HOW TO VENTILATE POTATO STORAGES

by Eric B. Wilson
Washington State University Extension Agricultural Engineer

If it pays to store potatoes for several months, it will pay to ventilate to maintain top quality.

Research has determined that proper temperatures can be maintained with forced ventilation. For summer storage the use of sprout inhibitors plus ventilation does a commendable job.

In general a ventilation system should force air up through the pile of potatoes. The air must be maintained at the proper temperature, about 40° F. with a relative humidity of about 90%.

For existing storages a practical method of forcing air through a pile of potatoes is to introduce the air into a system of delivery ducts laid on the floor. In order to be easily manageable these ducts should be portable, so they can be installed as the storage is filled and removed as the potatoes are taken out. In this way they can be kept out of the way of piling or unloading machinery.

For new storages the duct system can be built into a concrete floor or can be portable and similar to those for existing storages.

Duct Sizes and Shapes

Portable delivery ducts may be made in lenghts of 4 to 12 feet using lumber or plywood. A rectangular shape is desirable for stability under a heavy pile of potatoes.

Permanent ducts in concrete may have a dual purpose. If they are to be used for moving potatoes either with water or a conveyor, this use must also be considered. As far as ventilating air delivery is concerned, a duct of square cross-section is most efficient.

For good air distribution the ducts should be tight and the air released through holes in the side. See Figure 1. If the top of the duct is made with planks that overhang the sides about 2 inches, it is unlikely that any hole will become blocked by a potato or dirt.

Delivery air ducts should be spaced 10 feet apart, center to center. One inch diameter holes spaced as indicated in Table 1 will give the proper air distribution.

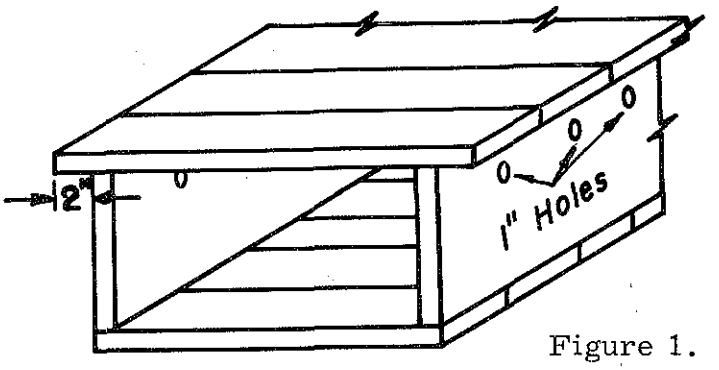

Figure 1.

Delivery ducts may be laid in any direction under the potatoes. Generally, for narrow storages (up to 48 feet) it is desirable to install them lengthwise of the building. See Figure 3. For storages 60 feet or wider

they are generally run crosswise. In all cases they should extend to within 5 feet of the edge of the pile, or the center if ducts come in from both sides.

Table 1--SPACING FOR 1" HOLES
(Both sides of Delivery Duct)

Depth of Potatoes	6'	8'	10'	12'	16'	20'
Hole Spacing	20"	15"	12"	10"	7-1/2"	6"

The size of the distribution duct depends upon the amount of air it must carry. The amount of air required is dependent upon the amount of potatoes to be ventilated.

With delivery ducts spaced 10 feet apart under potatoes 10 feet deep, the cross-sectional area for each duct of any length up to 200 feet may be obtained from Figure 2.

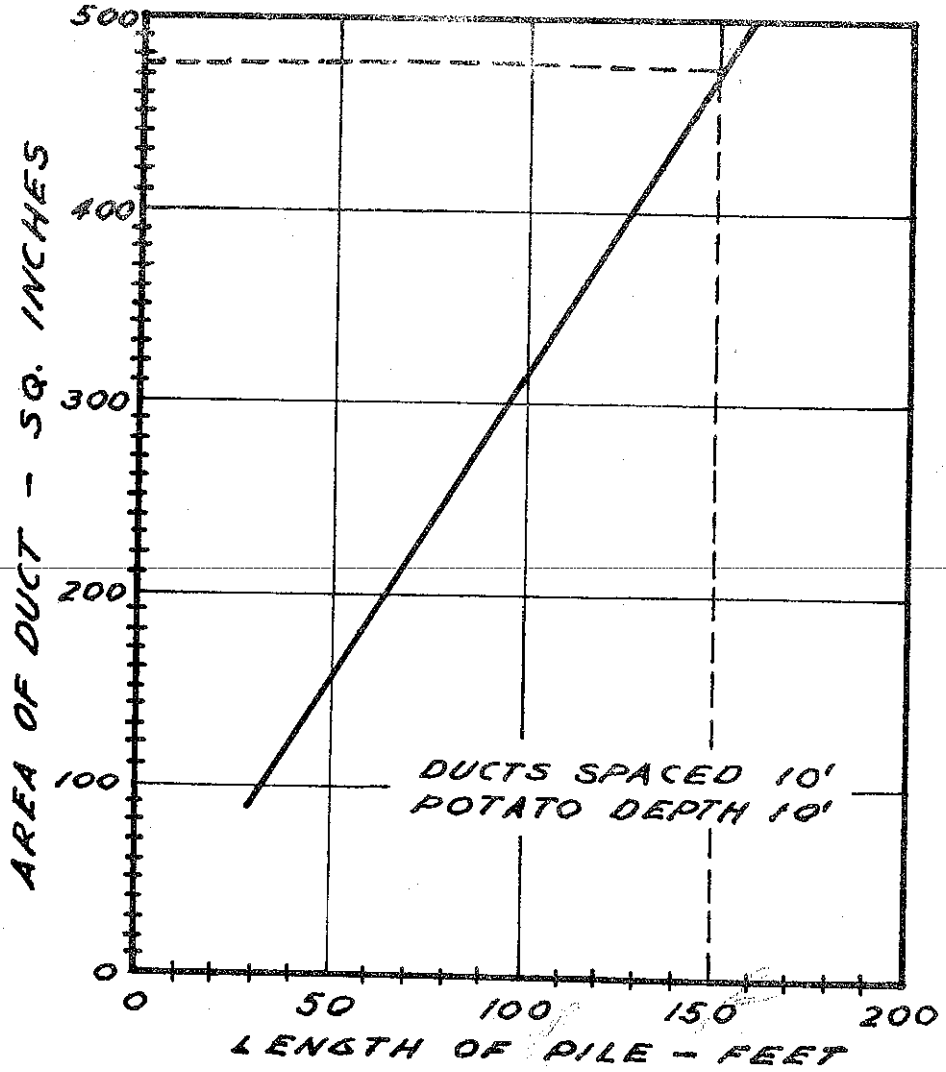

Figure 2. Area of Delivery Duct for Potato Storages of various lengths. Based on ducts spaced 10 feet center to center and a potato depth of 10 feet.

For depths other than 10 feet determine the area required for 10 feet from Figure 2, and multiply by the depth divided by 10. For example, find the area required for a duct 150 feet long under potatoes 12 feet deep. From Figure 2 the area of duct required is 475 square inches for the 10 foot depth. For 12 feet of depth the area of duct required would be 1.2 X 475 or 570 square inches. For an 8 foot depth the required area would be .8 X 475 or 380 square inches.

A duct should be wider than it is high for stability reasons. However, the width should not be more than 2-1/2 times the height for good air flow. Consequently good dimensions for a duct area of 570 square inches is 16" X 36".

In a similar manner sizes of ducts spaced something other than 10 feet a-part, center to center, can be determined. That is if the spacing is wider than 10 feet. Multiply the area from Figure 2 by the spacing divided by 10. For good air distribution, ducts should not be spaced more than 12 feet center to center.

Main Ducts

Air must be delivered to all of the delivery ducts through main ducts. Main ducts would ordinarily be across the end of the storage in a smaller cellar or down the sides in a large one.

Each main duct should have a cross-sectional area equal to the total of the areas of all the delivery ducts it serves. For example, a main duct that serves two 570 square inch delivery ducts should have a cross-sectional area of 1140 square inches. Or if one main duct would serve 15 delivery ducts with 120 square inches each, it would need 15 X 120 or 1,800 square inches.

Any duct may be tapered, but good air distribution can be obtained without tapering. At any point along the length of a tapered duct its cross-sectional area should be equal to or greater than the cross-sectional area of the re-maining distribution ducts that it feeds.

One other point about main ducts. If they are made circular, square or near-ly square, the cross-sectional area may be reduced 10% from the areas com-puted as described above.

Fan Size and Specifications

Before a fan can be ordered you will need to know what rate of air flow is needed and the static pressure against which the fan will operate.

The first part, air flow, is determined by providing 10 cubic feet per minute* for every ton of potatoes the storage will hold. To find the tons of potatoes, assume 50 cubic feet per ton and multiply length times width times depth to obtain volume in cubic feet. For example, a storage 100 feet long, 40 feet wide with potatoes 10 feet deep would contain 100 X 40 X 10 or 40,000 cubic feet of potatoes. Dividing 40,000 by 50 gives 800 tons of potatoes. Multi-

*Ten cubic feet per minute per ton of potatoes is recommended for this area. If higher rates are to be used the calculations for total air needed as well as duct sizes must be increased accordingly.

plying 800 times 10 gives 8,000 cubic feet per minute of air needed.

Static pressures may be estimated as follows: for small narrow cellars with a main duct across one end assume a static pressure of 1 inch of water. For longer and wider storages with main ducts along the sides assume a static pressure of 1-1/4 inches of water.

Thus, for the 100' X 40' X 10' cellar assumed above, a fan that will supply 8,000 CFM at 1 inch static pressure is required. A wide storage such as a 100 X 80 X 10 would require a fan to deliver 16,000 CFM at 1-1/4 inches of water.

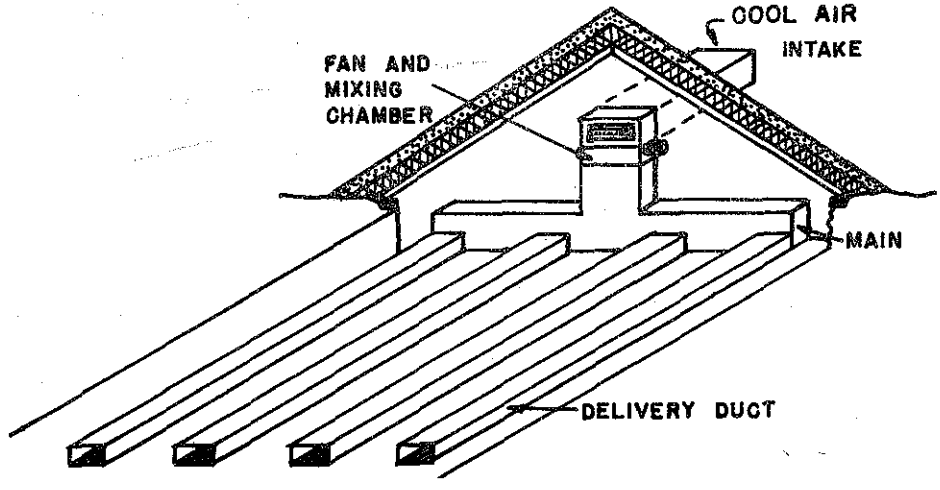

Figure 3
Typical Ventilation System
40' wide Potato Storage.

Controls and Accessories

The air must be supplied on an intermittent basis to control the temperature and humidity. If the air is not circulated enough of the time, the potato temperature will rise and if it is circulated to much of the time, undue loss of moisture will result. Thus, the fan should be started and stopped by means of a thermostat in the pile of potatoes. Also, if the potatoes need to be cooled, cool outside air must be supplied. However, if when the potatoes need to be cooled, the outside air is warmer than the potatoes, the fan must not circulate outside air. By recirculating inside air at these times and bringing in cooler air when it is available, the potatoes can be kept in good condition. See Figure 4.

Air must be circulated intermittently at all times. Sometimes the outside air is too warm to be used while at other times it may be cold enough to freeze the potatoes. Therefore, a system of dampers must be used so that outside air can be mixed with inside air in quantities sufficient to cool but not freeze the potatoes. Hence, a rather complicated set of controls is required. Controls are available for the automatic operation of such a system. Automatic controls are recommended not only as a labor saver, but because they can maintain a much more constant temperature than is possible manually.

To maintain the high relative humidity desired some type of humidifier is re-

commended. This can be a set of nozzles spraying water into the air stream. Fairly high humidity can also be obtained by blowing the air stream across a free water surface.

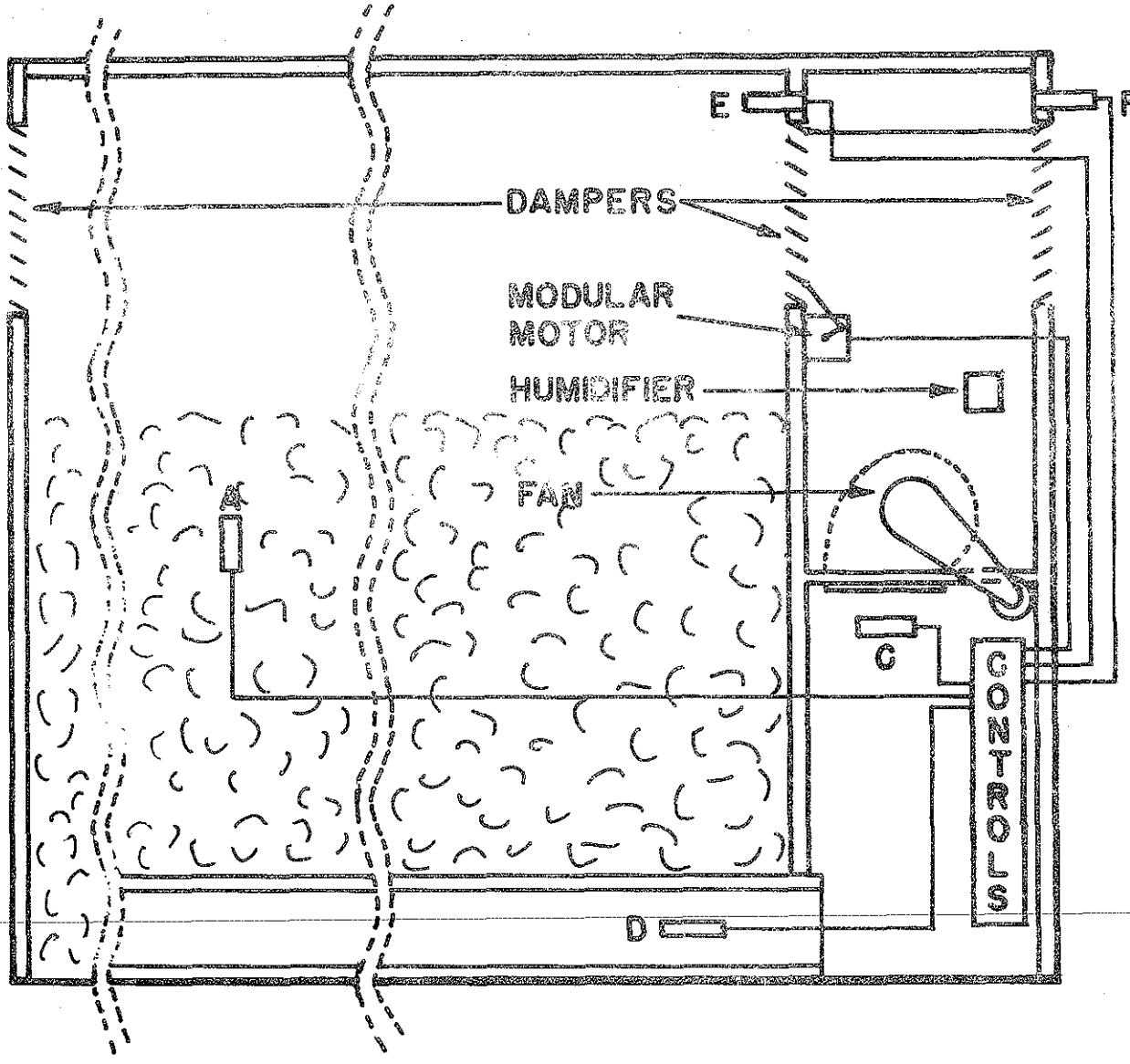

Figure 4

Packaged Units

In order that you might have the best trouble free ventilating system, I strongly recommend that you install a "packaged unit". Such a package should contain the fan, motor, mixing chamber with dampers, humidifier and all the controls indicated in Figure 4. It can be pre-assembled, pre-wired and even pre-adjusted, ready to be set on a farm constructed duct system. We, of the Washington State University Agricultural Extension Service will welcome any opportunities to talk further with any of you who are either contemplating the installation of a ventilating system, or would like to improve the system you have.

Also, we would welcome an opportunity to discuss the design, construction and installation of "packaged units" with interested equipment suppliers.