

Oct. 5, 1954

E. H. SMITH

2,690,905

DRIER

Filed July 2, 1951

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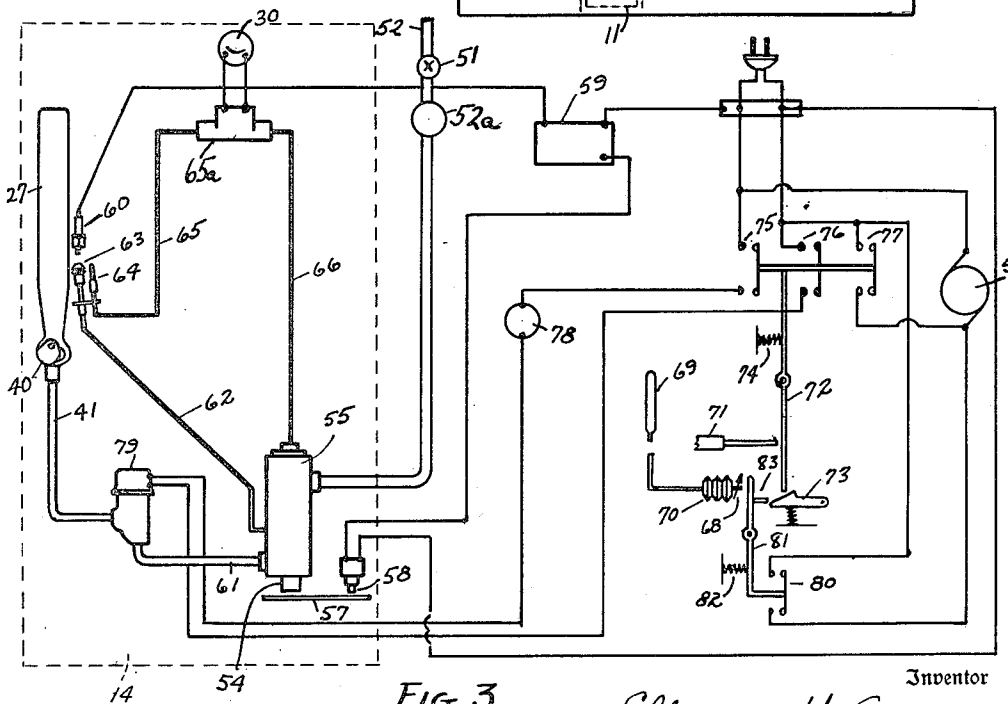
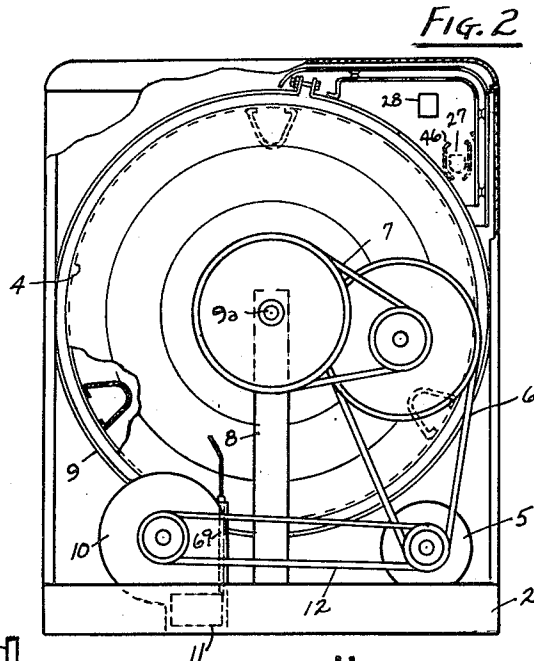
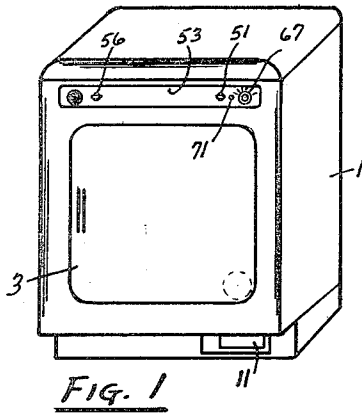


Fig. 3

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2 Sheets-Sheet 2

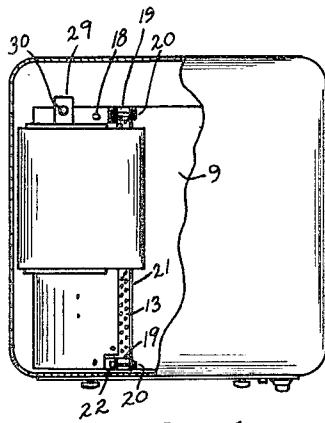


Fig. 4

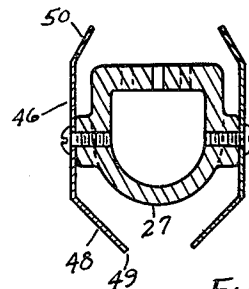


Fig. 5

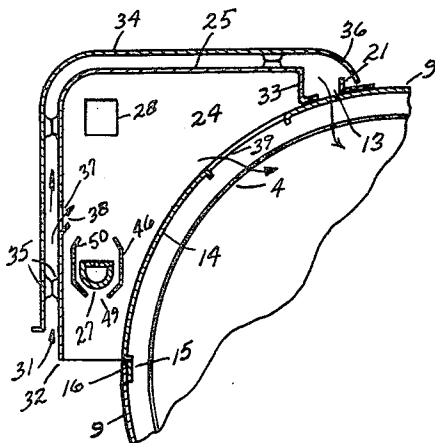


Fig. 6

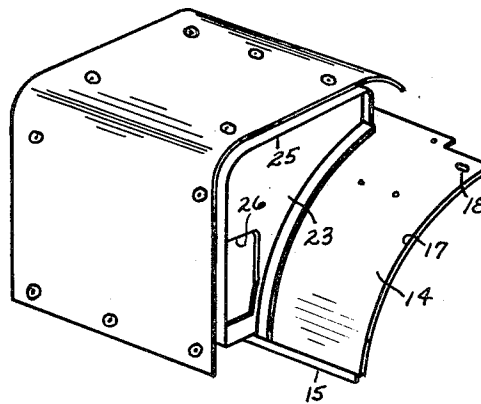


Fig. 7

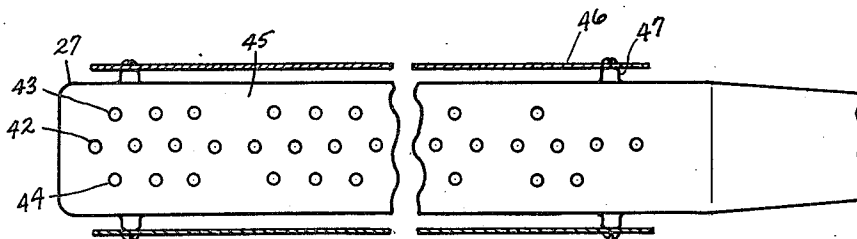


Fig. 8

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## UNITED STATES PATENT OFFICE

2,690,905

DRIER

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13 Claims. (Cl. 263—33)

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This invention relates to gas fired tumble type clothes driers for domestic use. Features include the design and control of the gas fired stove. The burner design is such that all types of gas may be burned in the same burner. The safety controls not only protect against explosion but against over-heating which might endanger the clothes. Further objects and advantages appear in the specification and claims.

In the drawings, Fig. 1 is a front view of the drier, Fig. 2 is a back view partly broken away to show the construction, Fig. 3 is a control diagram, the mounting plate carrying the stove and the ignition and gas supply controls being indicated in dotted lines, Fig. 4 is a top view broken away and with valves and piping removed to show the construction of the stove, Fig. 5 is a section through the burner, Fig. 6 is a section through the stove, Fig. 7 is a perspective of the stove housing and mounting, and Fig. 8 is a top view of the burner.

In the drawing, 1 indicates the cabinet mounted on a base 2; 3 indicates the door through which the clothes are loaded and unloaded into a rotatable perforate drum 4; 5 indicates the motor which drives the drum through a belt and pulley reduction drive 6, 7; 8 indicates the standard carried by the base and having a bearing 9a in which the drum 4 is journaled; 9 indicates the wrap-around sheet surrounding the periphery of the drum; 10 indicates the suction fan or blower for withdrawing air from the drum and discharging it out the front of the base through a discharge opening 11. The fan is driven by a belt 12 from the motor 5 so that the blower operates whenever the drum is rotated. The parts so far described are similar to the corresponding parts illustrated in Patent 2,550,118 which shows an electric clothes drier.

As explained more fully in the above-cited patent, air is drawn into the cabinet through suitable louvers (not shown) and enters the enclosure provided by the wrap-around sheet 9 through a slot 13 at the upper left hand corner as viewed from the front of the drier. The air flows diagonally across the drum intercepting and coming in contact with the tumbling clothes and enters the fan 10 at the lower right hand corner of the drum and is discharged out the front through the opening 11.

In order that the drier structure so far described may be used interchangeably with either gas or electric heating, the gas stove is made to fit the space usually occupied by the electric

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heating elements. This involves some additional problems, since the gas stove requires provisions for combustion air and for disposal of the products of combustion. The gas stove also requires more complex controls having to do with the ignition of the gas. In the gas stove to be described, the stove itself and the controls for the stove are carried on an arcuate mounting plate 14 having an offset flange 15 at its lower edge which hooks over the edge 16 of the wrap-around sheet 9 as illustrated in Fig. 6. The mounting plate has end extensions 17 provided with screw holes 18 by means of which the mounting plate may be attached to flanges 19 to which the front and back edges of the wrap-around sheet are attached. The wrap-around sheet is tightened against the flanges 19 by bolts 20 arranged between a flange 21 at the top of the wrap-around sheet and tension straps 22 attached to the lower edges 16 of the wrap-around sheet. The space between the flange 21 and the edge 16 of the wrap-around sheet is slightly greater than the width of the plate 14 so that when the bolts 20 are tightened there remains the slot 13 between the flange 21 and the adjacent edge of the stove mounting plate 14.

As shown more clearly in Figs. 2, 6 and 7, the stove is of generally triangular section having front and back walls 23 and 24 and top and side walls 25. The front wall 23 has an opening 26 through which a burner 27 is inserted. The burner is located in the lower corner of the stove so that the greater portion of the stove volume is available for combustion space. The back wall 24 of the stove has a vent opening 28 beneath a bracket 29 carrying a normally closed thermostat 30. During normal operation when the blower 10 is operating air is drawn in through the opening 28 into the combustion chamber. This incoming air keeps the thermostat 30 cool. If for any reason the blower should stop operating, such as for example the failure of the belt 12 or the interruption of the normal air circulation by opening the door 3 or by plugging of the discharge outlet 11, the air no longer flows inward through the opening 28 but instead the products of combustion flow out through the opening 28 and heat the thermostat which as will be later described shuts off the gas supply. The angular shaped top and side wall member 25 which arches over the top of the burner 27 has its lower end 31 spaced from the flange 15 to provide an air intake opening 32 in the lowermost corner of the stove. The upper front end of the wall 25 has a depending integral flange

33 which is fixed to the supporting plate 14. The wall 25, being an outside wall of the stove would get quite hot during use. This is prevented by an enclosing wall 34 of generally the same shape as the wall 25 and held in spaced relation thereto by projections 35. The lower end of the wall 34 provides an intake for air which flows up along the outside of the wall 25 and is discharged through a portion of the slot 13 beneath an overhanging lip 36. Since there is a continuous suction at the slot 13 during the operation of the blower 10, cooling air is drawn between the walls 25 and 34 at all times during the operation of the drier. A portion of the cooling air entering the space between the walls 34 and 25 is by-passed into the interior of the stove through an elongated vent opening 37 which has a lip 38 directing the air flow across the flame from the burner 27. The air flowing through the vent opening 37 mixes with and cools the products of combustion and flows through an opening 39 in the supporting plate 14 into the drum. The products of combustion flowing through the opening 39 mix with the air flowing through the slot 13 and provide the heated air stream which flows diagonally across the drum to the fan 16. The cooling air introduced through the vent opening 37 prevents excessive temperatures of the products of combustion so that the clothes are not subjected to localized overheating.

Because the interior of the stove is under negative or suction pressure, the burner design is especially adapted for operation under such conditions. As shown in Figs. 3 and 8, the burner 27 is in the form of an elongated pipe having a mixing chamber 40 at the intake end connected to the incoming gas line 41 as is conventional for atmospheric pressure gas burners. In the top wall of the burner tube are drilled three rows of ports. The middle row 42 extends down the center of the burner tube with substantially equal spacing. The outer rows 43 and 44 are arranged in groups of three with substantial spaces 45 between each group. The purpose of the spaces 45 is to permit air to reach the middle group or center row of ports 42. If the outer ports were continuous, there would be a tendency for the flame from the outer ports to shield the inner ports so that no combustion would take place in many of the inner ports. This would not only spoil the combustion but it would cause a dangerous concentration of carbon monoxide in the products of combustion which is objectionable in household appliances such as gas driers which may be used without a vent to the outside air. The combustion is further improved by longitudinal baffles 46 which are spaced from the sides of the burner tube 27 by projections 47. These baffles have lower ends 48 converging beneath the burner tube to provide a central intake opening 49 through which air is drawn by the suction created by the blower 10 at the opening 39. At the upper edge of the baffles 46 are converging lips 50 which deflect the air laterally across the burner from each side toward the center. These baffles 46 are effective in supplying air to the center row 42 of the ports and also for preventing "lifting" of the flame off the outer rows of ports. Lifting results in excessive CO. It could be said that the baffles 46 restrict the velocity of air flow past the outer row so as to prevent lifting and also deflect the air inward to the center row so as to obtain complete combustion in the center row. By reason of the arrangement

of the ports with the spaces 45 in the outer rows and by the supplemental effect of the baffles 46 the burner has been found to be effective on all types of gas, natural, mixed, manufactured and L. P. This is unusual in gas burners. Furthermore, the output rating of the burner has been materially increased. Satisfactory combustion is obtained on natural, manufactured, mixed and L. P. with a required input rate of 19,000 B. t. u. per hour over a wide range of air injection and under pressures of  $3\frac{1}{2}$  to 10 inches of water with a port loading of 27,000 B. t. u. per hour per square inch of port area while in conventional atmospheric burners the port loading for satisfactory combustion of natural gas is of the order of 15,000 B. t. u. per hour per square inch of port area. Furthermore, applicant's burner is substantially immune from flash back, that is burning within the burner tube due to the combustion exceeding the speed at which the mixture of gas and air leaves the burner ports. This problem of flash back is particularly noticeable in manufactured gas and it is unusual for a burner to operate satisfactorily under all types of gas at the varying service pressures encountered throughout the country. It is particularly necessary that flash back be prevented in devices such as clothes driers because under flash back conditions, the carbon monoxide concentration is dangerously high. While flash back may be quickly noticed in an ordinary gas range, it would hardly be noticed in a clothes drier where the burner is almost completely housed within the drier cabinet and the device will operate for long periods of time without any attention. Having the interior of the gas stove under a constant negative pressure is materially helpful in the solution of the flash back problem.

The operation of the drier will be explained in conjunction with the control diagram, Fig. 3. The operator first turns on the manual shut-off valve 51 in the incoming gas line 52 which may or may not have a pressure regulator 52a. This shut-off valve is conveniently located on an escutcheon plate 53 at the top of the drier cabinet. The operator next depresses the push button 54 of the automatic safety pilot 55 (e. g. Grayson TS-7) by means of a knob 56 at the left hand side of the escutcheon plate. The operation of the knob 56 moves a bar 57 inward and both pushes the safety pilot button 54 in and also closes a normally open switch 58 in the power circuit to a transformer 59 connected to a spark plug 60. The safety pilot 55 is of conventional construction so that when the button 54 is depressed the valve controlling the flow of main burner gas from the line 52 through the output line 61 is closed and a valve controlling the flow of gas to a pilot line 62 is opened supplying gas to the safety pilot burner 63 adjacent the spark plug 60, both being located adjacent the inlet end of the center row 42 of burner ports. The ignition of the safety pilot burner 63 causes heating of a thermocouple 64 which is connected through a line 65, function block 65a, the normally closed thermostat 39 and line 66 to a magnetic coil within the safety pilot. When the thermocouple 64 has been sufficiently heated so that the current in the magnetic coil is sufficient to hold the valve controlling the pilot line 62 open the knob 56 may be released and push button 54 returned to its outer position. The return of the push button opens the main burner valve controlling the flow of gas to the supply line 61. The release of the button 56 also opens

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the switch 58 and cuts off the supply of energy to the spark plug 60. The operation so far described is preliminary and is performed whenever the drier is to be put into operation if for any reason the pilot 63 has not been allowed to remain ignited. These operations need not be performed if the pilot 63 is already ignited.

The operator next loads the clothes into the drier and adjusts the degree of dryness of the clothes by means of the knob 67 at the right hand end of the escutcheon plate 53. The knob 67 actuates an adjustment diagrammatically indicated at 68 which determines the temperature of operation of a thermostat bulb 69 associated with a bellows 70. The thermostat bulb is located so as to be responsive to the temperature of air to be discharged from the drier and the location is selected so that the bulb will not become covered with lint. A suitable location for the thermostat bulb 69 is shown in Fig. 2 where the bulb extends tangentially of the scroll of the blower 10. The exhaust air temperature corresponds quite closely to the degree of dryness of the clothes; that is, the higher the exhaust temperature, the drier the clothes. The drier is set in operation by pushing a start button 71 located on the escutcheon plate 53 adjacent the knob 67. Pushing the start button 71 moves a switch arm 72 to the right as viewed in Fig. 3 until the lower end is caught by a catch 73. The switch arm is biased by a spring 74 to the open position illustrated and the catch 73 holds the switch arm against the force of the spring 74. The switch arm carries three sets of contacts 75, 76, and 77. The contacts 75 and 76 are in series with an over-temperature thermostat 78 (normally closed) and a standard gas solenoid valve 79 (normally closed). The closing of the contacts 75 and 76 causes opening of the solenoid valve 79 and the resultant supply of gas to the burner 27 provided the safety pilot 63 is ignited. If the safety pilot 63 is not ignited, then no gas can flow through the automatic pilot 55 and the opening of the solenoid valve 79 will not result in the supply of gas to the burner. Under over-temperature conditions, the thermostat 78 opens and causes closing of the solenoid valve. The thermostat 78 re-closes as soon as the over-temperature condition is relieved so that the thermostat 78 merely prevents the supply of excessive amounts of heat to the drier. A convenient location for the over-temperature thermostat 78 is in the upper part or dome of the cabinet where it responds to high temperatures usually reached in this region if for any reason the supply of air to the drier is interfered with. Contacts 77 control the power supply to the motor 5 which drives both the drum 4 and the blower 10. The closing of the contacts 77 accordingly starts the rotation of the drum and the circulation of the air through the drum at the same time that the solenoid valve 79 is opened, supply gas to the burner 27. As the clothes dry, the temperature of the exhaust air through the blower 10 increases and the bellows 70 expands. The first operation resulting from the expansion of the bellows 70 is the closing of contacts 80 which are controlled by a switch lever 81 biased to the open position by a spring 82. The contacts 80 are closed before the exhaust air temperature reaches the degree of dryness selected by the adjustment of the knob 67. Since the contacts 80 are in parallel with the contacts 77, the closing of the contacts 80 has no effect upon the operation of the drier. As the operation of the drier continues, the exhaust air tempera-

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ture continues to rise and when it reaches the value selected by the adjustment knob 67, the bellows 70 expands enough so that a projection 83 on the lever 81 engages and depresses the catch 73 releasing the switch arm 74 and permitting opening of the contacts 75, 76, and 77. The opening of the contacts 75 and 76 interrupts the current supply to the solenoid valve 79 and shuts off the supply of gas to the burner. The opening of the contacts 77 does not interrupt the power supply to the motor because of the previous closing of the contacts 80 which continue to supply power to the motor. Accordingly after the shut off of the gas to the burner 27, the drum 4 continues to rotate and the blower 10 continues to circulate air through the drum. Since heat is no longer being supplied to the drum, the exhaust air temperature gradually decreases and when it drops to a value a little below that at which the contacts 80 were first closed, the contacts 80 are opened thereby shutting down the drier. At this point, the clothes are ready for removal and the cycle can be repeated with the new load.

The drier is very easy to service. The gas stove and burner 23—36, and the ignition and gas supply controls the solenoid valve 79, the automatic pilot 55, the safety thermostat 30, the junction block 55a and the spark plug for igniting the pilot 63 are all carried on the mounting plate 14 and can be removed, tested and serviced as a unit. The mounting plate is essentially the size of an equivalent electric heating element so the drier can be easily converted from gas to electricity. Having the gas stove located in an upper quadrant of the drum casing makes it easier to service since all parts are accessible when the cabinet top is removed. This location also decreases the fire hazard since the clothes cannot fall on hot surfaces in case the drum should stop rotation for any reason such as belt failure.

Having the stove outlet generally diagonally opposite the air discharge from the drum casing provides for thorough intermingling and mixing of the heated air stream in the tumbling clothes. The diagonal relation of the air and stove outlets is not critical but there is a noticeable falling off in efficiency if the outlets are in adjacent quadrants.

What is claimed as new is:

1. In a clothes drier of the type having a horizontal clothes receiving rotatable drum, a cylindrical casing housing in the drum, a suction fan for withdrawing air from the interior of the drum casing housing and a drive for the fan and drum, the combination of a gas stove outside the drum casing and having an outlet for the products of combustion to the inside of the drum casing, a port type burner in the stove beneath the outlet whereby the burner ports are subject to suction preventing flash back, another outlet from the stove above the burner to the outside of the drum casing housing, said other outlet being subject to suction pressure drawing air into the stove during normal operation of the suction fan but serving as an outlet for the products of combustion upon failure of the suction from the fan, and a safety thermostat effective when heated to shut down the burner, said thermostat being arranged with reference to said other outlet to be cooled by air sucked in during normal operation of the fan and to be heated by the products of combustion flowing out upon failure of the fan.

2. In a clothes drier of the type having a horizontal clothes receiving rotatable drum, a cylin-

drical casing surrounding the periphery of the drum, a suction fan for withdrawing air from the interior of the drum casing having an intake in a lower quadrant of the casing, and a drive for the fan and drum, the combination of a removable mounting plate forming part of an upper quadrant of the cylindrical periphery of the casing, end and outer walls of a gas stove carried on the mounting plate, said end walls being spaced nearer to each other than the axial length of the mounting plate and one of said end walls being spaced inward from one end of the mounting plate to provide space on the mounting plate outside said one end wall for mounting controls for the stove, stove controls including a safety pilot mounted on the plate in said space, an air intake at the bottom of the stove, a gas burner in the stove above the air intake, and an outlet for the products of combustion through the mounting plate above the burner.

3. In a clothes drier of the type having a horizontal clothes receiving drum, a cylindrical casing surrounding the periphery of the drum, a suction fan for withdrawing air from the interior of the drum casing, and a drive for the fan and drum, the combination of a removable mounting plate forming part of the cylindrical periphery of the casing, end and outer walls of a gas stove carried on the mounting plate, an air intake at the bottom of the stove, an elongated gas burner in the stove extending axially of the casing above the air intake, ports in the top of the burner, baffles spaced on each side of the burner having lower edges converging beneath the burner and upper edges converging over the burner for deflecting air across the tops of the burner ports.

4. In a clothes drier of the type having a horizontal clothes receiving drum, a cylindrical casing housing in the drum, a suction fan for withdrawing air from the interior of the drum casing, and a drive for the fan and drum, the combination of a gas stove outside and arched over the casing and having an outlet in the upper part thereof for the products of combustion to the interior of the casing, an elongated burner tube beneath the outlet, inner and outer rows of spaced ports in the top wall of the tube, the ports in said outer rows at intervals along the length of the tube having increased spacing therebetween to allow air to reach the inner rows, and baffle means on each side of the burner deflecting air across the burner ports toward the inner rows.

5. In a clothes drier of the type having a horizontal clothes receiving drum, a cylindrical casing surrounding the periphery of the drum, a suction fan for withdrawing air from the interior of the drum casing, and a drive for the fan and drum, the combination of a gas stove outside the drum casing and having an outlet for the products of combustion to the interior of the casing located in an upper quadrant of the casing and an inlet in the lower part of the stove, a port type burner inside the stove above said air inlet and beneath the outlet and extending axially of the cylindrical casing whereby the burner ports are subject to suction preventing flash back, and an intake for air in an outer wall of the gas stove extending axially of the cylindrical casing above the burner and below said outlet whereby cooling air is sucked across the burner flame.

6. In a clothes drier of the type having a horizontal clothes receiving drum, a cylindrical casing surrounding the periphery of the drum, a suction fan for withdrawing air from the interior of the drum casing, and a drive for the fan and

drum, the combination of a removable mounting plate forming part of the cylindrical periphery of the casing, an air intake slot to the casing above the stove, end and outer walls of a gas stove carried on the mounting plate, an air intake at the bottom of the stove, a gas burner in the stove above the air intake, a shielding wall spaced from the outer wall of the stove extending over the intake slot and having its lower end spaced from the outer walls of the stove to provide an intake for cooling and drying air flow over the outside of the stove, said shielding wall directing the cooling air into the intake slot, and an outlet for the products of combustion through the mounting plate to the interior of the casing above the burner and below the intake slot.

7. In a clothes drier of the type having a horizontal clothes receiving drum, a cylindrical casing surrounding the periphery of the drum, a suction fan for withdrawing air from the interior of the drum casing, and a drive for the fan and drum, the combination of a removable mounting plate forming part of the cylindrical periphery of the casing, end and outer walls of a gas stove carried on the mounting plate, said end walls being spaced nearer to each other than the axial length of the mounting plate and one of the end walls being spaced inward from one end of the mounting plate to provide space on the mounting plate outside said one end wall for mounting controls for the stove, an air intake at the bottom of the stove, a gas burner in the stove above the air intake, a solenoid valve mounted on the plate controlling the flow of gas to the burner, a safety pilot mounted on the plate controlling the flow of gas to the solenoid valve, a thermostat means responsive to excessive temperatures in the casing for de-energizing the solenoid and shutting off the flow of gas to the burner, and an outlet for the products of combustion through the mounting plate to the interior of the casing above the burner.

8. In a clothes drier of the type having a horizontal clothes receiving drum, a cylindrical casing surrounding the periphery of the drum, a suction fan for withdrawing air from the interior of the drum casing, and a drive for the fan and drum, the combination of a removable mounting plate forming part of the cylindrical periphery of the casing, end and outer walls of a gas stove carried on the mounting plate, said end walls being spaced nearer to each other than the axial length of the mounting plate and one of the end walls being spaced inward from one end of the mounting plate to provide space on the mounting plate outside said one end wall for mounting controls for the stove, an air intake at the bottom of the stove, a gas burner in the stove above the air intake, a solenoid valve mounted on the plate controlling the flow of gas to the burner, a safety pilot mounted on the plate controlling the flow of gas to the solenoid valve, a thermostat means responsive to excessive temperatures in the casing for de-energizing the solenoid and shutting off the flow of gas to the burner, an outlet for the products of combustion through the mounting plate above the burner, another outlet from upper part of the stove leading outside the casing and subjected to suction inflow during normal operation of the fan and to outflow of the products of combustion upon failure of the fan, and a thermostat arranged to be heated by the outflow for interrupting the safety pilot.

9. In a gas stove having an outlet subjected to

negative or suction pressure, an elongated burner in the lower part of the stove, a secondary air intake below the burner, ports in the top of the burner, baffles spaced on each side of the burner having lower edges converging beneath the burner and upper edges converging over the burner for deflecting air across the tops of the burner ports.

10. In a gas stove having an outlet subjected to negative or suction pressure, an elongated burner in the lower part of the stove, a secondary air intake below the burner, inner and outer rows of ports in the top wall of the burner, the ports in said outer rows at intervals along the length of the burner having increased spacing therebetween to allow air to reach the inner rows, and baffle means on each side of the burner deflecting air across the outer rows toward the center.

11. In a clothes drier of the type having a horizontal clothes receiving drum, a cylindrical casing housing in the drum, a suction fan for withdrawing air from the interior of the drum casing and a drive for the fan and drum, the combination of a gas stove outside the drum casing and having an outlet for the products of combustion to the inside of the drum casing, a port type burner in the stove beneath the outlet whereby the burner ports are subject to suction preventing flash back, another outlet from the stove above the burner to the outside of the drum casing, said other outlet being subject to suction pressure drawing air into the stove during normal operation of the suction fan but serving as an outlet for the products of combustion upon failure of the suction from the fan, and a safety thermostat effective when heated to shut down the burner, said thermostat being arranged in the path of the air sucked in the other outlet during normal operation of the fan and of the products of combustion flowing out upon failure of the fan.

12. In a clothes drier of the type having a horizontal clothes receiving drum, a cylindrical cas-

ing housing in the drum, a suction fan for withdrawing air from the interior of the drum casing and a drive for the fan and drum, the combination of a gas stove outside the drum casing and having an outlet for the products of combustion to the inside of the drum casing and another outlet for the products of combustion to the outside of the drum casing normally subject to suction during operation of the fan, a pilot, a thermocouple heated by the pilot, an automatic shut off for the gas of the type held in the on position by the thermocouple, and a safety thermostat in series with the thermocouple.

13. In a clothes drier of the type having a horizontal clothes receiving rotatable drum, a cylindrical casing surrounding the periphery of the drum but leaving exposed an upper quadrant, a suction fan for withdrawing air from the interior of the drum casing having an intake in a lower quadrant of the casing, and a drive for the fan and drum, the combination of a unitary gas stove having top side and end walls defining a combustion chamber and a gas burner in said chamber, said stove with its burner being a complete operable unit and being mountable and removable as a unit and having one of its side walls formed as a mounting plate to support the stove on the casing and to fill in said exposed under quadrant.

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