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TOBACCO CURING SYSTEM

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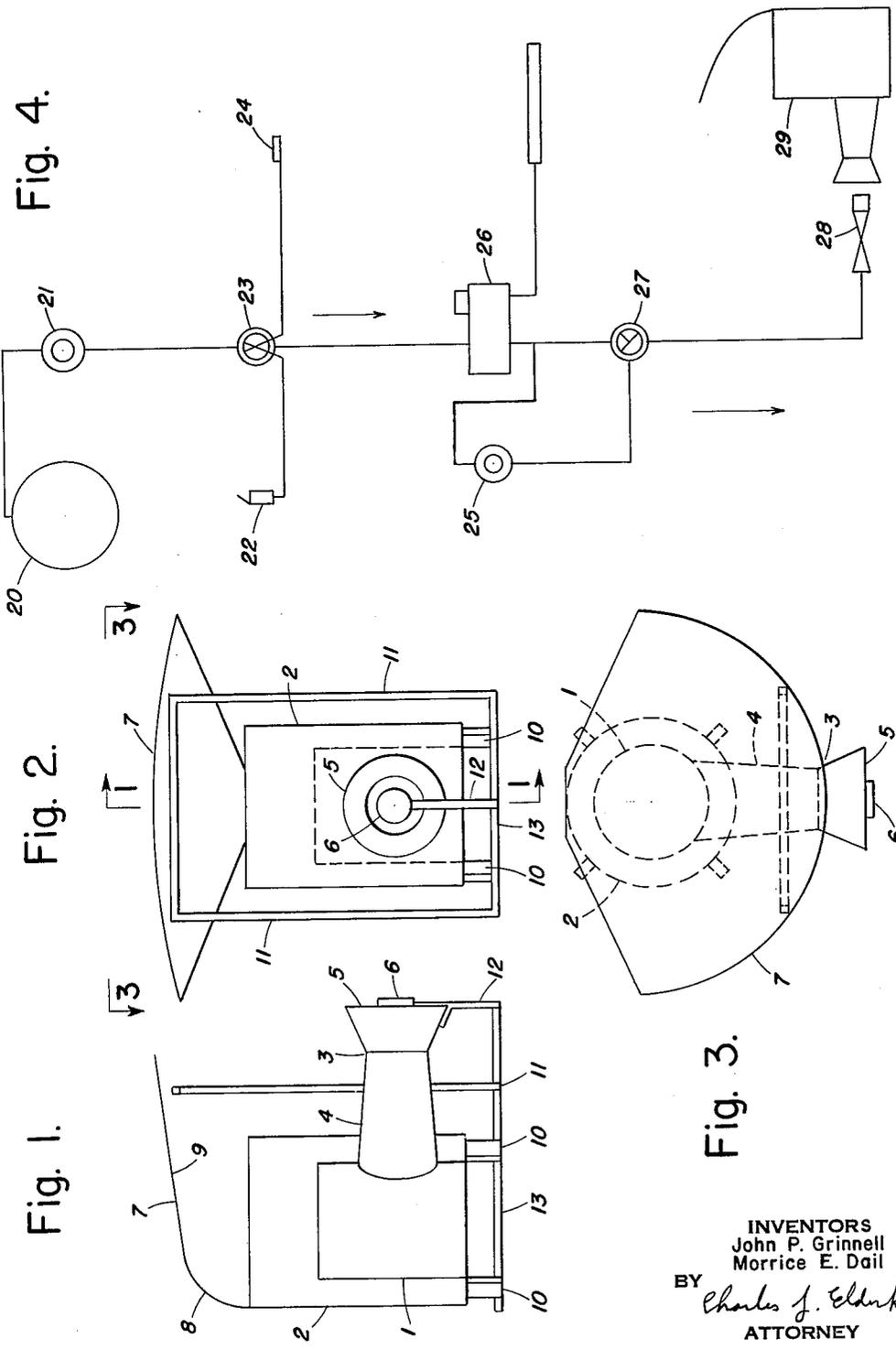


Fig. 4.

Fig. 2.

Fig. 1.

Fig. 3.

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TOBACCO CURING SYSTEM

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This invention relates to tobacco curing, and comprises a novel, portable tobacco curer assembly which is both simpler to operate and more efficient than any gas tobacco curer now in common use.

Ever since the 1860's, when tobacco growers first started to use artificial heating means for coloring and drying the tobacco leaf (these two steps being collectively termed "tobacco curing"), two general types of tobacco curing systems have evolved. The first is the permanent installation used in conjunction with a tobacco curing barn, which involves a plant for producing hot gases, and ducts leading through the barn to exhaust vents over the roof of the barn, hot gases passing through the ducts heating the ducts and, hence, the air in the barn, affecting the necessary coloring and drying. The second general type of tobacco curing system involves one or a plurality of heaters disposed within the barn itself which are connected to a source of fuel and heat air directly as it passes through same, the hot air passing up and curing the tobacco hanging within the barn. These differ from bulk curing systems, which use the forced convection of air and are termed curing systems which create a natural flow of hot air. The present invention is of the latter type.

In gas systems of this same general type currently available, 9 to 16 individual heaters are placed on the floor of the barn and connected to a common fuel source. Each heater has two burners: a small capacity burner is used to color the tobacco leaf and a high capacity burner is used to dry the leaf. Different temperatures are necessary for each stage, in order to prevent the green color from "setting," i.e., the leaf will only yellow while containing most of its moisture.

Increasing the heat too slowly between stages causes "running," red streaks around the stems, and too fast an increase causes "scolding" or "sponging," the effect being brown streaks on the leaves. In practice, the operator may or may not turn off each individual coloring burner, but in either case he must turn on each drying burner as he changes the curing cycle from the coloring stage to the drying stage. The heaters in common use are of more or less conventional air heater design, having a dish-plate diffuser located thereover. In general, there is little excess air flow through the heater itself, but the combustion gases issuing from the heater warm the surrounding air.

A variety of other heaters have been employed for this same general purpose; representative examples may be found in the U.S. Patents Nos. 1,221,949; 2,051,348; 2,170,735; 2,280,458 and 2,472,534. All of these prior art heaters have one or more burners centrally located near the bottom of the unit, combustion draws air upwards through the heater, and a deflection plate at the top distributes the heated air, prevents flames from igniting the tobacco, and keeps any falling leaves from getting inside the burner. In each case, however, either no provision is made for the two different curing stages or the procedures for changing from one to the other are manual and cumbersome.

It is, accordingly, an object of the present invention to provide a tobacco curing system in which both stages of the curing operation—coloring and drying—can be performed with but a single burner on each heater.

A further object of the invention is to provide a tobacco curer in which the fuel is more efficiently used, i.e., large

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volumes of air are heated to the required temperature without local overheating.

Another object of the invention is to provide a hot air diffuser which distributes the hot air in a somewhat horizontal direction before it rises, thereby spreading the heated air more evenly throughout the curing barn.

A still further object of the invention is to provide a tobacco curing system which can go through both coloring and drying stages automatically or, alternatively, can be switched from the coloring stage to the drying stage by merely turning one valve for each system (i.e., for each barn).

Yet another object of the invention is to provide a tobacco curer the outside of which is sufficiently cool so as to be locatable adjacent the walls of a barn, and in which the danger of accidental ignition of the hanging tobacco is effectively eliminated.

Various other objects and advantages will appear from the following description of an embodiment of the invention, and the novel features will be particularly pointed out hereinafter in connection with the appended claims.

In essence, our tobacco curer combines Venturi and chimney effects to maximize the flow of air through a space heater for use in curing tobacco, and employs a high pressure burner designed to retain its flame within a small conical volume in front of the nozzle (i.e., a simple gas orifice). The control system may employ a thermostatic control for maintaining pre-set temperatures during each stage, and high and low pressure regulators for delivering fuel at the proper pressure for each stage. By using a burner with a maximum turndown ratio, it is possible to properly operate the single burner at both low and high pressures, thus effecting both stages of the cycle with a single burner. Alternatively, a single thermostat effective over the entire range (roughly, room temperature to 200° F.) can be used with fuel delivered at a single high pressure.

In operation, the flame from the burner is injected into a Venturi to inspiate outside air before the flame can dissipate its energy. The Venturi, or inspiating tube, is in an essentially horizontal plane (or at some angle to the horizontal that is not vertical) and the products of combustion and the entrained inspiated air are discharged into an unobstructed vertical combustion chamber or chimney. This combustion chamber or chimney is open at the bottom and top and hot gases entering thereinto from the Venturi rise, creating a chimney effect, and thereby draw air in from the open bottom. The combustion chamber becomes hot and acts as a driving force for a second chimney coaxially surrounding the combustion chamber, and which is also open. Thus, air in the space between the vertical walls of the two chambers will be heated by the hot, inner combustion chamber wall and rises creating a second chimney effect. A diffuser is located over the top of the heater and, in the preferred embodiment, deflects the rising hot air in a generally horizontal direction.

It is believed that a better understanding of the invention will be gained by referring to the following detailed description of an embodiment thereof, taken in conjunction with the attached drawings, and in which,

FIGURE 1 is a side sectional view of the curer, taken along line 1—1 of FIGURE 2;

FIGURE 2 is a front view of the embodiment shown in FIGURE 1;

FIGURE 3 is top view of the embodiment shown in FIGURE 1; and

FIGURE 4 is a schematic diagram of a control system used to operate the invention.

With reference to FIGURES 1 through 3, it will be seen that the invention comprises a first chimney or combustion chamber 1 which is a cylindrical piece of sheet

metal open at both the top and the bottom. Chimney 1 is coaxially surrounded by chimney 2, which has the same general shape but is taller and wider than the first chimney. A Venturi indicated generally at 3 comprises two parts: a converging section 5 on the "upstream" end and a diverging section 4 on the "downstream" end. The Venturi 3 is mounted in the side of combustion chamber 1 at an orifice provided for same and it extends out through a suitable opening in the side of chimney 2. The Venturi is provided with a ring 6 or other suitable device for mounting the burner (not shown) in its open end.

A preferred diffuser, indicated generally at 7, comprises a curved supporting segment 8 for holding the diffuser above the chimneys, and a semicircular, flat segment 9, and is fastened to one side of the chimney 2 and, if necessary, to supporting members 11. Segment 9 may also be slightly bowed, as shown in FIGURE 2. Other supporting members 10, 12 are provided, and the entire unit may be mounted upon a base 13.

It is to be understood that while the diffuser 7, as shown, has certain advantages in minimizing back-pressure and distributing the heated air directionally and horizontally, thereby achieving a more even distribution of air throughout the barn, other diffuser designs, such as a simple dished plate, could be employed. A separate function of the diffuser is to prevent falling leaves from entering the burner and igniting. Also, while the Venturi 3 is shown as entering the unit at a right angle, it could also be mounted at an angle declined from the horizontal without adversely effecting operation of the heater.

It is to be noted that the positioning of the burner at an angle to the chimney and confining the flame to a small volume with the Venturi has an added advantage, in that the danger of accidentally igniting tobacco with a poorly adjusted burner is effectively eliminated. As noted hereinbelow, the double-chimney keeps the outer surfaces of the unit cool, adding to its safety.

The curer may be simply manufactured out of sheet metal of sufficient gage thickness to withstand the temperatures generated and normal usage and handling in a tobacco curing barn, by one skilled in the sheet metal-forming art, by conventional procedures.

In operation, the burner is treated as a simple gas orifice. By injecting the flame (primary air being inspired by the burner Venturi) into Venturi 3, secondary air and surplus air is inspired into the open end of Venturi 5, the flame, combustion products and excess air traveling into chimney 1. The air and combustion products, being hot, rise through chimney 1, creating a chimney effect and drawing additional air through the open bottom thereof. After the unit has been in operation a short while the walls of chimney 1 are heated, heating the air between chimneys 1 and 2; this creates a second chimney effect, and additional volumes of air are thus heated. By having the outer chimney 2 taller than the inner chimney 1, air from both have an opportunity to mix and reach a uniform temperature, although this is not a necessary feature of the invention. It is to be noted that, in operation, chimney 2 remains quite cool and as a result the heater may be placed adjacent to the walls of the barn without fear of fire hazard.

In the above-described embodiment of the invention, it was found that the proper heat for yellowing was achieved by limiting the delivery pressure to each burner to 11 inches water column; a satisfactory heat for leaf drying was achieved allowing the pressure to increase to 20 p.s.i.g. (the allowable maximum). Satisfactory heat input per unit varies from 5,000 to 6,000 B.t.u.'s per hour for coloring, to about 35,000 B.t.u.'s per hour for drying. It is also to be understood, of course, that the number of units used will vary with the size of the barn. Actual air temperatures generated will also vary with each individual installation, but approximately 90°-100° F. for yellowing to a maximum of 160°-170° F. for drying is average.

The controls employed for operation of one embodi-

ment of the invention are illustrated in FIGURE 4. A fuel supply 20, commonly liquid petroleum gas, is piped (in gaseous form, of course) to an ordinary 20 p.s.i. regulator 21, and then to a safety valve 23 which is connected to a pilot generator 22 in series with a 190° F. high-temperature limit switch 24, the latter being located within the barn as a safety device only. A three-way valve 27 determines whether the gas flows through low-pressure regulator 25 or at 20 p.s.i. Thermostatic control 26 maintains the proper temperature at each stage by controlling the delivery pressure to the burners. In either event the gas flows from the valve 27 into burner 28 which is mounted in the orifice of the Venturi of the heater, indicated generally at 29. As will be obvious, any number of burners 28 may be connected to the valve 27 through suitable manifolding, and in this way an entire curing barn (usually containing ten or more heaters) may be controlled by the single valve 27 when it is desired to switch the curing cycle from coloring to drying. In this manner, the operator need only light each burner once over the entire curing cycle.

An alternate control method employs only a single gas pressure and depends on thermostat 26 to maintain the proper temperatures. In this embodiment, the low-pressure regulator 25 and three-way valve 27 are eliminated. The gas travels at a single pressure (20 p.s.i.g.) to the thermostat 26. Thermostat 26 allows the gas to flow at full pressure to the burner (or burners) 28 until the barn reaches the pre-set temperature, and then lowers the gas pressure so that only sufficient gas to maintain that temperature is allowed to pass. From the foregoing it will be clear that the only practical function of low-pressure regulator 25 is to provide a positive control over burner delivery pressure during the coloring stage to insure that "setting" of the green color does not occur.

The proper number of burners are generally permanently installed in the barn and connected to the external fuel source through suitable manifolds. In operation, the operator sets thermostat 26 for 90° F. or so and lights the burners, which are run at either low or high pressure depending on which control system is being employed. In either case, when the pre-set temperature is reached the thermostat cuts the gas supply back to a level which maintains that temperature. When coloring is completed and drying commenced, the thermostat is reset for a slightly higher temperature (valve 27 being turned to high pressure if present) and, over a period of time, the temperature is incrementally increased to the aforesaid maximum of 160°-170° F. A gradual rise in temperature is required during drying to prevent "scolding" or "running."

To prevent local overheating within the barn and consequent "setting" of green in some of the leaves therein, it is advantageous to place the sensor for thermostat 26 at the first-tier level in the barn (i.e., at the level of the lowest leaves).

In one unit of the type shown in FIGURES 1-3, operating with a 75 H.P. Hones burner at 20 p.s.i.g., with a 7½ inch Venturi having a 3-inch throat, 4-inch exit diameter, and an outer chimney 16 inches long, a total air flow in excess of 18,000 cubic feet per hour has been measured. It is believed that this air flow through the unit was greater than for any gas tobacco curer of this type presently available.

It will be understood that various changes in the details, materials, steps and arrangements of parts, which have been herein described and illustrated in order to explain the nature of the invention, may be made by those skilled in the art within the principal and scope of the invention as expressed in the appended claims.

Having thus described the subject matter of our invention what it is desired to secure by Letters Patent is:

1. A tobacco curer that comprises:
 - a first unobstructed chimney open at both ends and having an orifice near the bottom end;

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- a Venturi-type tube having one end connected to said first chimney at said orifice at approximately a right angle to said first chimney; a fuel burner disposed in the other end of said Venturi-type tube to provide combustion only within said tube and whereby only the products of combustion and inspirated air are discharged into said first chimney creating a first chimney effect to draw air in from said open bottom end;
 - a second chimney open at both ends and coaxially disposed around said first chimney and spaced therefrom, and having an orifice therein to allow passage of said Venturi therethrough, the top of said second chimney extending beyond the top of said first chimney to heat the air between said first and second chimneys creating a second chimney effect and for mixing the air and said combustion products from said first chimney with the air from between said chimneys substantially within said second chimney;
 - a directional diffuser located above and secured to the top of said second chimney, said diffuser having a substantially flat, semicircular segment and a curved supporting segment attached to said second chimney; and
 - means connected to said burner for delivering fuel thereto.
2. The tobacco curer as claimed in claim 1, wherein said means for delivering fuel comprises;
- a fuel supply;
 - a maximum pressure regulator connected to said fuel supply;
 - a thermostat connected to said regulator; and
 - a distribution pipe connected between said thermostat and said burner.
3. The tobacco curer as claimed in claim 1, wherein said means for delivering fuel comprises,
- a fuel supply;
 - a maximum pressure regulator connected to said supply;
 - a thermostat connected to said regulator;
 - a three-way valve connected to said thermostat;
 - a low pressure regulator connected to said three-way valve and between said thermostat and said three-way valve, whereby said three-way valve controls the fuel pressure being fed to said burner; and
 - a distribution pipe connected between said valve and said burner.

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4. An air heater that comprises:
- a horizontally mounted burner unit that comprises a fuel delivery pipe disposed within an air-inspiring tube having a converging section nearest said pipe and a diverging section away from said pipe to provide combustion only within said tube;
 - a first vertical unobstructed chimney open at both ends and having an orifice in its side to which the end of said diverging section of said inspiring tube is attached whereby only the products of combustion and inspirated air are discharged into said first chimney creating a first chimney effect to draw air in from the open bottom end;
 - a second vertical chimney open at both ends coaxially disposed around and substantially taller than said first chimney and spaced therefrom to heat the air between said first and second chimneys creating a second chimney effect and for mixing the air and said combustion products from said first chimney with the air from between said chimneys substantially within said second chimney, said second chimney having an orifice in its side to allow passage of said inspiring tube therethrough; and
 - diffuser means located above said chimneys and secured to said second chimney for deflecting heated air rising therethrough.
5. The air heater as claimed in claim 4, wherein said diffuser means comprise,
- a substantially flat, semicircular segment;
 - a supporting segment integral with said semicircular segment and adapted to hold the latter above said chimneys; and
 - fastening means for attaching said supporting segment to said second chimney.

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