CANADA PLAN SERVICE

M-5310
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BROILER HOUSING

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SITE SELECTION

Regardless of the type of commercial poultry production being considered, a relatively large building site is a key requirement. Future expansion should always be considered.

The proposed building site should be reasonably level to accommodate manure handling, feed handling, and load out. Having all farm buildings on the same elevation will make it easier to tie the systems together later on. Good drainage away from the buildings is also required.

Depending on the number of barns and the desired layout, space must be provided in the poultry yard for manure storage and between the barns for proper ventilation, fire safety and snow and wind control. A distance of 15 to 30 m (50 to 100 ft.) is usually adequate and still practical.

Site selection must also take into account various Municipal and Provincial By-Laws and Regulations that may impact on such things as distance to neighbors, type and timing of manure disposal, environmental concerns, etc.

A good water source that has both adequate quantity and quality is another critical factor to consider in selecting a building site. A well should have a capacity of 1 to 1 1/2 gallons per minute per 10,000 birds and have total dissolved solids of less than 2500 ppm. Nitrate/nitrites should be less than 100 ppm and alkalinity should be less than 1000 ppm. Dugout capacities should be based on about 800 gallons per day per 10,000 birds. Algae and turbidity in dugouts needs to be controlled to prevent fouling of water lines and drinkers

BARN CONSTRUCTION

Broiler barns are single or multi-storey barns (Figure 1 and 2) constructed by either the pole-frame or stud-wall method. Today the most common types being constructed are two storey stud frame and single storey stud frame. Both balloon and platform framing methods are used for two storey construction.

Two or three storey barns are popular because of lower construction costs and heat savings. Barn construction costs can be reduced by about 15% per floor if a multi-storey barn

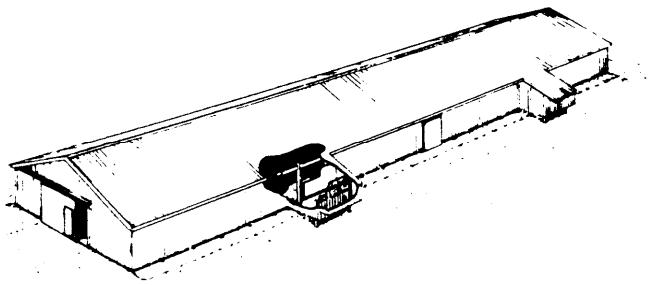


FIGURE 1 SINGLE STOREY BROILER BARN

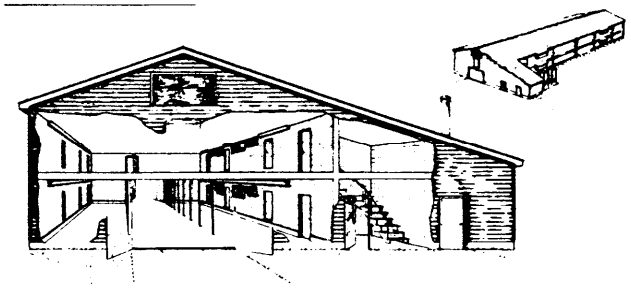


FIGURE 2 TWO STOREY POULTRY HOUSE

'Alberta Agriculture; Barrhead, Alberta
20ntario Ministry of Agriculture, Food and Rural Affairs; Strafford, Ontario

COMPLETE INSTRUCTIONS

The Canada Plan Service, a Canadian federal/provincial organization, promotes the transfer of technology through factsheets, design aids and construction drawings that show how to plan and build modem farm structures and equipment for Canadian agriculture.

For more information, contact your local provincial agricultural engineer or extension advisor.

TABLE 1 - FLOOR, FEED AND WATER SPACE REQUIREMENTS - BOILER HOUSING

TYPE OF BIRD	FLOOR SPACE	FEEDING SPACE	WATERING SPACE(per 100 birds)
Broilers			
2 weeks (0.3 kg) (.67 lbs)	0.04 m² (.43 ft²)	2.5 cm (1 ")	75 cm (30")
6 weeks (1.85 kg) (4.1 lbs)	0.07 m² (.75 ft²)	7.5 cm (3")	50 cm (trough) (60")
Roasters			
8 weeks (3.5 kg) (7.7 lbs)	0.09 m² (1.0 ft²)	7.5 cm (3")	150 cm (trough) (60")
			100 cm (circular) (40")

barn is built, and energy costs can be reduced as much as 20% to 50%, depending on the age of the broilers. The main disadvantage of two and three storey barns is the row (or rows) of floor support posts which have to be worked around during clean-out, as well as loading problems.

Rigid-frame or wooden arch-rib buildings can also be used for broiler barns if a high ceiling is needed (i.e. when mounting a positive pressure-tube ventilation system).

Most barns are 10.9 to 12.2 m (36 to 40 ft.) in width but some are 17 to 18.3 m (56 to 60 ft.) wide. Table 1 shows the space necessary in broiler housing to properly accommodate floor, feed and water requirements.

Essentially all broilers are reared on the floor. Straw or shavings are placed on the floor for litter, and litter is removed at the end of each flock. Multi-storey barns usually have a concrete main floor and plywood upper floors. There are some single storey barns with packed clay floors. Good management of leaking waterers and proper clean-out is required to maintain the firm clay base.

Disinfection of the clay base after clean-out must also be done on a regular basis. Concrete floors are easier to clean but are more costly.

Plywood upper floors must withstand the wheel loads of small tractors used for cleaning purposes. 16 mm (5/8 inch) tongue and groove plywood is the most commonly used flooring material, but 22 mm (7/8 inch) plywood may be necessary in some situations.

Wind damage to multi storey barns sometimes occurs, especially with long 61 to 91 m (200 to 300 ft.) barns. Properly designed wind bracing should be used and all "links' in the "chain" should be installed, including, for example, proper anchorage to the foundation. Building designers use diagonal bracing, knee bracing, diaphragm roofs, ceilings, floors and rigid frames such as steel portal frames to provide wind bracing.

Adequate insulation and correct insulation placement are of primary concern in poultry buildings. Insulation is required for the foundation, walls and ceiling to minimize building heat loss. This insulation must be properly placed between studs and joists to eliminate cold spots and consequent wet spots on the inside of the building. Barns should be built to accommodate RSI 1.4 (R8) foundation insulation, RSI 3.5 (R20) wall insulation, and RSI 3.5 to 5.3 (R20 to R30) ceiling insulation.

The types of insulation most commonly used in barn construction are the rigid polystyrene boards for the foundations, fibreglass batts for the walls, and either fibreglass batts or cellulose fibre blown-in insulation for the ceiling. Rodent damage to the building can be minimized if care is taken in sealing any wall openings, especially those at the foundation-wall connections and in the building corners.

The insulated structure must be carefully and totally lined with a polyethylene vapor barrier on the warm side of the wall. This will prevent moisture penetration into the insulation as well as excess air leakage. The interior can then be sheathed with either plywood or metal for a durable inside finish.

MANURE SYSTEM

Most manure systems involve the simple cleaning of the entire floor area with a tractor blade or front-end loader. Litter is removed from floor barns after every flock. Some operators are attempting to raise several flocks on the same litter by using strong disinfection procedures. Odor levels and disease potential increase, offsetting the cost of removal and new litter.

Storage of the removed litter is often necessary until land is ready for spreading. A curbed concrete pad on a well drained site is usually satisfactory. For some sites a runoff storage may be necessary to protect streams and drains. It is best to locate the storage a distance from the barn, in order to break disease and insect life cycles but this requires that manure be loaded and transported at extra cost. Some use hydraulically dumped two wheel carts for this removal system. When stored close to the barn, a

tractor and loader can transfer the litter to storage. Nevertheless, locate the curbed storage pad at least 20 m from the barn. The litter should be spread on cultivated land and incorporated as soon as possible. Odor problems associated with broiler litter are usually not of great concern.

HEATING SYSTEMS

Heat in the broiler house comes from three different sources: from the birds themselves; from the heating system; and from lights, motors and solar heat. Broilers produce a significant amount of their own heat in the form of sensible heat that is useful in helping to maintain barn temperature in cooler weather. The birds also release latent heat energy in the form of respired water vapor and moisture in the feces. Unfortunately, this is the energy that must be expelled by the ventilation system in order to keep the barn dry. As outside ambient air temperatures fall, both the ventilation heat loss and the building heat loss increase and eventually surpass the sensible heat production. This resultant heat deficit must then be made up with a supplemental heating system of some kind. A heating system is obviously needed at any time of the year for brooding.

The heating system used in most broiler barns is a hot water boiler and 50 mm (2 in.) black iron pipes. Which serve as the heat radiators. Water temperatures of 93 to 98°C (200 to 208°F) produce approximately 200 watts/m (200 BTUH/ft) of pipe. The pipes are usually hung on one wall, running the length of the barn at about 200 to 300 mm oc (8 to 12 in. oc) as shown in Figure 3.

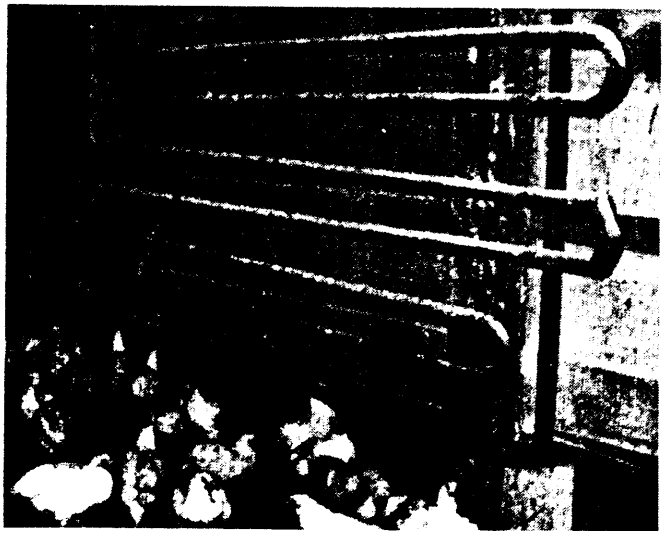


FIGURE 3 HOT WATER PIPES HUNG ON THE WALL

Zone brooding with a hot water system should be used to conserve fuel. This might be achieved in a number of ways:

1. Having the panels of black iron pipe adjustably suspended from the ceiling (lowered for brooding, raised for general heating) as shown in Figure 4.

2. Installing cross-overs and control valves in the wall-hung heat pipes to provide maximum heat only in one-half the barn. In conjunction with this, a plastic curtain or insulated fold-down panels could be installed across the barn to reduce the barn heat loss (during brooding) by about 40% (Figure 5).

Additional information on hot water heating can be found in CPS leaflet M-9735.

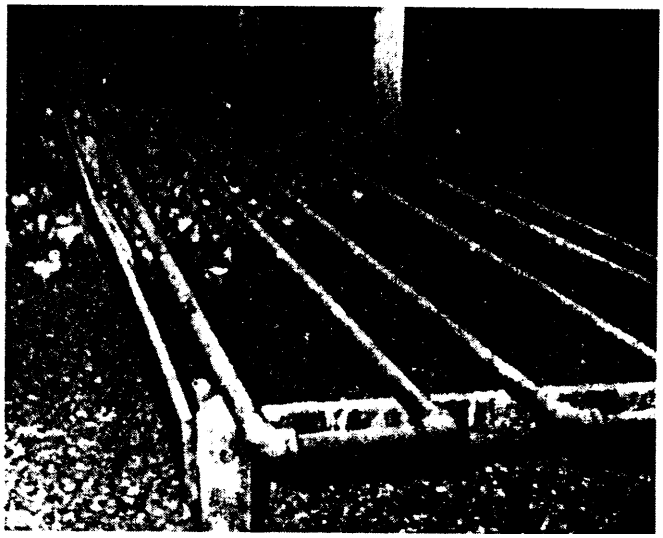


FIGURE 4 HOT WATER PIPES SUSPENDED HORIZONTALLY

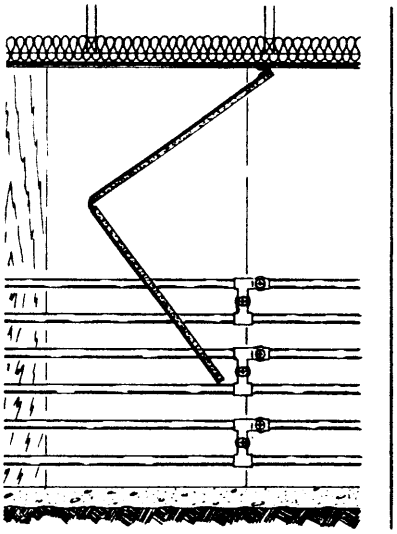


FIGURE 5 DROP PANELS OR SURTAINS AND HOT WATER PIPE CROSSOVERS FOR PARTIAL ROOM BROODING

A forced air system may be more economical than a hot water system in smaller operations, but it is a high maintenance heat source because of the recirculated dust and moisture unless it is installed in a separate, heated equipment room. Uniform heat distribution may be a problem unless it is directed into a recirculation air duct system (described in ventilation section). A new style of unvented, gas (or propane) fired space heaters (Figure 6) can also be used in conjunction with recirculation air systems.

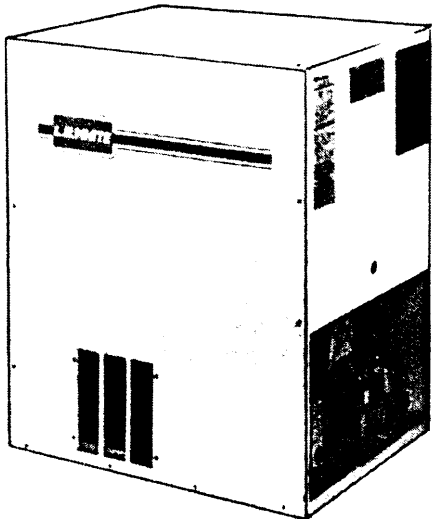


FIGURE 6 UNVENTED, GAS (OR PROPANE) FIRED SPACE HEATER

A gas-fired hooded brooder (Figure 7) can also be more practical than hot water for a smaller broiler operation, but it adds extra moisture to the air and it constitutes a greater fire hazard because of open-flame combustion. It is, however, a low cost system. These are about 1.8 to 2.4 m (between 6 to 8 ft) in diameter, and are initially hung about 600 mm (24 in) above the floor for the brooding of about 500 to 750 chicks. As birds get older, they are raised and used for providing the total heat for the barn or may be used as a back-up for another heating system.

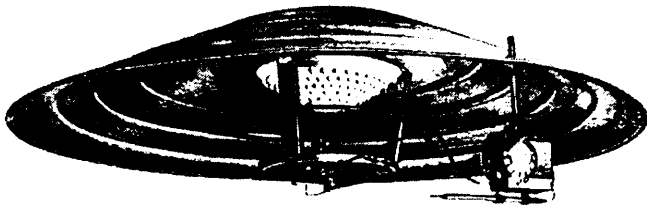


FIGURE 7 GAS-FIRED, HOODED BROODER

Gas fired infra-red radiant tube heaters (Figure 8) are also used in some broiler operations. They use the heat of combustion from several flame units to heat a length of pipe which then radiate the heat onto the birds. The system only provides heat and comfort to the birds and does not provide heat to warm the barn air (except for some re-radiation from the warmer surfaces). As a result some moisture build-up in them barn occurs at lower temperatures [below -20°C, (-4°F) outside]. This is caused by the reduction of ventilation rates in order to maintain a reasonable in-barn temperature. An infra-red radiant tube heater is comparable in cost to a hot water heating system, but does have a higher fuel efficiency because less heat is exhausted via the flue gases.

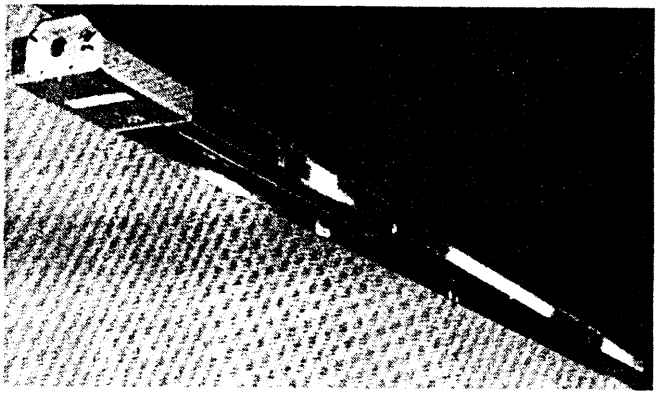


FIGURE 8 GAS-FIRED, INFRA-RED RADIANT TUBE HEATER

Slab heating is intended more as a substitute for scarce or unsuitable litter materials, and not as a source of heat, although it is used quite successfully for brooding. A concrete slab (floor) is heated by forcing warm water through heating pipes which are embedded in it. A thermostatically controlled boiler supplies the hot water. Generally no litter is required on the heated slab, as heat for brooding comes up from below. Since chickens feather poorly on heated floors, usually only a portion of the concrete floor is heated (either to one end or just a narrow strip down the middle of the building).

VENTILATION SYSTEMS

VENTILATION Confinement rearing places the responsibility on the operator of providing his birds with a satisfactory air environment, ideally within their "comfort zone". This zone is dependant on the age and weight of the birds and is achieved by the proper temperature, relative humidity, better moisture and air speeds for that group of birds.

Ventilation is required in the winter to remove stale air containing respired water vapor, carbon dioxide, dust, manure gases, and air-borne disease organisms. This stale air is then replaced with cold, fresh air while the heating system maintains the temperature to keep the barn within the

comfort zone of the birds.

Ventilation is required in the summer to remove excess heat. Sensible bird heat, equipment heat and any solar heat gains must be removed using ambient air that can also be very high in temperature. Hence, much larger volumes of air are required for summer ventilation (usually 10 to 20 times as much as winter rates). The minimum and maximum ventilation rates are given in Table 2.

Typical ventilation systems are either negative pressure systems, positive pressure systems or in some regions, natural ventilation systems.

TABLE 2 - VENTILATION AND HEATING REQUIREMENTS FOR BROILERS'

AGE OF BIRD	VENTILATION RATE (L/s per bird)[3]			SUPPLEMENTAL HEAT (watts/bird)[4]			
	Winter	Spring/Fall	Summer	-35°C	-30°C	-25°C	-20°C
Full Room				6.0	5.6	5.2	4.8
Brooding	Infiltration[2]	0.02	0.05				
Half Room				4.2	4.0	3.7	3.4
2 weeks (0.30 kg)	0.04	0.12	0.72	4.3	3.9	3.5	3.1
6 weeks (1.85 kg)	0.14	0.48	3.10	5.6	4.7	3.9	3.1
8 weeks (3.5 kg)	0.22	0.96	4.70	9.5	8.1	6.7	5.5

1. Ventilation and heating requirements are calculated on the basis of maintaining barn temperatures of 38°C and 70% RH for brooding, 27°C and 70% at 2 weeks of age, 21 °C and 70% RH at 6 weeks of age and 16°C and 70% RH at 8 weeks of age. Barn construction is RSI 3.5 insulation in walls and ceiling, with RS11.4 perimeter foundation insulation. These rates are also based on maintaining the litter inside the barn at 35% moisture content.
2. Infiltration rate of air is taken as less than one-half air change per hour.

NOTE: If hood type gas-fired brooders are used, the ventilation rates for birds older than 2 weeks should be increased by about 7% and the supplemental heat requirements should be increased by about 15% to compensate for the additional moisture added by the brooders.

NEGATIVE PRESSURE Most poultry buildings use negative pressure systems. That is, exhaust fans expel air from the barn, creating an interior vacuum which draws fresh air into the building. The exhaust fans must have the capacity to handle large volumes of air required in the summer, and lower rates for other reasons. Air distribution and mixing within the barn is controlled by the air inlet or baffle system. A well constructed air inlet baffle that can be adjusted to maintain a desired velocity of 4 to 5 m/sec(800 to 1000 ft/min) is required. This is achieved by providing 1.0 m2 to 1.25 m2 of inlet area for each 5000 Usec of fan capacity (or providing 1.0 ft2 to 1.25 ft per 1000 cfm). This velocity is very critical, especially in colder temperatures, to ensure good air mixing, and to prevent drafts.

In an attempt to keep the barn as air tight as possible, the air inlet baffle is usually installed on one side of the pen only, although very good results are being obtained with intermittent air inlets on both walls, especially in bams wider than 36'. During brooding and in winter when ventilation rates are low, a circulation duct under the air inlet baffle would help to carry fresh air into the pen without drafts on the birds. It also helps to ensure good air mixing within the barn. This style of air inlet is shown in Figure 9.

Such a duct can be designed using information in C.P.S. leaflet 9750 "Ventilating and Heating Small Livestock Rooms".

There are a number of commercially available ventilation inlet systems that do not use an air inlet baffle. They fall in the following categories.

1. Telescoping door air baffle.
2. Air intake door directed to a fan powered air blending and distributing unit.
3. Powered air intake, recirculation and exhaust unit with modulating dampers to control the ventilation rate.
4. Positive pressure powered air intake and recirculation unit with modulating dampers to control the air intake rate. Exhaust through dampened ports.

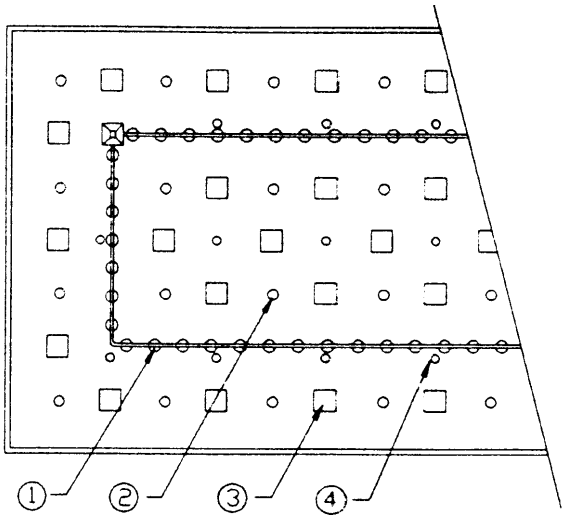
are grown under continuous light from one-day-old to slaughter age. This lighting method is somewhat hazardous however, because in a power failure the flock could panic when confronted with total darkness for the first time. Therefore, it is good practice to provide at least one hour of darkness each day from two days of age to the end of the growing period.

Recently, some interest has been shown in using continuous light the first week followed by an intermittent lighting program (such as three hours of light followed by one hour of darkness) for the remainder of the growing period. To use an intermittent lighting program effectively, it is essential that the building be blacked out to prevent entry of light through doors or ventilation openings. If you are using a continuous lighting program with good results, do not switch from it without first consulting a poultry specialist.

Most broilers are maintained on fairly high light intensity of 10 to 20 lux (1 to 2 foot candles, which is equivalent to 40 to 80 watts per 18 m2 of floor area) the first week, so that young chicks will be able to locate feed and water readily. This may be followed by low light intensity of 5 lux (0.5 foot candles or 15 watts per 18 m2) to reduce power costs and prevent cannibalism. Often, growth of broilers is better under low-intensity light.

However, it is important to have good light distribution so that feeders and waterers are adequately lighted. Light intensity can be controlled by using commercial type rheostats. Rheostats should be disconnected from the electrical circuit when the building is being washed out.

Incandescent bulbs are considered superior to other light sources. Bright white light may contribute to feather picking, which can lead to cannibalism.



1. automatic feeders
2. automatic waterers
3. extra feed trays for brooding
4. extra waterers for brooding

FIGURE 11 TYPICAL FEED AND WATER LAYOUT

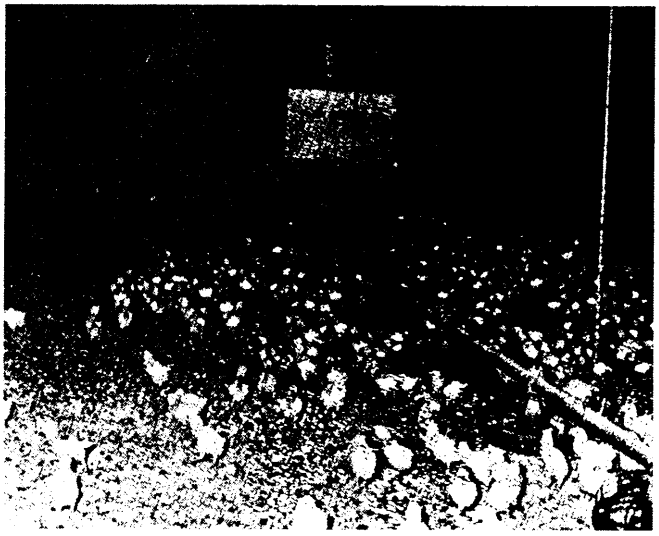


FIGURE 12 MECHANICAL FEEDER, SUSPENDED FROM THE CEILING

FEEDING AND WATERING SYSTEMS

For brooding chicks, besides the regular feeding system, cardboard feed trays and extra water jars should be placed within the brooding zone to ensure all chicks have access to both (Figure 11). They are gradually removed over the first 4 to 6 days as the chicks locate the automatic feeding system.

The usual feeding system used for broilers is the suspended automatic chain and trough feeder or the suspended automatic chain and pan feeder system (Figure 12). These systems normally make a complete circuit within the broiler barn, ensuring that enough feeder space is available if the birds are on ftAl feed. If a restricted feeding program is used, additional feeder space has to be provided.

Waterers are usually the hanging automatic bell type (Figure 13) or the newer nipple style drinkers (Figure 14). The automatic trough type (Figure 15) and the hanging water cups (Figure 16) are also available for floor or cage reared broilers. An ample, clean source of water is required. Birds have no stomach so their water retaining capacity is very low. They must drink freely and often as they require 0.9 to 1.4 kilograms (2 to 3 lbs) of water to efficiently utilize 0.45 kilograms (1 lb) of feed. The water source should be low in minerals and particularly low in salt as excess salt leads to watery droppings and consequently wet litter.

Both feeding and watering facilities need to be arranged so that a bird will not have to travel further than 3 m (10 ft.) Both systems are suspended from the ceiling by cable winch and rope so they can be elevated for tractor clean-out.

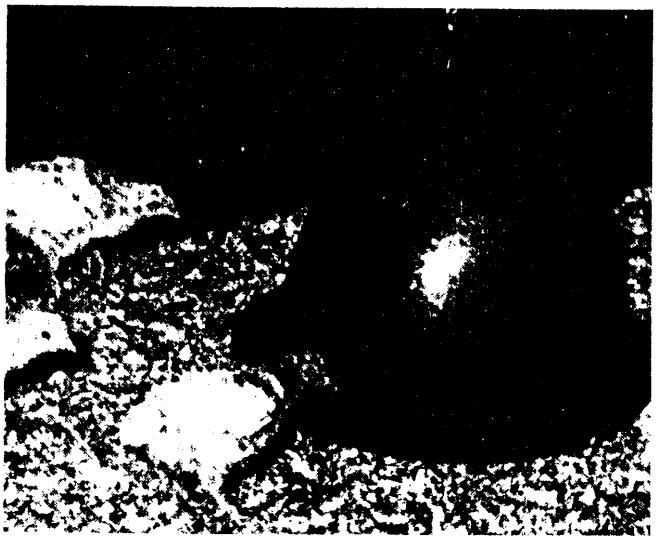


FIGURE 13 BELL TYPE AUTOMATIC WATERER

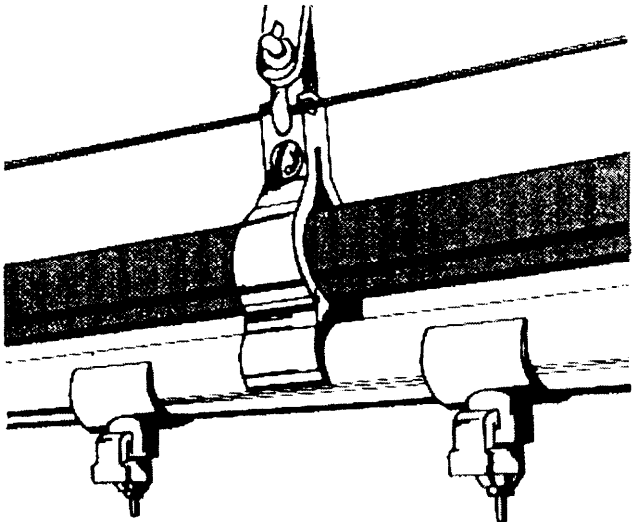


FIGURE 14 NIPPLE DRINKERS

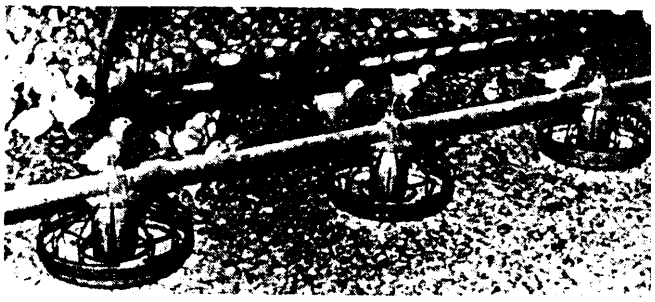


FIGURE 15 AUTOMATIC WATERING TROUGH (AND PART OF A MECHANICAL FEEDER)

FIGURE 16 HANGING WATER CUP