Aug. 11, 1936. C. E. ORR 2,050,625

LAUNDRY DRYING APPARATUS

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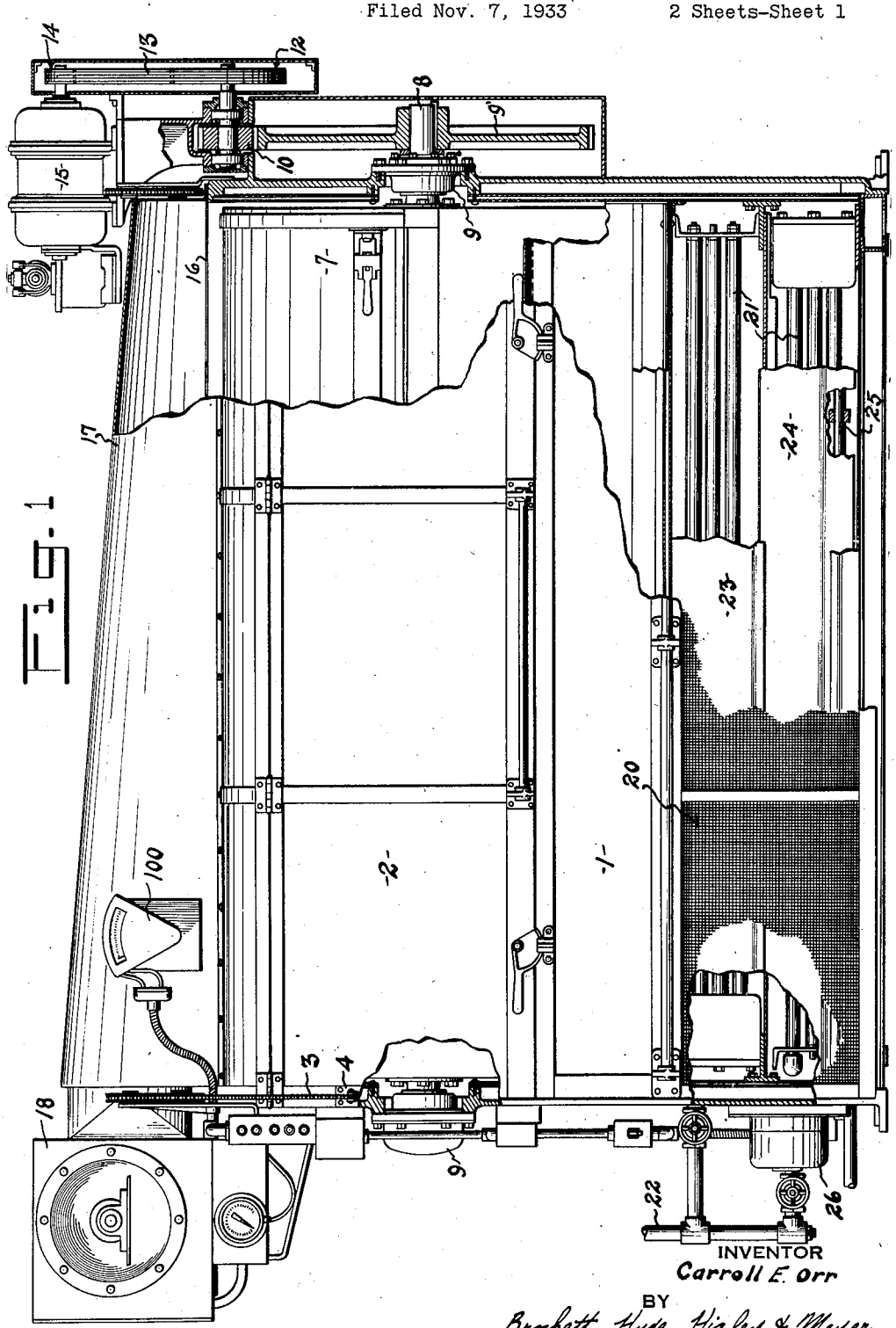

Fig. 1

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Fig. 2

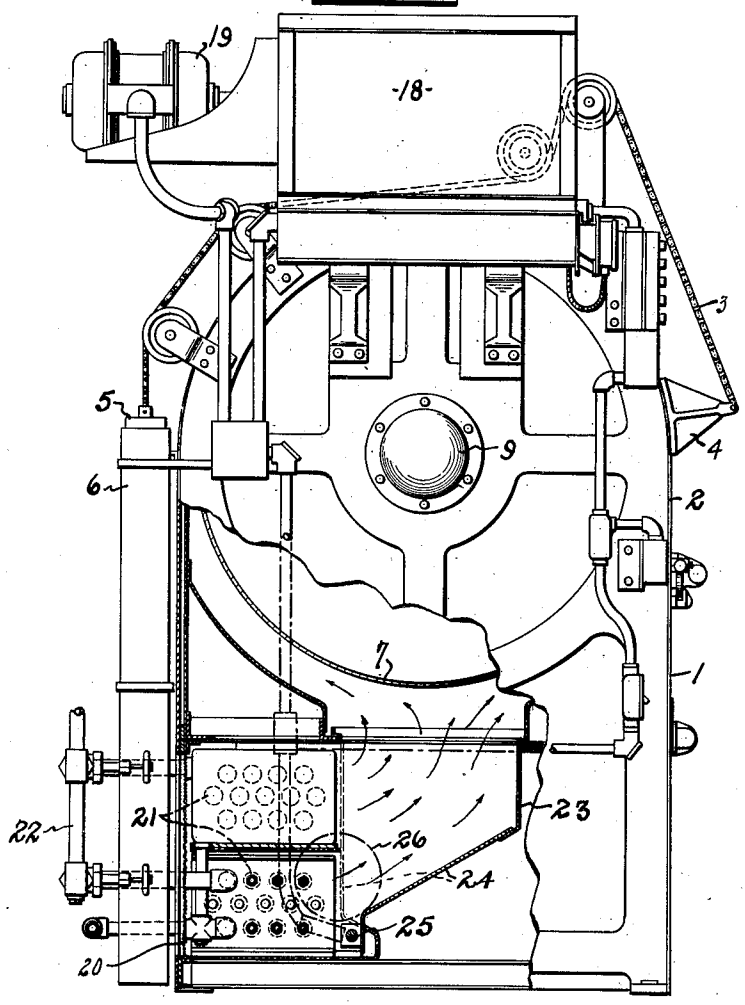
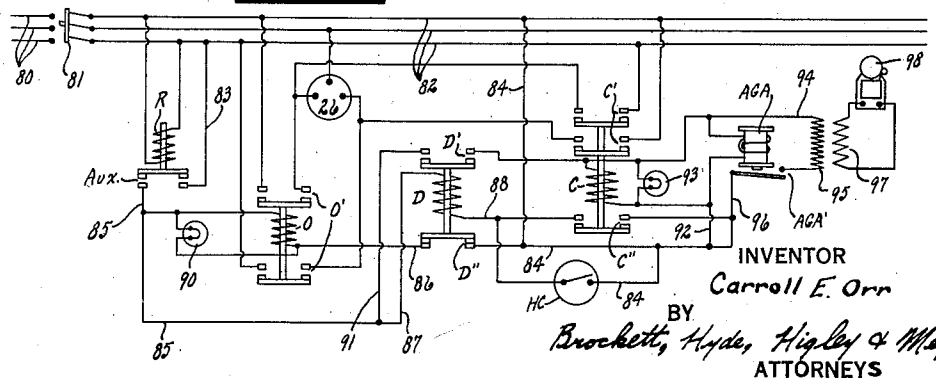


Fig. 3



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LAUNDRY DRYING APPARATUS

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4 Claims. (Cl. 34—5)

This invention relates in general to improvements in laundry drying apparatus such as tumbling dryers in which washed clothes or fabrics are subjected first to a drying action by means of a stream of heated air, and then to a cooling action by means of a stream of relatively colder air.

An important object of this invention is to provide an automatically operating apparatus in which the drying period in such a machine is automatically controlled under the action of the humidity of the air stream after passing over the clothes.

A more specific object of the invention is to provide an apparatus in which the wet clothes or fabrics are subjected to a drying stream of warm or heated air until their moisture content has been reduced to a desired value, upon which under control of the humidity of the issuing drying air the supply of heated air is cut off and the clothes or fabrics are then subjected, for a predetermined period, to the action of a relatively colder stream of air.

A still further object of this invention is to provide automatic control means for subjecting the clothes or fabrics to the relatively colder air for a predetermined period upon the termination of which a signal is given, indicating that the clothes or fabrics are ready for removal from the machine.

These and many other objects as will appear from the following disclosure are successfully secured by means of this invention.

This invention resides substantially in the combination, construction, arrangement and relative location of parts, all as will be more fully detailed in the following specification in connection with the attached drawings.

Referring to the drawings, Fig. 1 is a side elevational view of the machine of this invention with parts of the casing broken away to show the interior arrangement of the various elements; Fig. 2 is a left hand elevational view of the same mechanism with a portion of the casing broken away; and Fig. 3 is a simplified wiring diagram of a portion of the control circuit.

The present invention in its broadest aspect is adapted to automatically control the supply of heated and relatively colder air in various types of machines under the control of the humidity of the air stream. More specifically, the invention has been illustrated as applied to a clothes drying machine, particularly of the drying tumbler type in which a rotatable barrel or drum is employed. The machine as described is substantially automatic in operation, requiring only the attendance of an operator in starting and stopping of the machine at the beginning and end of the drying operation.

Referring to the drawings, the machine is shown comprising a casing 1, having a door 2 horizontally mounted on the side thereof for access to the interior of the casing. A heavy counterweight 5, operating in a protecting casing 6 is connected by means of a chain 3 mounted on roller supports and a bracket 4, to the door 2 to aid in raising and lowering the heavy door. At 7 is indicated a portion of the tumbling or drying drum which is mounted within the casing and is provided, in accordance with usual practice, with doors through which the materials to be treated may be inserted. This drum is mounted on a rotatable shaft 8 which is journaled in the bearings 9 at the ends of the casing. Keyed to the shaft 8 is a driving gear wheel 9' which meshes with a driving pinion 10 driven in turn by the electric motor 15 through the sprocket wheels 14 and 12 and the sprocket chain 13. Thus the motor 15 causes the tumbler 7 to revolve at the desired speed or, in accordance with well known practice, control circuits may be employed to rotate the drum intermittently in opposite directions. The top of casing 1, over the drum 7 is provided with an opening 16, over which is mounted a duct 17 which extends across the top of the machine and is connected to the casing of a suction fan 18. This fan is driven by means of a motor 19. The lower portion of casing 1 is proxided with a perforated or screened wall 20 on each side thereof.

Referring to Fig. 2, it will be seen that the space below the bottom wall of the casing and defined by the screened side walls 20 is divided into two compartments which extend throughout the length of the machine. These compartments are formed by a baffle wall 23 extending from one end to the other, and a shutter 24 likewise extending co-incidentally with the baffle wall 23. The shutter 24 is mounted upon a shaft 25 suitably journaled and connected either directly with, or through gears, to the torque motor 26. When the shutter is in the full line position shown in Fig. 2, air may enter into the upper portion of the casing around the tumbler drum 7, through the left hand side of the machine. In the left hand compartment thus formed is means for heating the entering air which is shown for purposes of illustration as

steam coils 21 provided with the steam supply connections 22. When the shutter 24 is in the dotted line position air can no longer enter the upper portion of the casing over the heating coils, but must enter it through the right hand perforated side of the machine and pass directly thereto without heating. The torque motor 26 is of the usual type which is, as well known, continuously energized in actuated condition. For the first part of the operation the motor 26 is energized so as to hold the shutter 24 in the full line position. When the energization of the torque motor is reversed, the shutter 24 is moved to the dotted line position and held there.

At 100 is indicated diagrammatically a humidity meter which may assume any one of a number of well known forms. This device is sensitive to the moisture content of air and has its sensitive element mounted within the duct 17 so as to be immersed in the air flowing from the drum 7 to the suction fan. Such a meter is calibrated in relative humidity of from 0 to 100 percent. The humidity meter is provided with a fixed and movable contact in accordance with standard practice, so that the movable contact will engage the fixed contact, depending upon the setting of the apparatus, when the moisture content of the air in which the sensitive element is immersed reaches a predetermined value. In accordance with this invention, and as diagrammatically illustrated in Fig. 3, this contact controls mechanism whereby the torque motor is reversed in its energization to swing the shutter 24 from full line to dotted line position.

The operation of this apparatus will be better understood by first referring in detail to the diagrammatic circuit arrangement of Fig. 3. At 80 are indicated the wires which are connected to the power source. At 81 is the main control switch which when the machine is to be operated connects wires 80 with wires 82. The circuit as illustrated is a usual three phase alternating current supply circuit. One of the wires 82 is connected by wire 83 to one of the contacts *Aux.* The other contact is connected by wire 85 through the relay coil O, wire 86 and normally closed contact D'' to wire 84 which returns to one of the wires 82. Wire 85 is connected by wire 87 through relay coil D, wire 88, contacts HC to wire 84.

The contacts HC represent the contacts of the humidity meter, one of which is fixed and the other of which is movable by the moving element of the meter. The contacts HC are shunted by the normally open contacts C''. Wire 85 is also connected by wire 91 through the normally open contacts D', solenoid winding C and wire 92 to wire 84. The solenoid coil O is shunted by the signal light 90 and the solenoid coil C is shunted by the signal light 93 which is preferably of a different color. The solenoid C is shunted by another relay coil AGA which is the relay coil of a time delay switch of which a number are well known in the art. One terminal of this coil is connected through wire 94 and the primary 95 of a transformer, contacts AGA' and wire 96 to wire 84. The secondary 97 of the transformer is connected to a signal device 98. It will be seen that all this control mechanism is connected across one of the phases of the power supply. At 26 is diagrammatically illustrated the torque motor which may be connected to the power supply source for energization in either direction through the pairs of contacts O' and C'. The symbols O and C on this diagram represent the open and closed position of the shutter 24, that is the full and dotted line positions, Fig. 2. The tumbler motor 15 and the suction fan motor 19 are not shown in Fig. 3, but are connected to the wires 82 so that when switch 81 is closed they are both energized. The operation of the apparatus is as follows:

The tumbler drum 7 is first charged with the wet clothes or fabrics to be dried. The drum is then closed, as well as the door 2 on the casing. Main control switch 81 is then closed. This energizes motors 15 and 19 causing the tumbler drum 7 to revolve and setting the suction fan 18 in operation. Referring to Fig. 3, the contacts HC on the humidity meter will be open. The closing of switch 81 will have energized a relay coil R, which closes the contacts marked *Aux.* The current then flows from lower wire 82 through wire 83, contacts *Aux.*, wire 85, relay coil O, as well as lamp 90 and parallel thereto, wire 86, normally closed contacts D'' and wire 84, back to the power supply. The energization of relay coil O will cause contacts O', in the torque motor circuit to close. This energizes the torque motor 26 to hold the shutter in full line position (Fig. 2). The steam supply will be on so that the heating coils 21 will heat the air which flows in through the left hand side of the casing over the heating pipes, up around and through the tumbler drum which is usually perforated in accordance with standard practice, thence to duct 17 and out through the discharge portion of the suction fan 18. Lamp 90 will indicate that this part of the operation is taking place.

As the clothes in the drum give up moisture the air passing through duct 17 will become dryer and dryer with an appropriate effect on the humidity meter. When the air has reached a dryness which has been predetermined by experience as indicating that the clothes have been sufficiently dried with hot air, the humidity meter will have moved to a position where the contacts HC close. The closing of contacts HC will cause the energization of relay coil D with the current flowing from the power source through wire 83, contacts *Aux.*, wire 85, wire 87, coil D, wire 88, contacts HC and wire 84, back to the current source. The energization of relay coil D causes the opening of contacts D'' and the closing of contacts D', thus energizing relay coil C with the current flowing from wire 85 through wire 91, contacts D', relay coil C, wire 92 and back to the current source through wire 84. With the energization of relay coil C, the reversing contacts C' are arranged to close, and at the same time contacts C'' are closed. The opening of the normally closed contacts D'' at the time that the contacts D' close, deenergizes relay coil O and causes the opening of the contacts O'. Substantially simultaneously with the opening of these contacts O' the contacts C' will close (under the control of relay coil C), causing a reversal of the energization of the torque motor 26, so that it will swing the shutter 24 from full line position to dotted line position. Unheated air is then drawn through the right hand side of the machine around and through the tumbler to duct 17 and out of the discharge port of the suction fan 18. During this action lamp 90 will be extinguished and lamp 93 will be energized, indicating which part of operation is taking place.

At the same time that relay coil C is energized the coil AGA of the time delay relay is

energized. At the end of a predetermined period, usually about four minutes, during which the clothes are subjected to the colder air, the contacts AGA' under the action of the coil AGA will close, thus completing a circuit to the primary 95 through wires 96 and 96. The result is that the secondary 97 will be energized and the signal device 98 will be operated. The operator will then open switch 81 which deenergizes all circuits, including the motors 15 and 19. The clothes will then be ready for withdrawal from the machine, having been properly dried and cooled so that they may be handled.

The contacts C'' controlled by the relay coil C are merely provided to complete a shunt circuit around the contacts HC of the humidity meter. The purpose of this arrangement is to prevent what might be termed hunting of the apparatus under transient humidity conditions which would be encountered in an apparatus of this type. The contacts HC are relatively light contacts which do not make a very strong contact, especially when they first come together at the critical time when the humidity is just passing through the condition for which the machine is set. In order to insure positive action of the apparatus the contacts HC merely initiate operations of the circuits which hold through the more positive contacts C''.

The device of this invention has been found to be exceedingly practical in use and very accurate in operation. The humidity of the air flowing through duct 17 is a most accurate indication of the moisture content of the clothes in the tumbler drum. The humidity of the issuing air is a more accurate indication of the condition of the clothes than the temperature of the air. It has been found, therefore, with the device of this invention that a very accurate control of the moisture content of the clothes may be had, which is of cardinal importance for efficient ironing operations.

With this machine properly set the clothes may be dried to just the desired degree with great uniformity in successive batches.

From the above description it will be apparent that this invention resides in certain principles of construction and operation which may be embodied by those skilled in the art in other physical forms, without departure from the scope of the invention. I do not, therefore, desire to be strictly limited to the disclosure as given for purposes of illustration, but rather to the scope of the appended claims.

What I claim is:

1. A drying machine of the type described comprising a chamber for containing materials to be treated, electric motor means for moving a current of air through said chamber, hot and cold air supply sources adapted to communicate with said chamber, motor operated means movable into first and second positions for establishing communication with said hot and cold air sources respectively, first and second power circuits for actuating said last named means into its first and second positions respectively, a device for energizing either of said power circuits and for simultaneously deenergizing the other of said circuits, means actuated by the supplying of current to said electric motor means for actuating said device into first-power-circuit-energizing position, and means responsive to a condition of the air issuing from said chamber for actuating said device into its second-power-circuit-energizing position.

2. In a drying machine having a chamber for treating work and means for circulating a current of air over said work including a conduit system, a control member in said conduit system movable into first and second positions for establishing hot and cold air circulating circuits respectively, electrical operating means for said control member having first and second power circuits for moving said control member into its first and second positions respectively, a normally open switch in each power circuit, a relay for closing each switch, an energizing circuit for each relay, spaced contacts in each energizing circuit, a reversing relay adapted alternatively to close the spaced contacts in either one of said energizing circuits and simultaneously to open the spaced contacts in the other of said energizing circuits, said reversing relay being arranged normally to close one pair of said spaced contacts, a control device responsive to a condition of the air in said conduit system on the discharge side of said chamber, an energizing circuit for said reversing relay, a normally open switch in said last named circuit, and means actuated by said control device in response to a predetermined air condition for closing said last named switch.

3. A control system for a drying machine as in claim 2 and including a shunt circuit around said last named switch, normally open contacts in said shunt circuit, and means for electrically closing said last named contacts upon actuation of said control device.

4. In a drying machine having a chamber for treating work and means for circulating a current of air through said chamber including a conduit system, a control member in said conduit system movable into first and second positions for establishing hot and cold air circulating circuits respectively, electrical operating means for said control member having first and second power circuits for moving said control member into its first and second positions respectively, a normally open switch in each power circuit, first and second relays for closing the switch in said first and second power circuits respectively, an energizing circuit for each relay, spaced contacts in each energizing circuit, a reversing relay adapted alternatively to close the spaced contacts in either one of said energizing circuits and simultaneously to open the spaced contacts in the other of said energizing circuits, said reversing relay being arranged normally to close the spaced contacts in the energizing circuit for said first relay, a control device responsive to a condition of the air in said conduit system on the discharge side of said chamber, an energizing circuit for said reversing relay, a normally open switch in said last named circuit, means actuated by said control device in response to a predetermined air condition for closing said last named switch, whereby said reversing relay closes the contacts in the energizing circuit for said second relay, an electrical device, a time-delayed relay for energizing said electrical device, and means for initiating the action of said time-delayed relay by energization of the circuit for said second relay.

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