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(To replace No. 279)

VENTILATION OF TOBACCO BARNS

A well-ventilated tobacco barn.

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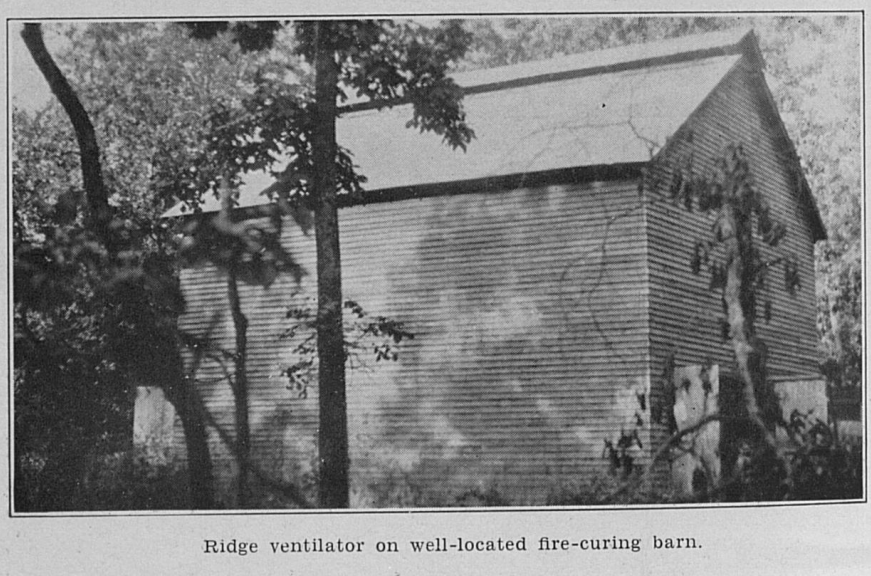

Ridge ventilator on well-located fire-curing barn.

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Ventilation of Tobacco Barns

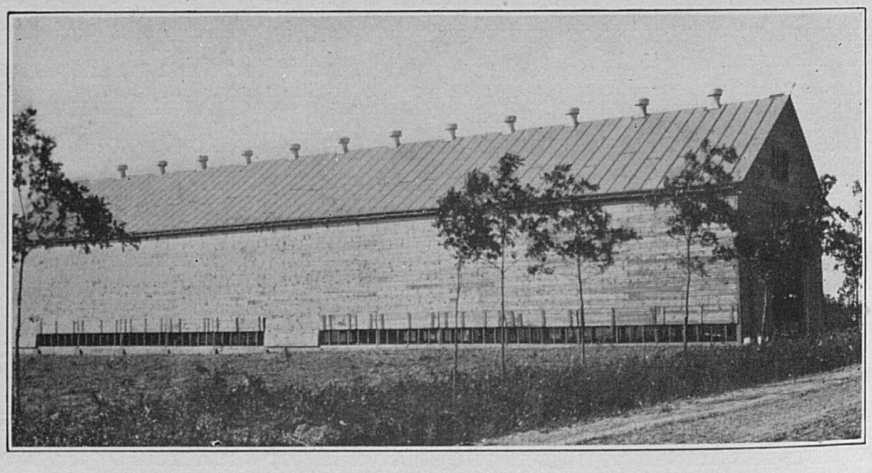
By RUSSELL A. HUNT and JESSE B. BROOKS

Curing is one of the most important operations in the production of tobacco. Successful curing depends largely upon the location and construction of the tobacco barn. In erecting a new barn or in repairing an old one, the important things to be accomplished are to construct it as nearly air-tight as possible and to provide a good system of ventilation. In general a site should be chosen which is thoroly drained and sufficiently removed from other buildings to allow free access of air. Since there are a sufficient number of barns in Kentucky to care for normal crops, the important problem confronting the tobacco grower at present is to improve existing structures by adding controlled ventilators rather than to construct new buildings. Most tobacco barns were built before there was definite information concerning the ventilation requirements for successful curing, consequently, comparatively few of them at the present time have any provision for ventilation in the roof, such as is shown in the cut on the title page, but controlled ventilation is an important feature in providing the best curing conditions.

The amount of ventilation required for a barn is determined by the location of the structure and the type of tobacco produced. A barn located on high ground and fully exposed to the wind and sun requires less ventilation than one in a valley or sheltered by a grove of trees. A barn designed for air cured tobacco, that is for white burley, one sucker or Green River, needs more ventilation than one designed for fire-cured tobacco. In so far as possible, an air-curing barn should be located on a ridge or hill and entirely in the open where there is free circulation of air, whereas a fire-curing barn should be in a grove of trees or valley, sheltered from the wind and sun.

THE NEED OF CONTROLLED VENTILATION

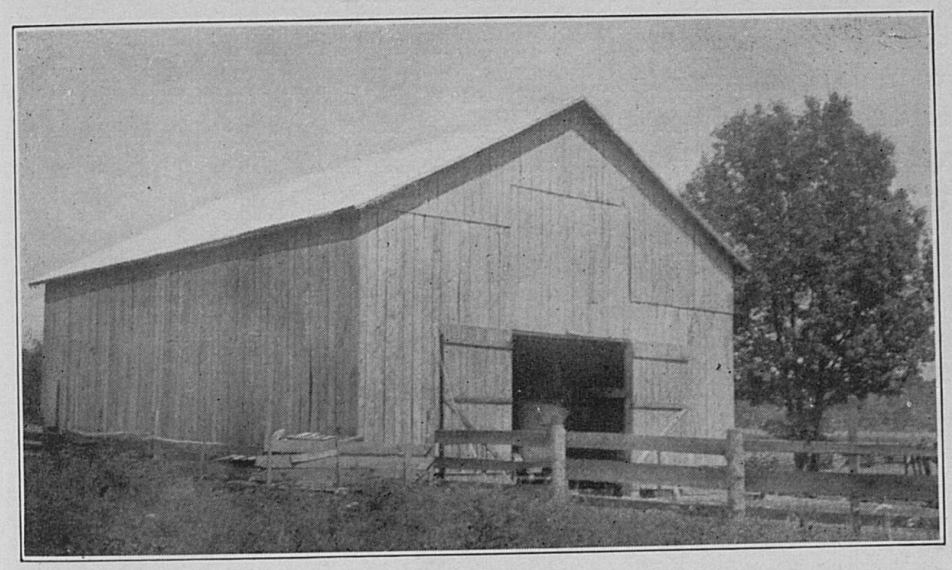
Circulating air is one of the important factors in curing tobacco, and the curing barn should be so constructed and ventilated as to permit rapid changing of air when needed. The tobacco is placed in the barn immediately following cutting, or after wilting, and the curing may be controlled by regulating the ventilation. Water constitutes the greater part of the ripened plant. During the first stages of curing this water is evaporated from the surface of the leaves, and one of the most important factors in curing is to properly regulate the rate of drying. If the leaf is dried too rapidly, it is killed prematurely, the curing is stopped and the color of the leaf remains green. On the other hand, if drying is too slow, the curing process goes too far, the tobacco either turns a dark red color or, possibly, becomes houseburned. The rate of drying of tobacco depends upon the humidity and temperature of the air and its rate of movement thru the barn.



Tobacco barn with insufficient ridge ventilation.

The water content of tobacco at the time of cutting and housing may range from 75 to 90 percent of the green weight. An acre of well-ripened tobacco yielding 1,500 pounds of cured leaf weighs when harvested 8 to 12 tons, including the stalks. Of this total weight, by far the greater part is water. To cure tobacco successfully, this large amount of water must be removed under such con-

ditions and at such a rate as best allow the other fundamental changes to occur. Experience has shown that the well-constructed barn, properly ventilated, provides the means for regulating the humidity in the curing crop, thru controlled air movement.



Unventilated barn.

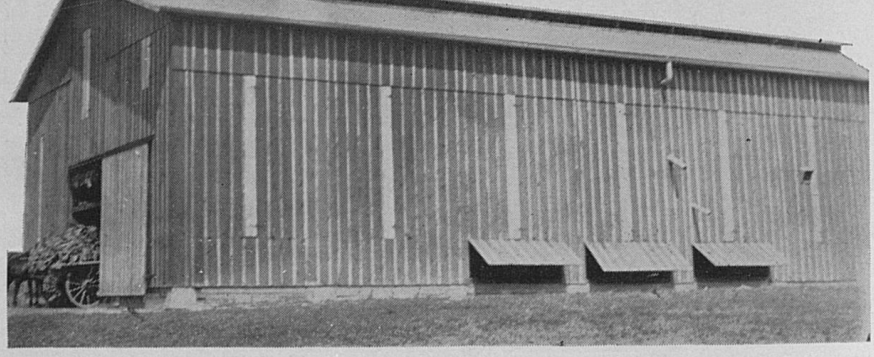
METHODS OF VENTILATION

Many plans have been devised for ventilating barns. Few have been satisfactory under all conditions. The hinged vertical shutter or side door 10 to 12 inches wide, for each bent, is one of the oldest and most generally used in Kentucky. It is effective only when the air outside the barn is moving sufficiently to cause some circulation in the barn. It is entirely ineffective in hot, sultry weather, when there is little or no air movement. Practically all barns in the areas producing air-cured tobacco are equipped with this ventilator.

The round, metal, roof ventilator, in general use, improves curing conditions when used with the side-door or vertical ventilators, just mentioned. The usefulness of this ventilator depends upon the number placed on the barn and the size of the openings. The most common sizes are the 16″ and 20″, and a few barns have ventilators 24″ in diameter. The approximate amounts of opening provided by the 16″, 18″ and 20″ circular ventilators are 1.3 sq. ft.,

1.8 sq. ft. and 2.2 sq. ft., respectively. The common practice is to use only one circular ventilator to each bent of 12 feet, so the amount of ventilation provided is inadequate unless natural conditions are favorable for curing.

Experience has proved that satisfactory ventilation for the various types of tobacco, suitable for all barns, is provided by the ridge ventilator, supplemented by horizontal ground ventilators. For the air-cured tobaccos it is advisable to provide the vertical side-door ventilators also. The vertical side-door ventilators are not recommended for fire-curing barns.



A well-ventilated air-curing barn with ridge, horizontal bottom and vertical ventilators.

Comparatively few barns have any provision for controlled ventilation in the roof. However, by the use of barns with the full-length ridge ventilator and the horizontal doors extending along the entire length of the sides, near the ground, many growers have cured their crops successfully. The ridge ventilator is undoubtedly the best type of top ventilator so far designed, for providing the proper curing conditions in all tobacco barns. It provides a continuous outlet opening at the top of the roof, from one end of the barn to the other, and when used with the horizontal ground ventilators, permits satisfactory control of air condition and movement. The ridge ventilator is recommended because it is simple to construct, easy to operate and, when constructed according to the specifications herein recommended, provides sufficient opening for thoro ventilation.

USE OF VENTILATION

After the tobacco is hung in the barn the water is evaporated from the surface of the leaves and the relative humidity of the air in the barn is increased. Since air of high humidity is lighter than drier air, the moist air rises. In warm, dry weather, opening the doors of the ridge ventilator and the horizontal ground ventilators, or the vertical shutters on the sides of the barn, usually is all that is needed to provide good curing conditions.

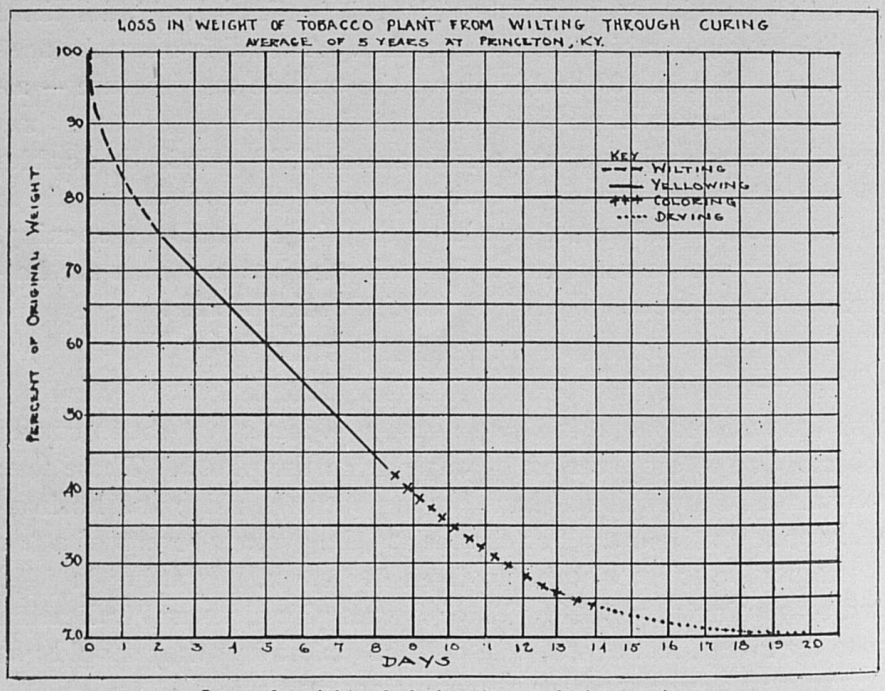
During rainy or foggy weather, when the air is practically saturated with moisture, ventilation alone is ineffective. Under these conditions some artificial heat is needed. A small increase in temperature — that is, 10° to 15° above the outside temperature — assists curing in two ways: first, warm air holds more moisture than cool air; for example, a rise in temperature of 20° practically doubles the water-holding capacity of air. Second, as soon as the air is heated, it rises and passes out thru the ridge ventilator opening, carrying away excess moisture. The air which enters thru the bottom openings becomes warm and continues the process.

LOSS OF WEIGHT IN CURING

Tests made at the Western Kentucky Substation at Princeton, with fire-cured tobacco, indicate the rate of loss of weight in curing tobacco, due to evaporation of water from the plants. These tests were made in a ventilated barn having both the ridge and horizontal bottom ventilators. The figures are the average results of a few representative sticks of tobacco from five crops, beginning in 1928 and continuing thru 1932. These figures give a general indication as to the rate of loss of water in curing tobacco but they should not be regarded as standard for all conditions and crops.

In each of the five years mentioned a few sticks of fire-cured tobacco were cut and hung and immediately weighed and then reweighed daily until completely cured. From these weights it was found that for each hundred pounds of tobacco freshly cut and hung on sticks, seventy-five pounds remained when wilted, fifty-three pounds when yellowed, twenty-five pounds when colored, and eighteen pounds when the leaf and stems were dry, but the stalks still green. Or, for a single stick of tobacco weighing thirty pounds when cut, twenty-two and one-half pounds remained when wilted,

sixteen when yellowed, seven and one-half when colored, and five and one-half when the leaves and midribs were dry. Approximately two-thirds of the original weight was lost by the evaporation of water during the first ten days the tobacco was in the barn. This would mean for each acre of fire-cured tobacco housed, there would be an average loss of 800 gallons of water, by the time the leaf was cured. It should be borne in mind that these studies were made with fire-cured tobacco but results obtained also probably apply to dark air-cured tobaccos, tho not to burley. The rate of loss of



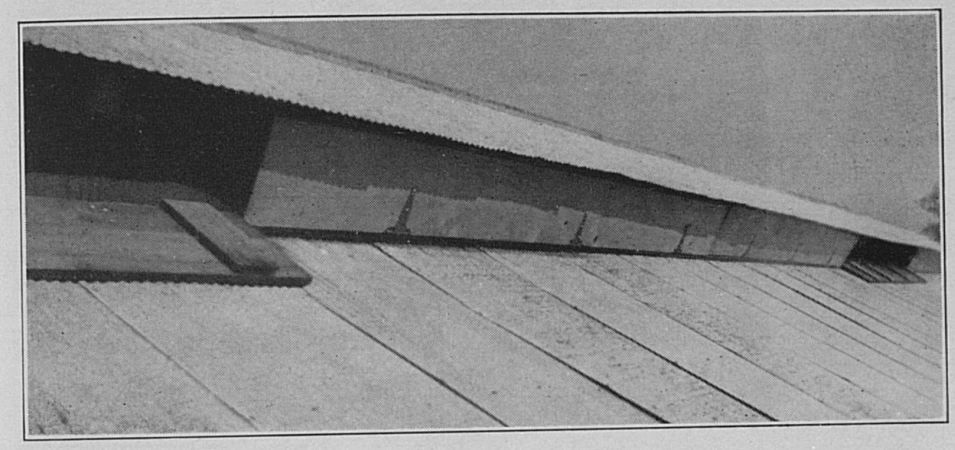
Loss of weight of dark tobacco during curing.

weight by loss of moisture is shown by the graph on page 8. Starting with 100 percent on the first day as the original weight the drop is to 18 percent on the 20th day. This graph shows *average conditions only*. The loss of water from individual crops undoubtedly would show considerable variation, according to the size of the plants housed and weather conditions during curing.

TO BUILD A RIDGE VENTILATOR ON AN OLD TOBACCO BARN

Two types of ridge ventilator are illustrated in Plans No. 1 and No. 2. There is very little difference in the cost of building these.

They may be used with all kinds of roof coverings, but it is difficult to fit the doors and hinges of plan No. 1 to roofs covered with sheet metal. Plan No. 2 has the following desirable features: (1) the door

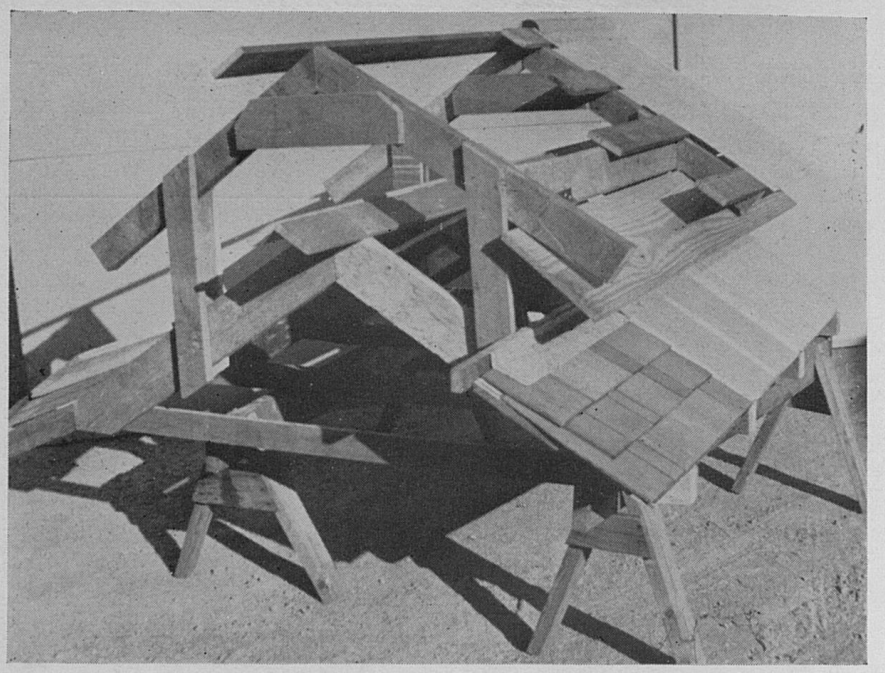


Ridge ventilator partially open. (Plan No. 1)

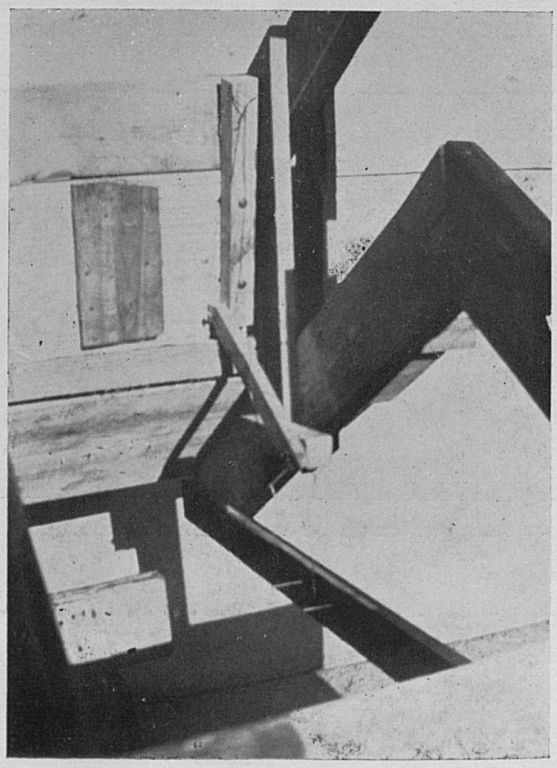
when open is held against the bottom edge of the rafters and is protected from sun and rain; (2) the hinges placed at the top edge of the door and under the ventilator roof are protected; (3) the door

Ridge ventilator being constructed on wooden shingle roof according to Plan No. 1, Fig. 7, page 17.

when closed rests against a flashing board which prevents the leakage of rain and snow under it, the flashings making a tight fit regardless of the kind of covering used (see Fig. 9); (4) simple levers



Model of ridge ventilator built according to Plan No. 2. Refer to Fig. 9, page 18.

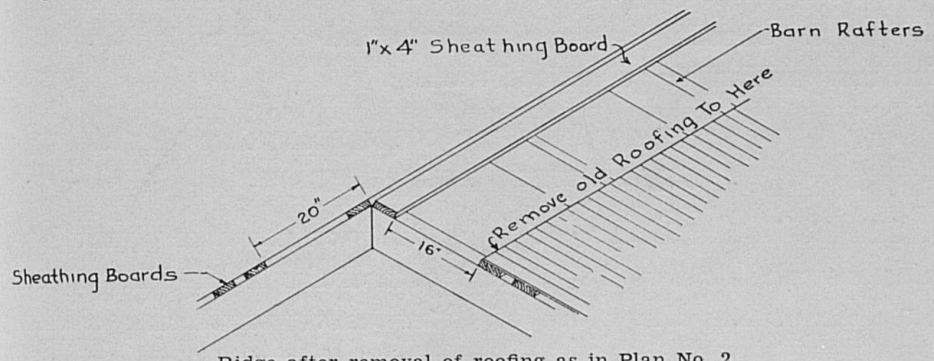


Detail of door levers used in Plan No. 2. Refer to Fig. 9, page 18.

and wire are used instead of pulleys and ropes to hold the door open and to close it tight.

Step 1. Select the plan, either No. 1 or No. 2, and study it until it is understood.

Step 2. Remove the roofing for the width on each side of the ridge indicated in the plan. Metal roofing may be cut with a bolt



Ridge after removal of roofing as in Plan No. 2.

cutter, heavy tin snips, shingling hatchet, or an old car spring or bumper sharpened on one edge. If the metal or composition roofing is in good condition after removing, it should be saved for covering one side of the ventilator top.

Step 3. Remove the sheathing. Usually a 4″ board is left on each side of the ridge; however, they may be removed when building according to Fig. 8, Plan 1. The sheathing is removed to the width from the ridge shown in the plan.

Step 4. Build the ventilator. For barns 24 feet wide or less, the effective ventilation opening should be 10 inches wide. For barns more than 24 feet wide, this opening should be 12 inches wide. Cut the false rafters for the ventilator roof 36 inches long. These are cut and nailed together on the ground; then raised to the top of the barn with a pulley. Refer to plan for the spacing of the false rafters. A string line should be used to line in the ends and ridge of the false rafters. A carpenter's level is used to plumb the upright ties in Plan 2, Fig. 9.

Step 5. After the rafters have been nailed in place, hang the door as shown in the plan. For the door, use 1-inch boards as wide as the ventilator opening, when building according to Plan 1. The door in Plan 2 is made 2 inches wider than the ventilator opening

in order to cover the flashing board. The doors are as long as one bent of the barn, cleated on the inside, and painted on both sides to prevent warping. After hinging the door, the pulleys, levers, ropes or wires may be connected and tested for ease of operation. In Plan 2, place a 2″ x 4″ block at an angle between the upright rafter ties for the ends of the door to rest on.

Step 6. Sheathe the ventilator top and cover with wood shingles, composition, or galvanized roofing.

TO PUT HORIZONTAL INLET VENTILATOR DOORS IN A DARK-FIRED TOBACCO BARN

The horizontal inlet ventilating doors at the base of the barn walls on each side should run full length of the barn. For barns 24 feet wide or less, the width of the effective ventilating opening should be 10 inches. For barns over 24 feet wide, this opening should be 12 inches. (Refer to Figs. 6, 6a, on Page 16, 10, 10a, 11, and 11a on Page 19.) Figs. 6, 6a, and 10 are plans for bottom ventilators where the barn is set on blocks. If the barn is supported on a solid foundation, a ventilator as shown in Fig. 11 should be built. Note that the doors on the bottom ventilators for fire-curing barns are placed so as to direct the air above the fires, when open.

Bottom ventilators built on a fire-curing barn (according to Fig. 11, Page 19) over a solid concrete foundation.

TO PUT IN AIR INLET VENTILATORS IN AIR-CURING BARNS

In air-curing barns, both horizontal and vertical ventilators are used in addition to the ridge ventilator. (See Fig. 1.) Three 12″ vertical ventilators on each side are provided for each 12-foot length of barn. The horizontal inlet ventilating doors run full length of the barn. The width of the opening of the bottom ventilators varies from 10″ to 4′ (see Fig. 3, page 15, and illustration on page 6).

Bottom ventilators built on a fire-curing barn as shown in Fig. 10, between the concrete blocks that support the barn posts. The middle door is shown partially open.

Bill of Material for Each 12 Feet of Ridge Ventilation

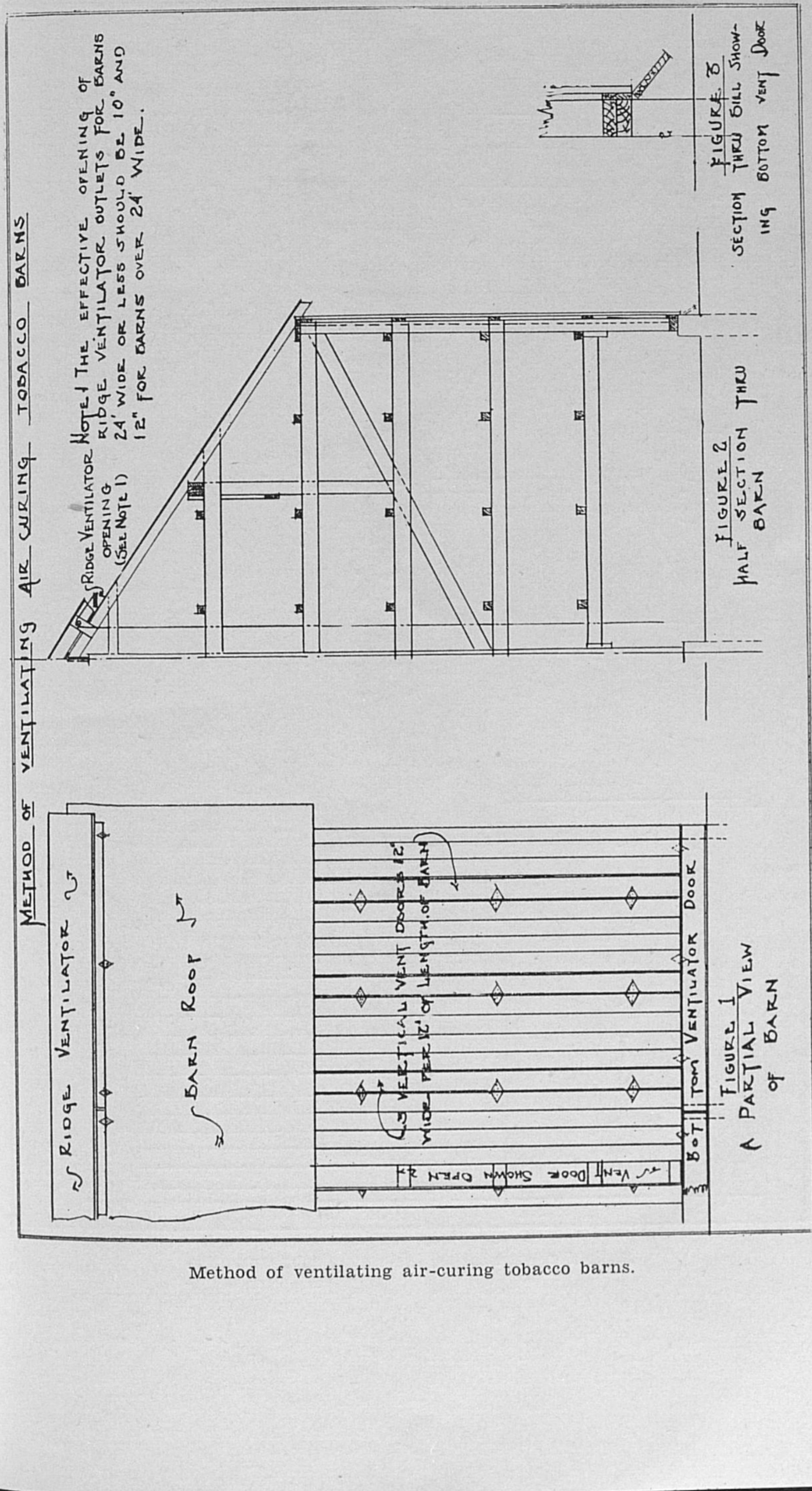
Note. Where original roofing and sheathing are used to cover the ventilator top, the amount of sheathing in each bill can be cut one-half. This depends upon the kind of material used for roofing.

Items	If built as in Figure 7
False rafters	3 pcs. 2″ x 10″ x 6′-0″ Or 3 pcs. 2″ x 12″ x 6′-0″
Supporting blocks	1 pc. 2″ x 4″ x 6′-0″
Ventilator door	2pcs. 1″ x 10″ x 12′-0″ Or 2 pcs. 1″ x 12″ x 12′-0″
Ties	1 pc. 1″ x 6″ x 12′-0″
Cleats	1 pc. 1″ x 4″ x 8′-0″
Sheathing	80 Bd. Ft.
Roofing	80 Sq. Ft.
Hinges	3 pr. 4″ galv. strap hinges
Pulleys	2 pr. galv. swivel awning rope-pulleys, wheel 1″ dia.
Rope	16′ of ¼″ rope
Bolts	2 pair screw-eyes or eye-bolts
Nails (approx.)	2 lbs. 8d, ¼ lb. 6d, and ¼ lb. 10d

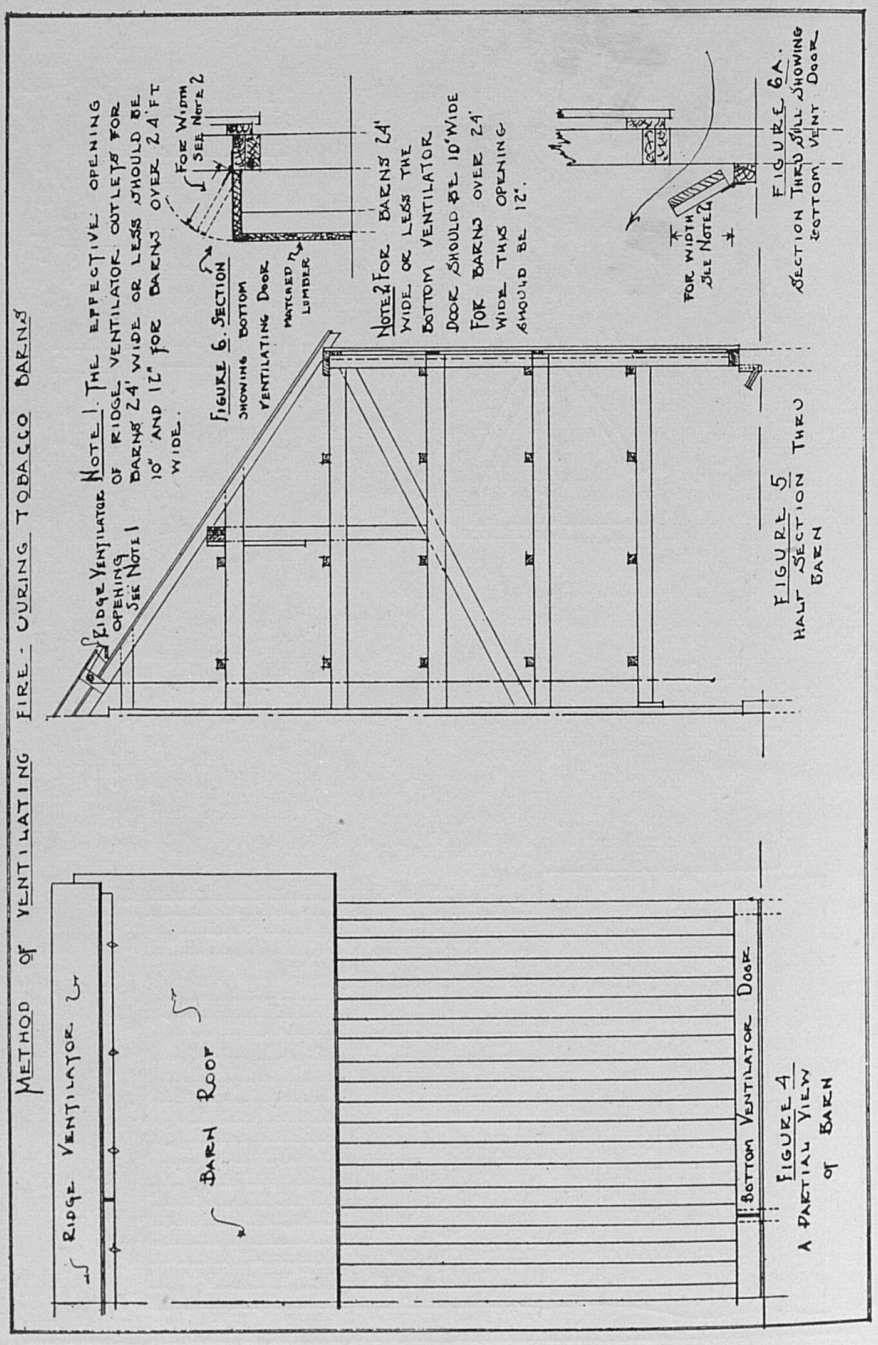
Items	If built as in Figure 8
False rafters	6 pcs. 2″ x 4″ x 6′-0″
Supporting blocks	Not necessary
Ventilator door	2 pcs. 1″ x 10″ x 12′-0″ Or 2 pcs. 1″ x 12″ x 12′-0″
Ties	3 pcs. 2″ x 4″ x 10′-0″
Cleats	1 pc. 1″ x 4″ x 8′-0″
Sheathing	80 Bd. Ft.
Roofing	80 Sq. Ft.
Hinges	3 pr. 4″ galv. strap hinges
Pulleys	2 pr. galv. swivel awning rope-pulleys, wheel 1″ dia.
Rope	16′ of ¼″ rope
Bolts	2 pr. screw-eyes or eye-bolts
Nails (approx.)	2 lbs. 8d, ¼ lb. 6d, ¼ lb. 10d

Items	If built as in Figure 9
Upright rafter ties	4 pcs. 1″ x 4″ x 8′-0″
False rafters	2 pcs. 2″ x 4″ x 12′-0″
Rafter ties	1 pc. 1″ x 4″ x 6′-0″
Boards between rafters	2 pcs. 1″ x 6″ x 12′-0″
Levers	1 pc. 2″ x 2″ x 10′
Flashing board	2 pcs. 1″ x 2″ x 14′-0″
Sheathing	80 Bd. Ft.
Roofing	80 Sq. Ft.
Door cleats	1 pc. 1″ x 4″ x 10′-0″
Ventilator door for 10″ opening	2 pcs. 1″ x 12″ x 12′-0″
Ventilator door for 12″ opening	2 pcs. 1″ x 6″ x 12′-0″ & 2 pcs. 1″ x 8″ x 12′-0″
Hinges	3 pr. 4″ galv. strap hinges
Flashing for corrugated roof	12 Ft. of ridge roll
Flashing for V-crimp roof	24 Ft. of flat sheet metal 9″ to 10″ wide
Stove bolts	16 bolts 2½″ x ¼″
Nails	4 lbs. 8d, 2 lbs. 6d, and ¼ b. 20d

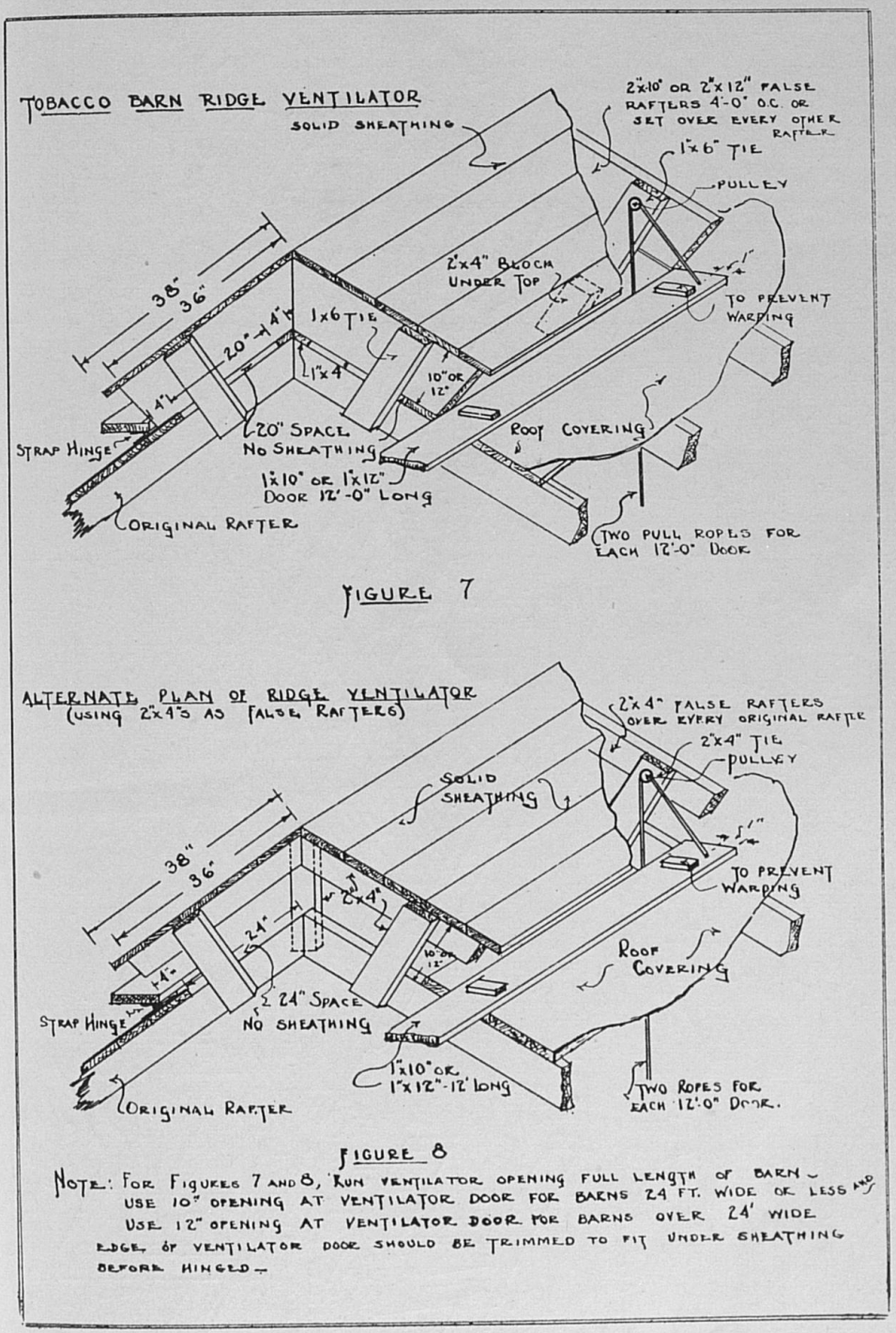
METHOD OF VENTILATING AIR CURING TOBACCO BARNS



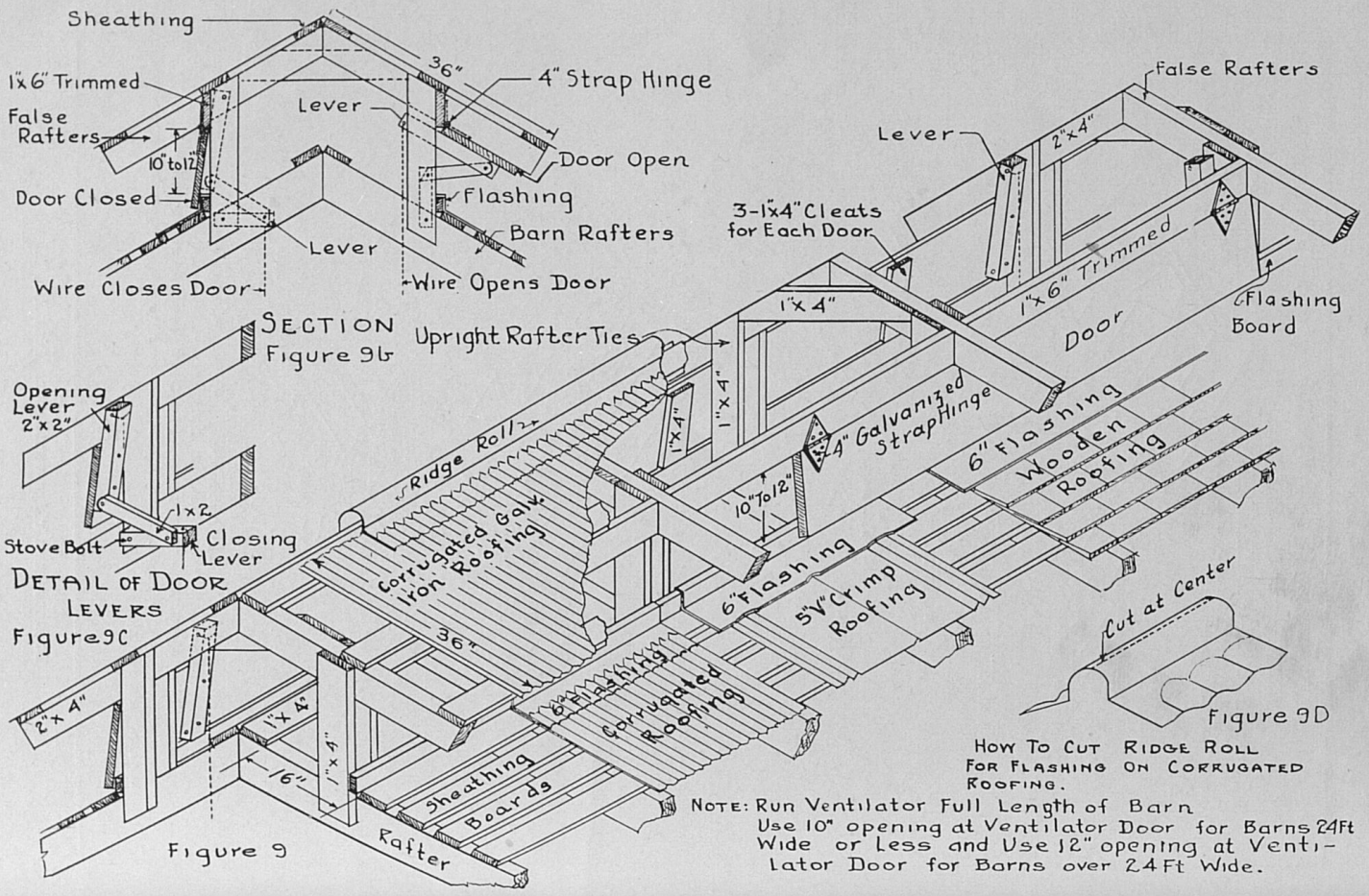
Method of ventilating air-curing tobacco barns.



Method of ventilating fire-curing tobacco barns.

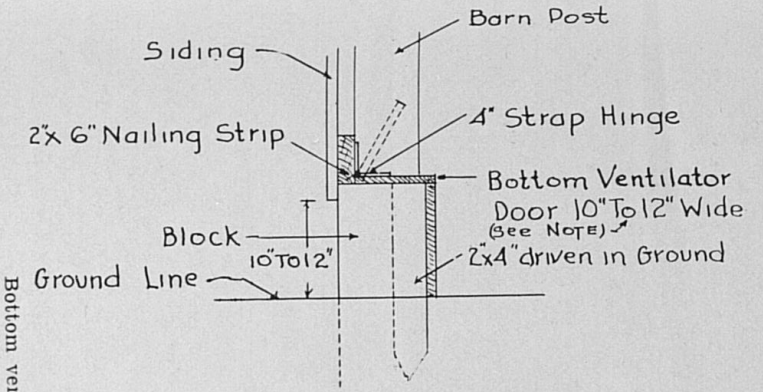


Tobacco barn ridge ventilator. Plan No. 1.



NOTE: Run Ventilator Full Length of Barn
Use 10" opening at Ventilator Door for Barns 24Ft Wide or Less and Use 12" opening at Ventilator Door for Barns over 24 Ft Wide.

Tobacco barn ridge ventilator. Plan No. 2.



SECTION

Figure 10

NOTE: Run Ventilator Full Length of Barn Use 10" opening at Ventilator Door for Barns 24 Ft Wide or Less and Use 12" opening at Ventilator Door for Barns Over 24 Ft Wide.

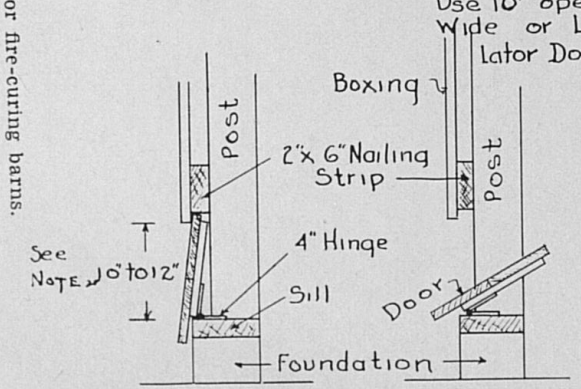


Figure 11

SECTION
Door Closed

SECTION
Door Open

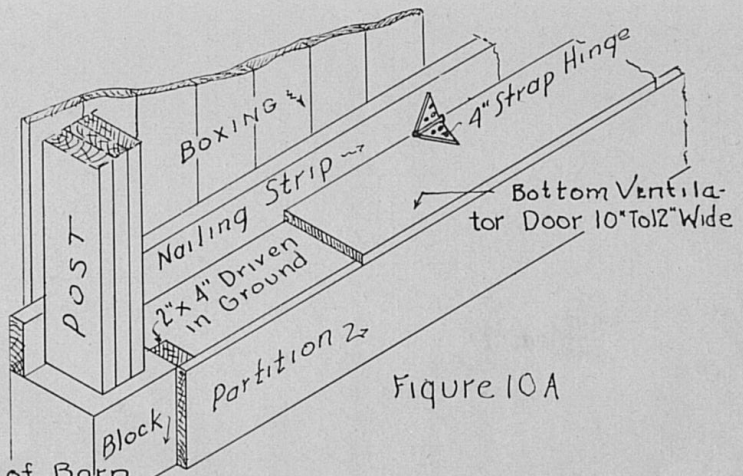


Figure 10A

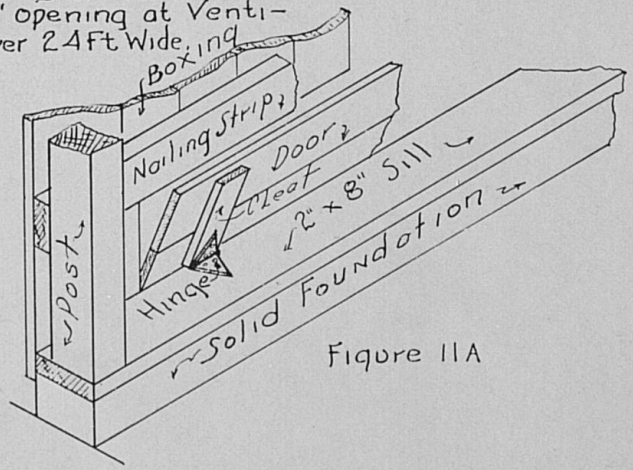


Figure 11A

Bottom ventilators for fire-curing barns.