PULLET 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 for 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

Pullet barns are single or multi-storey barns constructed by either the pole-frame or stud-wall method.

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

Most barns are 10.9 to 12.2 m (36 to 40 ft.) in width.

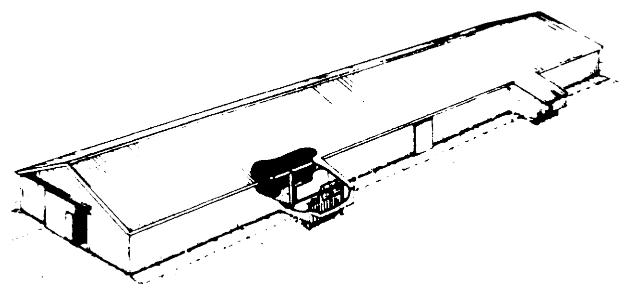

FIGURE 1 A SINGLE STOREY PULET BARN

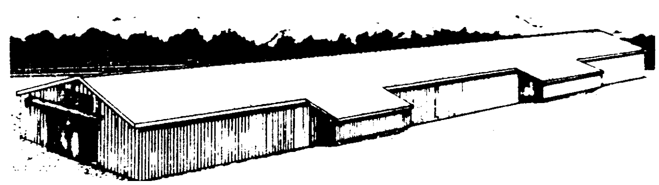

FIGURE 1 B SINGLE STOREY CAGED PULLET BARN

Essentially all replacement pullets for broiler breeder and layer breeder operations are reared on the floor (Figure 1A

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COMPLETE INSTRUCTIONS

and 2A). Straw or shavings are placed on the floor for litter, and litter is removed at the end of each flock. Multi-storey barns have a concrete first 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 in.) tongue and groove plywood is the most commonly used flooring material, but 22 mm (7/8 in.) 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.

Replacement pullets for commercial egg operations are usually reared in cages. Thus, the barns are very similar in construction and cage arrangement to the laying barns (Figure 1 B and 2B). The pullet cages are usually flat deck style cages to accommodate even brooding conditions, although two, three and even 4-tier cage systems are available. They are finer meshed wire cages with capacity for 20 to 50 birds.

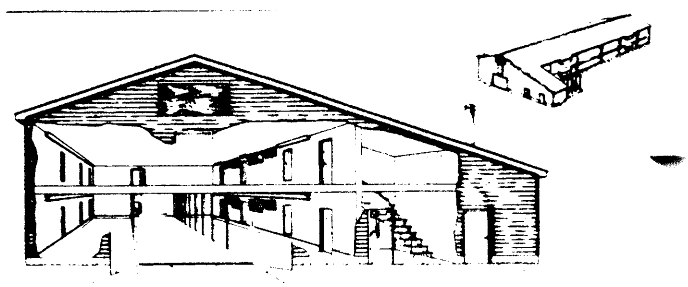


FIGURE 2A TWO STOREY PULLET BARN

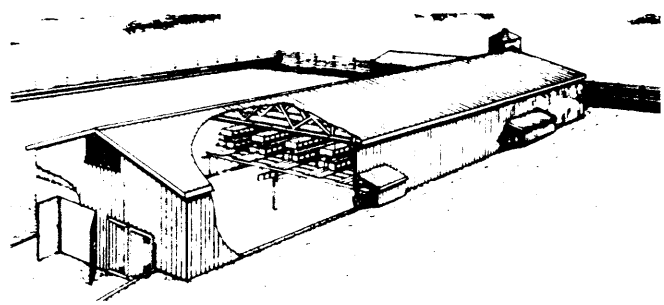


FIGURE 2B DEEP PIT CAGED PULLET BARN

Table 1 shows the space necessary in pullet housing to properly accommodate floor, feed and water requirements.

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

TABLE 1 FLOOR, CAGE, FEED AND WATER SPACE REQUIREMENTS FOR PULLET FLOCKS

FLOOR HOUSING

AGE & TYPE OF BIRD	FLOOR SPACE (per bird)	FEEDING SPACE (per bird)	WATERING SPACE (per 100 birds)
2 weeks	0.05 sq m (.5 ft2)	2.5 cm (1")	2-4L fountains (1/2-1 gal)
8 weeks	0.07 sq m (.75 ft2)	5 cm (2")	150 cm (trough) (6")
			100 cm (fountains) (4")
18 weeks (light breeds)	0.14 sq m (1.5 ft2)	75 cm (3')	150 cm (trough) (6")
20 weeks (heavy breeds)	0.19 sq m (2.0 ft2)		

CAGE HOUSING

AGE & TYPE OF BIRD	CAGE SPACE (per bird)	FEED SPACE (per bird)	WATER SPACE (per cage)
8 weeks	0.016 sq m (25 in 2)	25 mm (1')	15 birds per nipple
			25 birds per cup
18 weeks	0.029 sq m (45 in 2)	50 mm (2')	8 birds per nipple
			25 birds per cup

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, glass fibre batts for the walls, and either glass fibre batts or cellulose fibre blow-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

In floor operations, the litter area can be cleaned frequently, or more straw or shavings can be added until the litter depth is 300 mm (12 in.) as long as the litter remains dry.

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.

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 the manure be loaded and transported, an 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 (65 ft.) from the barn. The litter should be spread on cultivated land and incorporated as soon as possible. Odor problems associated with pullet litter from floor barns are usually not of great concern.

Cage pullet operations typically have two manure handling options. In single storey barns, there are concrete trenches 225 to 300 mm (9 to 12 in.) deep under the cage rows. Manure is scraped in these with either automatic gutter cleaners or by a small tractor scraper. (Tractor scraped gutters require a suspended cage system). The manure is moved to one end of the barn where it is either stored as a liquid in a large concrete manure tank or transferred to a lagoon. In some cases, it is handled as a semi-solid and immediately elevated outside to a manure spreader where it is spread on the land. With the liquid manure system (concrete tank or lagoon), it has to be agitated and handled using a liquid spreader tank. Water is usually added to the manure gutters 24 hours before clean-out to facilitate scraping. More water is added in a liquid system than in the manure spreader system. Owing to its sticky consistency, a large power unit is required to handle the manure if no water is added to it. Another alternative for a *dry manure* system utilizes endless manure belts under the cages. The manure is conveyed to one end of the barn, dumped onto a cross conveyer and elevated outside to the manure spreader. Another system uses a scraper or an *auger scraper.* The manure is scraped off the manure boards down on to a narrow barn cleaner or into a deep pit under the cages.

In two storey or *deep litter* cage operations, the manure drops into the lower storey and is stored there for at least one pullet flock. The ventilation fans are installed in the walls below cage level so that air flow goes down through the cages, across the top of the stored manure, and out the fans. This air movement is usually adequate to create a dry manure product that can be cleaned out with a front end loader. Additional circulation can be provided by circulation fans hung below the cages. This type of manure storage requires good quality water low in salts if the droppings are to remain dry enough to stay in a manure pile. Leaking waterers also create wet manure conditions and must be corrected if the manure storage is to remain dry and at low odor levels.

HEATING SYSTEMS

Heat in the pullet house comes from three different sources: from the birds themselves; from the heating system; and from lights, motors and solar heat. Pullets 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 losses 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 pullet 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°C) 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 o.c. (8 to 12 in. o.c.) as shown in Figure 3.

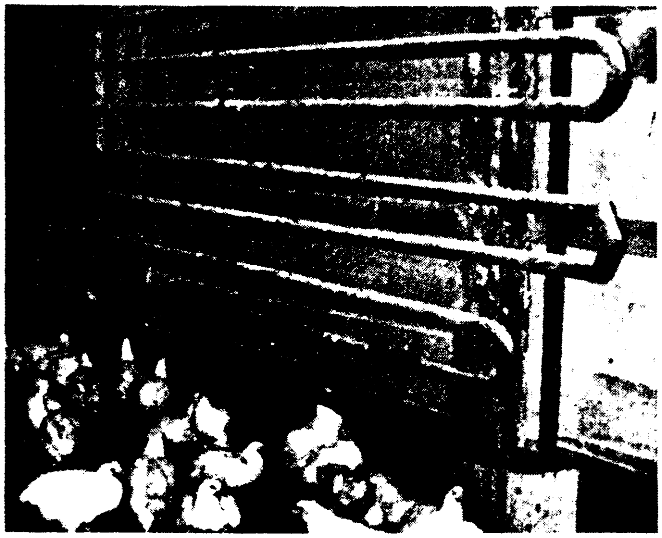


FIGURE 3 HOT WATER PIPES HUNG ON THE WALL

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.

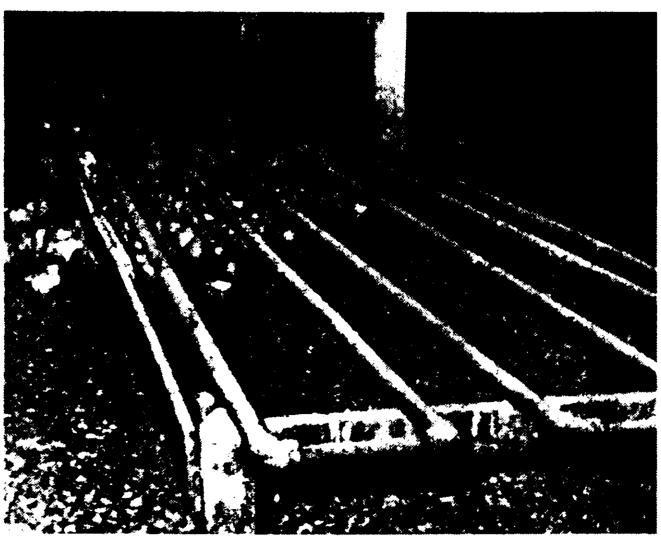


FIGURE 4 HOT WATER PIPES SUSPENDED HORIZONTALLY

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).

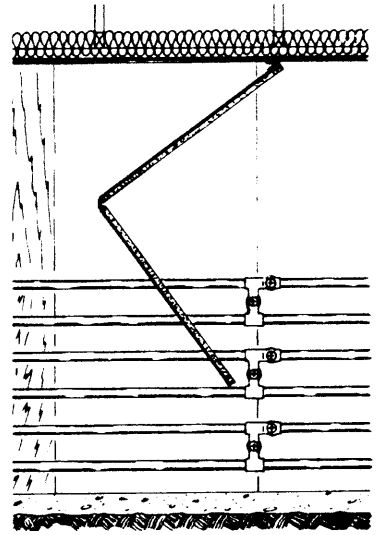


FIGURE 5 DROP PANELS OR CURTAINS AND HOT WATER PIPE CROSSOVERS FOR PARTIAL ROOM BROODING

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

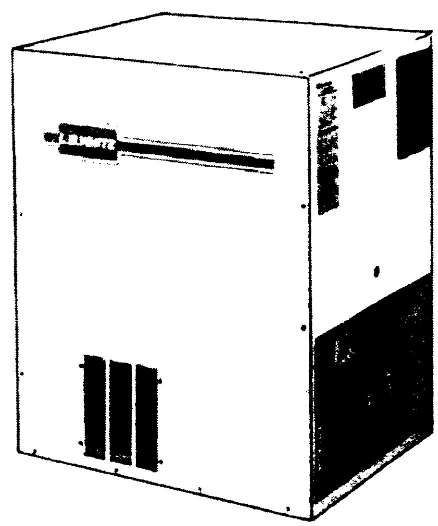


FIGURE 6 UNVENTED, GAS (OR PROPANE) FIRED SPACE HEATER

A forced air system may be more economical than a hot water system in smaller operators, 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 heater (Figure 6) can also be used in conjunction with recirculation air systems.

A gas-fired hooded brooder (Figure 7) can also be more practical than hot water for a smaller pullet 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 provide the total heat for the barn or used as a back-up for another heating system.

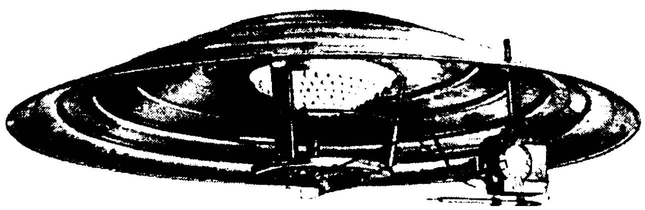


FIGURE 7 A GAS-FIRED, HOODED BROODER

Gas fired infra-red radiant tube heaters (Figure 8) are also used in some floor pullet 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 sytem only provides heat and comfort to the birds and does not provide heat to warm the barn air (except for some reradiation from the warmed surfaces). Ventilation rates have to be reduced in order to maintain a reasonable in-barn temperature. As a result some moisture build-up in the barn occurs at lower temperatures [below -20°C, (-4°F) outside]. 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.

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 19 mm (3/4 in.) pipes which are embedded in it. A thermostatically controlled boiler supplies the hot water. This requires less litter and provides warm, even brooding conditions. 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).

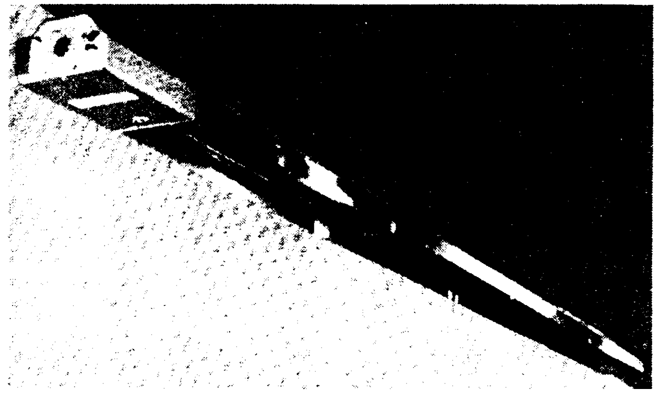


FIGURE 8 A GAS-FIRED, INFRA-RED RADIANT TUBE HEATER

In flat deck cage rearing systems, hot water pipes on top of each row of cages can be used for brooding and growing pullets. The total amount of heat required for brooding can be reduced in this style of brooding because the chicks are closer to the heat source. These pipes should be able to be raised so that more "air heat" can be provided for increased ventilation rates as the birds get older. The other common hot water heating installations for mufti-tiered cages are wall mounted pipes.

VENTILATION SYSTEMS

Confinement rearing places the responsibility on the operator to provide 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, litter 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 termperature. 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 or positive pressure systems.

TABLE 2 VENTILATION AND HEATING REQUIREMENTS FOR PULLET FLOCKS'

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
FLOOR HOUSING							
Brooding	Infiltration 2	.02	.05	6.0	5.6	5.2	4.8
2 Weeks (Light Breed)	.01	.09	.39	5.5	5.1	4.6	4.1
(Heavy Breed)	.01	.13	.36	7.2	6.6	6.0	5.4
8 Weeks (Light Breed)	.04	.18	1.9	4.8	4.2	3.6	3.0
(Heavy Breed)	.045	.23	2.5	6.3	5.5	4.8	4.0
18-20 Weeks (Light Breed)	.08	.57	3.5	5.3	4.5	3.6	2.9
(Heavy Breed)	.1	.64	3.9	7.0	5.9	4.8	3.8
CAGE HOUSING (Light Breed Only)							
Brooding	Infiltration	.02	.05	2.1	2.0	1.8	1.6
2 Weeks	.01	.04	.43	1.7	1.6	1.4	1.2
8 Weeks	.04	.23	2.0	1.3	1.1	.8	.5
18 Weeks	.08	.63	3.5	2.2	1.6	1.1	.6

1. Ventilation and heating requirements are calculated on the basis of maintaining barn temperatures of 32°C and 70% RH for brooding, 27°C and 70% at 2 weeks of age, 21°C and 70% RH at 8 weeks of age and 16°C and 70% RH for 18 week old birds. Barn construction is RSl 3.5 insulation in walls and ceiling with RSI 1.4 perimeter foundation insulation. These rates are also based on maintaining the litter (and manure) inside the barn at 35% moisture content. Barn sizes were based on 12 m X 76 m for floor housing and 7.3 m X 42.7 m for cage housing.
2. Infiltration rate of air is taken as less than on-half air change per hour.
3. For CFM (cubic feet per minute) multiply these rates by 2.
4. For BTU/br/bird multiply these rates by 3.41.

Note: If hood 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 seasons. 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 to 1.25 m^2 of inlet area for each 5000 L/sec of fan capacity (1.0 to 1.25 ft^2 per 1000 cfm). This velocity is very critical, especially in colder temperatures, to ensure good air mixing, and to prevent draft.

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 barns wider than 10.8 m (36 ft.). During brooding and in winter when ventilation rates are low, a circulation duct under the air inlet baffle will 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 CPS 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 distribution 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 modulation dampers to control the air intake rate. Exhaust through dampered ports.

Generally, for some winter conditions these systems offer the opportunity to make the barn more air tight by the use of more compact openings and tighter fitting doors. In addition, they offer several choices for easy retrofit. These systems must utilize good duct distribution systems in order to provide uniform air distribution.

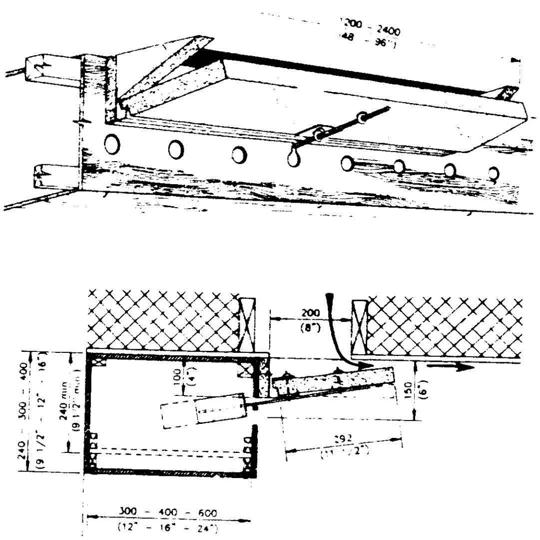


FIGURE 9 RECIRCULATION DUCT AND INTEGRATED SELF-ADJUSTING FRESH AIR INLET

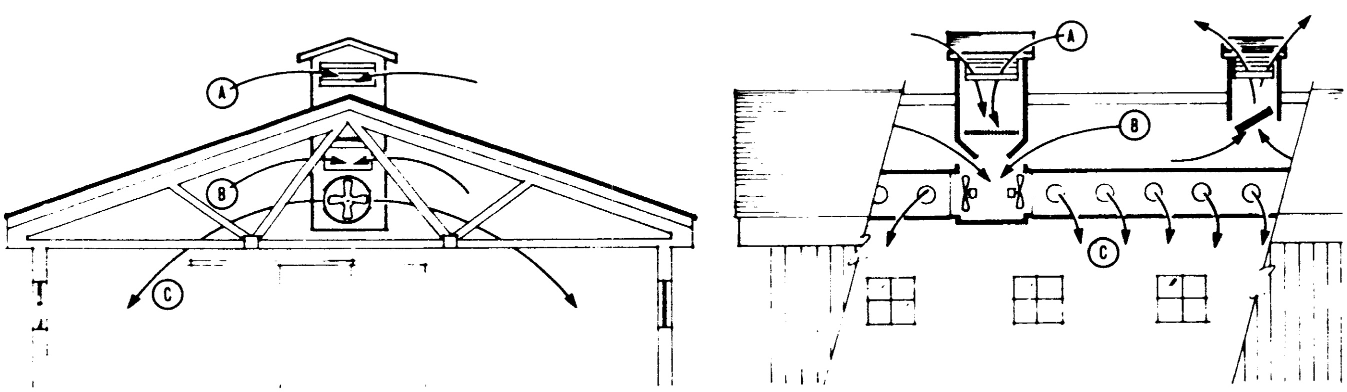
POSITIVE PRESSURE A positive ventilation system is one in which fans force fresh air into the barn causing a slight pressure. This pressure forces the moisture laden exhaust air out through the exhaust ports. The main advantage of the positive pressure system is that it provides excellent air distribution throughout the building. Air distribution ducts, together with the air blending features provide continuous air circulation regardless of the air exchange rate. The air exchange rate is controlled by the proportion of "fresh" versus .recirculated" air, while total air flow is constant. One of the disadvantages of this type of ventilation system is that unless a well sealed vapor barrier is provided, moisture can be forced into the insulation, reducing its effectiveness. Some systems also incorporate wall exhaust fans for summer conditions since the pressurizing fans do not have the capacity to meet summer ventilation requirements. A disadvantage of the combined tube and exhaust fan system is the difficulty in controlling the ventilation rate. This occurs when one system is trying to push air into the building, and the other is trying to pull it out.

Figure 10 shows the principle of a positive pressure ventilation system. Sufficient fan capacity for summer ventilation must be provided. Thus, as many as four distribution tubes may be required to achieve this.

FEEDING AND WATERING SYSTEMS

In small floor operations, the least expensive method of feeding is *hand feeding* using small self-feeders. Water is usually supplied in automatic troughs or fountains, or in hand filled fountains.

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. They are gradually removed over the first 4 to 6 days as the chicks locate the automatic feeding system.



A - FRESH AIR IN B - RECIRCULATED AIR C - STALE AIR

FIGURE 10 A POSITIVE PRESSURE SYSTEM

The usual feeding system used for floor raised pullets is the suspended automatic *chain and trough feeder* or the suspended automatic *chain and pan feeder* system (Figure 11). These systems normally make a complete circuit within the pullet barn, ensuring that enough feeder space is available if the birds are on full feed. If a restricted feeding program is used, then additional feeder space has to be provided.

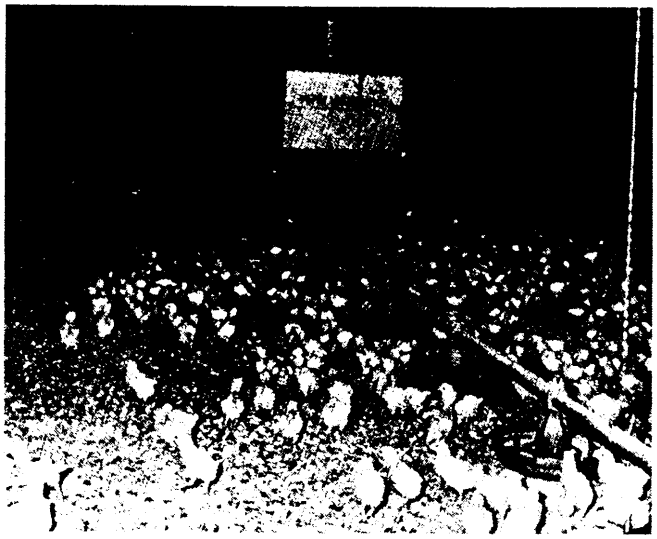


FIGURE 11 MECHANICAL FEEDER, SUSPENDED FROM THE CEILING

FIGURE 12 BELL TYPE AUTOMATIC WATERER

Waterers are usually the hanging automatic bell type (Figure 12) or the newer nipple waterers (Figure 13). The automatic trough type (Figure 14) and the hanging water cups (Figure 15) are also available for floor or cage reared pullets. 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 Ibs) 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 cleanout.

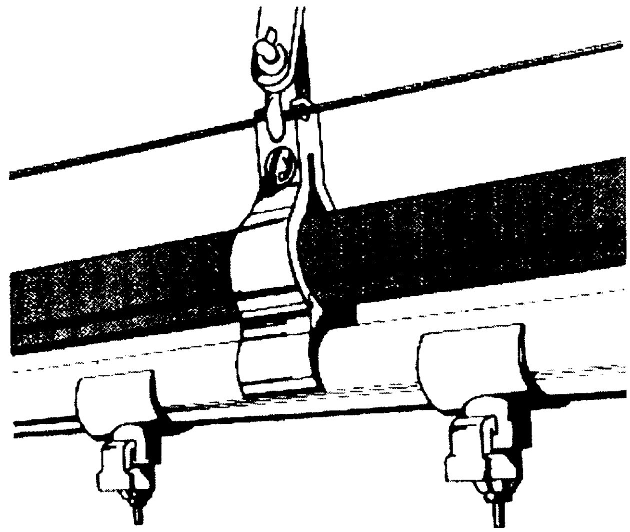


FIGURE 13 NIPPLE WATERERS

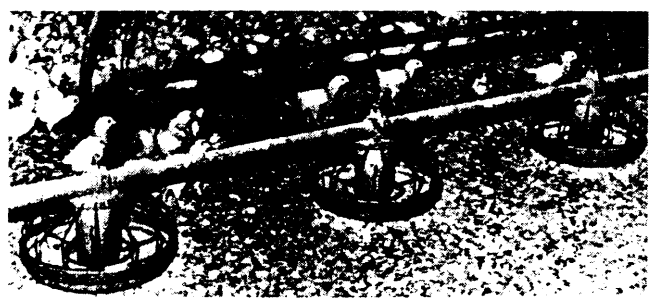


FIGURE 14 AUTOMATIC WATERING TROUGH (& PART OF MECHANICAL FEEDER)

FIGURE 15 HANGING WATER CUP

LIGHTING

For floor pullet operations, rows of 40 watt incandescent lamps 4 m (13 ft.) on centre with the lamps in each row staggered and spaced 6 m (20 ft.) apart are suggested. These should be on a dimmer and time clock so that any of the various light programs can be followed. For cage operations, 25 watt lamps, 4 m (13 ft.) on centre down the walk aisles ,are suggested for flat deck or double tire cage systems. These should also be controlled by a dimmer and time clock.

A convenience outlet should be provided every 30 m (100 ft.) around the perimeter in the floor pullet operation and down each alley in a cage pullet barn. Many pullet producers are interested in the various total light control programs recommended by different researchers and commercial companies to ensure the future egg production and breeding is maximized. This requires tight building construction and light traps over the exhaust fans and air inlets (see CPS leaflet M-5911 "Light Restricting Fan Houses and Air Inlets').