

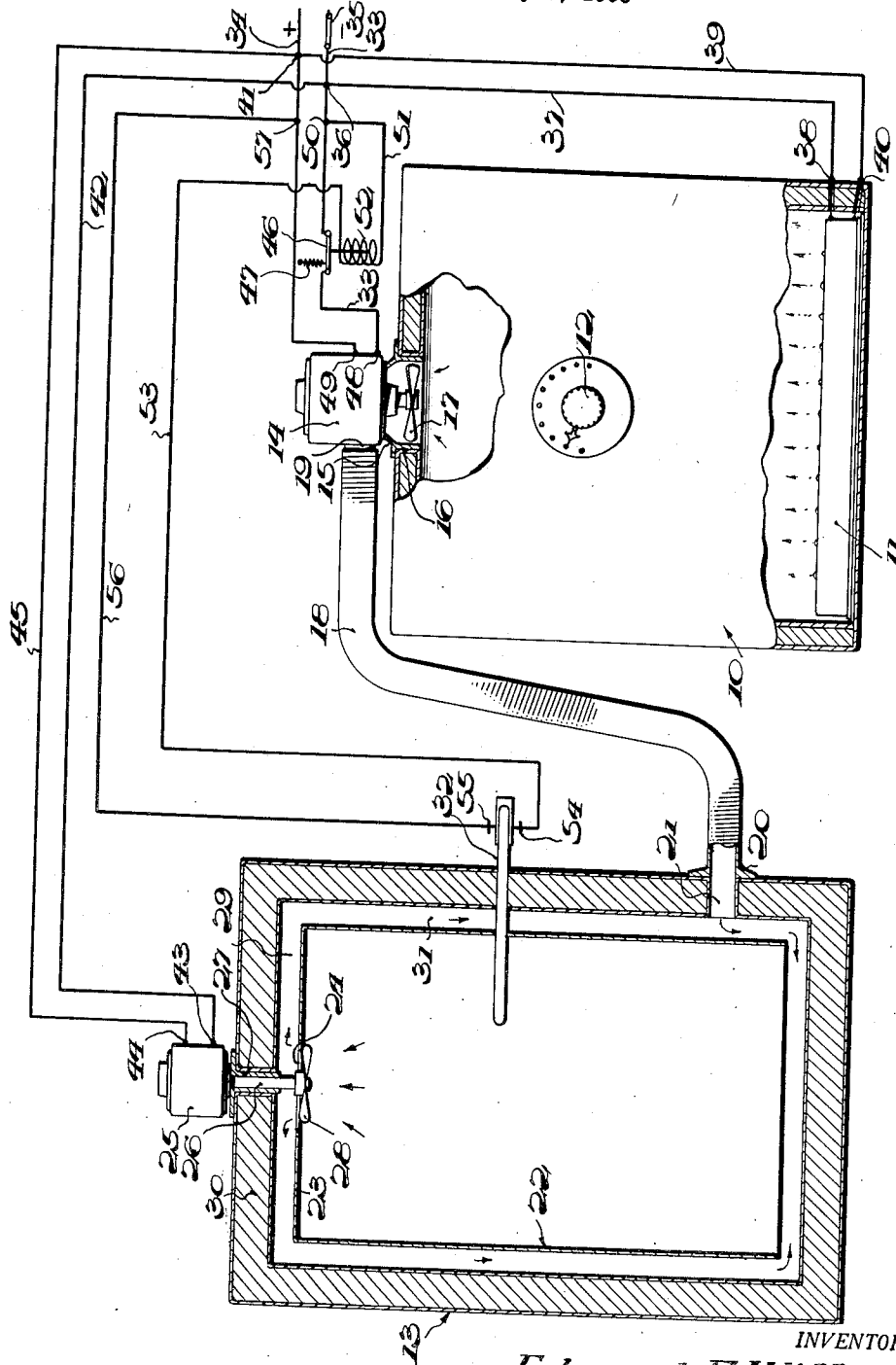
June 1, 1954

E. F. WILLIAMS

2,680,189

TEMPERATURE CONTROL APPARATUS AND METHOD

Filed July 7, 1953



INVENTOR.

Edward F. Williams

BY

W. F. Eccleston
ATTORNEY.

Patented June 1, 1954

2,680,189

UNITED STATES PATENT OFFICE

2,680,189

TEMPERATURE CONTROL APPARATUS AND METHOD

Edward F. Williams, Oreland, Pa., assignor to the
United States of America as represented by the
Secretary of the Army

Application July 7, 1953, Serial No. 366,641

8 Claims. (Cl. 219—39)

(Granted under Title 35, U. S. Code (1952),
sec. 266)

1 The invention described herein, if patented, may be manufactured and used by or for the Government for governmental purposes, without the payment to me of any royalty thereon.

My invention relates to a method of and apparatus for controlling temperatures, during laboratory tests, and the like.

Ordinary laboratory test ovens, having electrical heating units, with or without air circulating means, are generally capable of maintaining a given temperature within a range of accuracy of + or -.5 degree F. to + or -1 degree F., at the very best. For certain types of laboratory tests, this temperature variation is too great for the desired accuracy of the tests, and accordingly, it is a primary object of the present invention to provide an apparatus and method for establishing and maintaining a desired constant temperature, which will fluctuate no more than + or -.05 degree F., or the like.

A further object is to provide an apparatus and method of the above-mentioned character, wherein the test temperatures may be varied over a wide range at the will of the operator.

A further object is to provide apparatus of the above-mentioned character which is simplified in construction and operation, highly efficient and reliable.

Other objects and advantages of the invention will be apparent during the course of the following description.

In the accompanying drawings, forming a part of this application, and in which like numerals are employed to designate like parts throughout the same.

The figure is a side elevation, partly diagrammatical, and partly in section of apparatus embodying the invention, and used in the practice of my method.

In the drawings, where for the purpose of illustration is shown a preferred embodiment of the invention, the numeral 10 designates generally a laboratory type test oven or cabinet of generally conventional construction, and embodying a conventional variable resistance electrical heating element 11, controlled by conventional manually operated control means 12, associated with the oven 10 as indicated. The oven 10 is capable of establishing and maintaining temperatures over a relatively wide range, and maintaining these temperatures constant to within + or -.5 degree F to + or -1 degree F.

I provide a primary thermal test cabinet or oven 13 in conjunction with the oven 10, and within which the actual testing in accordance

2 with my method is conducted. Like the oven 10, the primary oven 13 may be of generally conventional construction, as regards the usual heat insulated walls, access openings, air vent means, and the like, not shown.

A suction blower 14, carried by a tubular adapter 15 is mounted upon the top of the oven 10, with the tubular adapter engaging within an opening 16 in the top wall of the oven 10, as indicated. The blower 14 has a rotary impeller or fan 17, which draws air from inside of the oven 10 and forces it through the tubular adapter 15 to the inside of the blower casing 14, which has passage means communicating with a flexible reinforced conduit or tube 18, having one end connected with the blower casing 14 as shown at 19. The other end of the conduit 18 is connected with the primary test oven 13 near and above its lower end, as shown at 20. This end of the conduit 18 communicates with an opening 21 in the side wall of the oven 13 and leading to the interior of the oven.

The test oven 13 is provided with an internal secondary wall or baffle 22, spaced from the outer insulated walls of the oven 13 upon all sides of the latter and having its bottom open and including a top 23, provided with a central aperture 24. As it is immaterial to the present invention, whether the test oven 13 is cylindrical or rectangular in horizontal cross section, the baffle 22 may comprise a cylindrical or rectangular sleeve, open at one end, and positioned centrally within the test oven 13 by suitable conventional means, not shown.

35 A blower 25 is mounted upon the top of the test oven 13 and has an impeller shaft 26 journaled within a suitable bearing 27. An impeller or fan 28 is secured to the lower end of the shaft 26, within or just below the aperture 24 of the baffle 22. This fan 28 is adapted to draw air upwardly through the bottom open end of the baffle 22, and to drive this air through the aperture 24 and into the upper passage 29 between the top wall 23 of the baffle and the top wall 30 of the oven 13. This air now circulates outwardly in the direction of the arrows through the passage 29, and then downwardly in the direction of the arrows through the vertical passage 31, between the baffle 22 and side walls of the oven 13. The air traveling downwardly in the passage 31 mixes with the heated air entering the oven 13 from the conduit 18, and subsequently re-enters the bottom open end of the baffle 22. In this manner, a continuous and thorough mixing of the air within the primary test oven 13 is ef-

3
fected, during the operation of the apparatus which will be described in detail later.

A conventional metastatic mercury thermoregulator 32 is mounted within an opening in the side wall of the oven 13, near the vertical center of the same, and the thermoregulator 32 extends through the vertical passage 31 and well inside of the test chamber defined by the baffle 22.

Power lines or wires 33 and 34 convey current to the apparatus, and the line 33 may have a line switch 35 connected therein. The wire 33 is connected at 36 with a wire 37, leading to and connected at 38 with one terminal of the electrical heating element 11. A wire 39 is connected at 40 with the other terminal of the heating element 11, and the wire 39 is connected at 41 with the opposite power line 34, thus completing a circuit through the heating element 11.

The power line 33 is likewise electrically connected at 36 with a wire 42, leading to the blower 25, and connected at 43 with one terminal of the blower. The other terminal 44 of the blower 25 is connected with a wire 45, leading back to the power line 34, and connected therewith at 41, to complete a circuit through the blower 25.

The power line 33 has a relay switch 46 connected therein, and held normally closed by a spring 47. Beyond the relay switch 46, the wire 33 is connected at 48 to one terminal of the blower 14, the other terminal 49 of which is connected with the wire 34, as indicated.

The wire or power line 33 is further electrically connected at 50 with a wire 51, connected in series with a magnetizing coil 52 of the relay switch 46. The coil 52 is in turn connected in series with a wire 53, leading to and connected with one terminal 54 of the thermoregulator 32. The other terminal 55 of the thermoregulator is connected with a wire 56, leading back to the line 34 and connected therewith at 57.

The operation of the apparatus in the practice of the method is as follows:

The line switch 35 is closed to complete the circuits through the heating element 11 and the blower 25, which elements operate continuously as long as the line switch 35 is closed. The control means 12 is adjusted to regulate the degree of heat produced by the heating element 11. A substantially constant temperature is established by the heating element 11 within the oven 10, and this temperature is preferably about 10° F. above the temperature which it is desired to establish and maintain within the oven 13. As previously stated, the temperature within the oven 10 can only be held constant to within about + or - .5 degree F. to + or - 1 degree F.

The normally closed relay switch 46 will at this time complete the circuit through the suction blower 14, which will draw heated air from the oven 10 and force the same through the conduit 18 and into the test oven 13, by way of the opening 21. As previously explained, the continuously operating fan 28 effects a thorough and complete mixing of the heated air within the oven 13, and aids materially in establishing a constant temperature throughout the entire oven 13.

The above described operation continues, until the primary test oven 13 is brought up to the desired temperature approximately 10° F. below the temperature of the oven 10. When this desired temperature is slightly exceeded, the mercury in the thermoregulator 32 expands, and completes the circuit through the wires 53 and 56, and through the magnetizing coil 52 and the wire 51. When this circuit is completed, the mag-

netizing coil 52 of the relay is energized, and the relay switch 46 opens. This immediately stops the operation of the suction blower 14, and no more hot air from the oven 10 is forced through the conduit 18.

When the temperature within the oven 13 decreases slightly, the thermoregulator 32 effects an opening of the circuit through the wires 53 and 56, and this de-energizes the coil 52 and allows the relay switch 46 to close, for again starting the blower 14, which supplies additional heated air to the primary test oven 13.

With this arrangement, the temperature within the test oven 13 may be held constant to within approximately + or - .05 degree F., over a considerable range of test temperatures. There is practically no time lag in supplying heat to the test oven 13, and when the temperature therein exceeds that which is desired, there is practically no time lag in cutting off the supply of heat. This contrasts with the conventional laboratory oven wherein there is a considerable time lag in bringing the oven up to the desired temperature, and then an appreciable overshooting of the temperature, because of the time required to remove heat from the heating element. My apparatus and method greatly improve this situation, and allow the conducting of tests which require great accuracy in the holding of temperatures constant.

It is to be understood that the form of the invention, herewith shown and described is to be taken as a preferred example of the same, and that various changes in the shape, size and arrangement of parts may be resorted to, without departing from the spirit of the invention, or scope of the subjoined claims.

I claim:

1. A method of controlling temperatures in a test chamber comprising heating a fluid heating medium to a substantially constant temperature in excess of the temperature desired in the test chamber, establishing a flow of the heated medium into the test chamber, mixing the fluid heating medium within the test chamber to create a uniform temperature throughout the test chamber, and intermittently stopping the flow of the heated medium to the test chamber to maintain the desired temperature therein constant within close limits.

2. A temperature control method comprising heating a mass of air to a temperature in excess of a desired temperature in a test chamber, establishing a flow of the heated air into the test chamber and thereby establishing in the test chamber the desired temperature, mixing the air within the test chamber to create a uniform temperature throughout the test chamber, and intermittently interrupting the flow of heated air into the test chamber so as not to exceed the desired temperature therein.

3. A method of maintaining a substantially constant temperature in a test chamber comprising heating air in a first chamber to a temperature in excess of the desired temperature in the test chamber, causing the heated air within the first chamber to flow from the first chamber into the test chamber and thereby elevating the temperature in the test chamber to the desired degree, circulating the heated air within the test chamber for mixing the same and maintaining a uniform temperature within the test chamber, and intermittently interrupting the passage of the heated air from the first chamber to the test chamber by temperature sensitive means within the test chamber.

4. A method of controlling temperatures in a test chamber comprising heating air in a first chamber to a temperature somewhat in excess of the desired temperature in the test chamber, forcing the heated air in the first chamber to flow into the test chamber by means of a blower to establish the desired temperature in the test chamber, mixing the air within the test chamber to render the temperature uniform throughout the test chamber, controlling the operation of said blower with electrical means operable to interrupt the operation of the blower, and operating said electrical means with a temperature responsive device within the test chamber.

5. A temperature control apparatus comprising a test chamber within which it is desired to maintain a substantially constant temperature, a secondary chamber separate from the test chamber, a heating element within the secondary chamber for establishing a temperature therein in excess of the desired temperature in the test chamber, a blower connected with the secondary chamber for drawing heated air from the same, conduit means leading from the blower to the interior of the test chamber for conveying the heated air from the secondary chamber to the test chamber, a temperature responsive regulator connected with the test chamber and operated by extremely small fluctuations in temperature within the test chamber, and a relay switch electrically connected with said blower and regulator for intermittently interrupting the operation of the blower in response to the action of said regulator.

6. A temperature control apparatus comprising a test chamber within which it is desired to establish a substantially constant temperature, a secondary chamber separate from the test chamber, an electrical heating element within the secondary chamber for establishing a temperature therein in excess of the desired temperature in the test chamber, a blower mounted upon the test chamber for circulating and mixing air within the same, circuit means connected with the electrical heating element and blower for effecting constant operation of the same, a blower mounted upon the secondary chamber for drawing heated air from the same, a conduit connecting the blower and test chamber for directing the heated air from the secondary chamber to the test chamber when the blower of the secondary chamber is operating, circuit means including a relay switch connected with the blower of the secondary chamber for intermittently interrupting the operation of such blower, and a temperature responsive switch device connected in the last named circuit means to intermittently

open said relay switch and communicating with the interior of the test chamber.

7. A temperature control apparatus comprising a test chamber within which it is desired to maintain a substantially constant temperature, a secondary chamber separate from the test chamber, an electrical heating element for the secondary chamber for maintaining a temperature therein in excess of the desired temperature in the test chamber, a blower mounted upon the secondary chamber for drawing air therefrom, a conduit connecting the blower and test chamber for conveying the heated air from the secondary chamber to the test chamber, baffle means within the test chamber defining a passage between the walls of the test chamber and said baffle means, said conduit opening into the passage defined by said baffle means, a blower mounted upon the test chamber and adapted to circulate the air within the test chamber through said passage for mixing such air with the incoming heated air from the conduit, electrical circuit means connected with said heating element and the blower of the test chamber for causing continuous operation of the same, circuit means for supplying current to the blower of the secondary chamber, a normally closed relay connected in the last-named circuit means, and a temperature responsive circuit breaker mounted upon the test chamber and connected in the last-named circuit means and causing the normally closed relay to open for interrupting the operation of the blower of the secondary chamber when the temperature within the test chamber exceeds the desired limit.

8. A method of regulating the temperature within a test cabinet between extremely small limits comprising heating the atmospheric contents of a first substantially closed test cabinet to a substantially constant temperature in excess of the temperature which it is desired to maintain in a second test cabinet, establishing a flow of the heated atmospheric contents of the first test cabinet into a substantially closed second test cabinet to thereby establish in the second test cabinet the desired constant temperature, and intermittently interrupting the flow of the heated atmospheric contents of the first test cabinet into the second test cabinet so as not to exceed the desired constant temperature in the second test cabinet.

References Cited in the file of this patent

UNITED STATES PATENTS

Number	Name	Date
2,050,633	Stallard	Aug. 11, 1936
2,234,288	Smith et al.	Mar. 11, 1941
2,248,867	Hallman	July 8, 1941
2,568,493	Garrison	Sept. 18, 1951