Mechanical Hay Dryers
Michigan State University Extension Service
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Issued October 1961
26 pages

Extension Bulletin 376 *October 1961*

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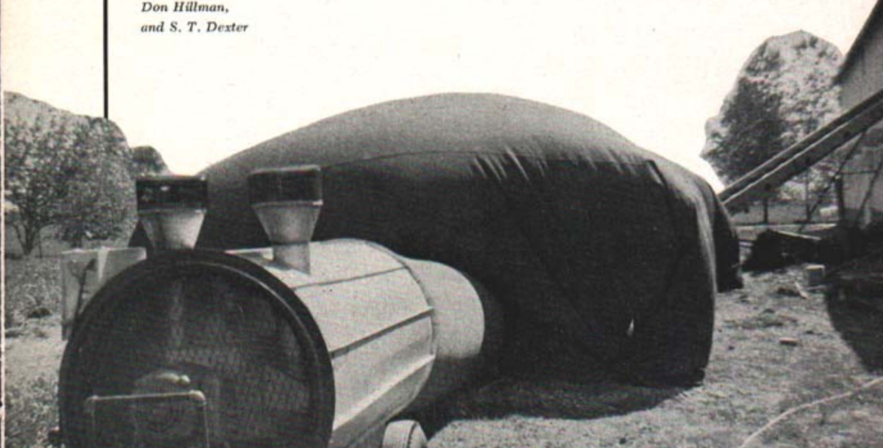

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MECHANICAL HAY DRIERS

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GENERAL INFORMATION

A MECHANICAL HAY DRIER is essentially a power-driven fan and a duct or system of ducts for distributing unheated or heated air through a quantity of hay which has been partly cured in the field. Air forced through this hay evaporates moisture and carries it away.

There are two types of mechanical hay driers:

The storage type drier is built into the barn where hay is stored. until used.

The batch type drier uses heated air for rapidly drying baled hay or chopped hay in a special structure or on wagons. The dried batch of hay is removed and stored elsewhere.

It is both practical and economical to remove damp hay from the field and finish the drying process mechnacially even during good haying weather. During unfavorable seasons, mechanical drying is necessary to make good hay and avoid serious field losses of hay.

Helps Make Better Hay

The goal of efficient hay-making is to reduce moisture in forage for safe storage with the least possible loss in nutrients. A mechanical hay drier can help to attain this goal. Hay can be chopped or baled and hauled out of the field while damp. There is less exposure of hay to weather hazards, less waiting for hay to dry in the field, less dust, and most of the leaves are retained. Hay can be harvested on cool cloudy days; therefore, more days become hay harvesting days, see Table 1. Hay can be harvested earlier in the season when the TDN (total digestible nutrients) is high.

Reasons For Cutting Hay Early

Many feeding experiments have shown that early harvesting greatly improves the feeding value of hay for livestock. In general the research findings agree with farmer experiences in that cows fed early harvested hay eat more hay, produce more milk and require less protein supplement than cows fed late cut hay.

Table 1.—Hay harvesting days and inches of rain during haying season (June 1 to June 21, inclusive)

Day of Month	'49	'50	'51	'52	'53	'54	'55	'56	'57	'58	'59	'60	'61	
1	•°	1.85†	.52	U‡	•	.39	•	•	.41	1.70	.63	H	.20	
2	•	.38	.02	U	•	.48	U	U	•	.01	.01	.21	U	
3	H§.03		H	.50	U	.20	U	H .06	U	H		H	•	
4	•	U	U		.74	.44	•	U	U	•	•	•	•	
5	•	•	U	U	.58		•	U	U	•	•	.15	•	
6	U	•	U	•	.03	•	.30	U	U	•	•	•	•	
7	•	•	U	•	U	U	2.71	U	U .01	•	•	•	.45	
8	•	U	H .11	H .11	H .07	U	.06	H .03	U	H .08	•	•	.08	
9	•	.35	U	•	U	U	.54	•	•	.43	•	•	H .03	
10	•	.10	U	•	H .04	U	.24	•	•	.21	•	•	U .02	
11	•	H	U	H .09	H .04	U	.47	•	H .16	H	H .03	•	U .03	
12	•	U	H .08	H .01	U	H .16		•	U	.29	H .03	H .07	•	
13	.38	.73	.61	U	U	•	U	•	H .12	.30	•	.67	.24	
14	.82		H	•	•	U	U	•	.23	U	•	.18	.27	
15	1.11	H .07	U	•	•	U .02	U	H .09	H .09	U .01	H .04	.14	H	
16	.87	U	U	•	•	H .17	•	.77	U	•	•	.60	H	
17	H	•	U	H .16	•	.46	U	.38	U	•	•	.94	U	
18	U	U	H .02	•	U		•	.12	H .19	•	U		•	
19	•	U	.57	•	U	1.11	•	U	•	U	•	•	U	
20	•	U	H	.37	•	.68	.31	•	•	U	•	•	.41	
21	H .10	•	.08	H	H .06	.07	H	U	•	•	•	•		
Total harvesting days each season													6	**Ave.**
•	12	5	—	9	7	2	6	8	6	8	14	10	5	7.2
U	2	7	10	4	7	7	6	7	9	4	1	0	11	5.3
• + U	14	12	10	13	14	9	12	15	15	12	15	10	3	12.5
H	3	2	6	5	4	2	1	3	4	3	3	3	14	3.2
• + U + H	17	14	16	18	18	11	13	18	19	15	18	13	1.73	15.7
Total inches of rain each season	3.31	3.48	2.01	1.24	1.56	4.28	4.63	1.45	1.21	3.03	1.74	2.96	2.51	

°• Days which were good for drying hay in the field.

‡U Additional days when hay could have been harvested and placed in a drier using unheated air.

§H Days in addition to • + U when hay could have been harvested and placed in drier using heated air.

†Inches of rain.

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Mechanical Hay Driers

ERRATUM

Table 1, page 4, Columns 14 ('61) and 15 (ave.) under headings, Total harvesting days each season and Total inches of rain each season, align as follows:

	Ave.
6	7.2
5	5.3
11	12.5
3	3.2
14	15.7
1.73	2.51

Recent experiments have shown that:

(1) Cows ate 25 to 30 percent more early cut hay, harvested in the *bud to 1/10 bloom* stage of maturity, than they ate of hay harvested at *full bloom* or later in maturity.

(2) Early cut hay was generally 20 to 30 percent more digestible than late cut hay; and therefore, required less supplementing with grain and protein to maintain high level milk production and growth. In Michigan State University studies, it was necessary to add 509 pounds of shelled corn to a ton of ordinary hay to produce the same amount of milk as the cows produced with a ton of the early cut hay alone. Thus, it would require an extra 2,300 pounds of grain per cow during the barn feeding period to make the mature hay equivalent to the early cut hay in feed value.

(3) When early cut hay was fed as the only ration, cows produced from 30 to 50 percent more milk than when fed mature hay as the only ration. This increased production of milk was a result of increased consumption of hay and the higher digestibility of the early cut hay.

PRINCIPLES OF DRYING HAY

Three and one-half tons of freshly cut forage with a moisture content of 75 percent are required to make one ton of dry hay. By the time the moisture content has been reduced to 40 percent, over 2 tons of water have been evaporated and 900 pounds of water yet remains to be removed by evaporation before the hay is dry. (Table 2).

Heat is always needed to evaporate water. Evaporation from damp hay takes place when the relative humidity of the air is not more than about 75 percent. Air movement is needed to carry away the evaporated moisture.

If the relative humidity of the air goes above 80 percent, as it does nearly every night during the haying season, partially dried hay lying in the swath or windrow will absorb moisture. If the air remains at a high relative humidity, the hay will mold.

The stems of plants readily carry moisture lengthwise from the roots to the leaves. Movement of water crosswise in a stem is very slow. With good drying conditions, freshly cut hay dries rapidly until

Table 2.—Changes in condition of hay with various moisture contents, amount of forage needed to make one ton of "dry" hay, and the amount of water that must be removed.

Condition of forage or hay	Average moisture content	Amount of forage or partly cured hay needed to make a ton of dry hay	Amount of water to be removed in making a ton of dry hay
	(*percent*)	(*pounds*)	(*pounds*)
Freshly cut	75	7,000	5,000
Wilted—very heavy to handle	50	3,500	1,500
A*			
Still heavy to handle	40	2,900	900
Begins to handle like hay	35	2,700	700
Leaves still hang on	32½	2,600	600
Tough—leaves rattle	30	2,500	500
Would heat in ordinary storage	27½	2,420	420
Slightly tough—leaves shatter off	25	2,340	340
B			
Dry enough for ordinary mow storage	20	2,190	190
Time to stop the fan	15	2,060	60
C			
"Dry" hay	12½	2,000	None

*Above line A, the forage is too heavy to handle and is too wet.
Below line B, the hay is dry enough for ordinary mow storage.
Below line C, usual condition after 1 or 2 months of storage—one ton of dry hay contains approximately 250 pounds of water and 1750 pounds of dry matter.

the leaves wilt. After the leaves wilt, the drying rate becomes progressively slower. The evaporation of the first 2 tons of water, in making a ton of dry hay, is done most economically with the hay in the swath and/or windrow. Typical field drying rates with good haying weather are shown in Fig. 1.

Crushing hay helps speed the drying rate by cracking the stems to let moisture escape to the air. Chopped hay dries faster than long hay because the stems are in shorter pieces and there are more cut ends to give up moisture. Baling slows the drying rate by reducing the freedom of air movement through the hay.

Immature Hay Difficult To Field Cure

Immature alfalfa and grasses are difficult to field cure at any time during the haying season. Young, succulent living plant tissue is low in fibre; it packs down more and hangs onto water more tightly than does mature hay. Early in the season, when nights are cool and the ground under the hay is cool and damp, young early cut hay is very difficult to cure in the field. Weather conditions are seldom favorable for field curing hay early in the season. See Table 1.

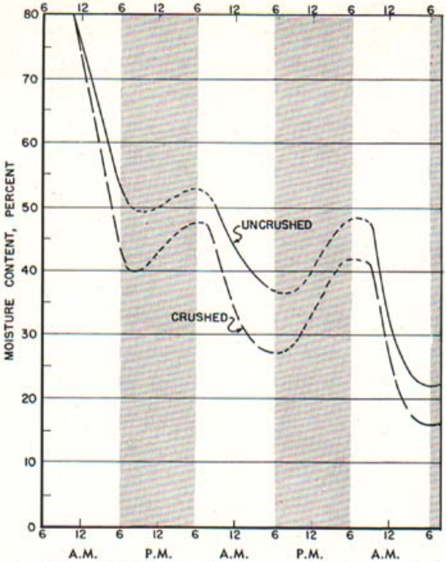

FIG. 1.—Typical field drying rates for uncrushed and crushed alfalfa.

Drying Hay In The Storage Type Drier

Damp hay placed in a storage type drier continues to dry for the same reasons that hay dries in the field. The breeze to move air and carry away moisture is provided by a fan, and the heat to evaporate moisture is taken from the moving air. When moisture is evaporated the temperature of the air is lowered, (Table 3). The temperature of air going into and coming out of the hay may be measured with an ordinary thermometer. This temperature difference is small if the outside air is cold an damp, and large if the outside air is hot and dry.

Approximately one pound of water is evaporated during an hour when air passing through the hay at 1,000 cfm (cubic feet per minute) is cooled 1°F. For example: 25,000 cfm of air being cooled 4°F. carries out 100 pounds of water per hour:

$$\frac{25{,}000}{1{,}000} \times 4 = 100 = \text{lb/hr.})$$

Table 4 shows the number of days of fan operation needed to dry hays of various moisture contents with natural air cooling 2° to 6°F.

Table 3.—Moisture removal by evaporative cooling of air.

Temperature	Relative humidity	Decrease in Air Temp.	Amount of water removed in 1 hour using 1,000 cfm
90°F. 80 70 60 50	69% 68 67 66 64	2°F	2 lbs.
80 60 50	65 62 59	3°F	3 lbs.
90 70 50	63 60 54	4°F	4 lbs.
90 80 60	60 58 53	5°F	5 lbs.
80 70 60	55 52 48	6°F	6 lbs.

*Cubic feet per minute.

Table 4.—Drying time in days using unheated air at 400 cfm per ton of hay.

Initial moisture content	40%	37½%	35%	32½%	30%
Temp. drop of air passing through hay					
2°F.	44	40	35	30	24
2½°	33	32	28	24	19
a*					
3°	30	27	23	20	16
3½°	24	23	20	17	14
4°	22	20	17½	15	12
b*					
4½°	20	18	15½	13	10½
5°	17	16	14	11	9½
6°	15	13½	11½	10	8

*Usual performance between line a and line b.

in passing through the hay. With the fan operating, the hay is kept cool regardless of weather conditions, and the danger of spontaneous combustion is eliminated. In a storage type dryer the hay nearest the air distribution duct dries first. In this deep layer drying, the drying zone moves progressively through the mass of hay. When the top layer is dry, all of the hay is dry. The storage type drier is most efficient when the weather is hot and dry.

Table 5.—Drying time in days using 95°F. heated air at 400 cfm per ton of hay.

Initial moisture content	40%	37½%	35%	32½	30%
Air tem. drop					
12°	7½	7	6	5	4
14°	6½	6	5	4½	3½
16°*	5½	5	4½	4	3
20°	4½	4	3½	3	2½

*Most usual performance expected.

Heated Air Dries Hay Faster

Heated air drying is the surest method of curing top quality early cut hay with the highest retention of leaves and green color.

Practically all of the energy put into the motor which drives the fan is converted into heat which helps warm the in-going air. Based on a fan output of 3,500 cfm per horse power, input, electric motors warm the air about ¾°F., and gasoline engines warm the air about 3°F. Any heat added to the in-going air increases the amount of water it can carry and decreases the time required to dry hay. Added heat is especially helpful during an unfavorable haying season.

Let us assume that natural air with a temperature of 65° and 75 percent RH (relative humidity) is forced through hay. Some heat is generated by the respiration of the hay, and some by the motor driving the fan. Otherwise, there would be practically no drying. The fan would be running and the hay would be kept cool. If this air is heated to 85°F. the relative humidity is reduced to less than 40 percent. The heated air passing through the hay evaporates water until a relative humidity of about 75 percent and a temperature of 73°F. is reached. This temperature drop of 12° (85° to 73°) in the air passing through the hay is very effective in drying hay.

Table 5 shows the number of days required to dry hay when heat is used to reduce the relative humidity of air used in deep layer drying. The amount of heat that may be used in deep layer drying is limited. A temperature drop of more than 25°F. in air passing through the hay is likely to cause condensation of moisture on the top layer of hay. This would be conducive to rapid mold growth.

Batch Type Drier With Heated Air

In a batch type drier, a shallow layer of hay is rapidly dried with a large volume of air heated to a temperature of 115 to 130°F. Mold does not have time to develop. Table 6 shows the approximate

Table 6.—Drying time in hours using 120° heated air at 1,500 cfm per ton of hay in batch drying.

Initial moisture content	50%	45%	40%	35%
Air temp. drop				
30°F.	32	25	19	15
35°*	27	21	16	13
40°	23	19	14	11

*Most usual performance expected.

number of hours required to dry loosely pressed bales of hay in a batch drier using 1,500 cfm of air per ton of hay.

Chopped hay dries more rapidly. After drying hay with heated air, cool air is blown through it for an hour to cool the hay before removal from drier to storage. The daily capacity of a batch type drier should be such that it will handle one day's harvest of hay.

STORAGE TYPE HAY DRIER USING UNHEATED AIR

The storage type hay drier is recommended primarily for chopped hay. It is a must if a chopped hay handling and feeding program is to be satisfactory. Long hay may be dried readily in a storage type drier and baled hay only when the bales are loosely pressed. A mow filled with 35 percent moisture hay will contain about 10 percent more dry hay than a similar size mow filled with field cured hay.

The rate of filling a storage type drier using unheated air is limited by the amount of water than can be removed from the hay during a period of about a week after the hay is put into the drier. Table 7 shows the maximum rate for putting 35 percent moisture hay into a storage type drier during average weather conditions. If the moisture content of hay is greater than an average of 35 percent, or the weather is cool, the rate of storing hay must be reduced. Following an interruption of 4 days or more in hay harvesting, do not haul in more hay than the amount shown in Table 8. These amounts may be hauled in, provided that the quantities given in Table 7 are not exceeded.

Table 7.—Maximum rate for filling a storage type drier with 35% moisture content hay.

30%	full during 1st day of hauling
35%	full during 2 days
40%	full during 3 days
45%	full during 4 days
50%	full during 5 days
80%	full during 10 days
100%	full during 14 days

Table 8.—Filling rate after an interruption of 4 days or more in hauling hay.

20%*	in 1 day
30%	in 2 days
40%	in 3 days
45%	in 4 days
50%	in 5 days

*Of total capacity.

Tables 7, 8 and 9 are based on the following assumptions:

(1) that average Michigan weather conditions will prevail (about 1 day out of 3 will be favorable for harvesting hay);

(2) that the storage type drier will be filled during a period of about 2 weeks with hay that has an average moisture content of about 35 percent (some of this hay may be 40 percent and some of it 30 percent or less);

(3) that the fan will run continuously for about 3 weeks.

Planning Your Storage Type Drier

The following basic steps are given as a guide in planning a storage type drier to fit your barn. As planning progresses, consideration should be given to time and labor saving changes in the procedure you use for making and feeding hay.

1. Decide how many tons of first-cutting hay you wish to dry and whether the hay will be long, chopped, or baled.
2. Examine the barn for structural weakness.
3. Determine the amount of air and power needed.

Table 9.—Amount of air, static pressure and horsepower needed for storage type hay driers using unheated air.*

Size of hay mow		Depth of first cutting hay at time of storage†			Tons of hay	Fan requirements		
(1) Width and length in feet	(2) Approx. area in sq. ft.	(3) long	(4) chopped	(5) baled	(6) dry basis	(7)‡ Cubic ft. of air per min.	(8) Static Pressure in inches	(9) Horse-power needed
30' x 34'	1,000	15 ft.	12 ft.	8 ft.	25-30	10,000	1	3-4
32 x 50 36 x 45 40 x 40	1,600	15 20 23	12 16 18	8 12	45-50 65-75 80-90	18,000 26,000 32,000	1 1¼ 1½	5-7 8-11 12-16
34 x 80 36 x 70	2,400	15 17½ 20	12 14 16	8 10 12	65-75 80-90 95-110	26,000 32,000 38,000	1 1⅛ 1¼	7-10 10-13 12-16
34 x 100 36 x 90 40 x 80	3,200	15 20 23	12 16 18	8 12	90-100 130-145 160-180	36,000 52,000 64,000	1 1¼ 1½	10-13 17-22 23-30
36 x 120 40 x 100	4,000	15 17½ 20 23	12 14 16 18	8 10 12	110-125 135-155 160-180 200-220	44,000 54,000 64,000 80,000	1 1⅛ 1¼ 1½	12-16 16-21 20-27 29-38

*The use of heated air will increase the drying rate (Tables 4, 5) and permit a more rapid harvest and storage. Heated air is recommended for over 100 tons of hay.

†Long hay and chopped hay will settle 10 to 15%.

‡Based on 350 and 400 c.f.m. per ton of hay indicated in Col. 6. The c.f.m. per ton is greater when the storage is partly filled.

Table 10.—Dimensions of triangular shaped main air ducts.*

Width of mow, in feet	Maximum depth of hay, in feet†			Height, in feet	Width, in feet	Maximum c.f.m.
	Long	Chopped	Baled			
18..........	12	11	12	6	6	18,000
24..........	16	14	12	7	6	21,000
30..........	20	17	....	8	6	24,000
32..........	21	18	....	8	6	24,000

*Provides for a maximum velocity of not more than 1,000 ft./min. The cross sectional area is at least 1 square foot for each 1,000 c.f.m. of air needed.
†These depths include second-cutting hay on top of first cutting hay.

Table 11.—Dimensions of rectangular shaped main air ducts.*

Width of mow, in feet	Maximum depth of hay, in feet†			Inside height of duct, in feet	Inside width of duct, in feet‡			
	Long	Chopped	Baled		18,000 c.f.m.	27,000 c.f.m.	36,000 c.f.m.	50,000 c.f.m.
32......	20	17	12	6.......	3½	4½	6	....
36......	22	19	12		3½	4½	6	8⅓
40......	24	20	12		3½	4½	6	8⅓
36......	24	21	....	8.......	....	4½	5	6¼
40......	26	22	....		....	4½	5	6¼

*Provides for a maximum velocity of not more than 1,000 ft./min. The cross sectional area is at least 1 square foot for each 1,000 c.f.m. of air needed.
†These depths include second-cutting hay on top of fiirst cutting hay.
‡Minimum width for usual sizes of propeller fans and double-inlet single-unit centrifugal fan.

4. Determine whether electric service is adequate, and plan for adequate wiring.
5. Select a fan to fit your needs.
6. Plan the air distribution system.

Step One—Determine the size of hay drier wanted.—In Table 9, Column 1, find a mow size similar to yours and a storage depth that will hold the tonnage of first-cutting hay you wish to dry in your storage type drier. If you are not sure of the dimensions, of your hay mow, measure the length, width, and depth. The tons listed are for dry hay and the depths given are for hay when put into storage. Second cutting hay may be dried on top of first cutting hay, provided that the depths in Tables 10 and 11 are not exceeded.

Step Two—Examine barn for structural weakness.—When chopped hay or long hay is stored at 35 percent moisture content, the load on the barn floor joists is from 20 to 25 percent greater than when the mow is filled to the same depth with field cured hay. Any joist which shows signs of overloading should be strengthened or replaced.

The floor will need to be tight to prevent leakage of air. Heavy roofing paper and, in some barns, asphalt impregnated building board have been used effectively for sealing the floor against leakage.

Any leaks in the roof should be repaired to prevent water from wetting the hay.

Step Three—Determine how much air and how much power is needed.—The air flow rates given in Table 9, Column 7, are based on a minimum of 350 cfm per ton for the larger figures in Column 6, and the amount 400 cfm per ton for the smaller figures in Column 6. The fan should be capable of delivering this volume of air against the static pressure given in Column 8. Column 9 gives the usual range in the amount of power needed for the amounts of air and static pressures listed.

Step Four—Provide adequate electric power—When you have determined how much power will be needed, consult your electric power representative to see that the transformer and the wires leading to your buildings have sufficient capacity to supply your total electrical needs.

Motors operating hay drying fans are expected to run continuously at full rated capacity for approximately 3 weeks. In order to do so, the wires leading to these motors should be of ample size to carry the electricity needed without excessive voltage drop. It may be necessary to install larger wires to insure satisfactory operation. Your power company representative will want to help you with your wiring problems. Every motor used for hay drying should have protection against over current. The magnetic switch with thermal protection is recommended. Humidistat and time clock controls are not needed.

If adequate electric power can not be obtained you can use an engine or tractor to operate your fan.

For safety, keep the engine at some distance from the barn, use a good spark arrester, and check with your insurance company to be sure that you have insurance coverage.

By shrouding the engine or tractor to make use of the waste heat, the temperature of the air entering the fan can be raised 3°F. or more. Your fan dealer will be glad to help you plan a safe installation.

Step Five—Select the fan.—The minimum fan requirements are given in Table 9, Columns 7 and 8. Propeller type fans, Fig 2, and centrifugal fans with backward inclined blades, Fig. 3, are preferred for use with electric motors. When properly installed, neither will overload the motor regardless of how much or how little hay is in the barn.

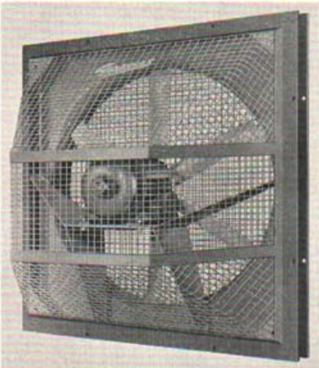

Fig. 2.—Propeller type fan mounted on motor shaft. Note heavy screening on both sides to exclude birds.

The propeller type fan requires less mounting space and in many cases is mounted directly on the electric motor shaft. The centrifugal fan makes less noise than a propeller fan.

Centrifugal fans with straight blades or with forward curved blades are not well suited for use with an electric motor in a storage type hay drier. Either one will overload the motor when the static air pressure is low unless there is some way to reduce the amount of air passing through the fan. Any type of fan including the centrifugal with forward curved blades can be used with an engine or a tractor because the speed of an engine can be regulated.

Regardless of fan type, there is a minimum speed at which a given size must operate in order to obtain the pressure needed to force air through the hay. An increase in speed will increase the air pressure or the air volume, or both air pressure and air volume. An increase in fan speed will increase the amount of power required.

The mechanical efficiency of a fan decreases with an increase in speed and capacity. Therefore, to be highly efficient mechanically, a fan must be large enough to move the desired amount of air at a low discharge velocity. The most economical size will be a compromise based upon the capacity needed, the amount of power required for that capacity, and the installed cost of the fan and power unit.

Your fan dealer has data to show what his fan will do under the conditions that will prevail in your barn, and he can advise the most economical size to buy and operate. Any fan to be used with an electric motor is a poor investment if it requires more power than indicated in Table 9, Col. 9.

In general, the maximum practical capacity of a fan for a storage type hay drier is about 2,500 cfm of air for each square foot of discharge opening of the fan. When using a gasoline engine or tractor, the capacity may be increased to about 3,500 cfm per square foot of discharge opening.

Caution: Do not run any fan faster than the maximum safe speed Recommended by the manufacturer of the fan.

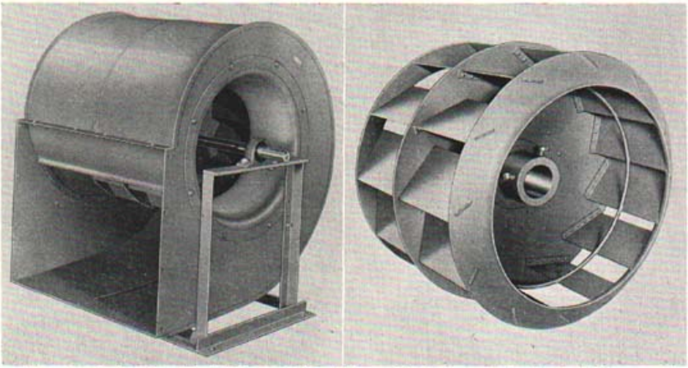

Fig. 3.—Left: Double inlet centrifugal fan with backward inclined blades on the wheel. Right: Fan wheel with backward inclined blades.

Step Six—Plan the air distribution system.—The air from outside of the barn must go through the hay. The design of an air distribution system for uniform air distribution is governed largely by the shape and size of the mow and the depth of hay storage. Other factors to consider and (1) arrangement of posts, roof braces and hay chutes, (2) the way hay is handled (long, chopped, or baled) and the interference of the air ducts with the storing and removal of hay, (3) cost of the installation.

The Rectangular Barn

A central duct, Fig. 4, is recommended if the hay mow is not more than 36 feet wide. The general relation of maximum storage depth to height of the central air duct and width of the mow is shown in

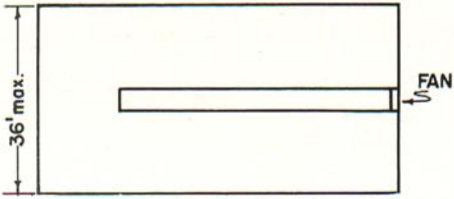

FIG. 4.—Main center duct for a rectangular barn.

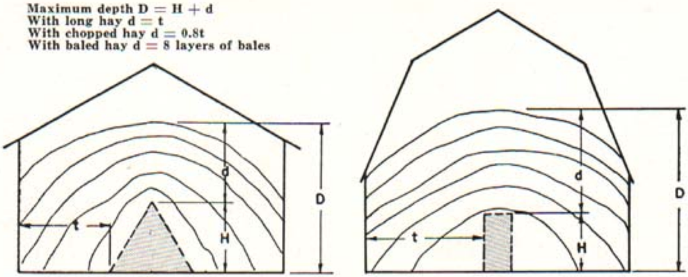

FIG. 5.—Relation of storage depth of hay to height of air duct and width of hay storage.

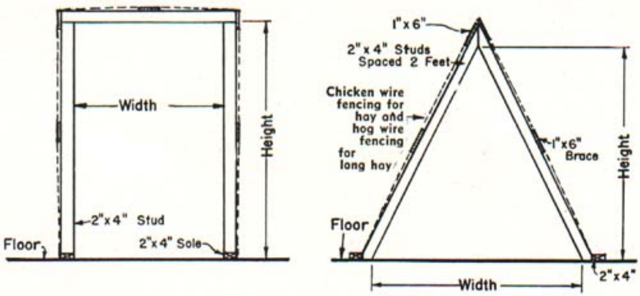

FIG. 6.—Construction details for home built ducts.

Fig. 5. Uniformity of air distribution through the hay is dependent on an even spreading of hay over the central air duct.

Approximate sizes of ducts are suggested in Tables 10 and 11. Typical construction details for home constructed ducts are shown in Fig. 6. Commercially made ducts similar to Fig. 7 are available and may cost less installed than home built ducts.

In a long barn requiring more than 10 horsepower, the use of two fans, one at each end as in Fig. 8, reduces the size of air duct needed. One or both of these fans may be operated as needed, and your electric power company may prefer the use of two smaller motors. This arrangement does require tight doors for closing off the fan that is not in use.

The T-shaped duct arrangement, Fig. 9, may provide a more convenient location for a single fan in a long barn. It does not interfere with loading in hay through the end doors. The central duct would be the same size as though two smaller fans were used, as in Fig. 8, although somewhat shorter in length. The trunk of the T is made tight.

Fig. 7.—Commercially made steel duct.

The Wide Barn

The arrangement shown in Fig. 10 using two or more fans, one for each 30 feet of mow length each with a single duct, is probably the least expensive for barns more than 36 feet wide.

The Square Barn

For the square barn 36 to 40 feet in size, the central duct with a stub towards each corner, as in Fig. 11, is recommended. Square barns larger than 40 feet by 40 feet are treated like wide barns, as in Fig. 10.

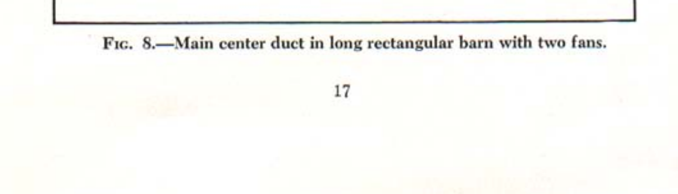

Fig. 8.—Main center duct in long rectangular barn with two fans.

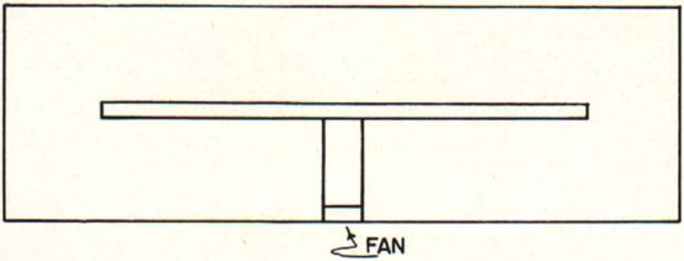

FIG. 9.—T-shaped duct for a long rectangular barn.

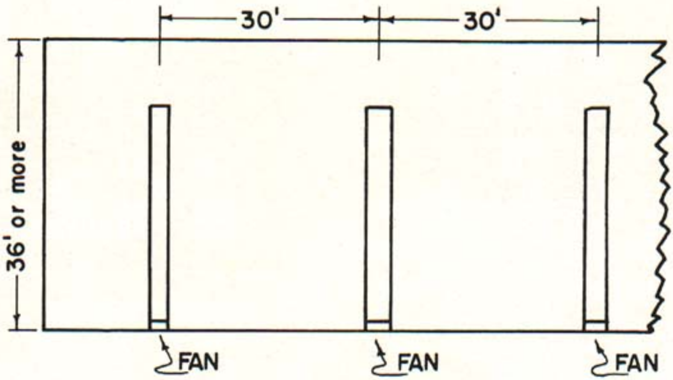

FIG. 10.—Using two or more fans and ducts in a wide barn.

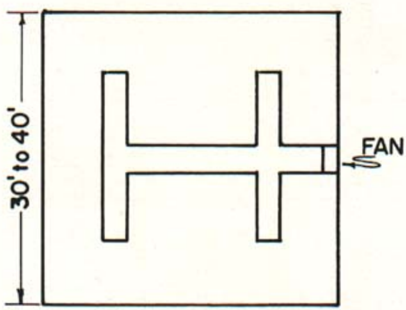

FIG. 11.—The square barn.

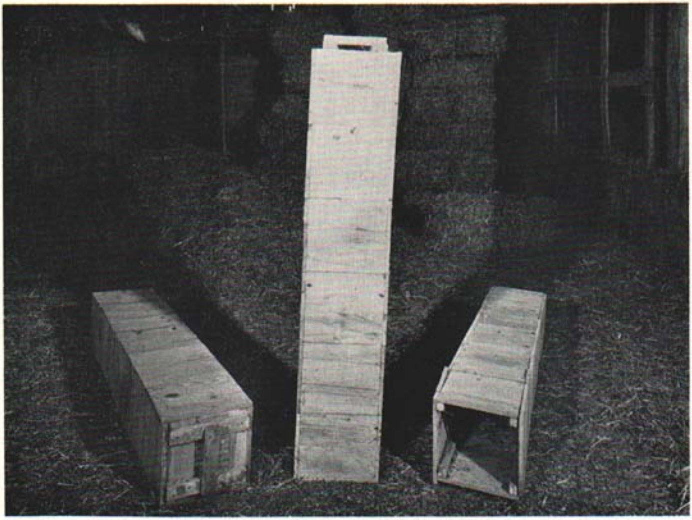

Fig. 12.—Flue-formers.

The Narrow, Deep Hay Mow

It is most difficult to distribute air through hay uniformly after the depth above the duct exceeds half the width of the hay mow. The flue-former (Figs. 12 and 13) has been used to form vertical flues in chopped hay above the central duct. As hay is blown into the mow, the flue-former is pulled up from time to time so that the bottom end is always about 3 feet below the top of the hay.

In some cases, the flue-former is pulled out when the hay is several feet deep above the main duct and a second central duct is laid on top of the hay. Several feet of hay is then stored on top of the second duct.

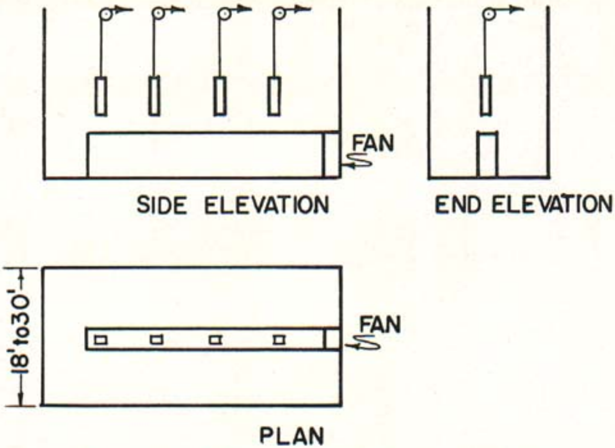

Fig. 13.—Narrow deep mow with center duct and flue-formers.

BATCH TYPE HAY DRIERS

The batch type hay drier is recommended for 100 tons or more of loosely pressed damp baled hay. With favorable hay harvesting weather, all hay harvesting operations—cutting, raking, hauling the previous batch from drier to storage, baling, hauling damp bales to drier, and operating the drier—are performed during a day. The capacity of a batch drier is, therefore, limited to one day's harvest of hay. Ten batches of first-cutting hay per season is considered the maximum when planning for a batch type drier.

The Drying Platform

The drying platform Figs. 14 and 15, is low in first cost. Bales are stacked tightly together three to five layers deep with cut edge down. A covering over the hay is necessary to keep the hay warm and prevent condensation of moisture on the top layer of bales. The heating unit shown is of the heat exchanger type. The products of combustion do not go through the hay. Safety devices include a high temperature limit switch, a device to detect flame failure and shut off the fuel supply and a switch to permit the burner to operate only when the fan is running.

Fig. 14.—Drying platform for baled hay.

Fig. 15.—Drying platform loaded with baled hay and with fan running.

Fig. 16.—Wagon drying baled hay.

Drying Hay On Wagons

Wagon drying requires special wagons, each with a built-in air duct. The direct-fired heater shown in Fig. 16 burns natural gas or LP gas with the products of combustion passing through the hay. One to seven wagons may be dried by the unit shown. Bales 27 inches long fit tightly into a 7 x 14 ft. wagon box. Loading is easier and bales stay in place better with high sides on the wagon; however, high sides increase the labor of unloading bales. An advantage of drying bales on the wagon is that handling of the bales is reduced.

Wagon drying with down-draft heated air, Fig. 17, is more efficient than up-draft. High sides and a slatted bottom are used for either

Fig. 17.—A structure to accommodate 5 wagons. Air is forced downward through baled hay or chopped hay.

baled hay or chopped hay. A hood lowered to the wagon box directs air down through the hay. This arrangement is good for either baled hay or chopped hay and requires less work to connect a wagon to the dryer than for up-draft drying.

INSTALLATION AND OPERATING COSTS

Storage type drying equipment, installed, costs about $15 to $20 per ton of capacity for drying first-cutting hay. Electric power costs $1 to $1.50 per ton of hay dried. Gasoline for a tractor would cost about the same.

Batch type driers, ready-to-use, cost about $500 to $700 per ton of daily drying capacity. Operating costs for fuel and power run from $3 to $5 per ton of hay dried.

Costs of owning and operating hay drying equipment should be considered in terms of the reduced weather hazards of hay making, the increased tonnage of hay harvested per acre, and the increased feeding value of the hay.

Other Uses

The heater and fan are usually mounted as a portable unit for convenience in moving. It may be used to advantage in drying combined oats, wheat, picker-shelled corn and ear corn. Ask your county agricultural extension director for information on grain drying.

ACKNOWLEDGMENTS

The authors are indebted to:

The Aerovent Fan Co. for Fig. 2, 7, 14, 15 and 16.

The Clarage Fan Co. for Fig. 3.

The Detroit Edison Co. for Fig. 12.

Mark E. Singley, Department of Agricultural Engineering, Rutgers University, for Fig. 17.

Cooperative extension work in agriculture and home economics. Michigan State University and the U. S. Department of Agriculture cooperating. N. P. Ralston, Director, Cooperative Extension Service, Michigan State University, East Lansing. Printed and distributed under Acts of Congress, May 8 and June 30, 1914. 1P–10M–10-61–ST