Aug. 16, 1949. R. D. TOUTON 2,479,526

APPARATUS FOR CURING GREEN TOBACCO

Original Filed Dec. 11, 1940 2 Sheets-Sheet 1

FIG. 2.

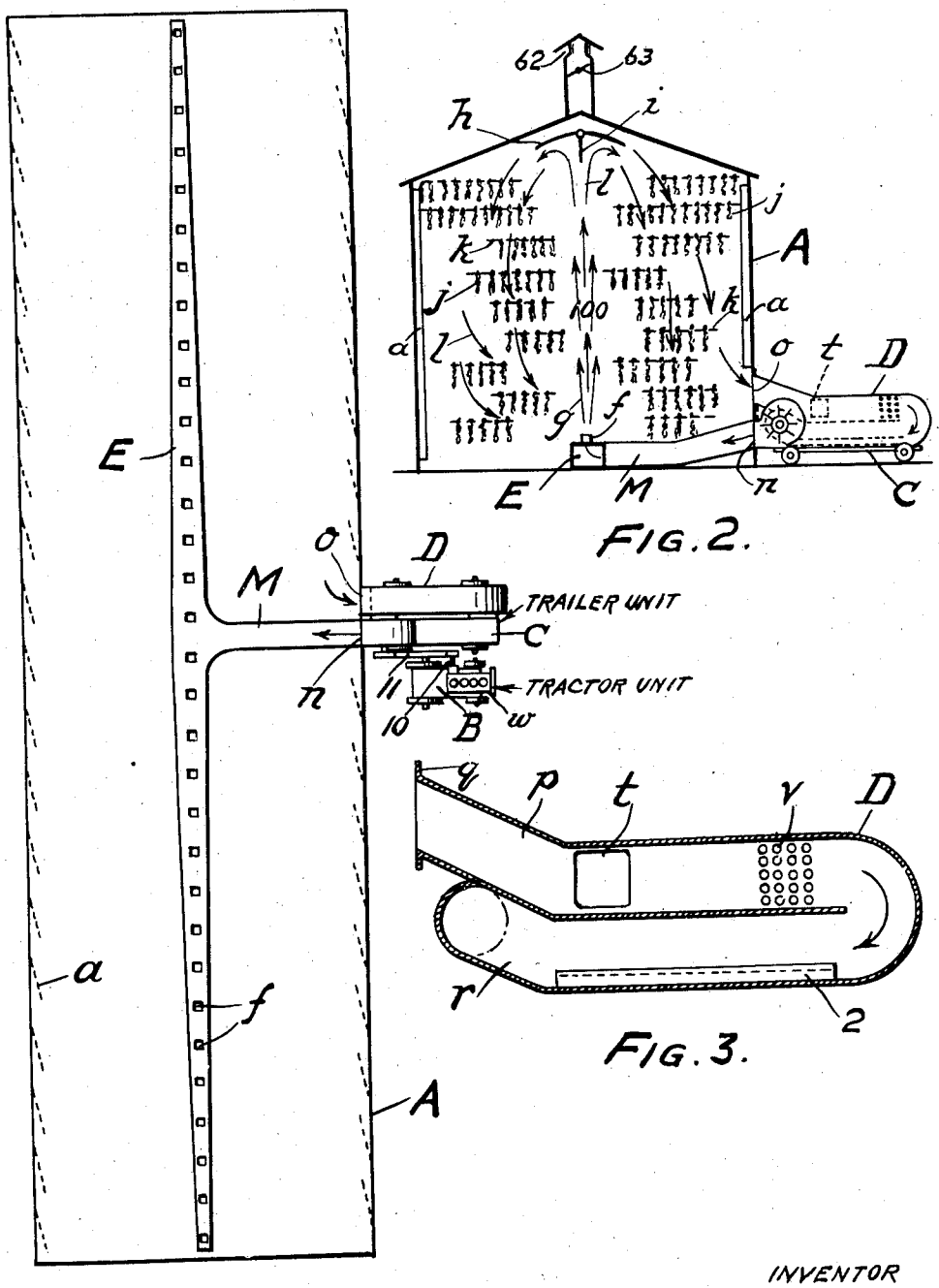

FIG. 1.

FIG. 3.

WITNESS:

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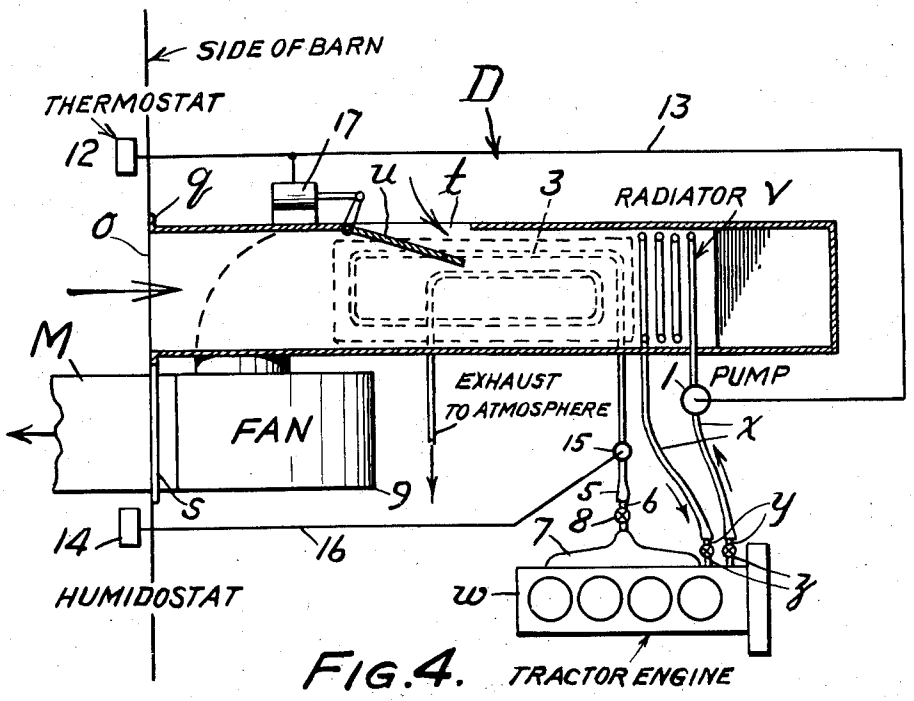

FIG. 4.

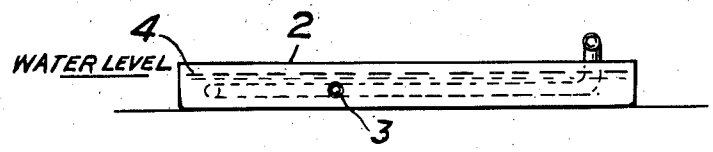

FIG. 5.

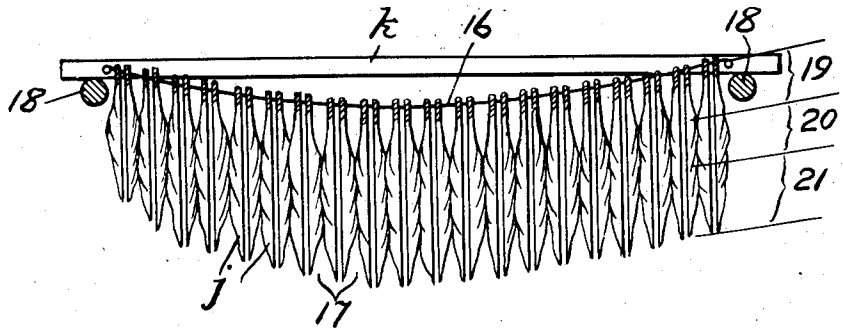

FIG. 6.

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UNITED STATES PATENT OFFICE

2,479,526

APPARATUS FOR CURING GREEN TOBACCO

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2 Claims. (Cl. 34—221)

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This invention relates to apparatus for curing green tobacco and more particularly relates to apparatus adapted for the curing of green tobacco in the field following its harvesting.

As is well known, green tobacco leaves after harvesting have heretofore been strung closely in pairs and hung in banks in a dense mass for curing in so-called sheds, having a tight roof and walls formed by louvers capable of adjustment for various openings.

The curing of the green tobacco leaves in the sheds requires about 30 days, more or less, and it has been sought to obtain desired atmospheric conditions; i. e., temperature and moisture content, within the sheds by various adjustment of the louvers and the burning of charcoal pots within the sheds with respect to the prevailing temperature and moisture content of the outside atmosphere, the wind velocity and its direction with respect to the sheds.

However, it has been found that the closeness or dense packing of the leaves as they are hung in the shed results in unsatisfactory curing of the leaves near the walls of the shed and insulation of the inner leaves toward the center of the shed so that they do not receive proper treatment. This insulation of the inner leaves is particularly objectionable while the leaves are still green, starchy and distended to their full face area and at the same time contain a maximum water content.

It has also been found that non-uniformity in the curing of the tobacco in any given shed arises from the fact that uncontrolled curing of the tobacco in the upper part of the shed, which is placed first, starts and often proceeds substantially before curing of the tobacco in the lower part of the shed, placed last, starts,

Further, under present practice and with present equipment it is extremely difficult, if not impossible, to maintain the necessary conditions for good curing during the latter stages of the operation, as for instance, after the sixth to seventh day, due to the shrinking of the leaves which permits too great a circulation of dry air, together with the fact that the leaves no longer contain sufficient moisture to create the necessary relative humidity.

The present procedure, essentially dependent upon general atmospheric conditions, of necessity is lacking in any uniform control of the conditions under which the tobacco is cured, makes no allowance for the different characteristics of different parts of the tobacco leaf and frequently results in the production of tobacco of low quality,

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from the standpoint of texture, color and taste, and consequently of a value considerably less than could be expected from the nature of the green tobacco when harvested.

A careful study of the nature of the green tobacco leaf and of the requirements of proper curing shows that the butt and stem portions of the leaf are relatively coarse and sappy and contain a relatively large amount of moisture, while the median portion, containing less moisture than the butt and stem, contains substantially more moisture and is coarser than the relatively fragile tip portion. Furthermore, the maximum width of the leaves occurs in this median portion setting up an overlapping condition with a resultant impedance of circulation when the leaves are placed in the curing shed.

In the curing of the green tobacco leaf, it is the object to remove the moisture, to the desired extent, and bring the leaf to desired color, while, at the same time, retaining its texture. In general, it is usual to support in the average shed about 40,000 pounds of green tobacco leaves, of which weight some 80% is moisture. In the curing, the tobacco leaves are brought down to a weight of about 10,000 pounds, of which some 20% is moisture. In the curing the major moisture loss occurs in the first five to six days and care must be exercised, especially between the second and sixth days, to avoid rotting or "pole sweat" which is most likely to occur in the median portion of the leaf, when the leaf has partially wilted and part of the leaf cells are dead, but the leaf still contains from 50% to 70% moisture, which promotes the growth of pole sweat spores in the dead cells.

In the prior practice indicated above, as will be obvious, the tobacco leaves are essentially subjected to atmospheric air, the humidity, temperature and flow of which was subject to variation with the physical condition of the leaves, time of day or night and local meteorological conditions under such control only as could be exercised by adjustment of the louvers forming the sides of sheds and the burning of charcoal pots within the sheds; and, again, the dense packing of the leaves prevented any approach to uniform circulation through the mass of tobacco. Also, the necessity for wide open louvers to admit sufficient air for anything like circulation in the center of the mass often causes wind damage on the leaves near the outside of the shed near the open louvers and, in any event, subjects the outside leaves to over drastic treat-

ment in comparison with that received by the inside leaves.

As a result of the non-uniform condition of the atmospheric air available to the shed and the inefficient control thereof, especially of the volume and direction of its flow with respect to the tobacco leaves and the different parts thereof, wide variation in the conditions occurred locally within the shed from the effect of the drying tobacco upon the air.

Now in accordance with this invention there is provided a highly efficient and economical form of apparatus for the curing of green tobacco, and by use of which the curing of green tobacco in the usual shed is enabled and production of tobacco of high quality is assured.

Generally speaking, the apparatus according to this invention will comprise a chamber having louvers, or controllable openings, in its side walls and a controllable opening, or ventilator, in its roof. For example, the chamber may be the usual tobacco shed, as heretofore used in the curing of tobacco in the field, modified by the provision of a ventilator, or ventilators, in its roof. Combined with the chamber will be an air conditioner, which in general may be of any usual type and within the chamber will be means, such as the usual sticks and supports therefor, for supporting green tobacco leaves within the chamber, and a duct system connected with the air conditioning equipment and arranged in a particular manner with respect to the means for supporting the tobacco leaves and consequently with respect to the leaves, and constructed so as to enable the delivery of conditioned air to tobacco leaves within the chamber in a particular manner and variously with reference to the operation of the ventilator.

In apparatus in accordance with this invention green tobacco leaves or plants are strung and hung in close relation as heretofore in the chamber, which may be a curing shed of the present type having louvers in its walls and modified only by provision for ventilation through the roof. The conditioning equipment is arranged to supply uniformly conditioned air or atmospheric air tempered with conditioned air to a uniform condition through the duct system to the tobacco in controlled volume and direction of flow with respect to the leaves and also with respect to outside conditions, such as temperature and humidity and wind direction and velocity, so that the different parts of the leaves are subjected to air at a condition and in circulation best suited to their curing at a proper rate, with uniformity, with avoidance of rotting and with retention of texture and flavor and acquisition of desired color.

Having now indicated in a general way the nature and purpose of the apparatus according to this invention, it is believed that it will be understood in detail from the following description of a form of apparatus embodying the invention, with reference to the accompanying drawings in which:

Figure 1 is a plan view showing an embodiment of apparatus in accordance with this invention.

Figure 2 is a diagrammatic end view of apparatus in accordance with this invention.

Figure 3 is a cross-sectional view showing details of the air conditioning instrumentalities included in the apparatus shown in Figures 1 and 2.

Figure 4 is a detailed view, partly in section, showing the instrumentalities included in the air conditioning apparatus in operative association with a tractor engine.

Figure 5 is a side view of humidifying apparatus included within the air conditioning apparatus shown in Figures 3 and 4.

Figure 6 is a side view of a string of tobacco leaves as hung in a tobacco curing shed.

Referring initially more particularly to Figure 6, 16 indicates a string upon which are threaded or strung a series of green tobacco leaves *j*. The string 16 passes through the butts of the leaves and the leaves, as is customary, are strung in pairs 17, the leaves of the pairs facing oppositely. In similar manner stalks may be hung. The string 16 is secured at its ends to a stick *k* adapted to be supported in the shed on rack members 18.

The tobacco leaves *j* are divided into three essential portions, as illustrated in Figure 6, namely, the butt portion 19, the median portion 20 and the tip portion 21.

Referring now more particularly to Figures 1–5, A indicates a tobacco shed, which may be of any desired size and construction, and desirably will have louvers *a* in its walls. The shed will be located in any convenient position to the tobacco fields. A ventilator or series of ventilators 62, controlled by a damper 63, are provided in the roof of the shed to afford a stack effect where desired.

B indicates a tractor of any ordinary or desired type. The tractor may be and desirably will be such tractor as may be used in connection with the growing of tobacco to be ultimately cured in the shed A.

C is a trailer unit adapted to be coupled to and drawn from place to place by the tractor B. Upon the trailer unit is an air conditioning apparatus or instrumentalities for the conditioning of air.

Within the lower part of the shed A and extending longitudinally of the center thereof is an air duct E, provided on its upper side with a series of upwardly directed nozzles *f*. The nozzles *f* are extended from end to end of the duct E and are spaced sufficiently close so that streams of air *g* issuing from the nozzles will blend and travel upwardly and outwardly within the shed, in and from a free zone 100 between or centrally of the banks of tobacco leaves, as will appear. Beneath the ridge of the roof of the shed A and extending in a line above the nozzles *f* in duct E is a curved baffle *h*, divided centrally by a vertical member *i*. The member *i* is directly in line with the nozzles *f* and adapted to divide air traveling in zone 100 therefrom when it reaches the baffle.

As will be obvious from an inspection of Figure 2, the blended streams of air *g* from the nozzles *f* passing upwardly within the shed A, in a zone 100 extending vertically between the ends of the masses of tobacco supported on stacks *k* in which the air is desirably at a positive pressure, will extend outwardly into the mass of tobacco and such as reaches the baffle *h* will be divided by the member *i* and directed oppositely downwardly by the curved baffle *h* so that a downward circulation of air will be set up within the shed, as indicated by the arrows Figure 2. By virtue of the direction of the circulation the air directed downwardly will first pass downwardly along the butts of the leaves and then along the median portions and then along the tip portins.

Leading from the duct E, a lateral duct M aligns with an opening *n* in the side of the shed. Adjacent the opening *n* with which the duct M communicates is an opening *o* in the side of the shed.

The air conditioning instrumentalities mount-

ed upon the trailer C comprise, as shown in Figure 3, an intake duct *p* adapted to be aligned with the opening *o* in the side of the shed and provided with a flange *q* adapted to bear against the side of the shed and make a tight connection and a discharge duct *r*, adapted to connect with the opening *n* in the side of the shed with which the lateral duct M extending from the duct E communicates. The end of the discharge duct is provided with a flange *s* (Fig. 4) adapted to bear against the side of the shed and make a tight connection. The intake duct *p* is provided with an opening to the atmosphere *t*, controlled by means of a swinging closure *u*.

Within the intake duct is a coil *v*, the ends of which are adapted to be connected with the water jacket of the tractor engine *w* through the medium of flexible pipes or hose *x*, *x* connected to nipples *y*, *y*, let into the walls of the water jacket and provided with valves *z*, *z*. A pump *l* is provided for effecting circulation of water from the tractor engine water jacket through the coil *y*, with return to the water jacket.

Within the discharge duct is a pan 2 containing a coil 3 and adapted to contain water to a level 4 to cover the coil 3. The coil 3 is connected at one end through a flexible pipe 5 to a nipple 6, which extends from the exhaust manifold 7 of the tractor engine and is provided with a valve 8. The other end of the coil 3 leads to atmosphere, or preferably into a pit (not shown) adapted to absorb exhaust gases. The end of the coil connected to nipple 6 is provided with a valve 15 adapted to throttle and control the amount of exhaust gases passing from the engine manifold 7 into the coil.

As will be obvious, when exhaust gases are permitted to circulate through the coil 3, which is beneath the water level 4 of the water in the pan 2, water will be evaporated into the air passing through the discharge duct and over the pan.

A fan 9 is provided in the discharge duct adjacent its juncture with the lateral M within the shed. The fan is adapted to be driven from the power take-off 10 of the tractor through the medium of a belt 11. The fan is arranged to operate to draw air from within the shed into the intake duct in heat interchange relation with coil *v*, then over the pan 2 and discharge it into the lateral duct M, through which it passes to conduit E, from which it passes into the shed, as described above, through the nozzles *f*. The fan also serves to draw into the intake conduit fresh air through the fresh air opening *t*. The fan 9 may be reversed to reverse the direction of circulation which may variously be desirable.

Within the shed is positioned a thermostat 12, which operates to control the circulation of heating fluid through the coil *v* through control of the operation of the pump *l*. The control of the pump *l* by the thermostat may be of any suitable or well known type, the control connections being indicated by the line 13.

A humidostat 14 is positioned within the shed and operates to control the circulation of exhauts gas through the coil 3 by control of the valve 15. The humidostat may effect control of the valve 15 by any known or desired means, the connection between the humidostat and the valve being indicated by the line 16.

The operation of the apparatus described above for the treatment of tobacco will, it is believed, be obvious. However, it will be noted that the humidostat and thermostat within the shed will be set for the conditions desired for the curing of leaves of green tobacco *j* hung in banks on opposite sides of the zone 100 within the shed. The tractor and air conditioning apparatus upon the trailer having been connected together as described above and the intake and exhaust conduits of the conditioning apparatus having been moved into engagement with the side of the shed in alignment with the openings therein, the tractor engine will be started. In operation of the tractor engine, the fan 9 will be rotated and circulation of air into, within and out of the shed will be set up. The fan will be operated to deliver such quantity of air as to set up a positive pressure within the shed, which may be readily accomplished due to introduction of the air in a zone centrally of the mass of tobacco, which will act to baffle the passage of the air to the sides of the shed. The circulation within the shed will be such as described and as shown by Figre 2. The closure *u* for the fresh air opening *t* will be adjusted, as will the louvers *a* to admit atmospheric air. The adjustment of the louvers and of the closure *u* will depend upon the condition of the atmospheric air with respect to the condition desired in the shed and the direction of the wind. Variously during the curing period the louvers *a* may be entirely closed and variously when the curing has progressed the air conditioning apparatus may be shut down and the curing allowed to proceed under atmospheric air admitted through the louvers. The air passing outwardly and downwardly between the banks of leaves will be deflected downwardly within the mass of leaves by the leaves as it progresses outwardly.

Hot water from the water jacket of the tractor engine will be circulated through the coil *v*, for adjustment of the temperature of the air withdrawn from the shed together with the fresh air added thereto, by means of the pump *l*. The amount of circulation with reference to the heat of the water will be controlled by the thermostat 12, so that the air will be brought to the desired temperature. As desired, hot exhaust gas from the exhaust manifold of the tractor engine will be circulated through the coil 3 for the evaporation of water from pan 2. The amount of gas passed through the coil 3 for the evaporation of such an amount of water from the pan 2 to bring the air to the desired relative humidity will be controlled by the valve 15, under control of the humidostat 14.

As will be obvious, the air at desired relative humidity and temperature will then be returned to the shed for curing if the louvers *a* be closed or if they be open more or less to temper the atmospheric air entering through the louvers for the maintenance of desired conditions within the shed. Generally the outer portion of the mass of tobacco will act to baffle or hold the conditioned air within the mass.

In many, if not all, instances, it will be desirable variously to utilize the stack effect afforded by the ventilators 62. Thus, when the charging of the shed with tobacco is completed, it will usually be found that air heated by the sun on the roof has accumulated in the upper part of the shed and that the tobacco therein has started to cure as compared with the tobacco in the lower part. In such circumstances the damper 63 will be opened, before starting the conditioning apparatus, to release the hot air from the upper part of the shed and by the stack effect cause an updraft through the tobacco, all of which will permit curing of the tobacco in the lower part of

the shed to commence and, as it were, catch up with the tobacco in the upper part of the shed, to the end that all the tobacco will be uniformly cured in the subsequent treatment involving use of the conditioning apparatus and the introduction of air to create a positive pressure within the shed. Air under positive pressure within the shed may also be used variously during any stage of the curing when it is desired to heighten the stack effect. Such may be accomplished by the introduction of atmospheric air into the shed through nozzles *f* in the preliminary stage, or conditioned air when the stack effect is used in a subsequent stage of the curing.

It will be understood that the apparatus according to this invention and variously the details thereof are not limited in their application to the drying of tobacco, but variously are adapted for application to the moistening of tobacco, in which application they variously are of advantage.

It will be appreciated that it is not intended to limit this invention by the above detailed description given for illustrative purposes, since, as will be obvious, various modification in detail may be made without departing from the scope of the invention.

This application is a division of the application filed by me Serial No. 369,653, filed December 11, 1940 (issued as Patent No. 2,343,346, March 7, 1944) as a continuation-in-part of my application Serial No. 274,133, filed May 17, 1939, now abandoned.

What I claim and desire to protect by Letters Patent is:

1. Apparatus for the treatment of tobacco comprising a walled structure having a treating chamber therein, adjustable louvers in opposite side walls providing openings to the atmosphere from the treating chamber, means for the support of tobacco leaves in mass within said chamber, a conduit in the lower portion of the chamber substantially parallel with the side walls, a plurality of upwardly directed, spaced nozzles extending from the conduit, means for delivering conditioned air from an air conditioner to said conduit, a baffle in line with jets of air issuing from the nozzles above the tobacco leaves for directing the air laterally and downwardly over the tobacco leaves, and an inlet to the air conditioner for air from the treating chamber after passing over the leaves of tobacco.

2. Apparatus for the treatment of tobacco comprising a walled structure having a treating chamber therein, adjustable louvers in opposite side walls providing openings to the atmosphere from the treating chamber, means for the support of tobacco leaves in mass within said chamber, a conduit in the lower portion of the chamber substantially parallel with the side walls, a plurality of upwardly directed, spaced nozzles extending from the conduit, means for delivering conditioned air from an air conditioner to said conduit, a baffle in line with jets of air issuing from the nozzles above the tobacco leaves for directing the air laterally and downwardly over the tobacco leaves, an inlet to the air conditioner for air from the treating chamber after passing over the leaves of tobacco, an outlet from the treating chamber to the atmosphere above the baffle and shielded thereby and a control valve in said outlet.

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