Feb. 20, 1945. J. C. MILES 2,369,681

APPARATUS FOR HOT AIR HEATING SYSTEMS

Filed June 4, 1942 2 Sheets-Sheet 1

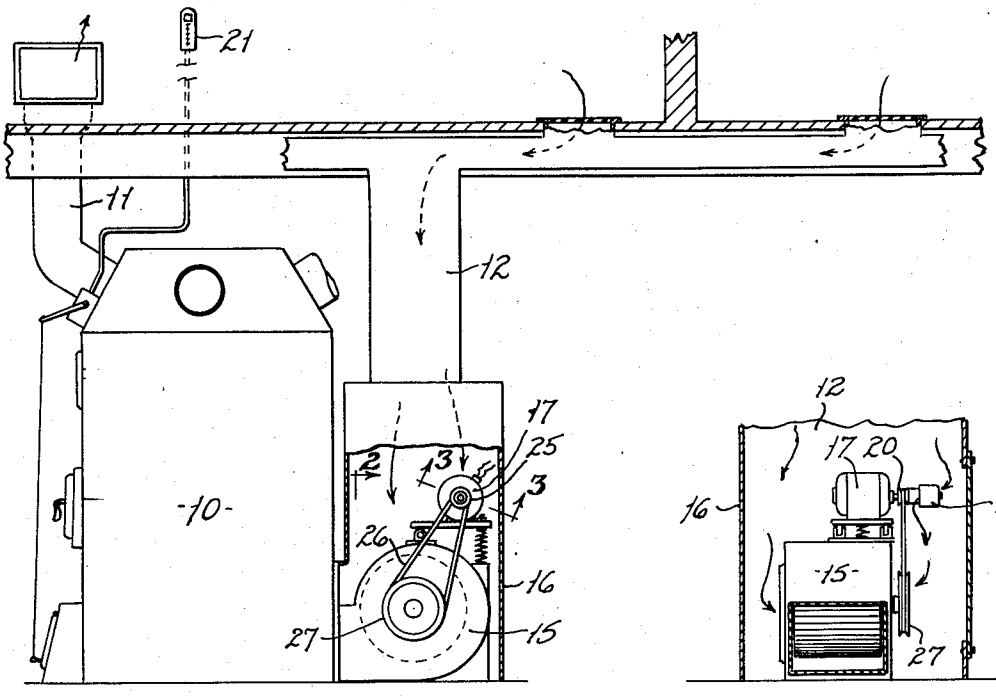


Fig. 1

Fig. 2

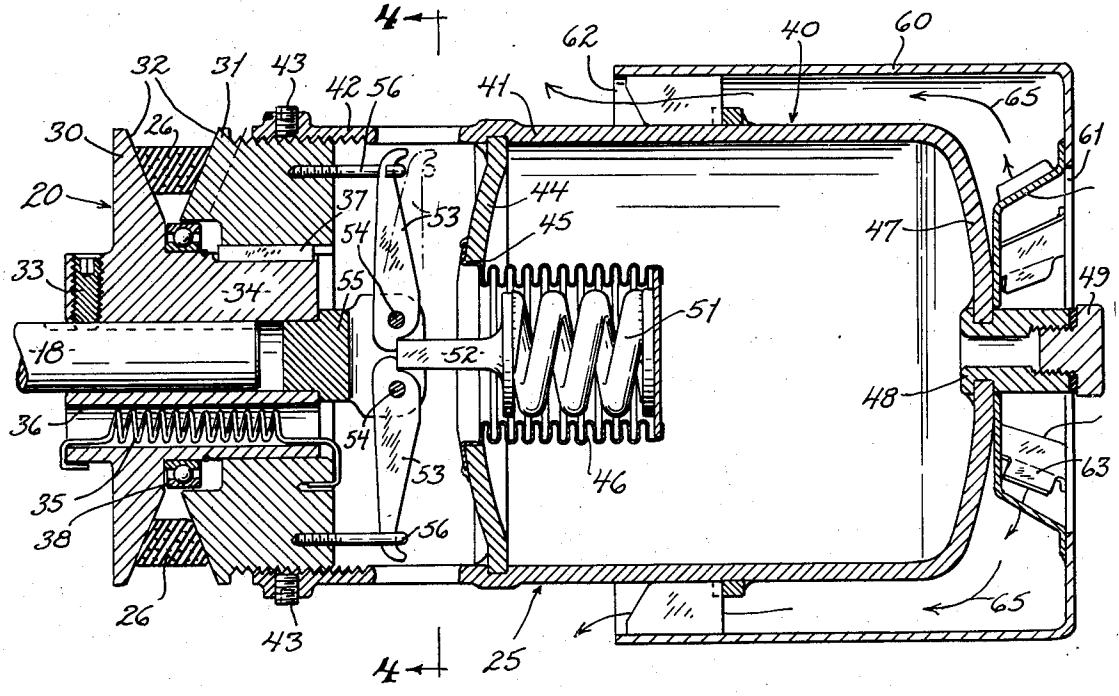


Fig. 3

INVENTOR.
JAMES C. MILES
BY
Bates, Teare, & McBean
ATTORNEYS

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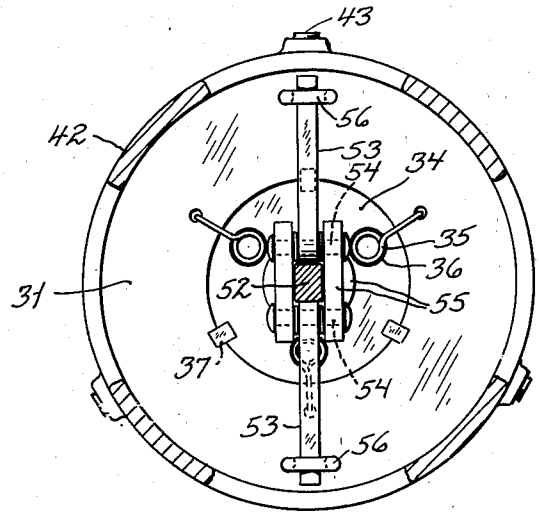


FIG. 4

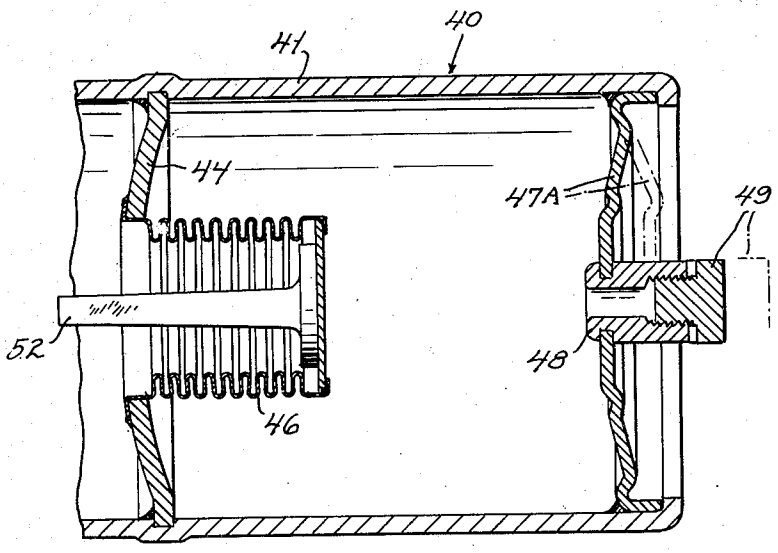


FIG. 5

INVENTOR.
JAMES C. MILES
BY
Bates, Teare & M'Bean
ATTORNEYS

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APPARATUS FOR HOT-AIR HEATING SYSTEMS

James C. Miles, Cleveland, Ohio

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14 Claims. (Cl. 236—10)

This invention relates to a change-speed device which is adapted particularly for use in connection with a hot air heating system. Where hot air heating systems are used in residences and where a blower is utilized in connection with the system and is operated intermittently, the control for the motor is usually located in one of the rooms, hence, the temperature of the air in the other rooms is not directly reflected in the operation of the blower.

An object of the present invention, therefore, is the provision of a device which will permit the use of a constantly operated motor, but which will cause a variation in the rate of rotation of the blower consequent upon variations in the temperature of air in the return air conduit. Inasmuch as the air in such conduit is drawn from all of the rooms to be heated, it is obvious that the operation of the blower is directly affected by the temperature in all of the rooms to be heated. This will minimize floor drafts, assure greater comfort, and result in increased economy of furnace operation.

Another object of the present invention is to provide a device which may be attached to existing structures where a motor and blower are used in connection with the operation of a hot air heating system, so that the system may be changed over without extensive modifications in the construction thereof.

The foregoing objects are accomplished by providing a change-speed device which is interposed between the blower and its driving motor, and which is operated by a thermal responsive device that is interposed in the path of the current of air flowing in the cold air return duct. The temperature responsive device and the change-speed device are so interconnected that as the returning air becomes colder, greater volume is caused to be circulated past the furnace, and as the temperature of the returning air increases, the volume circulated is correspondingly reduced.

A more specific object of the present invention is to provide an improved thermally responsive change-speed device which will react to small variations in the temperature with a high degree of accuracy. I preferably accomplish this by mounting a temperature responsive device directly on a rotary part of a change-speed unit, and in the path of a moving current of air flowing in the cold air return conduit. To assure immediate responsiveness of the device, I provide means for maintaining a circulation of air around the thermal unit at all times.

Other objects and advantages of the invention will become more apparent from the following specification, reference being made to the accompanying drawings wherein a preferred embodiment of the invention is shown. The essential and novel features of the invention will be summarized in the claims.

In the drawings, Fig. 1 is a view illustrating a heating system utilizing the present invention; Fig. 2 is a sectional view, the plane of the section being indicated by the line 2—2 on Fig. 1; Fig. 3 is an axial section taken through the change-speed mechanism, the plane of the section being indicated by the line 3—3 on Fig. 1; Fig. 4 is a transverse section through the change-speed mechanism, the plane of the section being indicated by the line 4—4 on Fig. 3, and Fig. 5 is a fragmentary section taken in the same plane as Fig. 3 and illustrating a modification thereof.

Referring now to the drawings in detail, my improved change-speed device is illustrated in connection with a hot air heating system of the usual type. As shown, the system comprises a furnace or heating unit 10 provided with the usual hot air conduit 11 and a cold air return 12. Circulation of the air is maintained by a blower 15 mounted in a housing 16 which is connected with the cold air return 12. The blower is driven by a motor 17 through the medium of a pulley 20 carried by a change-speed device, generally indicated at 25, and which will hereinafter be described in detail. A suitable driving belt 26, preferably of the V-type interconnects the driving pulley 20 with the driven pulley 27. The motor is preferably of the type suited for constant speed operation. The change-speed device 25 is controlled by a thermal unit, hereinafter to be described, which varies the speed of the blower in accordance with the change in temperature of the air in the intake or return air duct 12. The arrangement is such that as the temperature of the return air decreases, the speed of the blower will be increased, and vice versa. A thermostat 21, controlled by the air flowing in the bonnet of the furnace, or by the air in the room to be heated, operates the furnace dampers in the usual way to maintain a combustion rate which is required for optimum conditions.

The change-speed device includes the pulley 20 which comprises a pair of flanges 30 and 31 having oppositely facing beveled surfaces 32 which are arranged to coact to provide a V-shaped slot to receive the driving belt 26. The pulley flange 30 is secured to the shaft 18 of the motor 17 as by a set screw or key construction 33 and is provided with a hub portion 34 upon which

the pulley flange 31 is mounted for axial movement. The pulley flanges 30 and 31 are driven in unison and are normally drawn towards each other by tension springs 35 which are positioned in cylindrical bores in the hub 34. The flange 30 is keyed to the shaft 18 as heretofore mentioned, and the flange 31 is splined, as for instance by keys 37 on the hub 34. The distance between the tapered surfaces 32 of the respective pulley flanges is controlled by a thermal unit and the arrangement is such that when the two flanges are separated to the greatest extent, the driving belt 26 rides on the outer raceway 38 of a friction bearing member which is supported by the hub 34 of the pulley member 30, so that the operation of the motor may continue with the belt in contact with the bearing member, thus providing an idle or neutral position of the change-speed device.

The thermal unit for controlling the distance between the tapered surfaces 32 of the pulley members 30 and 31 is indicated in general at 40. It comprises a cylindrical member or container 41 adapted to receive a thermally responsive liquid of the type that expands under the influence of a rise in temperature. For example, I have obtained satisfactory results by using ethyl chloride, which when expanded under operating conditions, will develop a liquid pressure of approximately 400 pounds per square inch. As illustrated in Fig. 3, the container is supported by the pulley member 31 by means of a skirt portion 42 which threadingly engages the member. Suitable set-screws 43 are provided to secure the container to the pulley member.

As the member 31 is moved toward the member 30, the distance between the faces 32 is reduced, and the effective diameter of the pulley is increased, thus increasing the speed of the unit driven thereby. Similarly, as the member 31 moves away from the member 30, the diameter of the pulley is decreased and a proportional decrease occurs in the speed of the unit driven thereby.

One end of the container may be formed by a disc 44, secured to the walls of the cylinder, as by welding, and provided with a central opening 45. Secured to the disc and projecting through the opening 45 into the container is a collapsible metallic bellows 46. The other end of the container may be formed by the metal of the walls as shown in Fig. 3, or by a separate disc 47A as shown in Fig. 5. The latter has the advantage of preventing damage to the device due to abnormal temperatures during storage or shipping of the unit by permitting the wall to flex under such abnormal temperature as indicated by the dotted lines in Fig. 5. Upon return to normal temperature, the end wall 47 will return to its normal or full line position. The end wall 47 or 47A is provided with an inlet bushing 48 through which the temperature responsive fluid may be inserted into the container. This bushing is normally sealed by a threaded plug 49.

The expansion and contraction of the fluid within the container acts on the bellows 46 and through a spring 51 on a plunger 52 which abuts the inner ends of a pair of lever arms 53 pivoted as at 54 to a plug 55 which is rigidly secured to the hub 34 of the pulley member 30. The outer ends of these levers project into respective hooks 56 carried by the other pulley member 31. The foregoing arrangement of parts effects a separation of the pulley members 30 and 31 consequent upon a rise in temperature in the conduit 12, and effects a contraction of the pulley members, consequent upon a diminution of the temperature in the conduit. By turning the container 40 with reference to the pulley member 31, a suitable adjustment may be made, by means of which the device is responsive to a predetermined temperature range. After the desired adjustment is made, the parts may be locked together by tightening the set screws 43.

To protect the wall of the container from radiant heat, I provide a shield 60 which is in the form of a skirt that extends around and along the container and is rigidly mounted thereon. Each end of the skirt is open, as at 61 and 62 to permit the passage of a current of air between the wall of the container and the shield. By mounting fan blades 63 in such region, adjacent the end 61, a current of air is caused to flow lengthwise of the container and between it and the shield as shown by the arrows 65. The air flowing through such region is that flowing within the cold air return duct 12 and, hence, aids in accelerating responsiveness of the thermal device to various changes in the temperature of air flowing in the conduit 12.

I have found that in the mechanism heretofore described, a loading of approximately 300 pounds on the spring 51 is sufficient to maintain stability against vibration during rotation. Accordingly, the pressure built up within the container by the expansion of liquid must exceed 300 pounds before sufficient power is developed to move the bellows toward the collapsed position. A good working range is between 300 and 400 pounds, as this will provide adequate axial movement of the plunger 52 to actuate the levers 53, and thereby to move the pulley member 41 an adequate distance for effecting the desired range of belt movement. The metal of which the wall 47A is made is so chosen as to thickness to start an outward bulging thereof at an internal pressure of approximately 400 pounds per square inch, and the throw of the wall, or its degree of axial movement, is sufficient to prevent the internal pressure from exceeding any prohibitive amount.

The foregoing arrangement is effective to permit the use of a constantly operating motor and the variable operation of a blower consequent upon variations of temperature in the return air duct. Thus, any drop in the temperature of the returning air is reflected at once in an increased circulation so as to send additional heat through the distributing conduit. It is to be understood that the heating furnace is equipped with the customary damper control apparatus under the influence either of the temperature of the air in the furnace bonnet, or in one of the rooms to be heated, so as to vary the rate of combustion within the furnace in accordance with the demand for heat in the room to be heated. The essential features of the present invention are set forth in the appended claims.

I claim:

1. A change-speed device comprising a pulley having a pair of axially movable members, each having a tapered surface to provide a side wall arranged to coact with a V-type driving belt, a thermally responsive unit, means interconnecting the thermally responsive unit and members to move said members axially relative to each other and thereby control the effective diameter of the pulley, and means rotatable as a unit with one of said pulley members to circulate air across said thermally responsive unit, said change-

speed device and thermally responsive unit being interconnected and adapted for mounting as a unitary structure within a return air duct leading to a warm air heating furnace.

2. A variable speed driving device comprising a pair of trunco-conical discs adapted to be drivingly mounted on a shaft with one disc movable axially relative to the other to form a variable width belt groove, springs interconnecting said discs to move one disc axially toward the other disc, a plurality of levers pivotally interconnected between their ends with one disc and connected at one end to the other disc, a plunger coacting with the other end of said levers, and a thermally responsive element coacting with said plunger to cause it to act on said levers and cause a separation of said discs.

3. A variable speed driving device comprising a pair of trunco-conical discs adapted to be drivingly mounted on a shaft with one disc movable axially relative to the other to form a variable width belt groove, resilient means normally acting to draw said discs together, levers pivoted to one of said discs and connected to the other disc, a thermally responsive element carried by one of said discs, a plunger interposed between said element and said levers whereby said discs will be separated in response to the variations of said element.

4. A variable speed driving device comprising a pair of interconnected trunco-conical discs adapted to be drivingly mounted on a shaft as a unit, one of said discs being movable axially relative to the other disc to form a variable width belt groove therebetween, a plurality of levers pivotally interconnected between said discs, a plunger in axial alignment with said discs and bearing on said levers, a thermally responsive element carried by one of said discs, and a spring interposed between said element and said plunger to transmit the expansion of said element to said levers and cause a separation of said discs, and resilient means to return said discs.

5. A variable speed device comprising a pair of pulley members each having a tapered surface to provide walls between which a driving belt may be gripped, said members being arranged and adapted to be drivingly mounted on a motor shaft with one member axially movable relative to the other, resilient means normally acting to draw said members toward each other, a thermally responsive element carried by one of said members, a plurality of radially extending levers interconnected between said members, a thermally responsive element carried by one of said members, and means coacting with said element and said levers to separate said members in response to the expansion of said element, but at the rate of speed greater than the rate of speed of expansion of said element.

6. A variable speed device comprising a pair of tapered surfaced pulley members arranged and adapted to be drivingly connected to a motor shaft as a unit with one member movable axially relative to the other to form a variable width driving belt groove, resilient means interconnecting said members to draw them together, thermally responsive means to separate said members, said means comprising a container axially adjustable on one of said members, a diaphragm closing said container, a thermally responsive fluid in said container, levers interposed between said diaphragm and said members, each of said levers being pivotally secured to one pulley member and connected to the other, a common plunger acting on said levers, and a spring interposed between said plunger and said diaphragm to transmit the expansion of said fluid to said levers and cause a separation of said members.

7. A variable speed device comprising a pair of tapered surfaced pulley members arranged and adapted to be drivingly secured to a shaft with one member slidable axially and the other member fixed axially relative to the shaft to form a variable width driving groove therebetween, resilient means acting to move said movable member to decrease the width of said groove, a fluid container secured to said slidable member, thermally expansible fluid in said container, and means responsive to the expansion of said fluid and connected to said slidable member to widen the belt groove as the fluid expands.

8. A change-speed device for a heating unit blower, comprising a pair of pulley members, each mounted for axial movement toward each other and having an inwardly converging face arranged to form one surface of a belt receiving slot, a driving shaft for said pulley, a driving connection between the shaft and each of said pulley members, constantly operating means to drive said shaft, a thermally responsive unit carried by one of said members, levers carried by said members, means interconnecting said thermal unit with said levers to control the space between the surfaces of said members, said unit being mounted for bodily movement to and from said levers, and means to secure said unit in an adjusted position relative to said members.

9. In a variable speed device, a pulley member having a hub, a second pulley member splined to said hub for axial movement relative thereto, each of said pulley members having an inclined face arranged to form one surface of a trough to receive a V-shaped driving belt, a container secured to one of said pulley members and having a thermally responsive fluid therein, a diaphragm member carried by said container and responsive to the expansion and contraction of said fluid, levers interconnecting the two pulley members, means interconnecting said levers and said diaphragm whereby expansion of the fluid within the container moves said pulley members away from each other, and resilient means normally acting to move said pulley members toward each other.

10. In a variable speed device, a pulley member, a second pulley member mounted for axial movement relative to the first member, each of said pulley members having an inclined face arranged to form one surface of a trough to receive a V-shaped driving belt, a container secured to one of said pulley members and having a thermally responsive fluid therein, a diaphragm member carried by said container and responsive to said fluid, levers interconnecting the two pulley members and said diaphragm whereby expansion of the fluid within the container moves said pulley members away from each other, resilient means to move said pulley members toward each other, and a blower secured to said container to circulate air around the surface of said container whenever said pulley member is rotated.

11. In a heating system having a warm air heating unit, a duct for conducting air from the heating unit to the area to be heated, a return duct leading from such area, a blower arranged to draw air from the last-named duct, and to circulate it through the heating unit and the

first-named duct, means to drive said blower, means to vary the speed at which the blower may be operated, said last-named means including a change-speed device and a thermal element mounted as a unit within the return duct, said change speed device embodying opposed discs which cooperate to form a belt groove, one of said discs being movable with respect to the other, and said thermal element being adapted to actuate one of said discs and to move it toward and from the other to vary the speed at which the blower is operated, and operating to increase the speed of the blower as the temperature in the return duct is diminished and vice versa.

12. In a hot air heating system having a hot air heating unit, conduits leading from said heating unit to the area to be heated, a return duct leading from the area heated to the heating unit, blower means associated with said duct to draw air through it and to circulate it through the heating unit and through said conduits, a motor to drive said blower, a change-speed device interposed between the blower and the motor and mounted in the cold air return duct, said change-speed device embodying opposed discs which cooperate to form a belt grove, one of said discs being movable with respect to the other, and a thermally responsive element also mounted in the return duct and acting on said movable device to control the change-speed device and vary the speed at which the blower is driven solely in accordance with the temperature of the air returned by the return duct and operating to increase the speed of the blower as the temperature of the return duct diminishes and vice versa.

13. In a warm air heating system having a heating unit, a blower to circulate air through the heating unit and the area to be heated, a motor for driving said blower, a thermally responsive device comprising a closed container having an expansible portion in a wall thereof, means operated by movement of said expansible portion to drive the blower at variable speeds, and a housing substantially co-extensive with the container but spaced therefrom and having baffles therein to circulate air around said thermally responsive means independently of the operation of said blower.

14. In a heating system having a warm air heating unit, ducts for conducting air from the heating unit to a plurality of rooms to be heated, a common return duct leading from such plurality of rooms to the heating unit, a blower for inducing a flow of air through the common return duct and through the heating unit to the first-named duct, a motor for operating the blower, there being a belt drive between the motor and blower, a change-speed device acting on the belt, said device including a pair of oppositely facing discs which cooperate to form a belt receiving groove, one of said discs being movable axially of and relatively to the other, a thermal responsive device connected to the relatively movable disc, said disc and device being disposed within the common return duct and subjected solely to the temperature of the return air moving therein, said thermal responsive device operating to increase the speed of said blower consequent upon a decrease in the temperature of the air flowing in said return duct, and to decrease the speed of said blower consequent upon an increase in the temperature of the air flowing in said return duct.

JAMES C. MILES.