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DAIRY BUILDINGS FOR KANSAS

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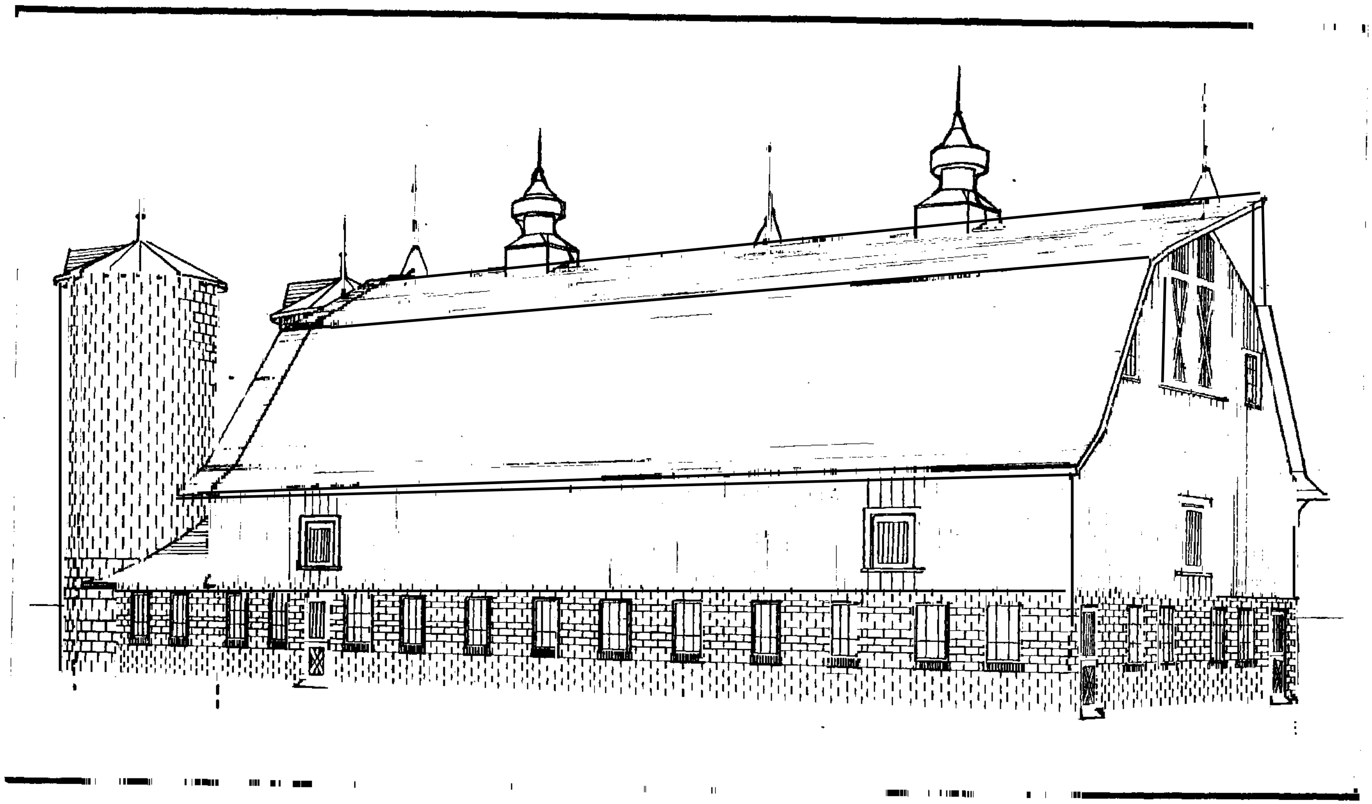

A TWO-STORY MODERN DAIRY BARN.

DAIRY BUILDINGS FOR KANSAS[1]

J. B. FITCH AND V. R. HILLMAN[2]

THE DAIRY INDUSTRY IN KANSAS

During the period 1914 to 1924 the number of farmers selling butter fat in Kansas increased from 28,000 to 60,000. In the same period of time the value of dairy products produced increased from 16 millions to 32 millions of dollars. Along with these increases has come a demand for dairy cattle of all breeds and a demand for information about the feed, care, and management of dairy cattle. It is possible that the interest in dairying in Kansas will not increase as rapidiy in the next ten years as in the ten-year period just closed, but there are many reasons why Kansas should continue to develop her dairy industry. Some of the more important reasons are as follows:

1. Kansas can produce alfalfa hay and silage crops as cheaply as any state in the Union. This is the best home-grown ration for dairy cows that can be produced.

2. Winter dairying fits well into the system of wheat farming very common in the state. Milking cows during the winter converts feed and what might otherwise be unemployed labor into cream checks.

3. To maintain soil fertility some system of live-stock farming must be adopted more widely than at the present time. Dairy cattle are bound to make up a part of this increase in live stock.

4. Should Kansas ever have a surplus of dairy cattle, our breeders will have an advantage in location for the sale of these cattle. Farmers to the west and southwest are not going to spend money for travel and for freight on dairy cattle from the north and east if they can get them in Kansas.

5. The milking of cows on Kansas farms has proved in the past to be a very safe protection from poor crops and adverse circumstances, and many farmers have reasoned that if milk cows are safe in poor years they should be safer as a part of a permanent farming system. The number of cows milked on Kansas farms varies with crop conditions and with the prices received for dairy products, but the number is increasing each year.

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KANSAS DAIRYING A SIDELINE

Most of the milking in Kansas is done as a sideline to other systems of farming. This is indicated by a report for 1921 from the Kansas State Board of Agriculture regarding the number of milk cows on Kansas farms. Of 149,500 farms reporting, the numbers of milk cows owned were as follows:

Cows	Farms
None	22,406
1 to 4	79,122
5 to 9	37,759
10 to 14	7,478
15 to 19	1,568
20 to 24	552
25 to 29	256
30 or more	362

People who are milking cows are interested in increasing their returns from their cows through better feed and care. Since the housing of dairy cattle is an important factor in their management, it is hoped the information presented in this bulletin will be of large service in the promotion of safe and profitable dairying either as a sideline or as specialized dairy farming. Suggestions are made for those who wish to remodel buildings already in use to accommodate dairy cattle as well as for the men who intend to build new dairy barns.

KANSAS MILK COWS NEED PROTECTION IN WINTER AND IN WEATHER CHANGES

Kansas is fortunate in that the winters are not so severe as those of the states farther north, and this fact no doubt accounts for the difference in housing facilities in Kansas and the states farther north. Kansas has, however, rapid changes of temperature, which reduce the advantages of the milder climate. In fact the live stock in Kansas frequently suffer even more than in some of the colder states where more adequate housing facilities are provided.

THE DAIRY BARN AND DAIRY SANITATION

Proper housing for dairy cattle includes other considerations than protection of the cattle alone. It means a clean, dry place for the cows to be milked, which means in turn cleaner cows and more wholesome products. The producer of milk is responsible, to a large extent, for the health of the people who use this product, and should produce this product under conditions that welcome rigid inspection.

The dairy barn should be comfortable, with plenty of fresh air and sunlight. It should be so arranged that the labor of feeding and cleaning may be reduced to a minimum. The barn should also provide for adequate and convenient storage of feed. Good housing of dairy cattle will lower the cost of production of dairy products, and

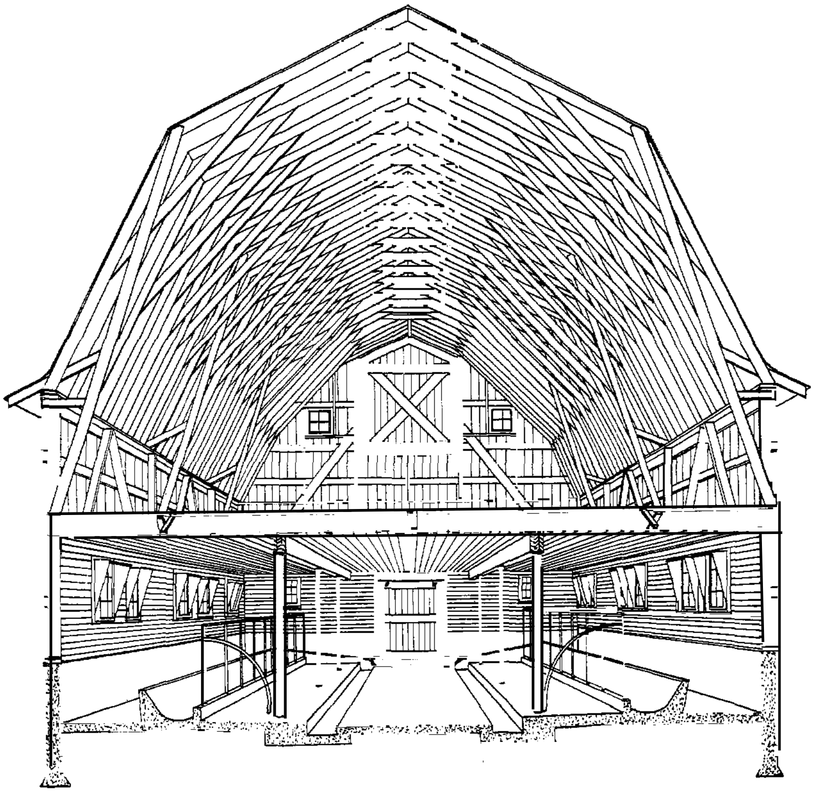


FIG. 1.—Inside perspective view of two-story dairy barn.

will also make the labor connected with the handling of dairy animals less objectionable.

All the essentials of good housing of dairy cattle are being met on many Kansas farms with but little cash outlay. While good housing is very desirable, no matter how well the cattle are taken care of the methods used in handling the dairy products will determine the quality of the products produced. Good methods are of equal importance to proper housing, but good housing makes good methods easier.

LOCATION OF DAIRY BARN

In selecting a place for the building of a new dairy barn the relation of the barn to other buildings already built should be first considered. If no other buildings are present, the contour of the land as affecting drainage of the barn and lots surrounding the barn should receive first consideration. Other factors to consider in selecting a building site are as follows: Water supply, outlets to pasture and barn lots, and outlets to fields and roads.

The location of the dairy barn should permit of convenient communication with other buildings, and should be arranged to reduce steps to the minimum and still not be close enough to other buildings to be a hazard in the case of fire. Buildings to be remodeled should be changed to meet the requirements mentioned above in so far as possible.

Good drainage is of great importance in the location of the dairy barn, because sufficient slope away from the barn will not only aid in taking waste water away, but will also keep the lots around the barn in which the cows are kept in better condition, and this in turn will mean cleaner cows.

Where possible to do so, and still meet other requirements, it is best to run the barn north and south in order to get a more equal distribution of sunlight on both sides of the barn, and in some cases to reduce the surface exposed to prevailing winds.

ESSENTIALS OF A GOOD DAIRY BARN

To be satisfactory, a barn should be convenient, sanitary, comfortable, well ventilated, and well lighted. With proper planning, these ideals may be realized at a reasonable cost.

Convenience.—The inside arrangement of the dairy barn should reduce to a minimum the steps and labor necessary in feeding, milking, and cleaning.

Sanitation.—The barn should be so constructed and the material used in the construction of the floors and walls of such a nature that it can be easily cleaned. Corners, ledges, and places where dust or cobwebs can gather should be avoided. If a barn or milk room can be easily cleaned it will be kept cleaner than a room that is hard to clean.

Warmth.—A dairy barn should be sufficiently well built to keep the animals warm enough to be comfortable during the winter from the heat generated by their own bodies. Consideration should also be given to making the barn comfortable during the summer.

Ventilation.—Frequently sheds can be closed up tight enough to keep the animals comfortably warm, but unless provision is made for proper ventilation the animals will not be comfortable for a very long time. One common sign of poor ventilation is the condensation of moisture on the walls and ceiling of the barn. A well-ventilated barn is generally dry, and is more easily kept clean than a poorly ventilated barn. A system of ventilation is necessary to provide fresh air and still retain sufficient warmth for the animal.

Light.—The usual requirement of window area for a dairy barn is four square feet of glass for each cow. This is desirable in order that the barn may be provided with sunlight for disinfectant purposes. A well-lighted barn appears more clean and comfortable than a dark, dingy shelter. Recent developments in the knowledge of nutrition indicate that sunlight may have a beneficial influence upon metabolism. It may prove to be desirable to make provision for getting more sunlight on milk cows. This can be done by turning them out in the sunshine or by arranging the windows so that they can be raised to allow direct sunlight to enter.

Storage.—Unless adequate storage space for feed and bedding is provided elsewhere, provision for storage should be made in the new barn.

Cost.—A well-built barn is generally the most economical in the long run. It is far better to build by degrees than to go in debt too heavily on barn equipment or to build too cheaply. Good accommodations for dairy cattle, meeting all the needs mentioned above, can be had at a very reasonable price—at such a price that a dairyman cannot afford to be without them.

TYPES OF DAIRY BARNS

The type of barn best suited to any given farmer will depend to a certain extent upon the number of cattle to be housed, storage space available in other buildings, and material available for construction. The following types are in most common use:

1. Two-story barn. (Fig. 1.)
2. One- and one-halfstory barn. (Fig. 2.)
3. One-story barn. (Fig. 3.)
4. Lean-to or shed type of barn.

If a new dairy barn is to be erected on a farm where storage space is needed, the two-story barn is most desirable and is perhaps the most common type. (Fig. 1.) On farms where feed storage space is already available the one-story barn (fig. 3) may be used.

In the case of a one-story barn, however, the inconvenience of hauling feed to the cows when fed inside many times offsets the additional expense necessary to build a two-story barn. On some farms a lean-to shed is built to a large barn to be used as a milking barn only. In this case provision can be made for getting feed from the

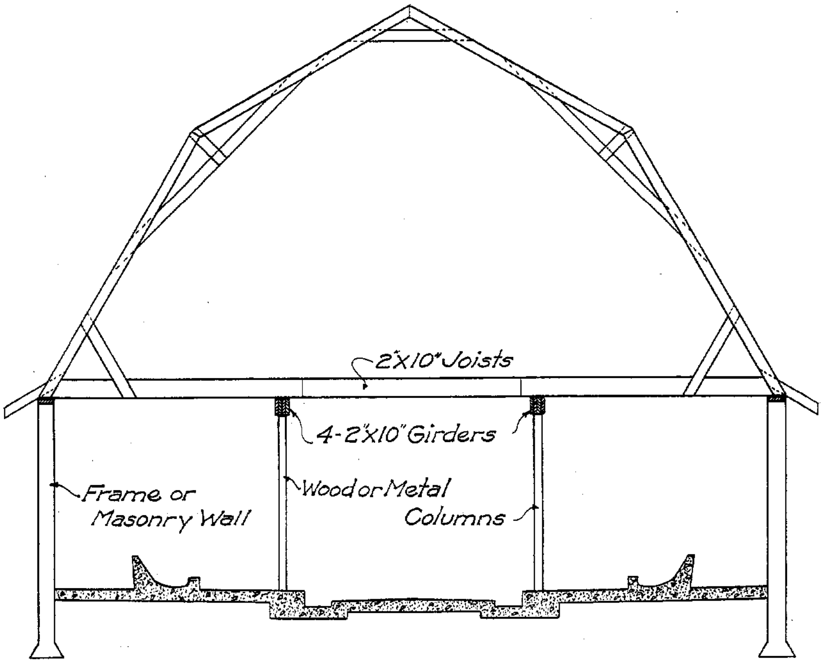


FIG. 2.—A one- and one-half-story dairy barn. This is a very practical type of barn where a large part of the necessary feed is in a silo or other building.

main structure without much difficulty. On many farms both horses and cattle are kept on the ground floor of a two-story barn, the horses on one side of a central feed alley and the cows on the other. A better arrangement, however, is to have the dairy section and the horse stable separated by a comparatively tight partition, and yet have both convenient to feed storage. Figure 4 suggests an arrangement of this kind, with the horse stalls arranged across one end of the barn and the dairy section occupying the remainder. In case it is desired to house more horses and fewer cows, this arrangement might be reversed and still retain the same convenience and other desirable features.

Arrangement.—One very common question arising in the erection of barns with two rows of stalls is whether or not the cows should be faced in or faced out. (Fig. 5.) Each plan has its merits, and each plan has as its chief adherents those who have become accustomed to using it.

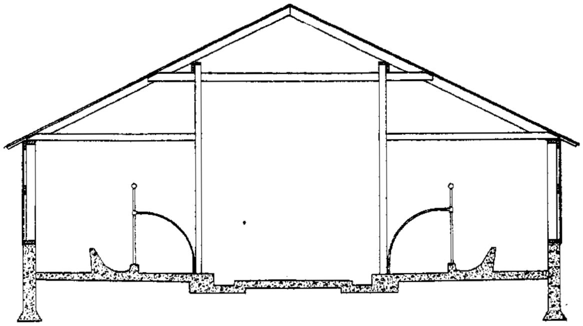


FIG. 3.—Section through a one-story dairy barn.

The chief advantage of having the cows headed in is in the feeding. Steps are saved in feeding the cows where the animals can be fed on either side of a central feed alley. By this arrangement also the udders of the cows are exposed to more light, and the barn

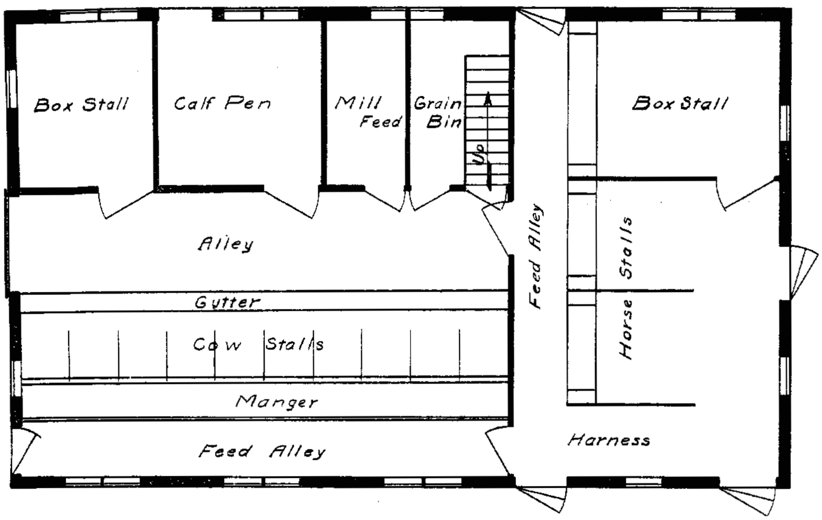


FIG. 4.—Typical floor plan of a small general-purpose barn.

may have the benefit of sunlight, and in this way both the cows and the barn may be kept cleaner. The foul air ducts may also be located more advantageously. The objections to heading the cows in is that more wall space is exposed to splattering from the cows, and this arrangement may also take more steps in milking and cleaning.

The chief advantage of heading out is that time can be saved in cleaning out the barn. On many farms the manure spreader is driven through the barn and the manure loaded from either gutter. Perhaps it is also more convenient to milk the cows when headed

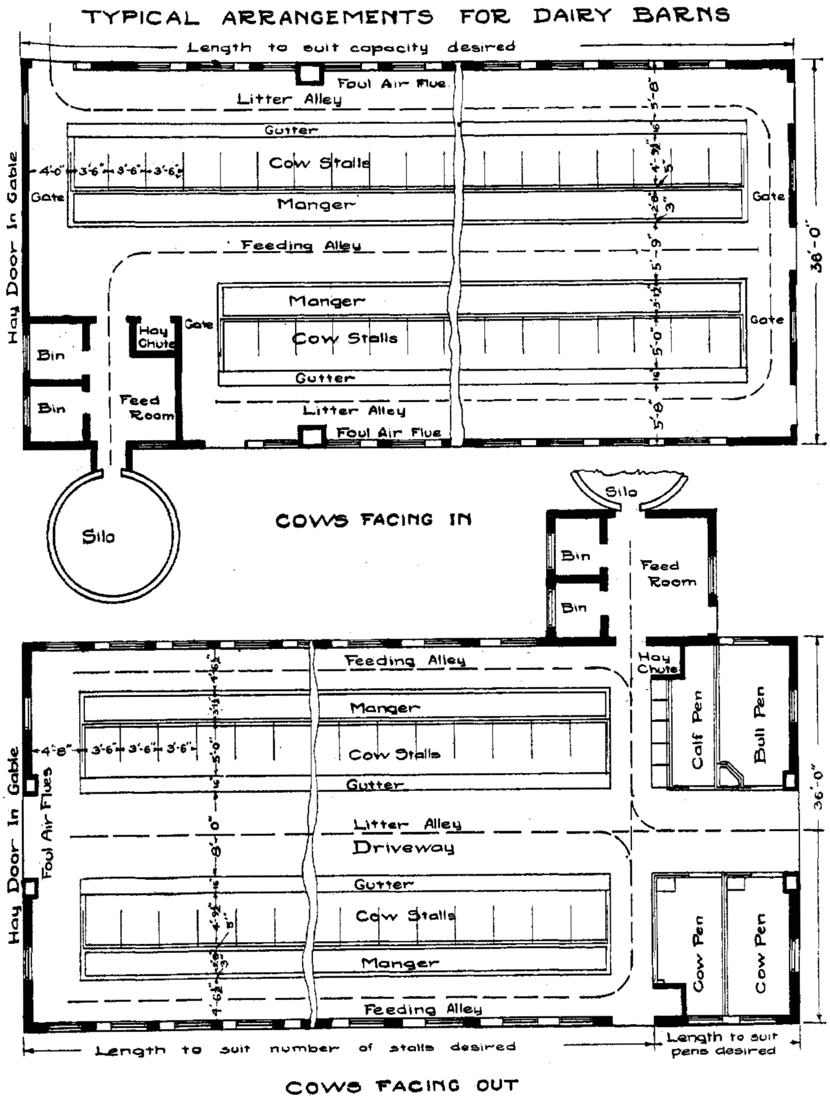
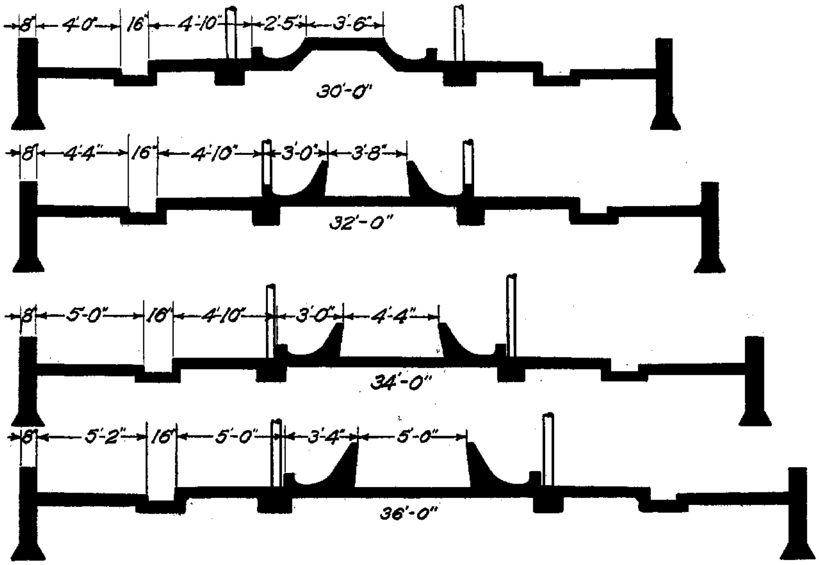
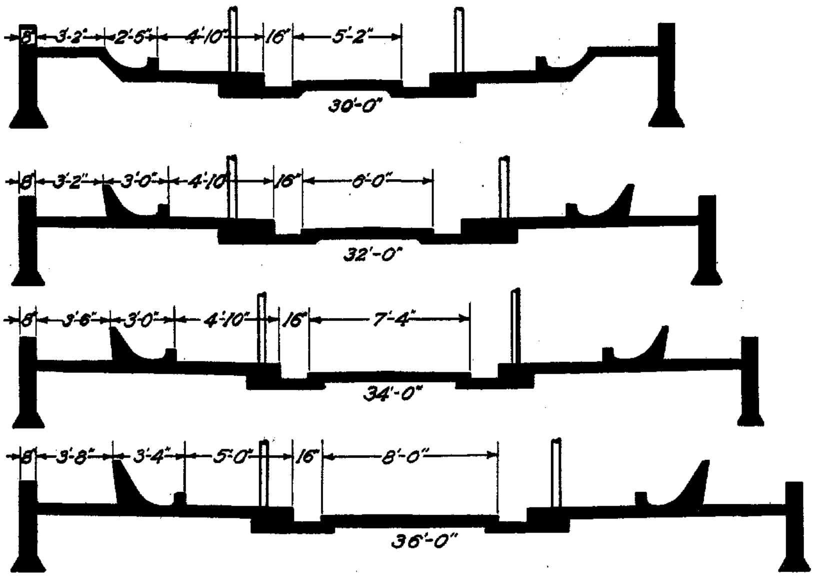


FIG. 5.—Typical floor plan arrangements for dairy barns—upper plan for cows facing in; lower plan for cows facing out.



FACING IN



FACING OUT

FIG. 6.—Typical sections showing plan for cows facing in or cows facing out in barns of different widths. A 34-foot width is a very common one, though a 32-foot width is often used with satisfaction. (Refer to figure 16 for correct stall length for different breeds.)

out. Where the milking machine is used there is even more of an advantage in favor of heading out. It is thought by some that cows headed out show off better from the rear than when headed in. This same effect, however, can be produced when the cows are headed in by making a wide alley back of them.

Width of Barn.—A common width for dairy barns is 36 feet outside. This width will accommodate the cows either headed in or headed out. Where the cows are headed out a feed alley 4 feet

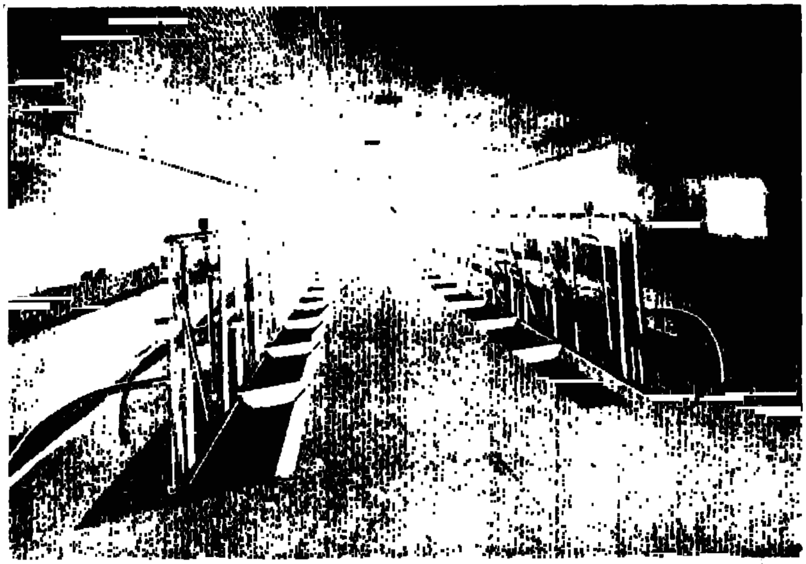


FIG. 7.—Interior view of dairy barn, Kansas Agricultural Experiment Station.

wide can be used, but the litter alley must be 7 to 8 feet. With cows headed in, the proportion given to the feed alley must be increased. Wide alleys whether in front or back of the cows make the animals show to better advantage. Figure 6 shows about the correct proportioning of widths for different width barns and for both facing in and facing out. Figure 7 shows an interior view in a barn of good type.

Size of Barn.—The size of the barn will depend upon the number of cows to be housed and whether or not calves and young animals are to be housed in the barn with the cows, and also upon the storage space desired. Under most conditions it is desirable to house calves in the cow barn, but the bulls and heifers can be more cheaply taken care of outside of the barn proper. With the width of the barn pretty well established, the length will depend upon the factors mentioned, bearing in mind that the width of stalls is generally 3 feet 6 inches. Passageways should be 3 feet to 3 1/2 feet wide. Calves require 24 inches to 28 inches of manger space.

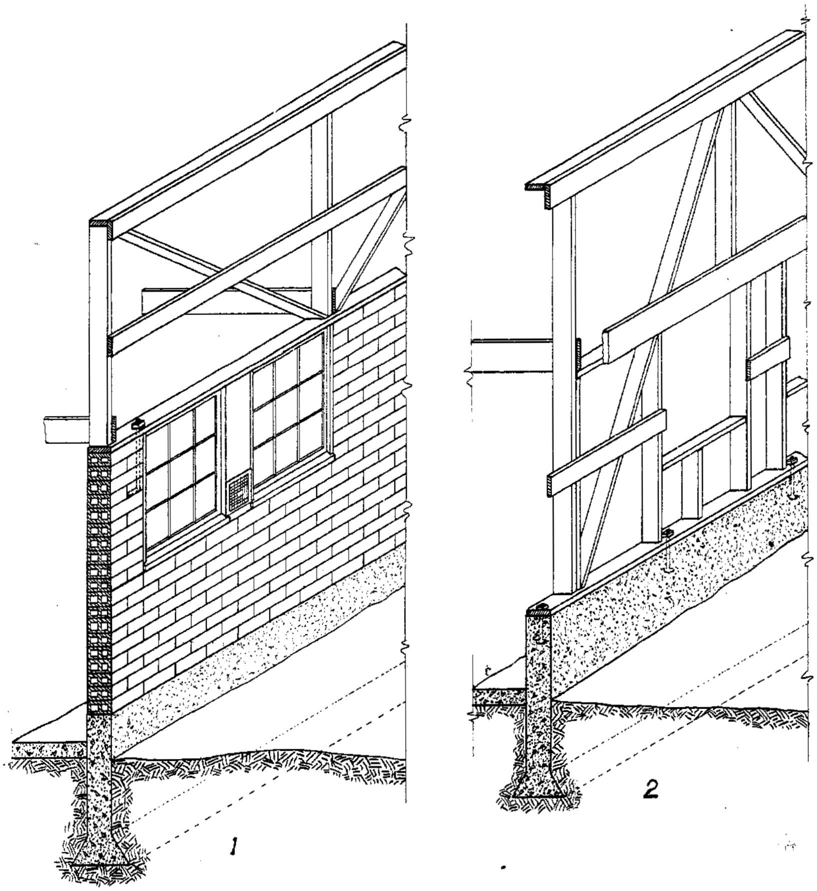


FIG. 8.—Concrete foundation with (1) tile wall and (2) frame wall.

Where possible, two or three box stalls 10 feet by 12 feet are very desirable to be used for maternity pens, and at times for calves.

Very commonly maternity pens, calf pens, and even bull pens are provided for in the dairy barn proper, although bulls can best be housed outside of the dairy barn. It is desirable that maternity pens and calf pens be provided in a wing or a separate barn from the milking barn due to the additional confusion that may result in caring for these animals. For storage space, a ton of loose hay takes 525 cubic feet. Straw requires slightly more space per ton. A cow will use a ton of straw in a year. Grain storage space requires 60 cubic feet per cow.

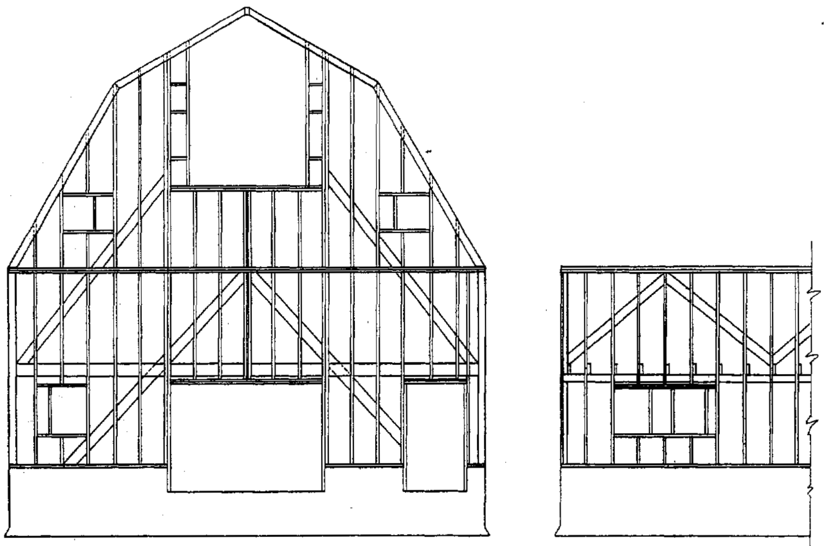


FIG. 9.—End and side wall framing and sway bracing for horizontal siding.

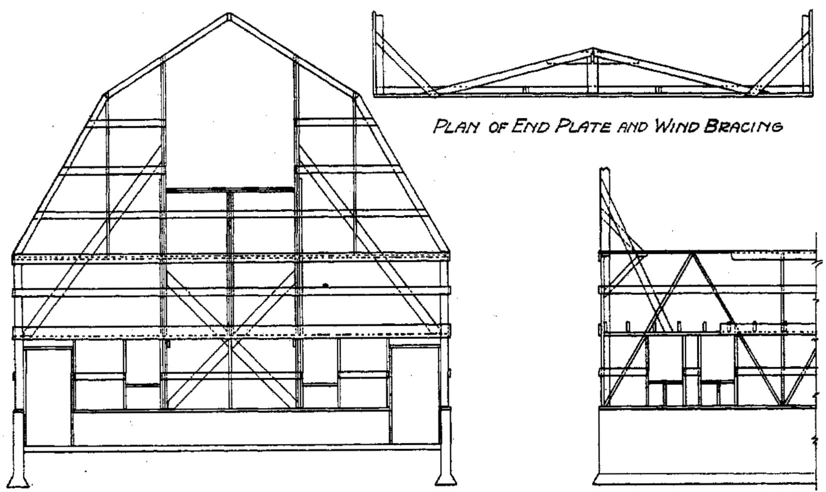


FIG. 10.—End and side wall framing and sway bracing for vertical siding.

DETAILS OF DAIRY BARN CONSTRUCTION

Foundations.—A concrete foundation for a good-sized dairy barn should be at least 8 inches thick at the top and 12 to 16 inches thick at the base. (Fig. 8.) About 16 inches is the minimum for a stone wall. The foundation should extend 2 1/2 or 3 feet below grade, and be carried at least 12 to 18 inches above grade to protect

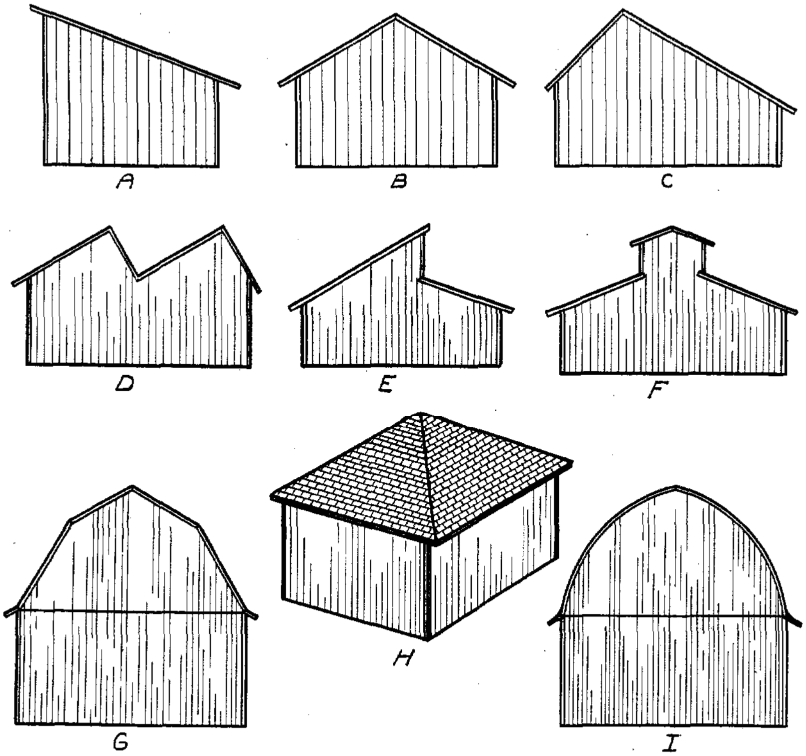


FIG. 11.—Roof shapes: (A) Shed. (B) Gable. (C) Broken gable. (D) Saw tooth. (E) Half monitor. (F) Full monitor. (G) Gambrel. (H) Hip. (I) Gothic.

sills. For smaller buildings, such as milk houses, a 6-inch wall may be used.

Walls and Ceilings.—The outside walls of frame barns (figs. 9 and 10) may well be of masonry up to or near the bottoms of windows, or to the haymow floor, as this places frame members well away from contact with moisture and gives smooth, easily cleaned walls for the dairy stable. Inside walls should be of concrete 3 1/2 or 4 feet above the floor, so they can be easily washed, and all walls and ceilings should be so constructed as to be easily kept clean.

Roof.—On a two-story barn only a self-supporting roof construction of approved design should be used. Either the gambrel or gothic type (fig. 11), if well built, gives a maximum of strength, combined with a minimum of materials and interference with hay storage. The gambrel type is preferred by many, but the gothic type is given the preference by some from the standpoint of appearance. Both are very satisfactory and neither has any decided advantage as to strength or cost if well constructed. (Figs. 12 and 13.)

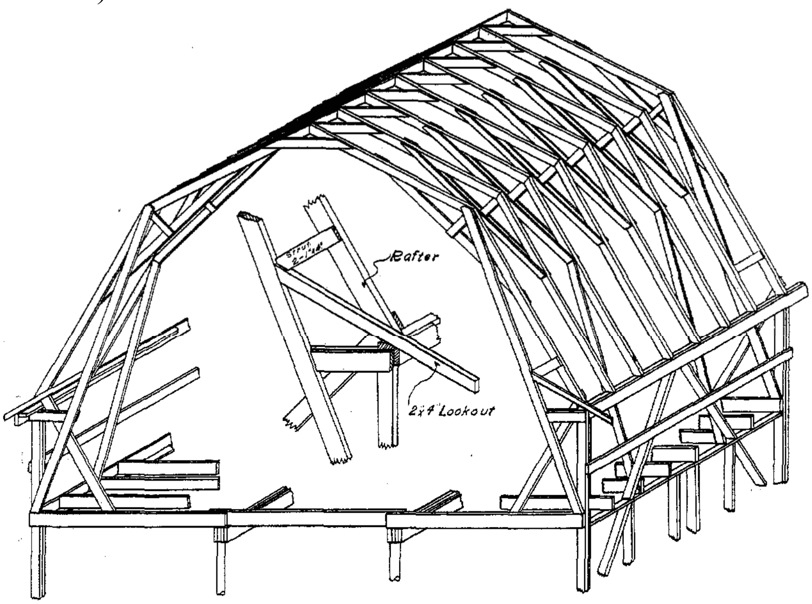


FIG. 12.—Braced rafter framing with detail of plate and foot of rafter.

Framing Details.—It is neither necessary nor desirable to use heavy timber in barn framing. Very seldom are timbers of greater thickness than 2 inches used in building the modern barn. Heavy timber construction is uneconomical in the use of materials, difficult to construct, and obstructs and reduces mow storage space. Figures 8 to 15 give typical details of different parts of barn framing which conform to good practice. An effort should be made in designing to use common sizes and lengths of dimension lumber, thus making it possible to secure all the material from local lumber yards without special order.

Floor.—A good floor is one of the most important features of a dairy barn. A floor that is impervious to moisture, durable, easily cleaned, and comfortable for the cows simplifies the handling of dairy cows more than any other feature of modern dairy barns. A concrete floor meets most of the requirements for a barn floor, and is relatively cheap. Perhaps the most common objection to a concrete floor for dairy cows is the fact that it is a good conductor and

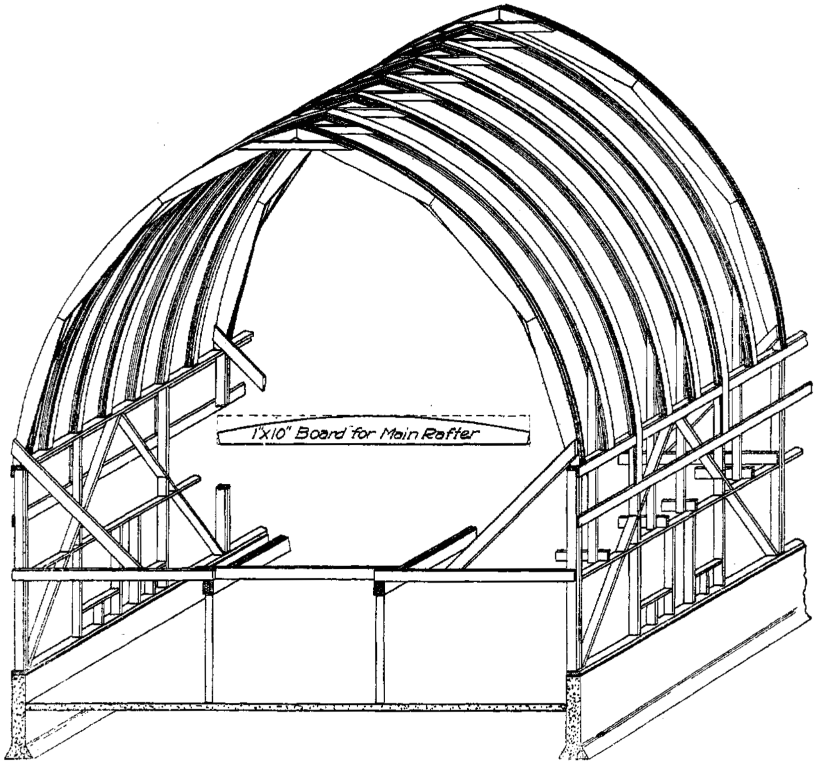


FIG. 13.—Gothic roof framing. Note the main rafter every 14 feet built up of 1" x 10" boards and sawed to curve; intermediate rafters of five 1" x 4" boards bent to radius and nailed.

may at times be cold. This may be overcome by proper construction, by bedding, and in some barns removable boards are put on top of the concrete to protect the cows' udders.

The stall floors (fig. 16) should not be of solid concrete laid directly on the ground, but there should be a layer of coarsely broken stone, or better yet a course of building tile laid flat, and a two-inch or three-inch concrete covering placed over this. Such construction makes an air space in the floor which breaks up the direct contact with the ground, and the floor is not as damp nor is it as cold as a solid floor. Creosoted wood blocks or cork brick built on a concrete base (fig. 17) are sometimes used, but this construction, while very desirable, increases the cost materially. Under Kansas conditions a concrete floor is highly satisfactory. Wood floors are short-lived, cannot be kept clean, and at present are little if any cheaper

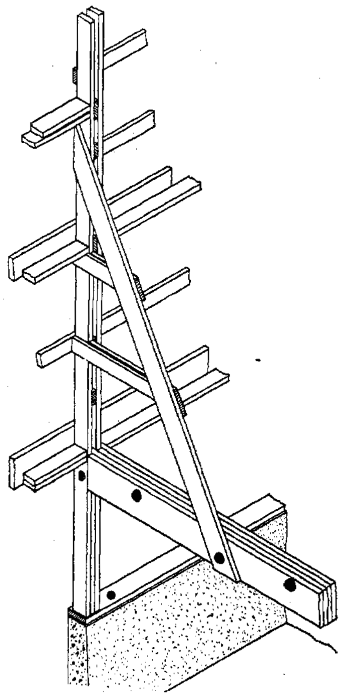


FIG. 14.—Girder and end wall construction.

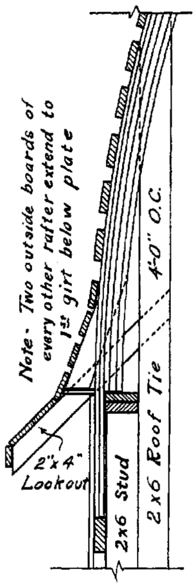
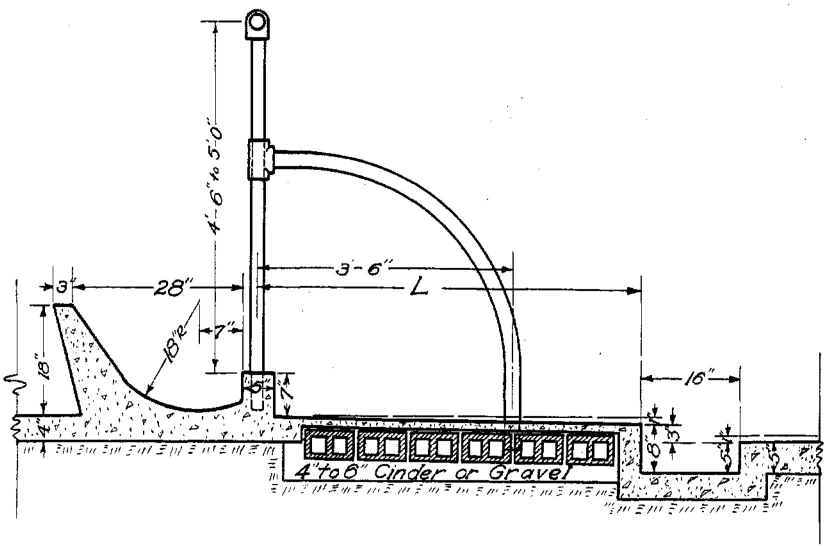


FIG. 15.—Gothic cornice construction.

than concrete, and for these reasons should not be used. In finishing concrete floors in dairy barns, the parts of the floor used by the cows should be finished with a wood float rather than a steel trowel. so that they will not be too smooth and slippery when wet.

The stall dimensions given in figure 16 are commonly accepted as standard sizes. These dimensions were compiled by M. A. R. Kelley, associate agricultural engineer of the United States Department of Agriculture.

Manger.—The manger when properly made will facilitate feeding and insure each cow's getting the feed intended for her. Four standard types of mangers are shown in figure 18. The high curb will prevent the cow's pushing the feed out in the feed alley, but the lower manger makes it very easy to sweep the feed back into the manger. In many barns the low manger is used with a movable wood or galvanized iron front that can be raised when sweeping the feed alley or cleaning the mangers. This front also has divisions



Breed	Width	Length L		
		Small	Medium	Large
Holstein	3'-6" to 4'-0"	4'-10"	5'-2"	5'-8"
Shorthorn	3'-6" to 4'-0"	4'-8"	5'-0"	5'-6"
Ayrshire	3'-6" to 3'-8"	4'-6"	5'-0"	5'-6"
Guernsey	3'-4" to 3'-6"	4'-4"	4'-10"	5'-4"
Jersey	3'-4" to 3'-6"	4'-2"	4'-8"	5'-0"
Heifers	2'-9" to 3'-2"	3'-8"	3'-10"	4'-2"

FIG. 16.—Standard stall section with table of sizes for various breeds.

to keep the cows' feed separate. All types of mangers are in wide use, but the low type is recommended only with movable front and raised feed alley and seems to be very popular. The bottom of the manger should be lowest near the stall curb, and should also be at least an inch higher than the standing platform and free from sharp angles. The manger should have provision for drainage so as to be easily washed, or if desired the cows may be watered from the manger.

Gutter. — The gutter when properly constructed will not only facilitate cleaning the barn but will also keep the cows cleaner. The gutter should be 16 inches wide, 8 inches deep on the stall side, and should have about 1 inch fall to each 20 to 25 feet toward the drain.

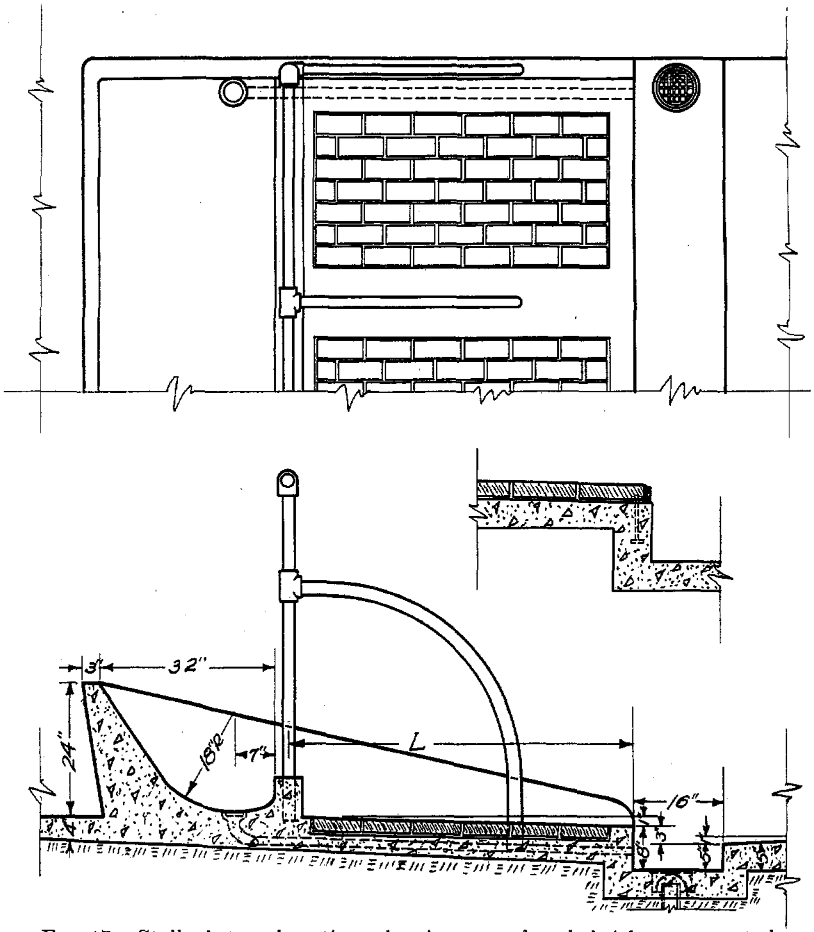


FIG. 17.—Stall plan and section, showing use of cork brick or creosoted wood-block flooring.

Cows show off better in stalls where the walk behind is 2 to 3 inches lower than the standing platform, and the cows get in and out more easily. This arrangement makes a desirable gutter, with the exception that there is more splattering where the one side is lower than the other. This is also the objection to making gutters less than 7 to 8 inches deep. By sloping the floor of the gutter slightly away from the cow the liquid manure may be carried away more rapidly. It is desirable that most of the liquid manure be absorbed by straw, but in any event the gutter should have a drain for cleaning purposes. The drain should be equipped with a bell trap and grating to prevent material getting into and eventually stopping up the tile.

Standing Platform.—The standing platform extends from the curb holding the stanchions back to the gutter. The length of this

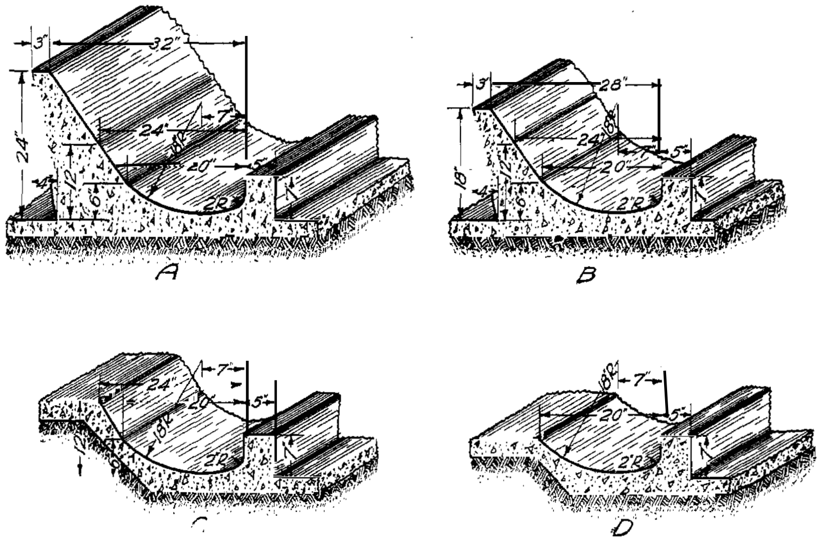


FIG. 18.—Standard manger sections. Mangers *C* and *D* are used only with raised feed alleys. Manger *D* is recommended only with lift mangers. These sections are the standard to which most manufacturers build their equipment.

platform with reference to the size of the animal will determine the cleanness of the animal. If the cow when standing comfortably is in such a position that the manure when voided will drop in the gutter the standing platform will remain clean. If, however, the standing platform is so long that the droppings fall on the standing platform the cow will become soiled when she lies down. Where all of the cows are of the same breed and are uniform in size, platforms can be built to suit their needs. A table giving the size of stalls suitable to different breeds will be found in figure 16.

Some stanchions have alignment devices which assist in holding the cows back to the gutter. In some barns the length of the standing platform narrows from one end to the other, thus making it possible to house both mature cows and heifers in the same barn.

The standing platform should have a slope of about 1 inch from the curb to the gutter. A very common plan is to make the platform level for 16 to 18 inches back of the curb, then make an abrupt rise of an inch, and then slope the platform to the edge of the gutter with a fall of 1 inch. This rise on the standing platform will permit the cows to stand level and keep the front feet of the cows from slipping when they reach for feed and may save some bruises on their bones.

A steel pipe stall partition extending from the stall upright to two-thirds the length of the standing platform is essential to keep

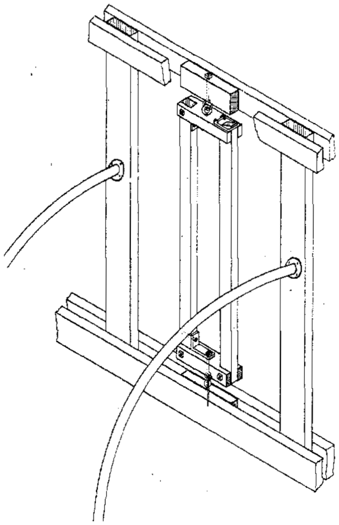
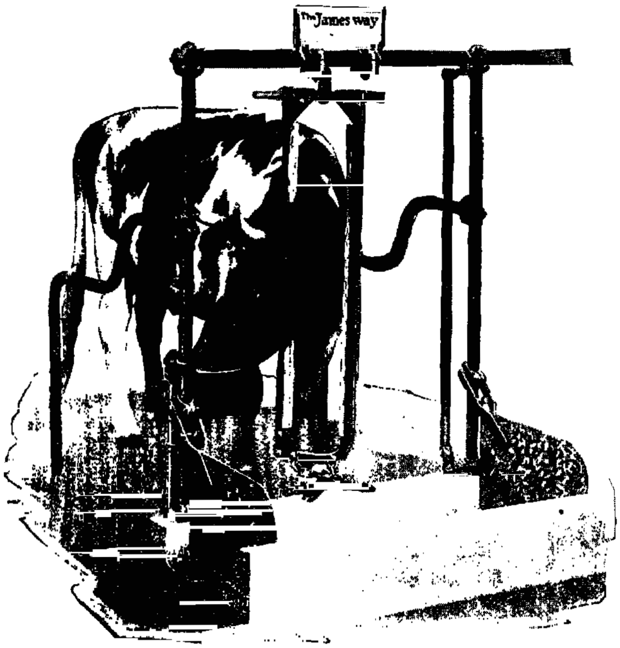


FIG. 19.—A home-made swinging wood stanchion.

the cows from stepping on each other's udders. The width between partitions will depend upon the size of cows, as shown in figure 16. Even where wood uprights are used a curved steel pipe partition is desirable.

Ties for Cows.—There is a great variety of ties used for cows; the most common, however, is some sort of a stanchion. Stanchions may be wood or steel, rigid or swinging. Figure 19 shows a home-made wood stanchion, and figure 20 a steel stanchion held by chains at the top and bottom. This steel stanchion permits the cow to lie down and draw her head around in a normal position, whereas, a rigid stanchion does not. The swinging steel stanchion as shown is very generally used. As previously mentioned, alignment devices are used on some stanchions at the points where the chains hold the stanchion to the uprights. This arrangement permits some adjustment of the cows to the standing platform. Another tie that has worked quite satisfactorily is made by putting a chain from one upright to the other in front of the cow. This chain moves up and down on two iron rods 2 feet long fastened to the uprights. A snap on the chain fits a ring on a leather strap on the cow's neck. This permits



Courtesy James Manufacturing Co.

FIG. 20.—A common style steel stanchion, showing also water bowl and manger partitions.

greater freedom for the cow than the swinging stanchion, but is less convenient to handle.

The uprights holding the stanchions or other ties can be made of wood or steel. The steel is better looking, easily kept clean, and may in the end be less expensive than wood construction. Where wood is used it may be necessary to brace the uprights from above. Steel pipe set in concrete makes a rigid upright that is very durable.

Doors.—A door 3' 6" in width will be satisfactory for one cow. (Fig. 21.) If wider, it should be wide enough to accommodate two cows without crowding.

Lighting. — Windows are more efficient, if placed with their tops near the ceiling and with their long dimension up and down. The window detail shown in figure 22 allows the top of the window to drop inward for ventilating purposes. This diverts the incoming air

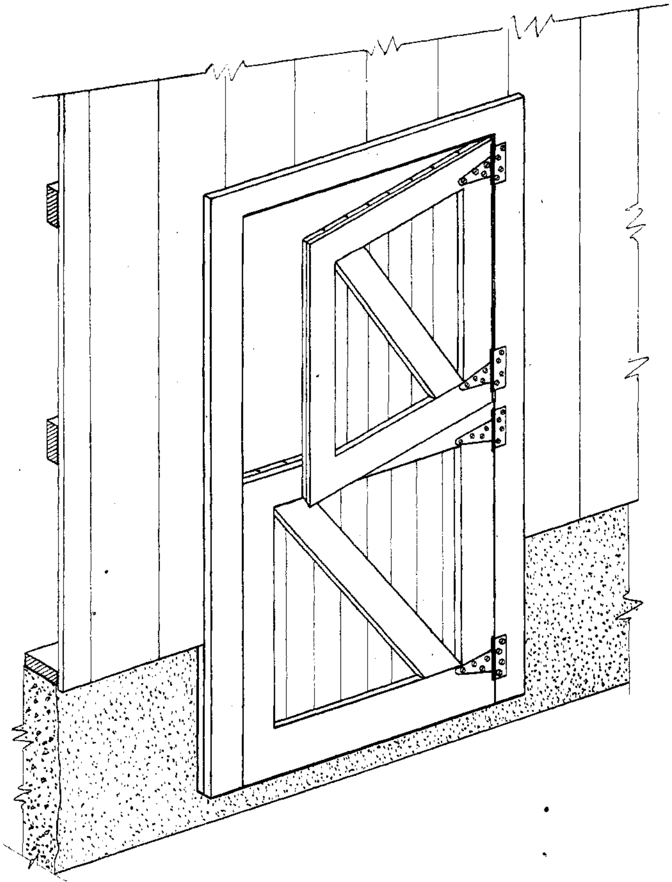


FIG. 21.—A Dutch door. This is a very convenient type of hinge door for feed alley or stock door. The top part may be left open for ventilation and if desired bars may be added to lower door to keep stock from reaching over it when the upper one is open.

toward the ceiling and prevents drafts. If desired, the window may be raised a few inches while in this position, allowing an opening at the bottom. It is quite common practice to hinge the sash at the bottom but this prevents raising the window. The sash is held in position either open or closed by window bolts.

The window sash shown in figure 22 are nine-light, 9- by 12-inch glass. Four of these sash admit about the required light for seven cows. When horizontal barn siding is used and the studs 2 feet apart, a six-light 8- by 12-inch sash is used, since this size will fit between studs without cutting them. This size window has a glass area required for one cow, so if used, one window should be installed for each cow provided for in the barn plan. Windows may be placed singly, or in pairs, or even as triplets if desired, but it is often found convenient in arranging ventilating flues to place windows in pairs with an intake flue between. (Fig. 22.)

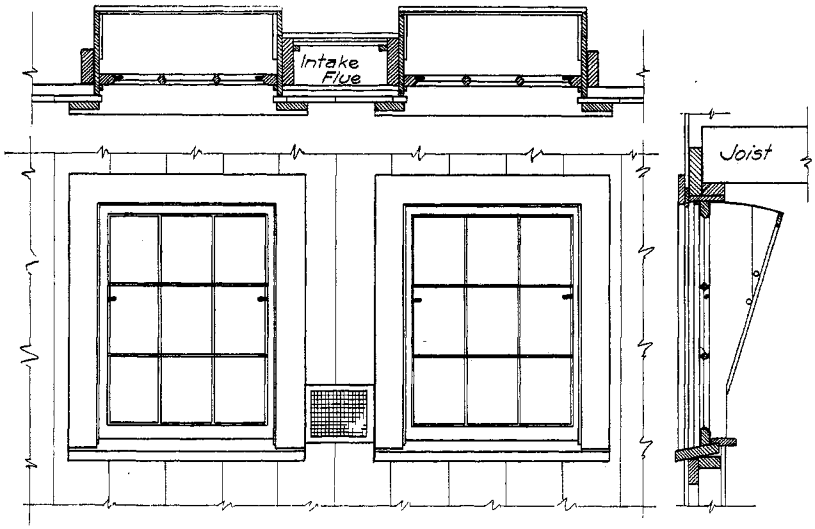


FIG. 22.—Nine-light windows, placed in pairs with intake ventilating flue between, is a very popular installation. Note the ventilating shield which deflects the air toward the ceiling when the window is tilted inward at the top, preventing direct draft on the cows. The window may be raised a few inches when in the open position so as to allow a direct draft for summer.

Ventilation.—As previously mentioned ventilation is one of the essentials that must be considered in dairy-barn construction. A cow breathes about 2,800 cubic feet of air a day, and in order to keep the air about her in a pure enough state for her use, it is necessary to maintain a constant change of air at the rate of about 56 cubic feet per minute. The purpose of ventilation, then, is to provide fresh air, to remove foul air, odors, moisture and other products of respiration, and to control barn temperatures.

The ventilation necessary may be gotten by any one of several methods, but every one is not equally satisfactory under all conditions. It is customary in summer to use open windows and doors and allow air to circulate into and out of the barn with the air movements out of doors. This is entirely satisfactory in summer, but, in cold weather and when the barn is filled to its capacity, if open windows and doors are depended upon for the admission of sufficient air, there will be undue drafts created and the stable temperature will be lowered to a very uncomfortable point.

Where animals are to be housed continuously for any length of time in cold weather it is necessary to use some other method of exchanging the foul air for fresh. The method most, commonly employed in Kansas is the modified King system, shown in "A," figure

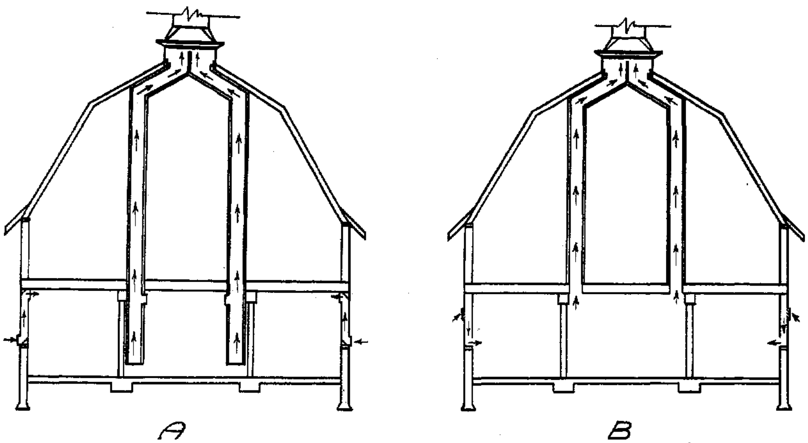


FIG. 23.—Ventilating flue arrangement. (*A*) The modified King system. (*B*) The Rutherford system. Note in *A* that the air enters the stable at the ceiling and foul air is removed from near the floor. In *B* fresh air enters near the floor and foul air is taken out at the ceiling. The modified King system has a small opening in the flue near the ceiling.

23. The system shown in "B," figure 23, is known as the Rutherford system, but is not as generally used in Kansas as is the King system.

The outtake flues (fig. 24, B) are from 2 to 4 square feet in cross-sectional area, and extend from near the floor out through the roof. They should be as nearly straight and vertical as possible. About 30 square inches of outtake flue area is provided for each cow housed in the barn. In the modified King system the outtake flue is often hinged at the ceiling so it may be raised to facilitate working about under it. In some installations this section of the flue is omitted entirely and all the outgoing air is removed from near the ceiling, as in the Rutherford system, rather than from near the floor.

The intake flues (fig. 24, A) are smaller in area and distributed along the outside walls. Their total area should be equal to or slightly in excess of the total area of all outtake flues. All flues must be well insulated to prevent cooling of the air and consequent condensation of the water vapor it carries. They may also have dampers installed to throttle the air when the movement is too rapid and cooling of the barn results.

A well designed ventilating system is dependent for its successful operation on having all other openings to the building closed. Open

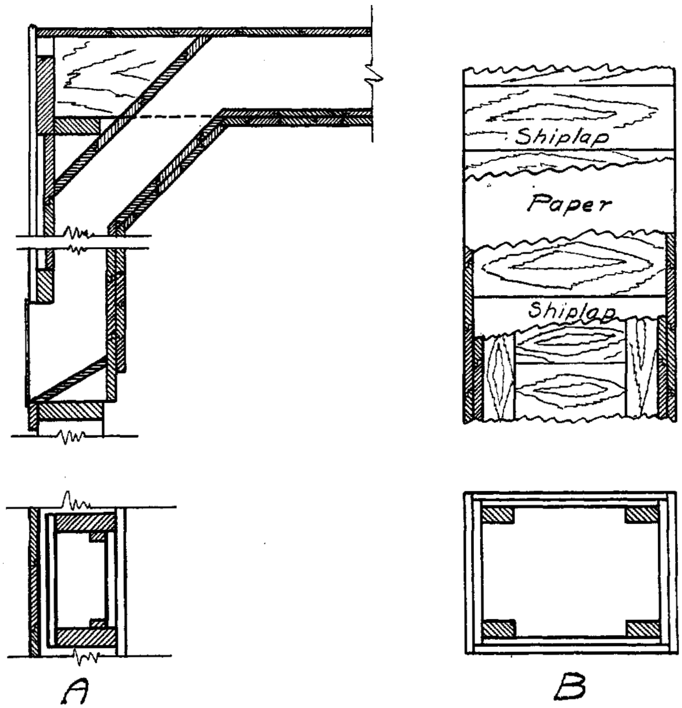


FIG. 24.—Details of ventilating flue construction. (*A*) Intake flue. (*B*) Out-take flue.

windows and doors, open hay and feed chutes, and unbattened cracks will prevent the best system from functioning.

ACCESSORY DAIRY EQUIPMENT

Calf Pens.—Calves should be fed as individuals, and for this reason provision should be made for tying the calves during the time they are fed their milk and grain. A very cheap tie can be made as shown in figure 25, which includes both stanchions and mangers. A tie 24 to 28 inches wide and 36 inches high will take care of calves until six months of age. The manger should provide a convenient place for holding a bucket and feeding grain and hay. Individual pens 5 by 7 feet are very desirable for young calves or calves that need individual attention. Pens accommodating eight to ten calves, with rigid stanchions to hold them during feeding,

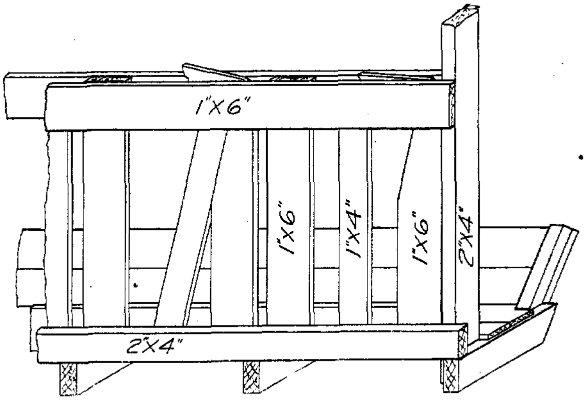
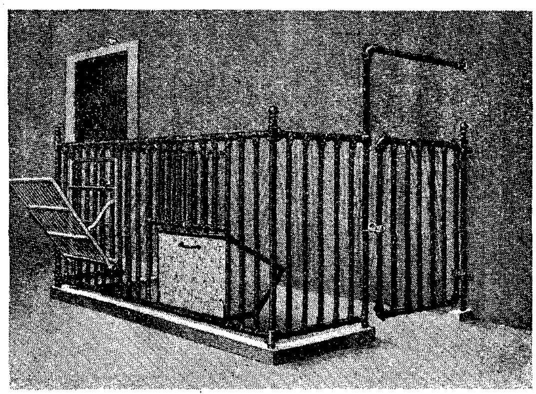


FIG. 25.—Calf stanchions and mangers of wood construction.

are most common. A pen 12 by 20 feet will hold 10 calves up to six months of age.

Housing Heifers and Bulls.—Heifers and bulls, after the time they stop getting milk, frequently get but little grain, but are fed liberally on silage and hay. As previously mentioned, they can be more cheaply housed outside of the dairy barn. During the pasture season they need very little protection. On most farms a



Courtesy J. E. Porter Company.

FIG. 26.—A steel pen which has feed and hay mangers attached. Such a pen is substantial, makes a good appearance, and is sanitary.

cheaper barn, or a shed provided with a hay rack and a feeding bunk, where they can be fed silage and grain is used for these animals. Three months before freshening the heifer can be brought into the milking barn and fed in the stall she will occupy when fresh.

Maternity Pens.—The cow should be taken from the milking barn four or five days prior to calving and put into a box stall until

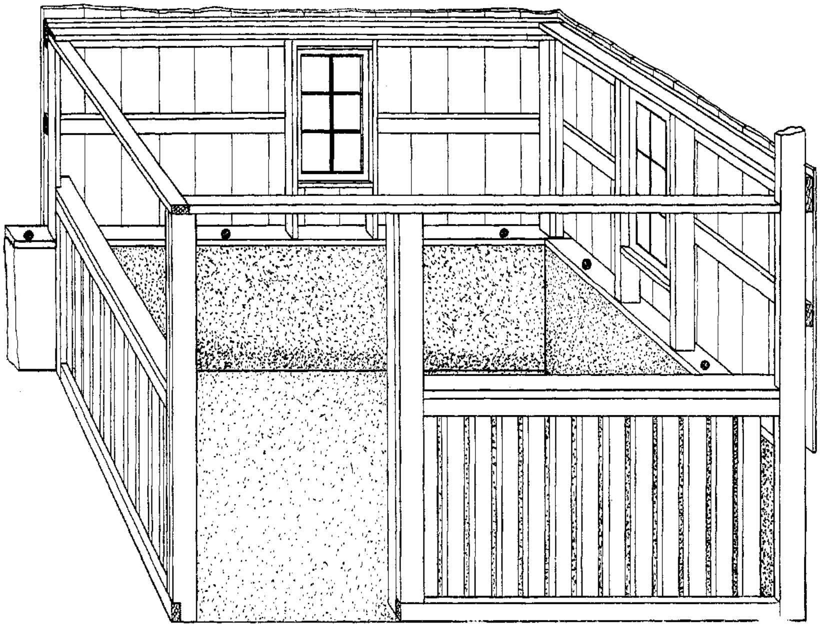


FIG. 27.—A wooden pen. Such a pen is often not as substantial nor as easily kept clean as is a steel pen.

ready to return to the milking barn. This box stall should be in a place where there is not too much confusion, but where the cow can be easily seen by the barn men. Stalls 10 by 12 feet equipped with a feed manger and hay rack are suitable. Figure 26 shows a steel pen with mangers attached that is very desirable. A wood-frame pen similar to the one shown in figure 27 is satisfactory if preferred to the steel equipment.

Feed Room.—The feed room should be near the feed storage, and preferably near the silos. It is desirable also to have feed-mixing space and storage up stairs, so that the grain can be run into the feed room from a hopper and chute. This also eliminates the storing of any large amount of mixed feed in the feed room, but will leave room for special feeds and for the feed cart. Overhead grain storage is convenient, but requires considerably heavier framing to support the extra load. Many barns are now equipped with overhead carriers, and the grain feed and silage are fed from carriers instead of carts. When the feed storage is at the same end of the barn as the silo, the feed can be brought in through a side door. It may be possible, also, to use a hoist of some kind for getting the sacks of feed into the barn. Feed bin floors should be dry, and the walls must be well anchored to the floor on account of the thrust produced by the weight of grain in the bin. (Fig, 28.)

Milk Room.—A great many city ordinances require that the milk room be apart from the barn or joined to the barn by

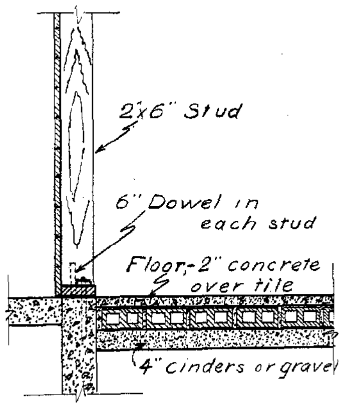
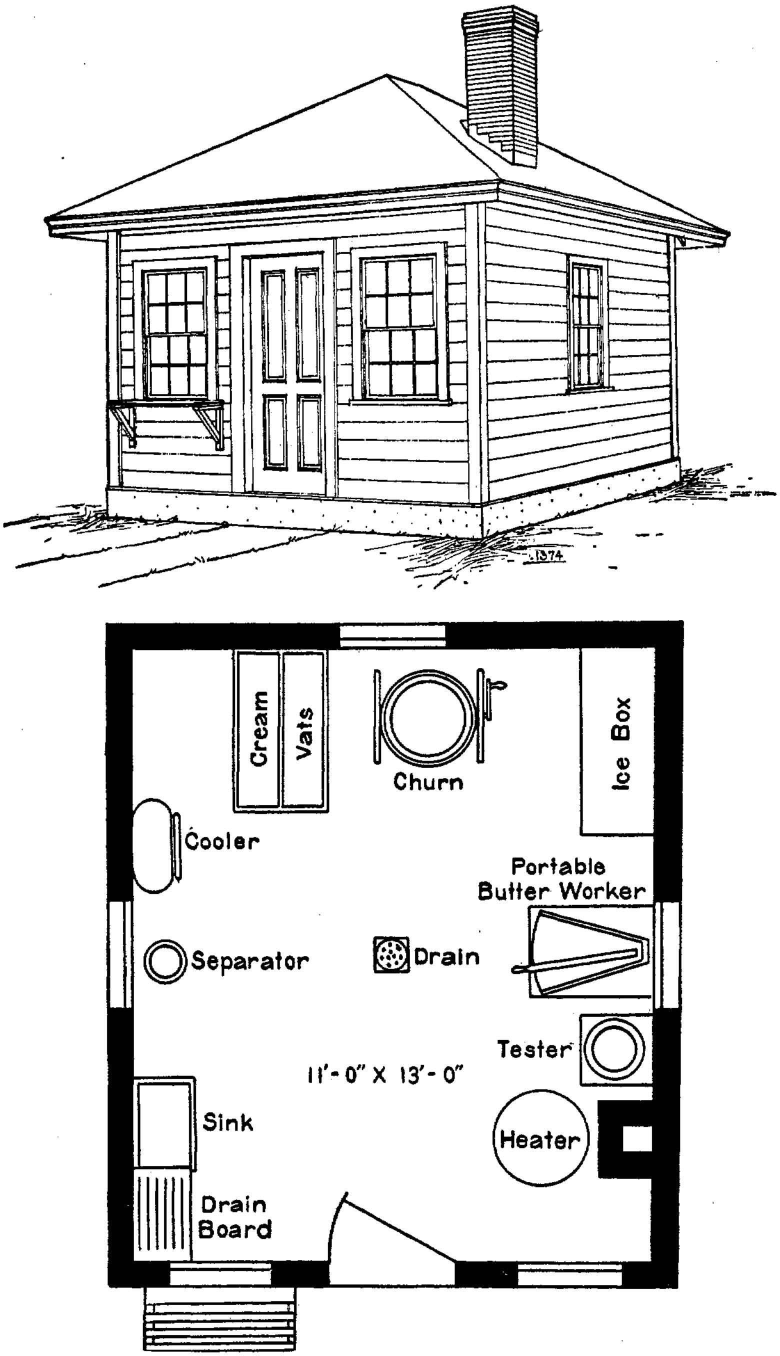


FIG. 28.—A grain bin, showing floor and wall construction. Bin floors should be dry and rat-proof. The walls should be well anchored to resist the thrust of several feet of grain.

means of a vestibule. This is particularly true when market milk is produced. If the milk room is built to one side of the barn, it should be built about midway of the barn and made easily accessible to all parts of the barn, and especially convenient to loading the milk or cream for market. On most farms the milk room can be built in the end of the barn opposite from where the cattle are turned out or where manure is piled. (Figs. 29 and 30.)

The milk room should be no larger than necessary to house the milking utensils, the articles necessary to keep them clean, and space for cooling the milk or for separation and holding milk or cream. The utensils housed here will depend upon the product, sold. (Fig. 31.) Some means of heating water is also necessary. Where an engine is used for pumping water or for running the milk-

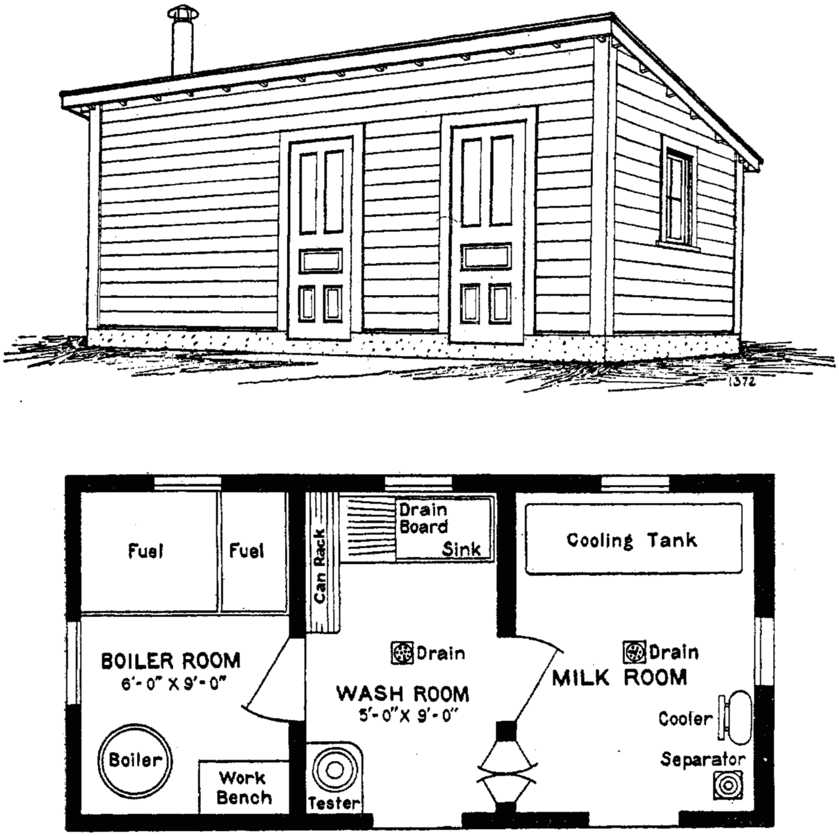


Courtesy Kansas State Board of Agriculture.

FIG. 29.—A one-room milk house.

ing machine, the engine should not be in the same room where the milk is handled. A screened drying rack is very desirable for drying dairy utensils.

Hay Chutes.—When the hay chute enters the milking barn, it is desirable to have a trap door closing the opening from above and

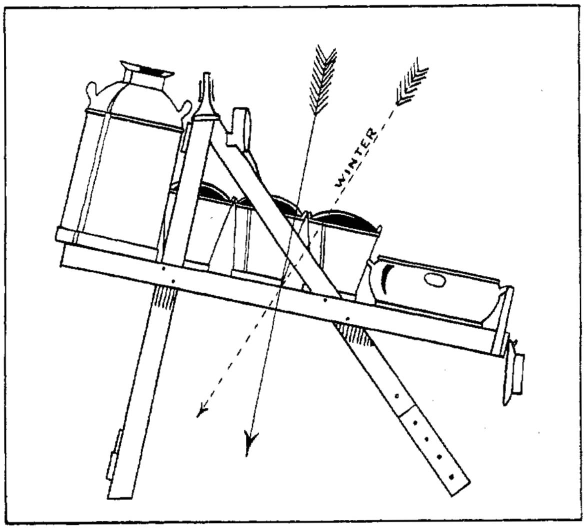


Courtesy Kansas State Board of Agriculture.

FIG. 30.—A three-room milk house.

a covering that can be pushed over the opening from below. This double arrangement will lessen the dust entering the barn from the mow and will prevent drafts that might interfere with ventilation.

Water Supply.—It is highly desirable that the barn and milk room be located near an abundant supply of good water. The cows need a large quantity of water, and should have it at least twice a day in such condition that they will use all they want of it. The dairy barn, the milk room, and, more important, the milk utensils, will be kept cleaner if water is easily accessible. If the cows are kept in during bad weather, provision should be made for watering them in the barn. This can be done by running water into the manger, or by the use of water bowls placed on the stall uprights (fig. 20) and filled under pressure or from a storage tank. Water bowls are now a part of modern barn equipment. They save time in watering the cows, are more sanitary, and best



Courtesy Kansas State Board of Agriculture.

FIG. 31.—Sunning rack for milk utensils.

of all they give the cows all the water they want whenever they want it and at a desirable temperature. The water bowl is a great convenience, and on farms where the cows were not adequately watered before the bowls were installed, many show an increase in the milk produced.

When it is necessary to water the cows outside during the winter, some provision should be made for furnishing them water at a temperature of 60 degrees F.

Manure Pits.—On many dairy farms the manure is thought of only as a necessary evil. There is, however, in Kansas an increasing appreciation of the value of farm manure. This is generally reflected in the method of handling. Manure piled without any cover will lose from one-third to one-half of the value it would have if hauled to the fields daily. By hauling out the manure daily the number of flies during the warm months will be reduced and the surroundings made more wholesome. Where manure cannot be hauled to the field each day, it should not be dumped closer than 50 feet from the dairy barn. A very convenient shelter for the

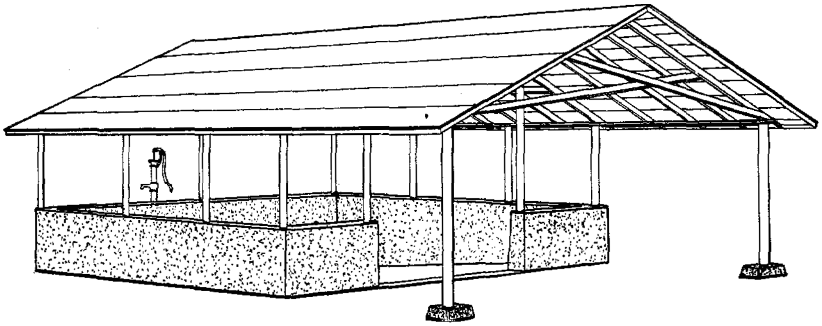
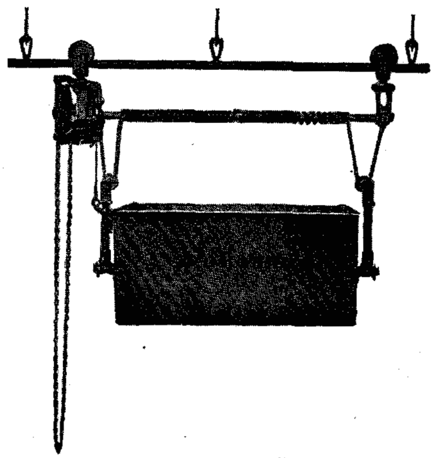


FIG. 32.—Covered concrete manure pit and shelter for spreader.

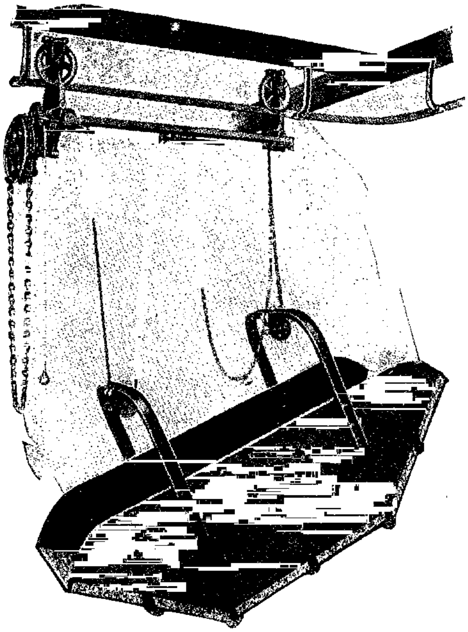
manure spreader may be built in conjunction with a covered manure pit, as shown in figure 32. The litter carrier track is carried over the spreader and the manure may be dumped directly into the spreader if it is to be hauled to the field immediately, or carried



Courtesy J. E. Porter Company.

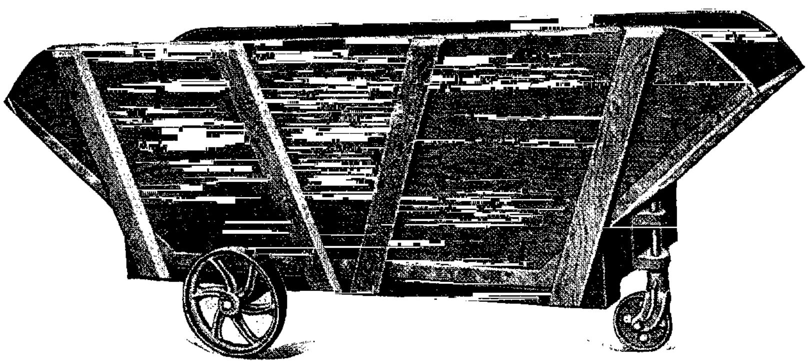
FIG. 33.—Litter carrier.

on into the pit, to be removed at a more convenient time. The floor of the pit should slope to the rear, where a small cistern or sump is provided to receive the liquid manure. From here it is removed by pumping, or by gravity if on a hillside. The litter carrier with overhead track (fig. 33) is not only making barn cleaning easier, but it is also shortening the time necessary to do the work. As the fertility of the land becomes a more serious question more care will be given in handling farm manure.



Courtesy Milwaukee Hay Tool Company.

FIG. 34.—Feed carrier.



Courtesy Milwaukee Hay Tool Company.

FIG. 35.—Feed cart. On comparatively smooth floors a feed cart is often more convenient than a track carrier.

Among other conveniences and time savers a feed carrier and a feed cart should be mentioned. (Figs. 34 and 35.)

Bull Pens.—As previously stated, the bulls can be more cheaply and more conveniently housed outside of the dairy barn. In Kansas a very suitable bull pen can be made by using a shed closed on the three sides toward the prevailing winter winds. A bull barn and the pen should be strong enough to stand the usage given them by bulls, and large enough so that the bull can get sufficient exercise. The barn shown in figure 36 has proved very satisfactory. A bull pen (fig. 37) is highly desirable.

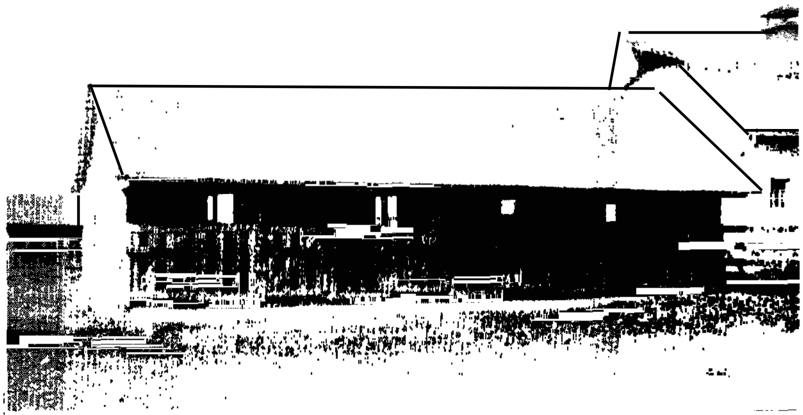
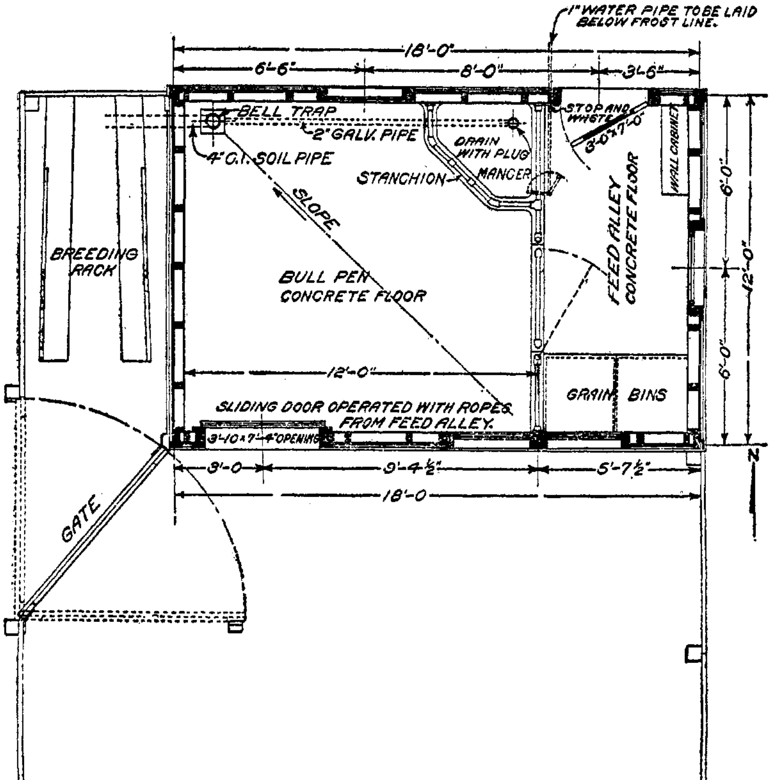


FIG. 36.—Bull barn, Kansas Agricultural Experiment Station.

Silos.—Rarely does it happen that a dairy barn is planned on a farm where a silo is absent. In other words a silo is generally built before much attention is paid to dairy barns and equipment. In fact the dairy barn is generally built close to the silo, which is considered the most important part of the barn or dairy equipment. The silo or silos are best located at one end of the barn (see page 4) or at some point where it is easy to get the silage into the barn. The material used for silos will vary with the location in the state. Where sand or gravel is available, some form of concrete silo will perhaps be cheapest. In other sections where hollow tile are made the tile silo may be more economical. Pit silos have proved very satisfactory in the western part of Kansas. Most of the silos on the market will keep silage well when properly erected.

In estimating the size of a silo necessary for a given herd of cattle, the silo should be of such size that two inches of silage can be fed off the surface each day in order that the silage will not dry out or spoil. The weight of settled silage varies slightly at different depths, but averages about 40 pounds per cubic foot.[3] The following table gives the number of cattle that must be fed to remove each day a sufficient quantity of silage from a silo of a given diameter to prevent spoilage:

Diameter of silo	Pounds in two inches of depth	Number of cattle fed, at 30 pounds per head
10 feet	525	17
12 feet	750	25
14 feet	1,025	34
16 feet	1,340	44
18 feet	1,695	56
20 feet	2,090	69
22 feet	2,535	84



Courtesy Kansas State Board of Agriculture.

FIG. 37.—A bull pen outside the main dairy barn is usually most satisfactory. The plan shown is a suggested arrangement for bull shed, breeding rack, and lot.

3. For more information on "Capacity of Silos and Weights of Silage," see Bulletin 222 of the Agricultural Experiment Station, K. S. A. C., Manhattan, Kan.

A silo should always be at least twice its diameter in height. The additional pressure exerted on a silo that is high in proportion to its diameter will assist the silage in settling.

Many silos are built without a floor or without a roof but for the convenience of the man who uses the silo it is desirable to have both. In building a cement or tile silo, bolts should be placed in the door frame for building a chute and in the top for tying the roof to the silo. The silo should be built outside of the barn, but can be enclosed at the bottom by a vestibule.

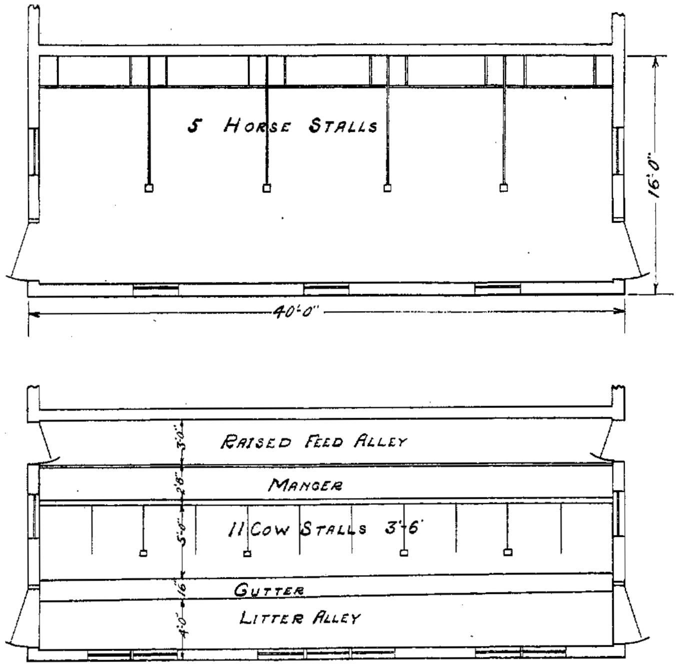


FIG. 38.—Remodeling suggestion. An unused stable may be converted into a well-arranged dairy section. Posts may have to be moved latterly to conform to new stall widths, but this shift usually can be made if an additional piece is added over the posts. Extra windows must be added, which can be done without disturbing those already in place.

REMODELING OLD BARNS

In making over barns to be used in housing dairy animals it may be impossible to follow all the suggestions made in this bulletin, but it does give suggestions that may be used as a guide. (Fig. 38.)

The Graves Stall.—One type of stall that can be made on the farm, and has frequently been used where one row of cows is housed, is the Graves stall. (Fig. 39.) The Graves stall, when properly adjusted to the cow, will keep the cow cleaner than the common cow stall. It will be noted that the cow stands with her hind feet back of a split 4 x 4 and is tied with a chain from a staple on the under side of the feed manger to a strap about her neck. When she lies down she steps in front of the split 4 x 4 and her head is under the manger. The 4 x 4 is lugged to 2 x 4's set in concrete and can be moved to suit the size of the cow. The height of the manger is also adjusted to the breed of cow when the barn is built. This type of stall has only a very shallow gutter back of the cows. The big objection to the Graves stall as generally used is that it is necessary to feed over the cows. This, however, is not considered a serious objection by those who have used this type of stall.

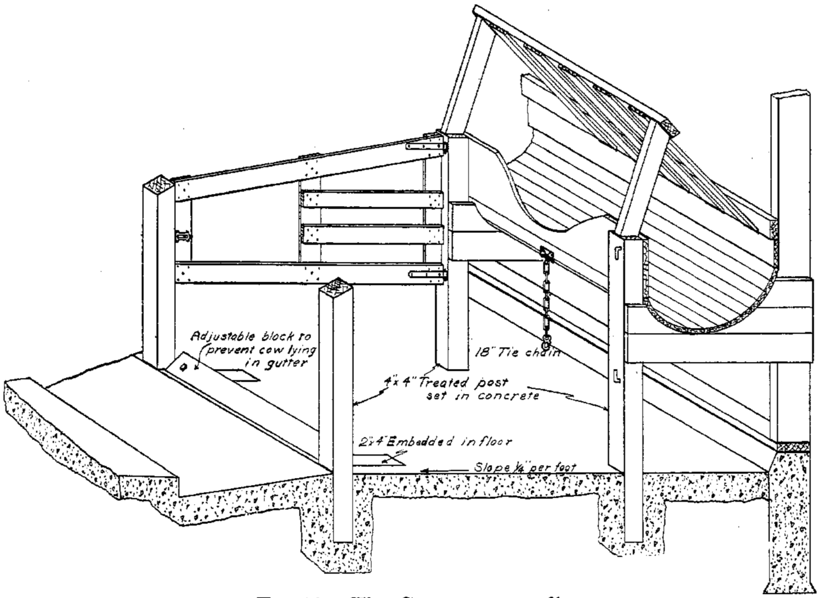


FIG. 39.—The Graves cow stall.

APPENDIX

Available Dairy Barn and Dairy Equipment Plans

K. S. A. C. PLANS

Blue prints for barns and equipment described below may be obtained from the Department of Rural Engineering, K. S. A. C., Manhattan, Kan. Order by number.

Nos. 72-151, General Purpose Barn.—34′ x 56′. Frame construction; gambrel roof; capacity, 6 horses, 11 cows, young stock, maternity pen, 2 feed bins, 60 tons hay.

Ten sheets, bill of material and specifications.............. 50c

Nos. 72-351, Dairy Barn.—36′ x 84′. Hollow tile walls first story, frame construction above; gambrel roof; capacity, 30 cows, 2 calf pens, 2 box stalls, 100 tons hay; 2 feed rooms and 2 silos shown in connection.

Nine sheets, bill of material and specifications............. 50c

Nos. 72-361, Dairy Barn.—34′ x 64′. Frame construction; Gothic roof; capacity, 23 cows, 3 maternity pens, feed room, 3 overhead feed bins, 75 tons hay.

Nine sheets, bill of material and specifications.............. 50c

Nos. 73-441, Milk House.—14′ x 18′. Hollow tile walls; hip roof; concrete floor; separator room; wash room; boiler room.

Three sheets, bill of material and specifications............. 25c

Nos. 77-321, Graves Cow Stall.—Adapted particularly to remodeling of old barns.

1 sheet 10c

No. 602, Ensilage Cart.. **10c**

U. S. D. A. PLANS

Nos. 1267-8-9-10, General Barn.—36′ x 60′. Two stories; 16 cow stalls facing central feed alley; 3 box stalls across one end of barn; feed room; stair to mow; mow capacity, 80 tons loose hay; gambrel roof; concrete foundations; ventilation flues suggested. Alternate plan provides one less box stall and the central feed alley extends full length of barn. Adapted to cold climates.

Four sheets, bill of material............................ $1.00

No. 495, Dairy Barn.—18′ x 30′. Two stories; 4 cow stalls; calf pen for 3 calves; storage on ground floor for about 2 tons of hay; stair to mow; mow capacity, 5 tons; gable roof; concrete foundation.

One sheet, bill of material................................ 15c

Nos. 687-8, Dairy Barn.—36′ x 71′. Two stories; 30 cows facing 8′ central feed alley; feed room; box stall; mow capacity, 75 tons; grain room and 2 bins, 48 bushels each in mow; gambrel roof; concrete foundations and floor. Adapted to cold climates.

Two sheets 50c

Nos. 755-6-7, Dairy Barn.—36′ x 70′. Two stories; 20 cows facing 8′ center driveway; calf pen; box stall; feed room; mow capacity, 75 tons; grain room with 3 bins, 36 bushels each on mow floor; gambrel roof with trussed rafters; concrete foundations and floor. Adapted to cold climates.

Three sheets, bill of material 75c

Nos. 774-5-6, Dairy Barn.—Same as design No. 755-6-7, but of bent construction with roof trusses spaced 14′, center to center.

Two sheets, bill of material 75c

Nos. 793-4-5, Dairy Barn.—34′ x 45′. One story; 20 cows facing out; 6′ center driveway; hollow tile stuccoed walls; gable roof. Designed for use with feed barn.

Three sheets 45c

Nos. 839-40, Dairy Barn.—Typical one-story design, 34′ wide, adapted to 8 different floor plans; concrete foundations and floors with 8′ center drive or 6′ feed alley; gable roof. Designed for use with feed barn. Drawings provide for barns of following sizes:

34′ x 45′, 20 cows facing out; 34′ x 45′, 20 cows facing in;
34′ x 62′, 30 cows facing out; 34′ x 62′, 30 cows facing in;
34′ x 84′, 40 cows facing out; 34′ x 84′, 40 cows facing in;
34′x105′, 52 cows facing out; 34′x105′, 52 cows facing in.

Two sheets 50c

Nos. 1155-6, Dairy Barn.—34′ x 70′. One story; 20 cows in one end; grain room and hay storage space in other end; hay storage capacity, 25 tons loose hay; gable roof; concrete foundations; sides covered with boards and battens.

Two sheets, bill of material 30c

Nos. 596-7, Bull and Calf Barn.—36′ x 56′. One and one-half stories; pens for 30 calves; 4 maternity pens; 1 bull pen; 8′ central driveway; mow for 20 tons of hay; gambrel roof; post and girder construction covered with boards and battens; concrete pier foundation with curtain wall; earth floor. Adapted to temperate climates.

Two sheets, bill of material 30c

Nos. 929-30-31, Calf Barn.—Center building 2 stories, 24′ x 32′; bedding, feed, and wash rooms; scale platform; mow capacity, 15 tons; two 1-story wings, 22′ x 52′, accommodating 55 calves total; gable roof.

Three sheets, bill of material 75c

Nos. 932-3-4-5, Feeding Barn.—36′ x 98′. Two stories; 10 box stalls; 1 bull pen; calf pen for 15 head; young stock pen for 7 head; feed room; closet; mow capacity, 150 tons; feed room with 4 bins on mow floor; gambrel roof; concrete foundations.

Four sheets $1.00

Nos. 936-7, Bull Barn.—12′ x 18′. One story; bull pen; feed alley; 2 grain bins, 12 bushels each; gable roof; concrete foundation and floor; iron stanchion and rail. Adapted to temperate climates.

Two sheets, bill of material 30c

No. 1416, Standard Cow Stall Details.—Shows dimensions of stalls for various sized cows, details of four types of mangers and two types of gutters. Details for building concrete and cork brick floors.

One sheet 15c

No. 1611, Cow Stanchions.—Homemade, of wood, showing method of attaching to post and girder supports.

One sheet 15c

No. 1616, Hay Feed Rack.—7′ x 28′ 10″. Shown built on concrete posts; solid board bottom and trough; 2″ x 4″ slats; height, 7′ 10″ above trough.

One sheet, bill of material.................................. 15c

No. 1613, Hay Feed Rack.—4′ x 12′ 4″. Portable on skids; solid bottom and trough; 1″ x 4″ slats, 2′ 10″ above trough.

One sheet, bill of material.................................. 10c

No. 1173, Feed Trough.—5′ x 14′. Box trough on skids; for cattle or horses.

One sheet, bill of material.................................. 10c

No. 1627, Dehorning Chute.—3′ 6″ x 8′. Stationary crate.

One sheet, bill of material.................................. 10c

Nos. 657-8, Monolithic Concrete Silo.—Typical drawing, bill of material for the following sizes:

10 feet in diameter; 20, 22, 24, 26, 28 and 30 feet high.
12 feet in diameter; 24, 26, 28, 30, 32, 34 and 36 feet high.
14 feet in diameter; 28, 30, 32, 34, 36, 38, 40 and 42 feet high.
15 feet in diameter; 30, 32, 34, 36, 38, 40, 42, 44 and 46 feet high.
16 feet in diameter; 32, 34, 36, 38, 40, 42, 44 and 46 feet high.
18 feet in diameter; 36, 38, 40, 42, 44 and 46 feet high.

Two sheets 30c

No. 633-4-5, Milk House.—18′ x 26′. Wash room; closet; milk room; built-in refrigerator; boiler room; 1 story frame, with concrete foundations and floors. Capacity, 20 to 40 head for market milk.

Three sheets, bill of material................................ 45c

Nos. 759-60, Milk House.—19′ x 33′. Combined milk and wash room; cooling tanks; closet; boiler room; sterilizer; brick chimney; ice house attached; 1-story, frame; concrete foundations and floors; gable roof. Adapted to cold climates. Capacity, 20 to 30 head.

Two sheets, bill of material.................................. 50c

Nos. 771-2, Milk House.—16′ x 19′. Combined milk and wash room; concrete cooling tanks; boiler room; sterilizer; brick chimney; 1-story, frame; concrete foundations and floor; gable roof; capacity, 20 to 30 head.

Two sheets, bill of material.................................. 30c

Nos. 1333-4-5, Milk House.—14′ x 24′. Milk, wash, boiler, and weighing rooms; built-in refrigerator; 1-story, frame; hip roof; concrete foundations and floors. Capacity, 25 to 50 head for market milk.

Three sheets, bill of material................................ 45c

No. 1336, Milk House.—10′ to 20′. Milk, wash, and boiler rooms; cooling tank; 1-story, frame; shed roof; concrete foundations and floors; capacity, 20 head; adapted to shipping milk and cream in cans.

One sheet, bill of material.................................. 15c

Nos. 1337-8, Milk House.—12′ x 20′. Work and boiler rooms; 1-story frame; hip roof; concrete foundations and floors; shed 5′ x 12′ attached, housing treadmill for animal power; shafting arranged for animal mechanical operation. Capacity, 25 to 50 head. For specializing in butter making by power.

Two sheets, bill of material.................................. 30c

Nos. 1339-40, Milk House.—27′ x 31′. (With ell.) Milk, wash, boiler, dressing, and refrigerator rooms; 1-story frame building; hip roof; concrete foundations and floors; 10′ x 10′ weigh room attached. Capacity, 40 to 100 head for certified milk.

Two sheets, bill of material.................................. 30c

No. 1341, Milk House.—12′ x 14′. One room, 1 story, hip roof; concrete foundation and floor; capacity, 20 head for butter making by hand.

One sheet, bill of material.................................. 15c

No. 1521, Milk House.—7′ x 9′. One room; 1 story; concrete foundations and floor; gable roof; shows vat for cooling cans of milk.

One sheet, bill of material..................................15c

Nos. 1342-3, Milk House.—29′ x 21′. Milk, wash, boiler, and toilet rooms; office; sterilizer, cooling tank built at floor level; 1-story frame building; hip roof; concrete foundations and floors. Capacity, 10 to 25 head for a small city bottling plant.

One sheet, bill of material.................................. 30c

No. 452, Low Pressure Sterilizer.—To be built of concrete; 3′ 6″ x 4′; 6′ 4″ high. Suitable for construction in milk houses, especially designs Nos. 633, 1342, 1330, and 1333.

One sheet 15c

No. 833, Milk Cooler.—Barrel with cover showing methods of circulating water and suggesting use of overflow for supplying stock-watering trough.

One sheet 10c

Plans for creameries and cheese factories are also available.

No. 1095, Manure Pit.—16′ x 20′. Concrete with gable roof on posts; roof projects to make shelter for spreader; cistern for collecting liquid.

One sheet, bill of material.................................. 25c

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