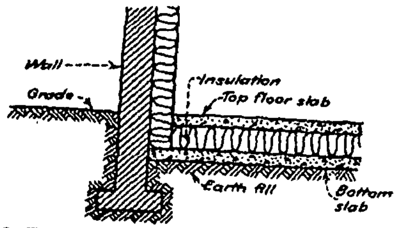
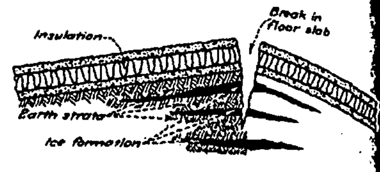
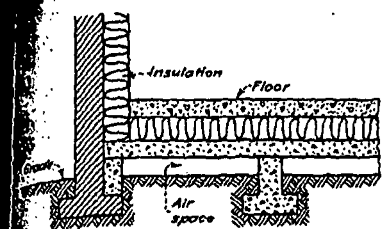


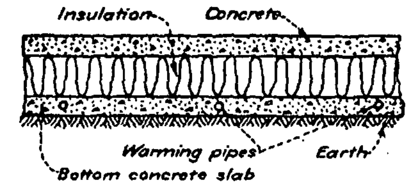
2 The usual design of freezing-room floor consists of two concrete slabs separated by a thick layer of insulation



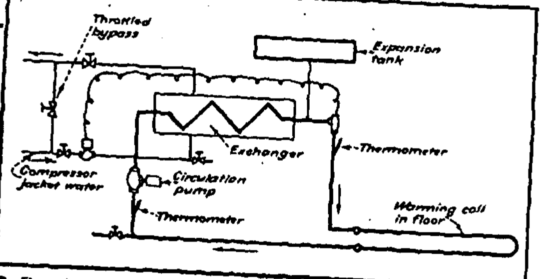
3 Freezing temperature in the ground causes ice to form in the solid layers that raise and rupture floor slabs



4 Where a high floor is not objectionable, space underneath permits summer air circulation to warm the floor



5 Warming pipes imbedded in lower slab add enough heat to keep ice from forming in the ground under the concrete



6 Flow diagram of heating system explains how temperature is controlled automatically. If compressor jacket water is the heating medium use a bypass line

7 Heat-exchanger, control valves, expansion tank, circulating pump and connecting pipe can be mounted outside freezing room on a wall above other machinery

other factors being equal. The earth, usually a fairly good insulator, resists the flow of heat from lower elevations *to balance the heat lost* upward through the room's floor insulation.

Consequently, in time, the earth gradually chills and finally reaches freezing temperature adjacent to the floor. *But the better the floor insulation, the slower the chilling action* on the earth. For this reason, insulating engineers usually specify 8 in. of cork for zero-F rooms and 10 in. or even 12 in. *for lower temperatures.*

Seasonal Effect. Because *soil temperature* and moisture content influence ice formation, the seasons probably govern effective ice buildup. This may account *for the strata formation of almost clear ice between thin layers of* earth. Experience indicates that ice once formed does not melt unless the *floor is* warmed up for some time.

In one instance the floor had buckled under a —30 F freezing tunnel. Steam heat was applied, through double-wall pipes *driven* under the *slab, for several weeks* before the ice melted and the earth *dried enough to allow the floor* to settle into position.

Method of Correction. Permanent solution to the problem is neither *thicker insulation nor drainage,* although both *will delay floor failure.* A method must be used that keeps the earth contact temperature above freezing (32 F).

Three methods have been successful:

1. Lay *electrical-heating* cable in the earth under the concrete slab and, by thermostatic control, keep the earth above freezing. This is usually uneconomical because of the power cost.

2. *Raise floor level* to provide *space for air ducts,* Fig. 4. Air circulating by convection warms the concrete slab during summer and prevents *destructive* ice accumulation. This method is objectionable *because of* the higher floor and extra construction costs.

3. Install a pipe-warming coil in the bottom concrete slab, as in Fig. 1 and 5 where the ¾-in. *wrought-iron* pipes are *in place. By circulating* a nonfreeze solution warmed to about 45 F, the earth *temperature* can be held at 40 F, thus positively preventing ice formation. Construction photograph, *Fig. 1, shows the warming* pipes in location before pouring the bottom concrete slab.

The fluid-warming circuit consists of a heater, circulating pump and automatic temperature controls, Fig. 6 and 7. Because of cost the fluid, *selected* for the ice-cream plant *of Penn Dairies* Inc, Lancaster, Pa., is No. 2 fuel oil although radiator nonfreeze solutions or transformer oil could be used.

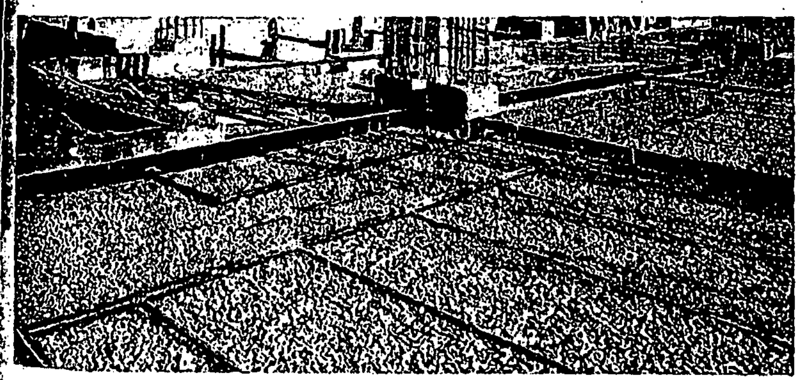
Jacket water from refrigerating machines is also *suitable as a source of* heat for the exchangers. This *water* is usually either thrown away or cooled for reuse, so extracting its heat for earth warming may reduce *operating expenses.*

Floor-insulation cost is another economy of major importance that can be taken advantage of. With *a* pipe-warming system, 6 in. of corkboard is justifiable *on* zero-F floors instead of 8-in., or more which is normally called for.

Refrigeration loss through *6 in.* of *cork* in the floor is so small that a thicker layer is not economically justified. Saving in insulating costs *is* usually more than sufficient to pay *for a* pipe-warming *system*, besides assuring a troublefree insulated floor.

Temperatures observed on a new installation of a —10 F room were:

Time	*Earth temp*
July (started)	60 F
August	50 F
September	40 F
October	Heating started
December	42 F



8 Heat flow up through the floor depends on the temperature drop across the insulation. Careful design adds enough heat to keep the ground from freezing, yet does not increase the temperature differential beyond a safe, economical point