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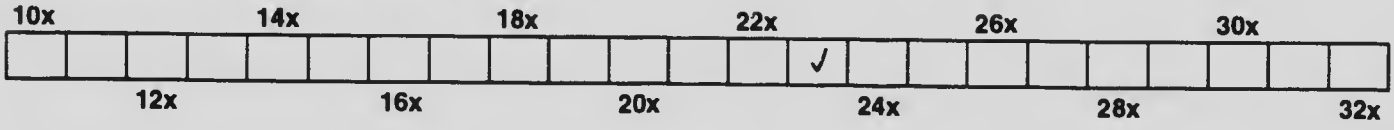
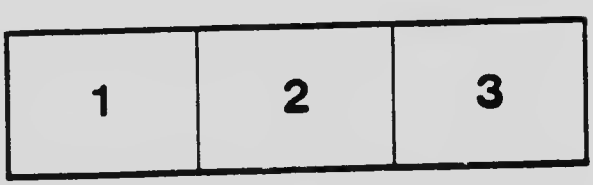
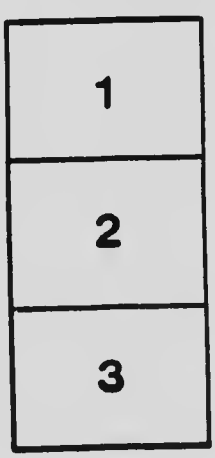
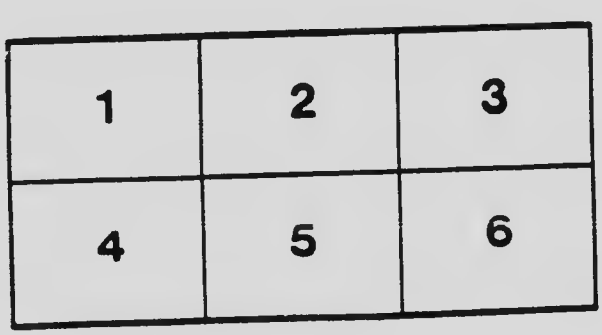
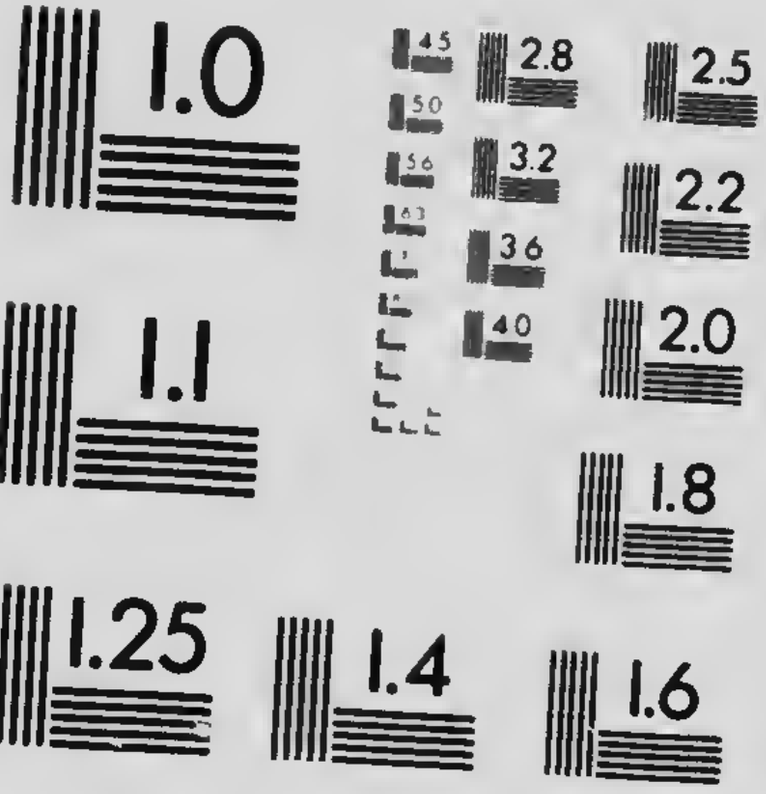




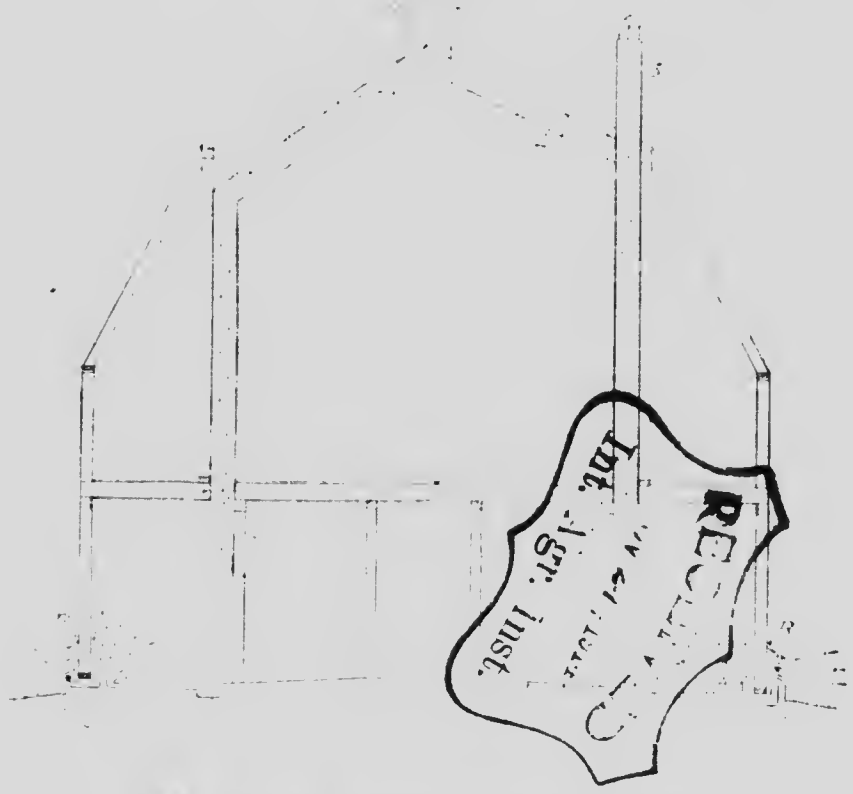






Bulletin No. 13 May, 1914

BARN VENTILATION



Manitoba Agricultural College

Winnipeg, Canada

L. J. Smith, B. S., Professor of Agricultural Engineering

Printed by the Authority of Hon. G. [illegible] Minister of Agriculture and Immigration.

Manitoba Agricultural College
Winnipeg,
May 24th 1911

To the Hon. George Law — c
Minister of Agriculture and Immigration,
Parliament Buildings
Winnipeg, Manitoba

Dear Sir:

I beg to present herewith copies of Bulletin No. 3 of the Manitoba Agricultural College entitled Barn Ventilation by E. J. Smith Professor of Agricultural Engineering.

This Bulletin is not intended as an exhaustive treatise on [illegible] nor as representing special investigational work carried on by the College [illegible] describes systems of ventilation, and [illegible] information is intended to be helpful to many farmers of [illegible] who are anxious to be informed on the subject.

Yours very truly,
W. J. BLACK,
President

Barn Ventilation.

INTRODUCTION

Only a recent years has the [illegible] to realize the necessity of good barns to the [illegible] of the health of those animals that are shut in for at least the greater part of the winter season. In erecting these barns the important items of construction necessary to the health of the stock to be housed, must not be overlooked namely good lighting, a sanitary interior and some means of providing ample ventilation.

Sunlight and ventilation must be had even at the expense of heat in the stable. Windows should be fairly small and uniformly distributed, cattle barns being large and few in number. They should be located high enough to let the sunlight well into the interior of the barn. No cold air leaking in around the windows made thus conditions will have time to mix with the warmer air at the top of the stable before reaching the stock. Putting windows in high also reduces glass breakage to a minimum. There should be one square foot of glass to every twenty or twenty-five square feet of floor space. The glass should be cleaned at least twice a year, in order not to cut off sunlight. This does not mean a painstaking washing and drying of windows, such as is done by the housewife, but merely a washing to get off the dust and cobwebs. The interior walls should be smooth so as to be easily brushed down, and should be whitewashed both for sanitary purposes and to prevent absorption of light. The stable floors should be of concrete to afford easy cleaning and wearing and to prevent absorption of liquids.

Contrary consideration in barn building.

BARN VENTILATION IN GENERAL

Barn ventilation is necessary to various regards to remove dust in the air, impurities from the skin, vapors and odours arising from the manures, to carry off the carbonic acid gas breathed from the lungs of the animals and to replace it with pure outside air; to keep down the amount of moisture in the air in the barn, to regulate the temperature of the

Why ventilate Barns.

stable are, [illegible] germs. If one animal in a stable has tuberculosis [illegible] strongly in favor of other animals contracting the disease unless the stable be flooded with sunlight and well ventilated and unless the air is changed frequently.

Limitations of a ventilation system.

No natural system of ventilation has yet been devised or probably ever will be devised, that will work entirely automatically. Like everything else its operation needs some attention. Nor is it possible to give the animals in the average barn all the air that is considered necessary and still keep the inside temperature above freezing during the coldest portions of Manitoba's winter months. Still, excepting the two coldest months, the temperature rises sufficiently high so that a full amount of ventilation can be had part of the time and a fair amount nearly all the time. At the same time it is possible to have a good system of ventilation in a barn and still be very unsatisfactory because of a lack of knowledge or attention in operating it.

How a natural ventilation system operates.

All natural systems of ventilation work on the same principle. Warm air rises. If out take flues are provided passing up through the loft of the barn, the warm air rises through the flues and equal volumes of colder air are drawn in to the barn through intake flues arranged along the sides of the stable, and by leakage around the doors and windows and in many cases, through the walls of the stable. The principle of ventilation is the same as the draft in the ordinary stove or furnace. In barn ventilation, the animals furnish the heat necessary to cause the circulation of the air.

Factors to be considered in regulating barn ventilation.

The efficiency of the system of ventilation adopted is dependent upon several factors, namely, the position and size of in take and out-take flues, the smoothness of the inside of the out take flues and the number of bends in the same, the rate at which the wind is blowing, and the difference in temperature between the inside and outside of the barn. As regards position of the flues, the higher the out take the greater the draft. Their size must be figured so as to ensure ventilation under most adverse natural conditions such as for quiet weather, and for the cool weather at the beginning and end of winter, for under such conditions the air moves at its slowest rate up the out-take flues. Other things being equal the circulation of air through the flues will be more rapid in windy than in quiet weather. In regard to the effect of difference in temperature, a partially filled stable, too much wall space caused by unnecessary high walls, poorly built walls, ill fitting doors and windows, waste space due to unnecessarily large passages, stalls

The two systems are Have Vents

THE RUTHERFORD SYSTEM

Intakes.

Figure 2 illustrates the Rutherford system of ventilation in a gambrel roof barn with purlin posts. The fresh air enters the intake flues just above the ground level, turns downward,

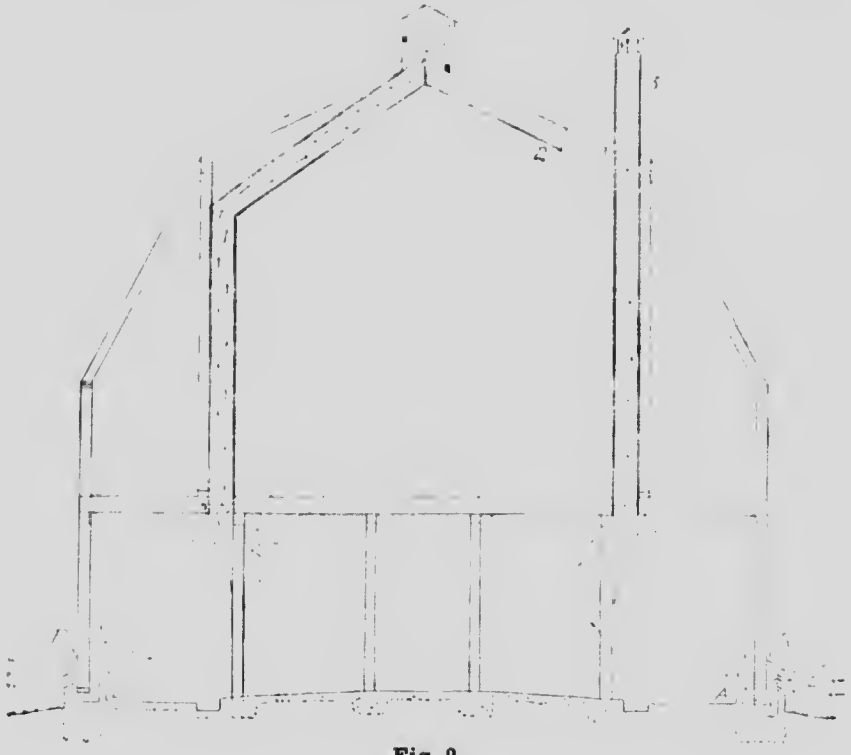


Fig. 2.

[illegible] and number of [illegible]

[illegible] square inches. If [illegible] in-take flues were used each would be 75 square inches, or an opening [illegible] which would make a bad [illegible] If six in-take flues were used the area of each would be 50 square inches, or less which would give an opening about 7x7. For our conditions a large number of small in-takes would be greatly preferable to a small number of large in-takes.

Number and location of out-take flues.

The out-take flues start at the ceiling and pass up through the loft usually alongside the purlin posts if there are any to the cupola, being put in in pairs in large barns. There will probably be one or two in the small barn, four in the ordinary barn, and six in the very large barn. The out-take flues can be carried up through the roof in various ways. At 1, the flue leaves the purlin post and takes a steeper slant up to the cupola which is better than 2 in so far as the ventilation system is concerned, but takes more space in the loft. Number 3 affords the most direct exit for the foul air and is, in the writer's opinion, the best one to use. It is a little unsightly and the outgoing air cools a little more rapidly in the portion above the roof exposed to the direct contact of the cold winter winds, but the suction is greater, and the hay track can be put in higher by not having the outlets feed into the cupolas. Also the cost of construction should be, if anything, a little less in the case of the straight out-take flue. When installing out-take flues, avoid carrying the flues along horizontally when it is necessary to get to the cupola, but rather keep the flues slanting upwards.

Size and regulation of out-takes.

The total area of the outlet flues in the Rutherford system is made twice the total area of the in-take flues. In other words, sixteen or more square inches of out-take flue is allowed

on each [illegible] the [illegible] lines it is figured [illegible] and correctly so that a good deal of the fresh air entering the stable escapes [illegible] doors, windows, etc. The outlet flues [illegible] dampers DD pivoted [illegible] [illegible] It has [illegible]

THE KING SYSTEM

Intake-flues [illegible] of the [illegible] between [illegible]

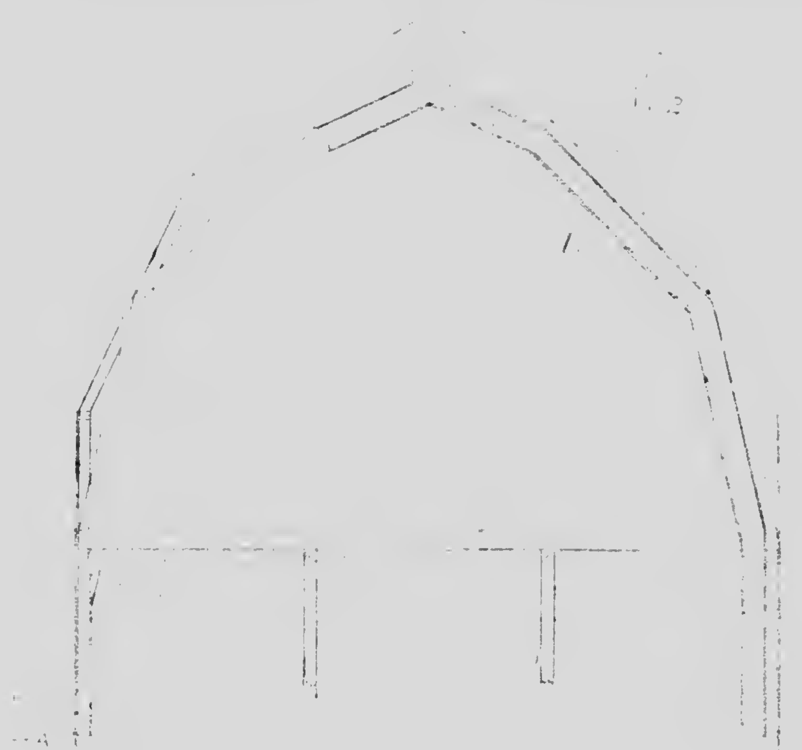


Fig. 3

[illegible] greater than that [illegible] which means that [illegible] weather [illegible] and other [illegible]

Area of Out-take Flues per Animal

[illegible]

		Square Inches	
Horse	[illegible]	[illegible]	[illegible]
Cow	[illegible]	[illegible]	18
Pig	[illegible]	[illegible]	16
Sheep	[illegible]	[illegible]	10

These figures [illegible] ample area for still weather conditions and where the temperature is 15 or 20 degrees F. above zero. Under these conditions we have a slower movement of air than when it is colder and more windy. This means that the flue area must be greatly reduced in windy and extremely cold weather.

Frosting of in-take openings. A slight objection to the King system of intakes is, that the air rising through the flues makes the inside walls very cold, and in the coldest weather the moisture in the stable forms a thick layer of frost, or even ice sometimes, on the wall at these points and then runs down the wall at the next rise in temperature if not kept scraped off. This trouble will occur, to some extent, around any in-take openings in the coldest weather. In the case of the King inlets it can be largely overcome by making a dead air space between the intake studding as shown at [illegible] fig. [illegible]

FURTHER SUGGESTIONS

Flue Regulation. With any system of ventilation, all the intake openings should be practically closed in cold weather rather than to entirely shut off some of them, except when the wind is blowing strongly against one side of the barn, in which case the intakes should be almost closed or entirely closed. A test of intake flues in windy weather will show nearly all, if not all, of the fresh air coming in on the windward side of the barn and none coming in on the opposite. But if the intake flue openings on the windward side are cut down, fresh air will be drawn in on

the open sash or also thus giving a [illegible] ventilation throughout the stable. In very cold weather all intakes are closed and the direct rays of the sun [illegible]

A test of Barn Ventilation.

[illegible] the writer [illegible] Barn during the cold [illegible] was found that with the intakes closed and [illegible] of the barn windows open [illegible] of air [illegible] the doors and windows [illegible] closed) and shutters of the intake flues [illegible] to change the air in the stable pretty close to three times an hour with an outside temperature of from 15 to 37 degrees F. below zero, and while the wind was blowing from 0 to 12 miles an hour. The temperature in the stable during this period varied from 7 to 47 degrees F. This is an exceptionally warm barn. It is brick veneered and has storm doors and windows. The wing tested contained thirty cattle.

A method of protecting inlet flues from heavy winds.

One of the main points to be watched in the operation of a ventilating system is the regulation of the intakes. If the intake flues are set for still weather conditions and a strong wind sets in before morning, the animals in the windward side of the barn get too much cold air. This is probably more true of the King inlet than the type of Rutherford inlet shown, though the King inlet gives the incoming air a better chance to spread

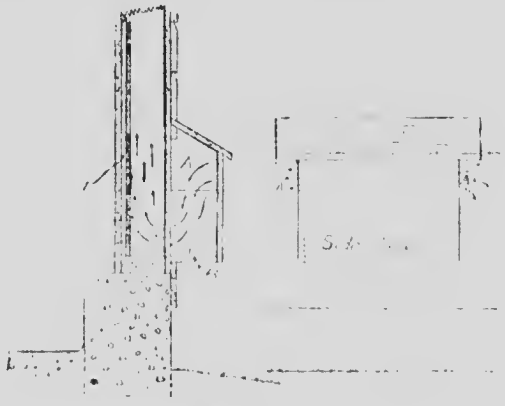


Fig. 4.

before reaching the animals. Figure 4 shows an arrangement for protecting the outside opening of the inlet flue from the direct force of the wind. There are no louvers on the front, but openings A, A, at each end directly under the little slanting

wood. [illegible] Without [illegible] the [illegible] the [illegible] angle [illegible] wood [illegible] If [illegible] of the [illegible] the [illegible] age [illegible] of [illegible] boxes [illegible] in [illegible]

No louvers in cupolas.

[illegible] the [illegible] the [illegible] be [illegible] and [illegible] but [illegible] mind [illegible]

CONCLUSION

[illegible] charges [illegible] in [illegible] the wall [illegible] should [illegible] two [illegible] stops, placed vertically above two [illegible] form [illegible]

[illegible] systems of ventilation [illegible] Agricultural College.

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