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TOBACCO CURING SYSTEM

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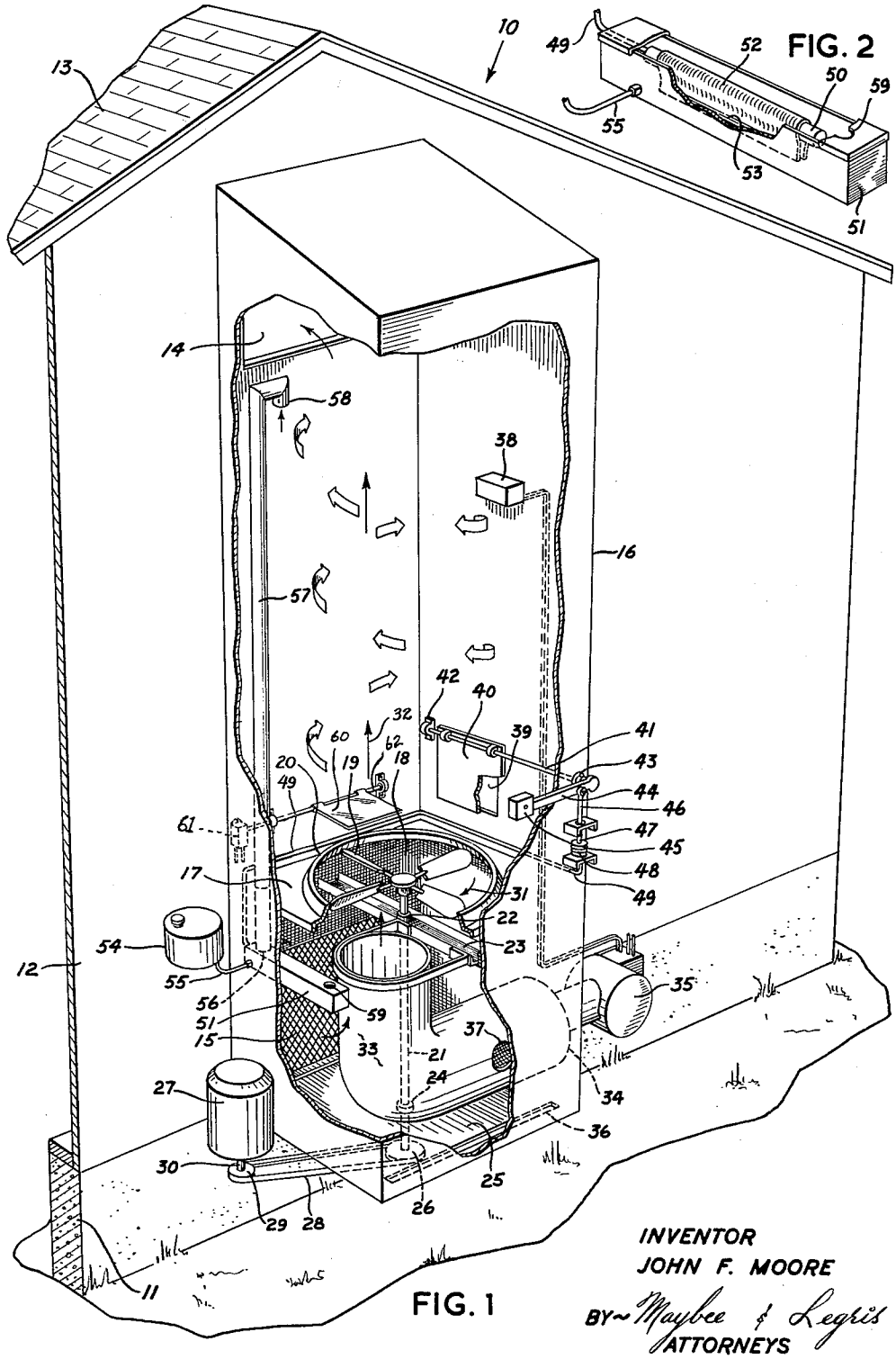


FIG. 1

FIG. 2

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TOBACCO CURING SYSTEM

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This invention relates to a system for curing tobacco and, in particular, to a system whereby the temperature and relative humidity of the air within the curing kiln may be controlled. In the curing of tobacco it is customary to hang the tobacco in a building or kiln which is substantially enclosed and sealed.

The interior of the kiln is heated and over a period of time certain chemical and physical changes take place in the tobacco leaves which result in the production of a "cured leaf."

The prior art has employed, for many years, a system wherein heat is supplied to the building along the floor thereof, the heated air then rising through the tobacco leaves and escaping through vents sometimes located in the ridge of the roof of the building.

This method or system, although in almost universal usage at the present time, suffers from the disadvantage that as the hot air rises through the cooler tobacco leaves there is a tendency for the hot air to "channel" or, in other words, to seek the path of least resistance through the tobacco from the source of heat to the vent at the roof of the kiln. As a result the tobacco leaves are unevenly contacted by the warm air and the curing process is not uniformly carried out.

The present invention proposes to supply the heated air at the top of the kiln and, by means of a closed circuit, forced flow system to drive the heated air downwardly through the tobacco and out through a vent located at or near the bottom of the kiln from which vent it is returned to the circuit after having been reheated.

This concept has the advantage that there is no tendency for the hot air to channel through the tobacco as it moves downwardly and it has been found that the tobacco is uniformly cured by this method.

Specifically, the invention proposes to provide a substantially sealed, enclosed kiln which is provided with a first opening adjacent the top of one wall and a second opening adjacent the bottom of that wall, the openings being joined by a vertically extending duct which encloses a fan and a heat source, the fan driving heated air in a closed circuit through the duct, the first opening at the top of the kiln, downwardly through tobacco within the kiln, and back into the duct through the second opening.

Means are provided in the duct to admit fresh outside air to the system and means are also provided to exhaust air from the system for purposes which will become apparent as the description proceeds.

The invention is described by way of a preferred embodiment illustrated in the accompanying drawings in which:

FIGURE 1 is a cut away perspective view of the curing system as attached to the outside of a tobacco kiln, and

FIGURE 2 is a detailed view of a portion of FIGURE 1.

Referring now to FIGURE 1, a tobacco kiln indicated generally by the reference character **10** may consist of a foundation wall **11** upon which is constructed a side wall **12** which extends upwardly to a roof portion **13**. The tobacco kiln is substantially sealed and enclosed so that there is a minimum of leakage of air into or out of the kiln.

An opening **14** is provided adjacent the top of the wall **12** and a similarly sized opening **15** is positioned vertically beneath the opening **14**, the opening **14** being hereinafter referred to as the first opening and the opening **15** being hereinafter referred to as the second opening.

The first opening **14** is located in the wall **12** at a level which is at least partly above the uppermost level at which tobacco may be hung in the kiln so that the heated air will enter the kiln above the tobacco. Similarly the second opening **15** is located in the wall **12** at least partly below the lowermost level at which tobacco may be hung so that the air must flow past all of the tobacco before escaping through the opening **15** in the wall **12**.

A primary duct **16** of any suitable construction is provided externally of the kiln **10** joining the two openings and within this primary duct **16** is contained the mechanism which is associated with the curing system.

Firstly, there is provided a transverse wall **17** which extends across the primary duct **16** adjacent its lower end and which is provided with a circular central aperture **18** within which is mounted a fan **19** adapted to sweep substantially the entire opening. The periphery of the opening **18** is provided with a flanged collar **20** to define the area swept by the fan **19**. The fan **19** is mounted on a substantially vertical shaft **21** which is journaled at **22** on a support member **23** extending diametrically across the opening **18** and positioned below it. A journal **24** is also provided where the shaft **21** passes through the lower wall **25** of the duct and, at its lower end, the shaft **21** is provided with a pulley **26**. An electric motor **27** drives the shaft **21** through a belt **28** which engages the pulley **26** on the shaft **21** and a pulley **29** on the shaft **30** of the motor **27**.

Accordingly, it can be seen that rotation of the shaft **21** by the motor **27** will cause the fan **19** to revolve in the direction of the arrow **31** and will drive air through the primary duct **16** in the direction of the arrows **32**, through the first opening **14**, into the kiln above the uppermost level at which tobacco may be hung, downwardly through the tobacco, and back into the primary duct **16** through the second opening **15**.

Below the wall **17** extending across the duct there is provided a source of heat which in the embodiment shown, comprises a secondary duct **33** which extends from the exterior of the primary duct **16** at point **34** across the bottom of the duct in a horizontal direction and then bends upwardly to terminate below the opening **18** in the wall **17**. The interior of the secondary duct **33** is in communication with the outside air at point **34** and at this point a fuel burner **35** is inserted into the end of the secondary duct **33**.

Combustion air may enter the secondary duct **33** at the point **34** where it communicates with the outside air and, in addition, an opening **36** is provided in the bottom wall **25** of the primary duct **16** through which outside air may enter the closed circuit. Further openings **37** are provided in the secondary duct **33** so that secondary combustion air may enter the duct **33** at this point from the interior of the duct **16**.

Heated air from the secondary duct **33** is discharged upwardly into the opening swept by the fan and into approximately a 90° quadrant of this circular opening **18**.

It can be seen, accordingly, that heated air will be driven through the closed circuit described in the direction of the arrows **32** by being forced by means of the fan through the primary duct **16**, into the kiln **10** through the first opening **14** above the tobacco and will then pass downwardly through the tobacco and back into the duct through the second opening **15**.

Suitable means such as a conventional thermostat **38** will control the burner **35** and will, accordingly, maintain the temperature of the air at a desired level. The thermostat may be controlled by suitable means which

are neither shown nor described so that the temperature may either rise over a period of time or fall over a period of time as circumstances may require.

During the curing of tobacco it is not only necessary that the temperature be closely controlled but it is also essential that the humidity of the air within the kiln be controlled. Since the curing of tobacco involves, at certain stages, the removal of moisture from the tobacco leaf, it is necessary to provide means to exhaust some of the moisture laden air from the kiln and to admit outside air, the relative humidity of which will be lower than that of the air within the kiln. For this purpose an opening **39** is provided in the wall of the primary duct **16** and this opening is closed by a damper **40** carried by a shaft **41** which is supported in bearings **42** and **43**. An arm **44** secured to the shaft **41** and provided with a counter-weight **45** ensures that under normal conditions the damper **40** remains closed.

Connected to the arm **44** is a vertical control rod **46** which, at its lower end **47** is secured to an expandable bellows **48**, the interior of which, by means of a conduit **49** is in communication with a bulb **50** contained within an enclosed box **51**. The box **51** is located within the primary duct **16** adjacent the second opening **15** and the bulb **50** is provided with a wick **52** which lies over its surface and which hangs into a water bath **53** occupying the lower portion of the box **51**. The water bath **53** is maintained at a desired level from a reservoir **54** which may conveniently be mounted externally of the primary duct **16** and connected with the interior of the box **51** by a conduit **55**.

The tube **50** contains a material which, under normal circumstances, exerts a substantial vapour pressure which is capable of actuating the bellows **48** and the control rod **46**. Such a suitable material is the gas ethyl chloride. The ethyl chloride contained within the tube **50** is in a liquid-vapour phase and the vapour pressure of the material, acting upon the bellows **48** will move the control rod **46** and thereby rotate the shaft **41** to open or close the damper in accordance with predetermined conditions for which the mechanism may have been adjusted.

The box **51** is provided with an opening **56** in its upper surface which opening is in communication with a duct **57** extending vertically in the primary duct **16** to a point adjacent the first opening **14** where it terminates in an open end **58** to receive air flowing upwardly in the primary duct **16**. A second opening **59** is provided in the box **51** at the end thereof remote from the opening **56** so that air flowing upwardlly in the primary duct **16** enters the open end **58**, passes downwardly through the duct **57**, flows over the water soaked wick **52** lying on the tube **50** and returned to the system through opening **59**. Accordingly, the temperature of the material within the tube **50** will be equivalent to the "wet-bulb" temperature of the air in the system and the vapour pressure exerted by the ethyl chloride within the tube **50** will be a function of the wet-bulb temperature of the air in the system.

If the wet-bulb temperature of the air becomes too high the vapour pressure of the ethyl chloride will increase and will cause the expansion of the bellows **48** which will cause the control rod **46** to move upwardly as seen in FIGURE 1. This will cause the clockwise rotation of the shaft **41** when viewed in FIGURE 1 which will open the damper and permit a certain amount of the air within the system to be exhausted through the opening **39**. The exhausted humid air will be replaced by fresh, less humid air entering through the opening **36** in the bottom wall **25** of the duct **16** and the over all humidity of the system will thereby be reduced until the wet-bulb temperature of the air within the system has fallen to a value such that the damper **40** may close due to a reduction in the vapour pressure of the ethyl chloride in the tube **50**. It may be seen, therefore, that it is desirable to locate the open end **58** of the tube **57** at such a point that the air it samples has been adequately mixed with whatever fresh air has been admitted and yet has not picked up any moisture from the tobacco in the kiln.

In order to ensure that freshly heated air coming from the secondary duct **33** does not escape through the opening **39** when the damper **40** is open it is to be noted that the upper end **60** of the duct **33** discharges heated air into approximately a 90° quadrant of the opening swept by the fan **19** which 90° quadrant is located substantially diametrically opposed to the opening **39** relative to the opening **18** in the wall **17**. Since the fan **19**, as seen in FIGURE 1, rotates in a clockwise direction (in the direction of the arrow **31**), the air will move upwardly through the opening **18** in a clockwise swirl which clockwise swirl will bring the heated air from the secondary duct **33** to a point above the opening **39** by the time it has swung around to a point adjacent the opening **39**. Accordingly, freshly heated air coming from the duct **33** will be preserved within the system and there will be a minimum of hot air lost due to the exhausting of the humid air through the opening **39** controlled by the damper **40**.

Since the system described is a forced air system there will be a super atmospheric pressure within the kiln **10** which will effectively prevent the inward leakage of cold outside air into the kiln. Any leakage of air through the kiln walls will be from the inside of the kiln outwardly due to the over pressure which exists within the kiln. As a result there will be no cold air leaking into the kiln to contact the tobacco leaves hanging therein and, accordingly, a substantially uniform temperature may be maintained throughout the entire volume of the kiln which, of course, will promote a uniform curing of the tobacco contained therein.

The construction of the primary duct **16**, as stated above, may be of any suitable material such as sheet-metal or composition board. The curing system which has been disclosed is adaptable for use with existing tobacco kilns since the only alterations in those kilns which need be made would be the provision of the first and second openings **14** and **15** and the closing of whatever exit vents may exist within the kiln structure. The device is also, of course, suitable for use in kilns specially designed to receive it and in such cases the construction of the kiln would need to take into account the fact that the invention proposes that the kiln should be enclosed and substantially sealed so as to provide a closed circuit for the forced air system driven by the fan **19**.

The source of heat for the secondary duct **33** is shown in the drawing as being a fuel burner. The fuel to be burned may be natural gas, synthetic gas, oil or any other fuel suitable for such an operation.

Although a specific means has been disclosed for controlling the damper **40** in response to the wet-bulb temperature of the air within the system, it is not to be considered that this diclosure is limiting but is merely illustrative of one form which such a control may take. There are other suitable controls which could be used and the invention equally contemplates their use. For example, an electrical sensing element could be used in association with the water soaked wick to control an electrical damper motor operating the damper **40**.

As a safety feature, a vane **60** is mounted in the path of air discharged by the fan **19**. Air flow from the fan will keep the vane floating or extending in an upward direction from the axis of the shaft **62**. In the event that the fan motor should fail and the air flow should cease, the vane **60** will fall and, in doing so, will open electrical contacts in a switch **61** mounted on the end of the shaft **62**. This switch **61** would shut off the burner **35** so as to prevent over-heating of the heating unit. It is to be understood that the switch **61** over rides the thermostat control **38**.

It will be seen from the above description that the

invention provides an economical, efficient and readily controllable system for curing tobacco wherein the temperature and the relative humidity of the air within the kiln may be closely controlled to achieve the maximum results.

It will be understood that the form of the invention herewith shown and described is a preferred example and various modifications can be carried out without departing from the spirit of the invention or the scope of the appended claims.

What I claim as my invention is:

1. In a tobacco curing system a kiln in which tobacco may be hung for curing, an opening adjacent the lower edge of a wall of the kiln, a second opening adjacent the upper edge of said wall, a duct extending between the two openings, and air-conditioning mechanism associated with the duct and located at the lower end thereof, and comprising a wall extending across the duct and having a central circular opening therein, a support member extending diametrically across the said opening and below it, bearings carried by said support member, a shaft journalled in said bearings, and carrying a fan capable of sweeping substantially the entire opening, means to drive said fan, a secondary duct extending from the exterior of the primary duct across the bottom of the primary duct and bending upwardly to terminate below said fan, a fuel

burner in said secondary duct, means to admit combustion air to the interior of said secondary duct, means responsive to the temperature within the kiln to control the fuel burner, means to admit external air to the duct, damper means to exhaust air from the duct and means responsive to the wet-bulb temperature of the air within the kiln to control the damper means.

2. A tobacco curing system as claimed in claim 1 in which the means responsive to the wet-bulb temperature of the air within the duct includes a duct to bleed air from the circuit and direct it over a wet-bulb, the bulb containing a material in a liquid-vapour phase, the vapour pressure of the material, through the medium of an expanding bellows, actuating mechanism to control the damper.

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