 of a substantially constant speed motor 22.

The blower 16 and motor 22 and other auxiliary equipment may be installed in a filter hous-

ing 23, comprising a metal housing of substantially rectangular shape, connected to the furnace casing 12, and having a screened inlet at 24. Supporting angles 25 in the filter housing may support a plurality of suitable air filters 26, through which the air passes to the inlet of the centrifugal blower 16, said blower being provided with an inlet at one or both of the ends of its housing, surrounding the shaft 17. Suitable cold air conduits 27 from the rooms are in communication with the cold air inlet 27 to the filter housing 23.

The blower motor 22 is preferably movably mounted by having its base 28 secured to a pivotally mounted base 29, which is carried by a bracket 30, by means of a pivot shaft 31.

A tension spring 32 has its upper end adjustably secured to a bracket 33, carried by the blower 16, and its lower end secured to a bracket 34, carried by the motor base 29. Thus spring 32 may have its tension adjusted by means of the nuts 35 on the threaded end of the spring, and the spring tends to urge the motor pivotally about the center of the shaft 31 in a counterclockwise direction so as to give the belt 19 a suitable tension.

The variable diameter pulley 20, carried by the motor shaft 21, is illustrated in detail in Fig. 3. It preferably consists of a pair of pulley sections 36 and 37. The pulley sections are provided with the radially extending flanges 38 and 39, which have the opposed frusto-conical surfaces 40 and 41, forming a substantially V-shaped groove 42 for receiving the wedge-shaped leather V belt 19.

The pulley section 36 preferably has a centrally located circular bore 43 in the cylindrical hub 44, and the bore 43 is adapted to receive the motor shaft 21, to which the section 36 is secured by a set screw 45 or a suitable key.

The end of the hub 44 may have a reduced threaded extension 46 for slidably receiving the spring seat 47 and receiving the threaded nut 48 and lock washer 49. The hub 44 is preferably provided with an outer cylindrical surface 50, formed with a keyway 51 for receiving the key 52 of substantially rectangular cross section, which is also received in a groove 53 in the pulley section 37.

The key 52 may have a tight frictional fit in one of the grooves 51 or 53 and be readily slidable with respect to the other of said grooves. In other words, the key may be secured to the section 36 or the section 37, but section 37 is adapted to slide freely relative to the section 36.

The pulley section 37 is provided with the tubular or cylindrical extension 54, having an inner cylindrical bore 55 slidably mounted on the hub 44. The tubular extension 54 may have a cylindrical enlargement at 56, engaging the inside of a compression coil spring 57 of helical form, and the end of the coil spring may engage against the outer face 58 of the pulley section 54.

The opposite end of the coil spring engages the spring seat 47, which may consist of a cast metal member having a hub 59, an outwardly extending body flange 60, and a cylindrical retaining flange 61.

The hub 59 has a bore 62 for receiving the reduced threaded portion 46 of the pulley section 36. The spring seat 47 may be mounted for sliding movement on the reduced portion 46, but is prevented from rotation by a rib or key 63, located in an axially extending slot 64. The outwardly extending flange 60 may be of frusto-conical form, and there may be a radial flange 65 for engaging the under side of the lock washer 49. The lock washer 49 may be provided with a plurality of radial slots 66, and the spring seat 47 with a rib 67 for engaging in any one of those slots.

It will be evident that the tension of the spring 57 may be adjusted by the position of the nut 48. The nut 48 may be locked in its adjusted position by the rib 67, and an inward pressure of the spring seat 47 against the spring 57 will remove the rib 67 from its groove 66 and permit an adjustment of the nut 48.

The operation of the spring pulley is as follows: The effective diameter of the pulley depends upon the point to which the belt 19 is drawn into the groove 42. This in turn depends upon the relative positions of the pulley sections 36 and 37, and the pulley sections 36 and 37 may take a position which depends on the action of the belt 19 and the belt tension.

When the motor 22 is pivoted toward the left in Fig. 1, or counterclockwise, the belt 19 is drawn farther into the V groove 42, the spring 57 giving away and permitting the section 37 to recede from the section 36. This naturally decreases the effective diameter of the adjusted pulley 20 and changes the speed of drive of the blower because the driving pulley 20 is smaller relative to the size of the driven pulley 18.

When the motor 22 moves to the right or pivots in the clockwise direction, the center of the pulley 18 being fixed, and the belt 19 being of constant length, the belt is permitted to ride out farther in the groove 42, the spring 57 forces the pulley sections 36, 37 closer together, and the effective diameter of the adjustable pulley 20 is increased. This increases the speed of rotation of the blower 16 because the size of the pulley 20 relative to that of the pulley 18 has been increased.

The position and movement of the motor 22 on its pivotal support 31 is preferably controlled by pressure responsive or thermally responsive means, such as a metal bellows 70.

The blower 16 and motor 22 are carried by a base 71, which may have an upwardly extending bracket 72 for fixedly supporting one end of the extensible metal bellows 70. The other, or right hand, end of the bellows has its face provided with a hub 73, connected to a connecting rod 74, which is pivotally secured by a pin or bolt 75 to a pivoted bracket 76, carried by the motor 22.

The bellows 70 comprises a pressure responsive device, but the pressure is preferably derived from a thermally expansible fluid which is contained in the bellows and which may be subjected to heat in any of a plurality of different ways. For example, the bellows 70 may have its fixed end in communication with a copper tube 77, which is also filled with thermally expansible fluid, and which is connected to an enlargement which is a copper bulb 78 located in the plenum chamber 79 of the furnace.

This bellows 70 may be subjected to temperature conditions within the plenum chamber 79.

Referring to Fig. 5, this is another modification in which the bulb 78 is carried by a metal block 80 of high thermal conductivity, which itself is secured to the metal wall 12 of the furnace casing.

In this case the bellows 70 is responsive to the thermal conditions in the plenum chamber as transmitted to the furnace casing 12.

The operation of the invention is as follows: The furnace 11 may be considered to be any source of heat, such as a furnace having an oil burner, a gas burner, or a coal stoker, or the furnace may be replaced by an ordinary radiator forming a part of the steam or water heating system. In the latter case the present air conditioning system would be a separate unit, applied only to one or more of the radiators for the purpose of providing a continuous and modulated circulation of air in a room.

The thermostatic control for the motor 22 may include a room thermostat for turning on the motor at a predetermined temperature, or the motor may be controlled exclusively by a furnace thermostat, such as that indicated at 90. In other cases the motor 22 may operate continuously at a low rate of speed, while the heating system is in operation, the motor circuit being closed by a plenum chamber thermostat 90 when the plenum chamber reaches a predetermined value, and thereafter the speed of the motor is controlled by means of the thermostat 70.

When the plenum chamber 79 has its air at a moderate temperature, the thermostat 70 is contracted, and the motor 22 is pivoted over counterclockwise in Fig. 1, a position to which it is urged by the spring 32.

The spring 32 is strong enough so that it is adapted to overcome the axial pressure of the spring 57 when the thermostat 70 is not working to force the motor in the opposite direction, and therefore the belt 19 is drawn deeply into the groove 42 of the pulley, and the pulley has its smallest effective diameter. Under these conditions the blower will be driven at a low speed because the driving pulley is smaller, and only a small volume of air will be driven through the furnace and out of the air registers.

As the temperature of the air in the plenum chamber increases, the thermostat 70 expands, moving the motor 22 toward the right on the pivot 31, and the length of the belt 19 being constant, the belt is permitted to ride outward in the groove 42, giving the pulley 20 a larger effective diameter. This increases the speed of rotation of the blower, and a larger volume of air is delivered, depending upon the temperature of the air in the plenum chamber.

The characteristics of the thermostatic control and the biasing springs may be made such that the relation between the temperature and volume of air delivered is substantially a straight line curve, and the volume of air delivered is substantially proportional to the temperature expressed in this manner.

When the furnace is very hot, a larger volume of air passes through it, and more heat is removed from the furnace, which is in accordance with its increased rate of production of heat. Thus the air blower system, which is the means of transferring heat from the furnace to the rooms to be heated, operates more efficiently than the devices of the prior art, and delivers more heat when there is more heat to be delivered. Yet the speed of operation of the blower and the temperature at which the motor is started need not be set so high as in the devices of the prior art where a blower usually is set at maximum speed in order to take care of the full load of the furnace.

The present device not only takes care of full load of heat delivered from the furnace, but also delivers a moderate amount of heat when the furnace is producing a moderate amount of heat, and the amount of heat delivered by the blower to the rooms in the form of hot air is continuously and uniformly graduated from a small amount to maximum delivery.

Referring to Fig. 5, the operation of this modification is the same, except that the thermal bulb 78, which is filled with expansible fluid, and connected to the bellows 70, is attached by a block 80 of high thermal conductivity to the metal 12 of the furnace bonnet.

It might be said, strictly speaking, that the thermostat is then responsive to the bonnet temperature, but the bonnet temperature follows quite closely that of the air in the plenum chamber and may differ only by a few degrees less than that of the plenum chamber. Therefore, in this embodiment the blower motor may be controlled by the temperature of the furnace bonnet.

It will thus be observed that I have invented an improved heating system which may be embodied in all types of furnaces or utilized with hot water or steam radiators for single units used in rooms.

My heating system provides a continuous and modulated change of delivery of heated air by means of a blower, the volume of which changes continuously and uniformly with changes in temperature of the furnace or the air to be delivered. Stratification is eliminated, and such a blower may be operated continuously without causing a cold blast of air at any time because when the air is cooler, the speed of rotation of the fan is lower, and a smaller volume of air, which is not so hot, may be delivered without causing the sensation of a cold blast.

While I have illustrated a preferred embodiment of my invention, many modifications may be made without departing from the spirit of the invention, and I do not wish to be limited to the precise details of construction set forth, but desire to avail myself of all changes within the scope of the appended claims.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent of the United States is:

1. A heat control system for air circulating blowers for hot air furnaces comprising an air blower having a shaft provided with a driven V-pulley, said blower being fixedly mounted on a support to deliver air to a furnace, an electric drive motor for driving said blower, said drive motor being pivotally mounted upon said support and having a driving V-pulley, thermostatic means having one end fixedly secured to said support and the other end connected to said motor at a point spaced from its pivotal support for varying the position of said motor in relation to its spacing from said blower, whereby the spacing of said V-pulleys is varied, a V-belt engaging said V-pulley, one of said V-pulleys being provided with a pair of belt engaging members slidably mounted with respect to each other and engaged by spring means urging said members together and urging said belt into a position of engagement with part of said pulley at a greater diameter, whereby said thermostatic means varies the position of said motor and varies the position of said pulley and varies the position of said belt in one of said pulleys to change the speed of drive of said blower responsive to temperature at said thermostatic means.

2. A blower controlling system for hot air furnaces, comprising a blower provided with a driven pulley of the V-type, a support carrying said

blower, a constant speed driving motor movably mounted on said support, and having a V-pulley for driving the blower, a V-belt embracing said pulleys, one of said pulleys comprising a pair of relatively movable sections spring pressed together to provide a groove of varying width and varying effective diameter, and means for controlling the speed of drive of said blower, comprising means for acting on said motor and moving it relative to said support to cause a variation in the effective size of said variable diameter pulley by variation of the distance between the pulley centers, said latter controlling means comprising a pressure responsive bellows having one end fixedly secured to said support, and the other secured to said motor, said pressure responsive bellows being filled with a thermally expansible fluid adapted to be subjected to heat generated by a furnace, the air of which is circulated by said blower.

3. A variable drive for air circulation of hot air furnaces comprising a support, a driven member comprising a blower, and a driving member comprising a constant speed motor, V-pulleys on each of said members, and a V-belt embracing said pulleys, one of said pulleys having a pair of spreadable sections engaging said V-belt, resilient means for urging said sections together, and relatively weaker resilient means for urging said members apart to maintain the belt at predetermined tension.

4. A variable drive for air circulation of hot air furnaces comprising a support, a driven member comprising a blower, and a driving member comprising a constant speed motor, V-pulleys on each of said members, and a V-belt embracing said pulleys, one of said pulleys having a pair of spreadable sections engaging said V-belt, resilient means for urging said sections together, and thermostatic means for moving one of said members relative to the other to change the distance between the centers of the driving and driven members, and to cause the V-belt to vary its effective diameter in said two-section pulley, whereby the driven member is driven at a variable speed depending on the temperature of the thermostatic means.

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