

April 30, 1946.

S. J. LOCKE

2,399,555

BALANCED SUCTION TUMBLER

Filed April 24, 1943

2 Sheets-Sheet 1

Fig. 1.

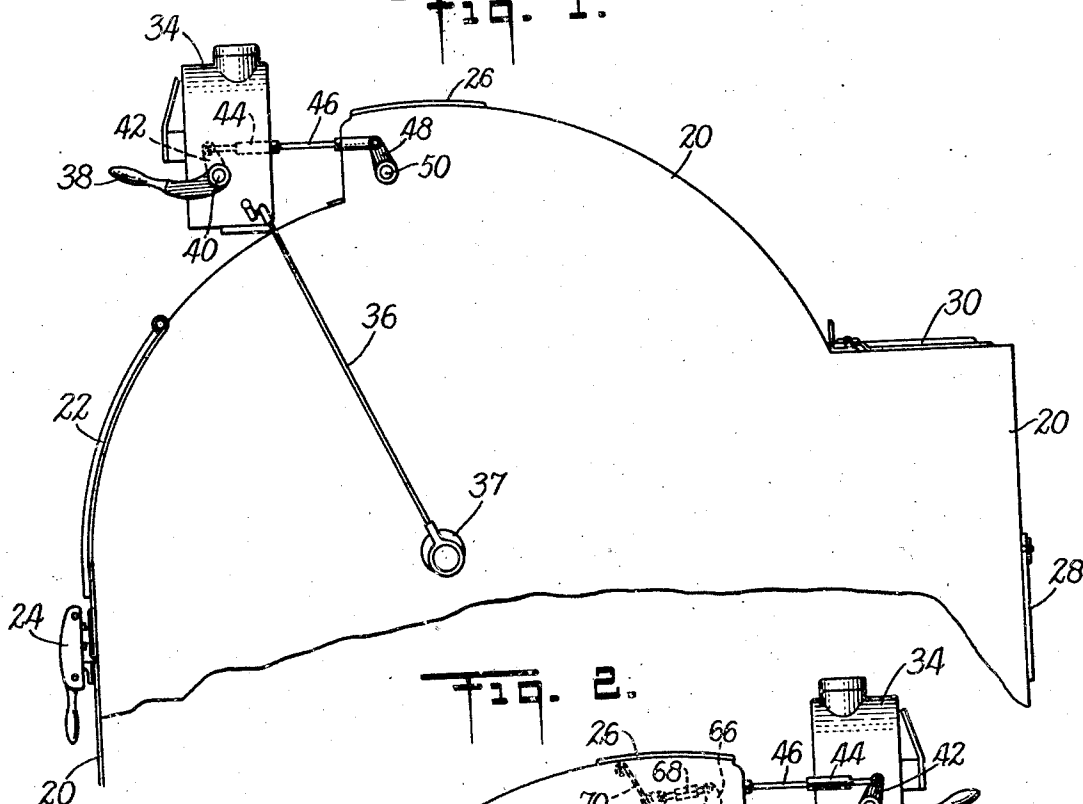
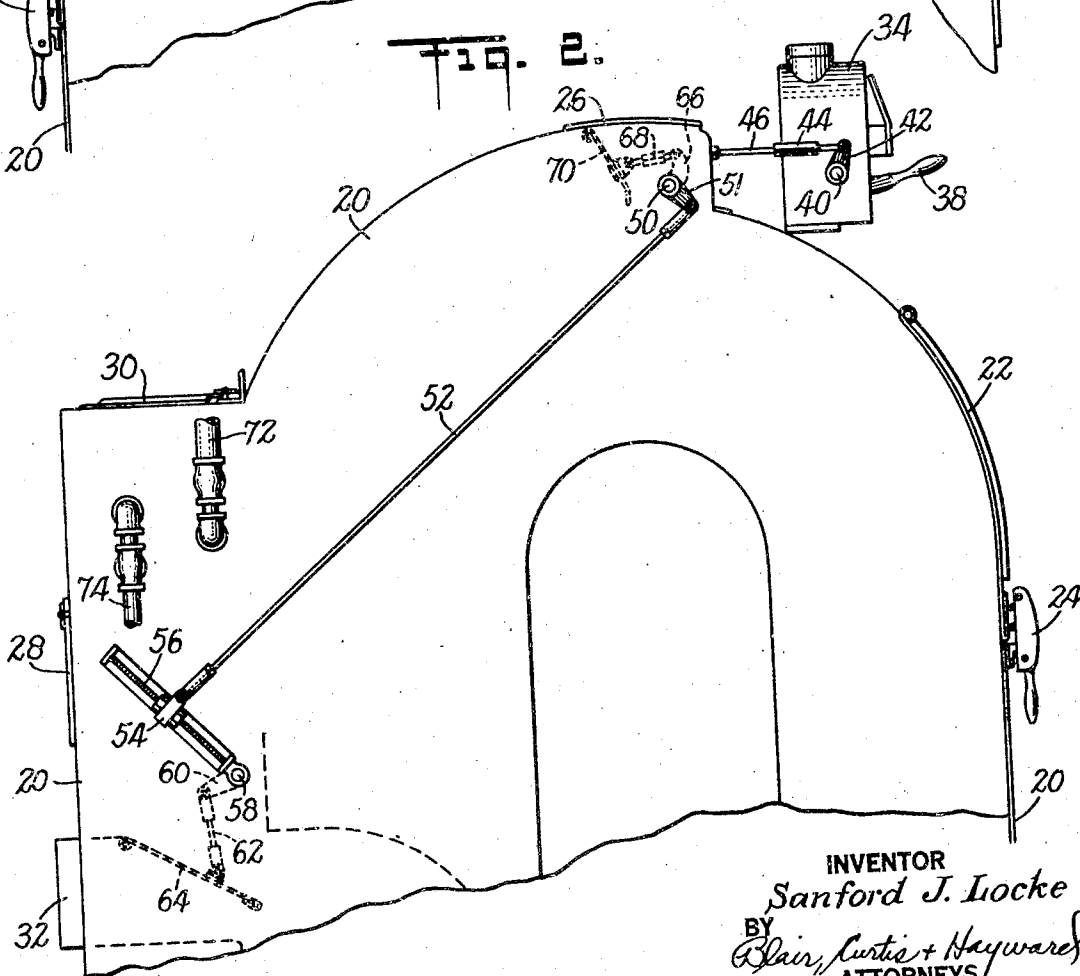


Fig. 2.



INVENTOR
Sanford J. Locke
BY
Blair, Curtis & Hayward
ATTORNEYS

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S. J. LOCKE

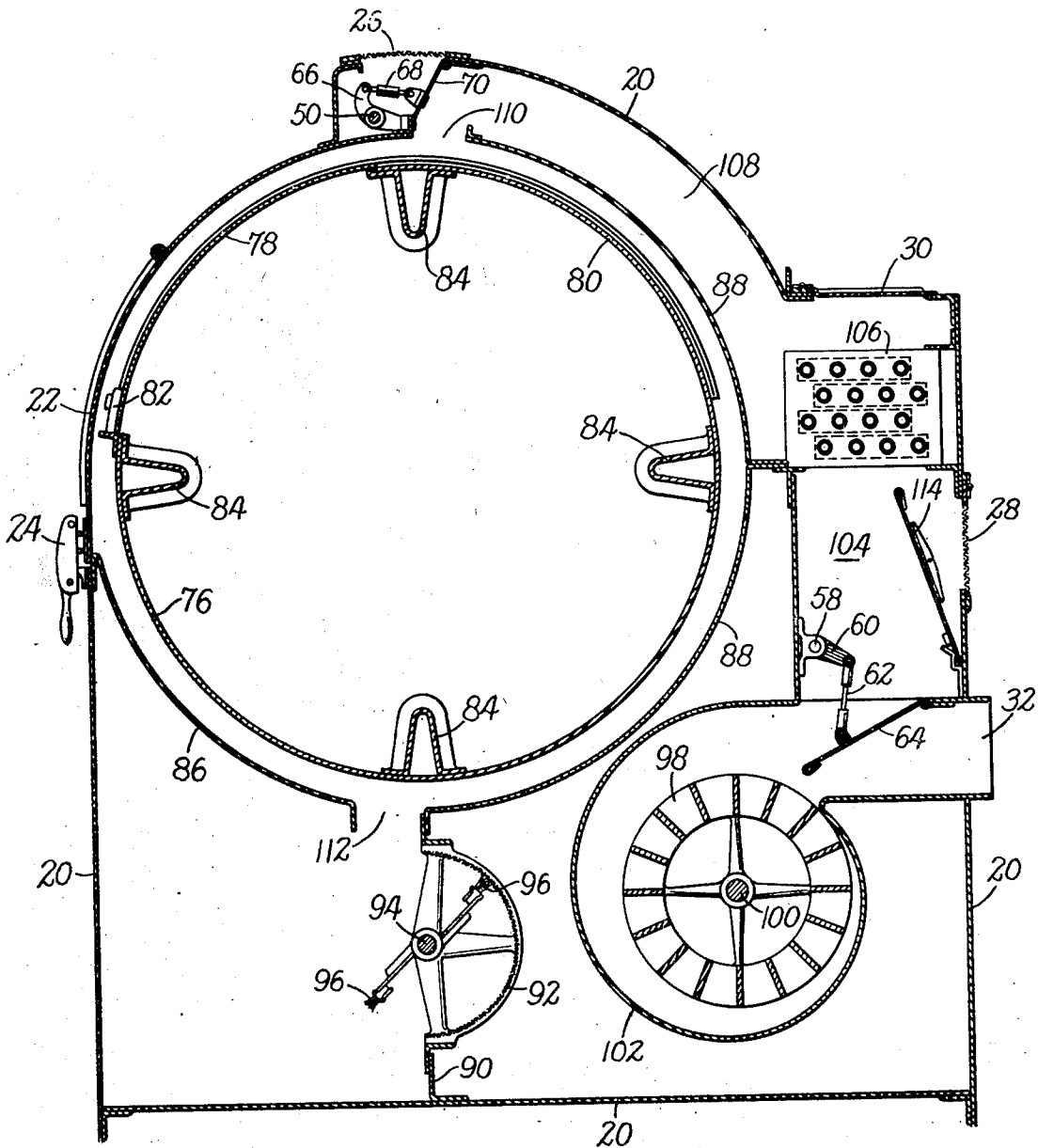
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2 Sheets-Sheet 2

Fig. 3.



INVENTOR
Sanford J. Locke
BY
Blair, Lurtz & Hayward
ATTORNEYS

UNITED STATES PATENT OFFICE

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BALANCED SUCTION TUMBLER

Sanford J. Locke, Syracuse, N. Y., assignor to
United States Hoffman Machinery Corpora-
tion, New York, N. Y., a corporation of Delaware

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1 Claim. (Cl. 34-133)

This invention has to do with laundry dryers and, more particularly, with a type of dryer wherein a stream of heated air is recirculated over and over through a drying chamber containing a laundry cylinder.

Commercial laundry dryers are commonly found in several forms. In some of them, known as recirculating dryers, the same air is passed again and again through the drying chamber; in some, all of the air which passes through the chamber containing the drying cylinder is discharged without any recirculation. This latter type of dryer is known to the trade as the once-through type. Some few of the laundry dryers are of a modified recirculating type wherein the moisture content in the recirculated air is kept below a given value by bleeding off a portion of the air after it leaves the dryer and by introducing fresh make-up air into the circulating air stream. It is to this modified recirculating type of dryer that the present invention especially relates.

In a few of the known recirculating dryers the air stream is so arranged that the static pressure within the drying chamber where the cylinder is positioned is subatmospheric, and laundry dryers made in accordance with the present invention are preferably of this type because it has been found that the lint which necessarily results from the drying and tumbling operations is more easily controlled, gathered and disposed of under such conditions, especially so when the pressure within the chamber is maintained subatmospheric by a definite exhausting action applied at the outlet of the drying chamber, for if the air passes through the chamber because of pressure at the entrance to the chamber, there is a tendency for lint to collect in an undesirable manner at the various cracks and openings which exist for one reason or another within the chamber and around the loading door. Furthermore, the subatmospheric pressure promotes more rapid evaporation of water from the damp laundry.

It has also been discovered that greater efficiency is achieved if the recirculated air and make-up air are thoroughly mixed and heated before being introduced into the drying chamber. More efficient heat exchange is effected with a corresponding saving in operating costs if all of the air which is introduced into the drying chamber passes through a heating chamber rather than if the recirculated air alone is heated and then mixed with the make-up air, with a consequent lowering of temperature. Furthermore,

by passing all of the air through the heating chamber, a lower operating temperature in the heating coils may be maintained than if only the recirculated air is heated.

Laundry dryers made in accordance with the present invention include means for bleeding off a predetermined proportion of the circulating air stream so as to maintain the moisture content of the stream more or less uniform throughout the drying period and means are also included for introducing make-up air into the stream in proportion to the volume of air bled off. It has been discovered that the pressure within the drying chamber can be maintained subatmospheric and that the bleeding off of air from and the introduction of make-up air into the stream may best be correctly balanced during operating conditions if certain critical relationships of air pressures are observed and promoted.

Thus, a machine made in accordance with the present invention operates with a recirculating stream of heated air and this stream of air, as it circulates, experiences certain pressure and temperature conditions whereby the lint produced during the drying is positively exhausted from the drying chamber and the volume of make-up air introduced into the stream balances itself automatically in response to the volume of air diverted from the stream to maintain proper humidity conditions.

It is an object of the present invention to provide methods and means of the character described, having to a notable extent the characteristics and capabilities above set forth. Another object is the provision of a method of drying laundry with a stream of air wherein temperatures and pressures within the drying chamber are maintained in accordance with predetermined values wherein moisture-laden air diverted from, and make-up air introduced into the stream automatically balance one another. Another object is the provision of a laundry dryer of a modified recirculating type wherein the pressure within the drying chamber may be maintained subatmospheric and wherein practical means are provided for automatically introducing make-up air into the air stream in proportion to the volume of air diverted therefrom. Other objects and advantages will be in part pointed out as the description proceeds and will in part become apparent therefrom.

The invention accordingly consists in the methods of operation, features of construction, combinations of elements and arrangements of

parts as will be exemplified in the structures to be hereinafter described and the scope of the application of which will be set forth in the accompanying claim.

In the accompanying drawings, in which is shown one of various possible embodiments of the invention:

Figure 1 is an end elevation of a laundry dryer embodying the invention;

Figure 2 is an elevation of the other end of the laundry dryer illustrated in Figure 1; and

Figure 3 is a sectional view through the laundry dryer taken looking in the same direction as in Figure 1.

Referring to Figure 1, a housing 20 appears provided with a loading door 22 carrying a latch 24. Toward the top of this housing the edge of a screen 26 is shown covering an inlet to the housing for fresh air, as will be described. The lower right-hand portion of the housing, as shown in Figure 1, is fitted with a screen 28 appearing in edge view and covering a make-up air inlet, to be described. A cover 30 to a clean-out opening appears in edge view in housing 20 above screen 28.

Figure 2 shows the housing viewed from the opposite end and with screen 26 again appearing in edge view toward the top but with loading door 22 on the right and screen 28 on the left. In the lower left-hand corner of Figure 2 an exhaust duct 32 is shown.

A control unit 34 located on housing 20 is shown in both Figures 1 and 2. This control unit is of a conventional type and need not be described here; but it may be noted that eccentric rod 36 (see Figure 1) is connected to the control unit to register therein revolutions made by cylinder shaft 37. This unit includes a manual control handle 38 carried upon and keyed to a control shaft 40 rotatably fixed in the unit. Shaft 40 carries a crank 42 which serves through a spring connection 44 and a connecting rod 46 to operate a crank 48 (see Figure 1) upon a damper shaft 50 located within housing 20.

Damper shaft 50 carries a crank 51 pinned by conventional clevises and a pitman 52 to an adjustment lug 54 upon a threaded arm 56. Arm 56 is keyed to a countershaft 58 and operates through a crank 60 and connecting rod 62 to position a recirculating damper 64, as will be described. Also keyed to damper shaft 50 is a crank 66 which operates a cooling air damper 70 through a connecting rod 68.

Referring to Figure 3 a drying cylinder 76 is shown positioned within housing 20 and provided with a sliding panel 78, through which access may be had when loading door 22 is open to the interior of the cylinder. Panel 78 is mounted in a track 80 and carries a latch 82. The cylinder is mounted for rotation upon cylinder shaft 37 (see Figure 1) and tumbling bars 84 are positioned within the cylinder for agitating the laundry therein when the cylinder is rotated.

The cylinder is located within a drying chamber formed of portions of housing 20, a cylindrically shaped wall 86 and a cylindrically shaped wall 88. Wall 88 at its bottom edge is secured to a vertical partition 90 which carries therein a semicylindrically shaped lint screen 92. A brush shaft 94 coaxial with the lint screen carries brushes 96, which are rotated during drying to remove lint from the lint screen as deposited thereupon by the circulating stream of air on its way from the drying chamber.

In a fan chamber formed within the lower

right-hand corner of housing 20, as illustrated in Figure 3, a fan 98 mounted upon a fan shaft 100 is indicated. Fan 98 cooperates with fan housing 102 to exhaust air from the drying chamber and to suck it through lint screen 92 into the fan chamber. The stream of air exhausted by fan 98 is divided by recirculating damper 64 with the major portion of the stream proceeding upwardly through air duct and induction chamber 104 while the remainder of the portion is diverted from housing 20 through duct 32 to the atmosphere. From air duct 104 the stream of circulating air passes over heating coils 106 located in a heater chamber above the induction chamber, in the present embodiment fed with steam from a pipe 72 (see Figure 2) and exhausted through a pipe 74. The heated air circulates upwardly through duct 108 and opening 110 to the drying chamber, then through exit 112, the lint screen, and back to the fan.

As pointed out in connection with Figures 1 and 2, screen 28 (see Figure 3) is provided over an opening in housing 20, and this opening communicates with air duct 104. A baffle damper 114 is hinged below this opening so as to cooperate therewith to allow make-up air to enter duct 104 through screen 28. Damper 114 is fixed at a suitable angle with respect to the flow of air through duct 104 so as to create a slight aspirating effect through screen 28 in response to the flow of air through duct 104 to the heater, and the quantity of make-up air thus drawn in through the screen, as will be understood, will be automatically controlled by the requirements of the fan to an amount sufficient to balance the loss of the volume of air diverted to the atmosphere through duct 32 by recirculating damper 64.

The static pressure within the circulating air duct will be at a maximum adjacent the exhaust from fan 98 and will be superatmospheric to the extent of perhaps .25 inch of water. The angle made by damper 114 with respect to the air stream, however, creates sufficient back pressure to cause a zone of substantially neutral or atmospheric pressure adjacent thereto. In the embodiment illustrated, the angle made by balanced damper 114 with the vertical wall of duct 104 is shown as having a value of approximately twenty to twenty-five degrees, but experience has shown that the setting of this baffle is not critical and need not be limited to an exact value. In this embodiment the drying cylinder is forty-two inches in diameter and may vary in length from about sixty inches to 120 inches or more. With a cylinder sixty inches long, two of the fans 98 are sufficient, spaced side by side upon fan shaft 100, whereas with a cylinder 120 inches long, four spaced fans may be used.

For proper operation it has been found that various pressure and temperature conditions must be established at certain points throughout the air circuit. These conditions are important in the correct control of the lint from the drying and tumbling operation and in maintaining the desired balanced relationship between air diverted from the stream and make-up air introduced thereinto. Thus, in one satisfactory arrangement, the static pressure in the stream of air diverted by recirculating damper 64 was plus .05 inch of water. The pressure toward the bottom of duct 104 between recirculating baffle damper 64 and damper 114 was plus .2 inch of water; it was minus .05 inch of water at the make-up air inlet, minus .25 inch at the inlet to the heating

coils, minus .35 inch of water in duct 108, minus .8 inch of water in the drying chamber, and minus 1.4 inches of water adjacent the entrance to lint screen 92.

With these or other satisfactory critical pressures and relationships prevailing, cylinder 76 rotates until a certain condition is reached whereupon control unit 34 rotates damper shaft 50 clockwise, as seen in Figure 3, thus moving cooling air damper 70 counterclockwise about the hinge at its upper edge to close off duct 108 and to put the drying chamber into communication with the atmosphere through screen 28 on the cooling air inlet. Simultaneously, damper 64 closes off duct 104 through connecting rod 52 and the associated linkage, as described in connection with Figure 2, to direct the entire output of fan 98 to the atmosphere through duct 32, thus instituting a cooling operation wherein heating coils 106 are thermally isolated and wherein the dryer takes on aspects of a "once-through" machine for the purposes of cooling the dried laundry.

Damper 70 is movable only between the two positions, that is, it either blocks off the fresh air inlet completely, as shown in Figure 3, or it moves counterclockwise about its hinge to block off duct 108 completely. It has no intermediate position. When damper 70 is moved to block off duct 108, recirculating damper 64 is moved to block off duct 104 and to divert the exhaust from the fan to the atmosphere. The position of recirculating damper 64 when cooling air damper 70 is in the position shown in Figure 3, however, depends upon the adjustment of adjustment lug 54 (see Figure 2) upon threaded arm 56. Hence, by means of this adjustment the dryer may be set so as to divert to the atmosphere any given predetermined proportion of air from the stream exhausted by the fan. During a drying operation the recirculating air stream picks up considerable moisture from the damp laundry and by diverting a predetermined proportion, for example 25 per cent, of the stream to atmosphere and by automatically introducing fresh make-up air from the atmosphere through the air inlet at 28, the moisture content, or relative humidity, existing within the recirculating air stream may be maintained within desired limits.

It is to be noted that the total volume of recirculating air and make-up passes over heating coils 106. These coils serve not only to give a uniform temperature to the air; but also they mix the recirculating hot, damp air with the fresh, cool and relatively dry make-up air so that the laundry being dried receives the full drying effect and benefits of the conditioned air stream, in a manner not possible where make-up air is allowed to enter the air stream between the heating and mixing chamber and the drying chamber.

The drying cylinder 76 is arranged to be rotated first in one direction and then in the other as is conventional. Likewise the operation of brushes 96 rotating about shaft 94 with respect to screen 92 is more or less conventional. The substance of the invention lies in the provision of the novel and practical methods of operation

and apparatus wherein all lint from the drying operation is necessarily exhausted through a selected exit from the chamber and wherein make-up air is introduced into the recirculating stream in a balanced and automatic manner in response to the setting of a recirculating damper which provides for maintaining air stream moisture content within specified limits.

As various embodiments may be made of the above invention and as changes might be made in the embodiment above set forth, it is to be understood that all matter hereinbefore set forth or shown in the accompanying drawings is to be interpreted as illustrative and not in a limiting sense.

I claim:

In a laundry dryer of the recirculated hot air type, in combination, a housing, a laundry cylinder for holding the articles to be dried, a drying chamber encasing said cylinder having an upper air inlet opening and a lower air outlet opening and located in the upper portion of said housing, a fan chamber communicating with the outlet opening of said drying chamber, an exhaust fan operably mounted in said fan chamber having a discharge duct in communication with the atmosphere, a heater chamber communicating with said inlet opening of said drying chamber, air heating means in said heater chamber, an induction chamber interposed between said heater chamber and said discharge duct and communicating directly with said heating means and with the interior of said duct in advance of its discharge outlet, a recirculating damper in said discharge duct to divide the air discharged by the fan into two parts, one of which is recirculated through said induction chamber and the other of which is delivered to the atmosphere, an opening for admitting make-up air to said induction chamber to compensate for the air delivered to atmosphere, a baffle damper associated with said opening within said induction chamber for facilitating the admixture of make-up air with recirculating air and directing the mixture through the air heating means to the drying cylinder, a cool air opening in said housing adjacent the inlet to said drying chamber, a cooling damper pivotally mounted to swing between a position closing off said cool air opening and a position closing off communication between the drying chamber and the heating chamber, said recirculating damper being pivotally mounted to swing between an open position to divide the air discharged by the fan and a closed position to direct the whole fan discharge to atmosphere, control means connecting said recirculating and cooling dampers whereby when said cooling damper is positioned to close off the heating chamber the recirculating damper occupies its said closed position and when said cooling damper is in its alternate position the recirculating damper occupies its said open position, and means associated with said control means for adjusting the degree of swing of said recirculating damper in relation to the full swing of said cooling damper.

SANFORD J. LOCKE.