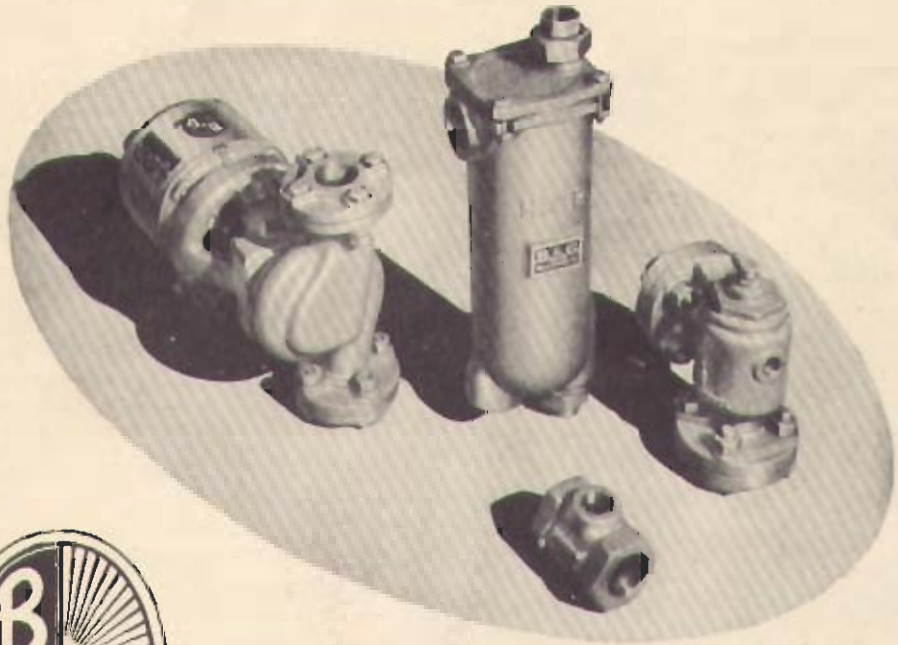
TROUBLE-SHOOTING RADIANT HEAT JOBS



Hydro-Flo HEATING

FORCED HOT WATER HEATING FOR RADIATOR,
CONVECTOR, BASEBOARD AND RADIANT PANEL SYSTEMS

BELL & GOSSETT COMPANY
MORTON GROVE, ILLINOIS

BULLETIN NO. BG-648

TROUBLE - SHOOTING RADIANT

Experience is a rare commodity in the new field of radiant heating—and therefore, precious. Here, an engineer who has such specialized experience tells ways to avoid costly errors, how to insure efficient operation of the system

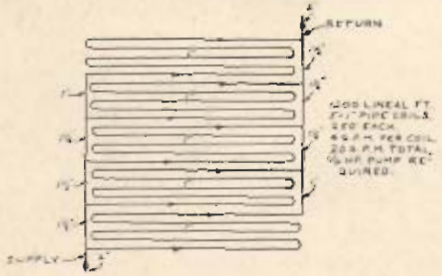
RADIANT HEATING has been gaining greater general acceptance so that more people are becoming concerned in its design and application.

It must be remembered that any method is successful or unsuccessful not in terms of the method itself, but in the utilization of the method. This means that we must give close attention to details if we are to be successful.

When any method is as new as radiant heating, there is bound to be controversy and difference in opinion, but as more and more people make use of a method, the handling of certain details becomes important. We are therefore suggesting that the following are precautions which, if properly carried out, will tend to promote good panel heating systems.

BREAK UP SERPENTINE COIL TO CUT CIRCULATION NEEDS

A serpentine coil installation was made with 1,200 lineal feet of one-inch pipe in a single continuous coil. This covered only an area of 50 feet by 50 feet. To supply the heat loss, 20 gallons-per-minute circulation through the coil



Coil broken into five equal parts

was required. Under these circumstances, a pump capable of supplying 20 gallons per minute at 125 pounds per square inch pressure was necessary.

In order to prevent a condition of this sort arising, this coil could have been broken into five equal parts, each containing 250 lineal feet of pipe. The total flow is thereby divided so that each section is supplied with 4 gallons per minute. Had this been done, a circulator could have been used capable of delivering 20 gallons per minute at 5.5 foot head. This would have been a standard hot water circulator, rather than a centrifugal pump. Using 10 horsepower in one case and one-sixth in the other, the comparison is obvious.

GUARD AGAINST EXCESSIVE PIPE SIZES FOR BEST RESULTS

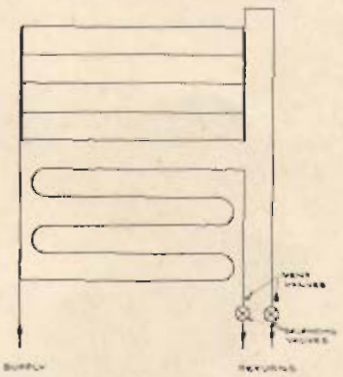
Pipe sizes that are too large may cause difficulty by requiring a circulating pump much larger than actually necessary to do a satisfactory job. This is caused by the low resistance which would be found in the coil. Thus, the pump would deliver more water than anticipated, and in certain instances, might overload the pumping equipment.

This is shown by what happened on one snow-melting installation. Two thousand lineal feet of 1¼-inch pipe were installed in two circuits, using a standard hot water circulator. The coil sizes were such that the circulator delivered water at the free delivery end of the curve. This could have been avoided by using smaller coils and more circuits, using circulators to the best advantage.

USE BALANCING VALVES ON RETURNS FOR EACH COIL IN ROOM

It is advisable to provide a means of throttling or balancing the panels in any given room. As a general rule, it is more convenient to install a balancing valve in the return line.

When two or more coils are within the same room, it is desirable to provide a balancing valve on each return. However, if the pressure drops through the two coils, or if the two grids are



Balancing valves for both coil and grid

equal, it is permissible to connect the returns from the two units in a reverse return hook-up and provide for one balancing valve in the one return. Should a coil and a grid be used in the same space or room, valve for each is needed.

AIR POCKETS MUST BE REMOVED WHEN PANELS ARE VENTED

It is desirable in all installations to provide a vent valve on each panel. This may be located at the return end of the panel and near the balancing valve. Whenever a panel is being vented, the vent valve should be left in an open position for a sufficient period to assure the removal of air pockets located within the panel and supply-and-return piping to the panel. When panels are initially filled with water, the air within

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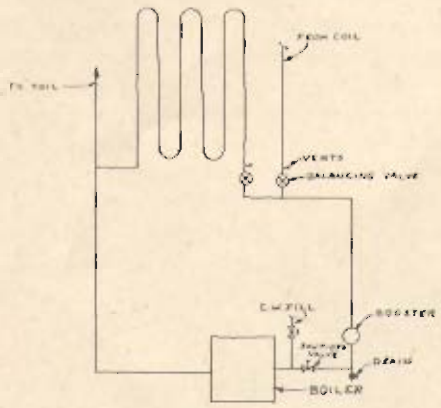
By H. A. LOCKHART *

the pipe is trapped and must be removed to start flow. To best accomplish this, it is desirable to provide a cold-water fill near the boiler, a drain on the return header and a shut-off valve between this drain and cold-water-fill connection.



Coil venting diagram

To purge the system, the shut-off valve is closed, all panel balancing valves are closed, drain valve is left open and the cold water supply valve is left open. The one panel balancing valve is opened and water allowed to flow out of the drain for a few minutes until a solid stream of water is showing. The panel balancing valve can then be closed. Each panel can be purged similarly.

SYSTEM DRAINAGE IS SAFEGUARD DURING SHUT-DOWN

It is desirable to provide a low point in all residential radiant heating systems in order that the major portion of water contained within the panels may be drained out. The average home-owner is not too familiar with ways and means of exhausting water trapped within a floor panel. Should the system be shut down for any reason during freezing weather for 24 hours or more, damage could result if the major portion of water is not drained out.

NOISY SYSTEM RESULTS FROM OVERSIZE PUMPS, HIGH VELOCITY

If a pump is over-sized, the velocity increase may cause noisy conditions in some parts of the system. It is desirable to hold the velocity below 48 inches per second at all times.

GUARD AGAINST EXCESSIVE SURFACE TEMPERATURES

Excessive surface temperatures are an objection to radiant heating. In ordinary residential installations a floor panel should never be designed to exceed 85-degree surface temperature. If it becomes necessary to have higher temperature in order to deliver the required amount of heat to the space, it would be far more desirable to install supplemental panels in the ceiling or wall. Ceiling panels should not be designed for surface temperatures above 90 degrees F. unless the ceiling heights are above 8½ feet.

BLACKENING BOOSTS RADIATING QUALITIES OF COPPER PIPE

Radiating qualities of copper may be increased by blackening the pipe. In convector heating, this is not necessary, since 98% of the heat is given off by convection. In radiant heating, where the tube is exposed in air spaces, heat is given off by radiation and convection in an approximate ratio of 50-50.

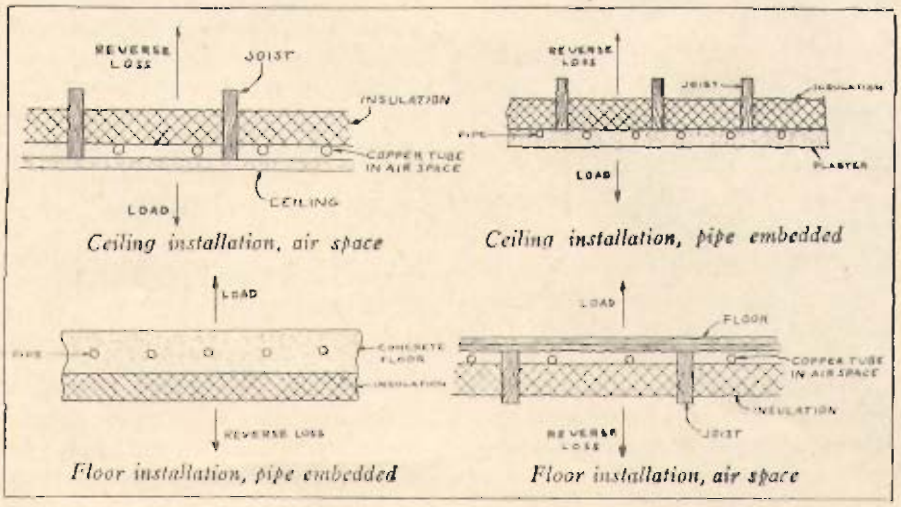
To increase the radiating qualities of copper pipe, two common methods are being used. One method is by surface oxidation of the piping; the other by application of a coating of a heat-resistant black paint. Painting is subject to adhesion problems. It must be remembered that paint has no bearing on tubes embedded in concrete or plaster.

AVOID OVERHEATING WITH HIGH-MASS PANEL, LOW-MASS WALL

We should always guard against an excessive total mass built into a panel relative to the total mass of the wall surrounding the panel. If we have a light wall construction and an excessive floor slab, the stored heat in the floor mass will cause over-heating when an outdoor temperature rise occurs.

PROPER INSULATION WILL CUT REVERSE HEAT LOSS

In the design of panel heating systems, it must be remembered that heat will flow in both directions from the panel. The heat loss downward from a panel on the ground is not too severe. However, in the case of a floor panel over an excavated area or crawl space, the reverse loss can be very high. It is evident that insulation must be used to reduce this reverse loss to a reasonable figure (see diagrams below). There still will be a loss per unit area which must be taken into account when determining the flow rate required for the



Ceiling installation, air space

Ceiling installation, pipe embedded

Floor installation, pipe embedded

Floor installation, air space

Mr. Lockhart, as chief engineer of Bell & Gossett Company, is a specialist in radiant heating systems.

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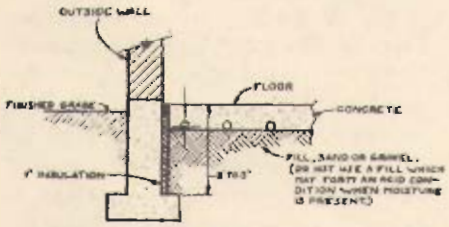
given panel. Should this reverse loss be neglected, a considerable increase in the temperature drop will occur causing a consequent lowering of the average water temperature, which in turn will reduce the output of the panel. The same condition can occur in a ceiling or wall panel.

AVOID "EDGE LOSS" WITH ONE-INCH BOARD INSULATION

There can also be a considerable loss along the outside edges of a panel commonly called "edge loss." This loss also should be guarded against by inserting insulation between the panel and the outside foundation or wall. Again in spite of the introduction of insulation, there will still be an edge loss which must be compensated for in the total flow requirement of the panel.



It is suggested that at least one inch of board form, or equivalent insulation value, be used on any reverse side. This should be sufficient to produce economical conditions. As suggested above, it is better to calculate these requirements.

DRAINAGE AROUND FOOTINGS OF BUILDING MAY BE NEEDED

It is advisable to provide drainage around footings of a building especially where a high water table exists. During the summer months, water may rise up within the building to a point where corrosion may take place in pipes installed upon the fill with concrete above. By provision of drainage, this danger can be relieved.

WATCH CHARACTER OF FILL IN CONTACT WITH PIPING

Wherever pipes are to be installed directly on fill, precautions should be taken to prevent any acid-forming fill from being used. Use only good gravel, crushed stone, or sand.

INSULATION ANSWERS PROBLEM OF SNOW-MELTING NEAR BUILDING

To prevent excessive snow-melting around the building where floor panels are installed in a floor on the ground, it is necessary to provide insulation between the outside wall and the heating panel. Since we cannot economically produce 100% insulation, we must arrive at an arbitrary figure which is within the range of overall reasonable economics.

It has been found that if we have the equivalent of three to four feet of concrete between the first tube along the outside wall, we will have a heat loss within reasonable range. Since in most residential installations it is necessary to use most of the available floor area for the panel, the first tube is generally within one foot of the outside wall. In normal construction, the foundation is one foot thick.

Thus, it is necessary to install between the floor slab and the foundation wall an insulation equivalent to between two and three feet of concrete. This amounts to approximately one inch of insulating board. This one inch of insulation should extend downward as far as possible below the floor level—between two and three feet would be ideal.

BEWARE TOO-HIGH TEMPERATURE DROP; 20 DEGREES IS GOOD

It has been found that a 20-degree temperature drop is about the most desirable for radiant heating. This gives us the maximum temperature differential for control purposes without an excessive surface temperature differential occurring in any panel. It also makes it possible to cover the so-called design errors by allowing a somewhat greater or lesser temperature drop to occur in some places.

If temperature drop is too high, that is, above 30 degrees, there would be a marked difference in the panel surface temperatures from the supply end to the return end. This is especially true when sinuous coils are used.

MAXIMUM TEMPERATURE RANGE MAKES CONTROL EASIER

Temperature design range should be as wide as possible. That is, at zero heat load, we would circulate water at room temperature (70 degrees). If we were to design our system with 100 degrees water as a maximum temperature at minus 10, we would have only a 30-degree temperature range to be apportioned throughout an 80-degree outdoor differential. This would make our system dependent upon very close control of water temperature. However, if the maximum water temperature were, say 140 degrees at minus 10, we would have a 70 degree-temperature range in the water as against an 80-degree outdoor temperature variation. This allows easier control over the entire range.

AUTOMATIC CONTROLS ARE "MUST" IN RADIANT HEATING

In the modern radiant heating system, it is desirable to provide ample control devices. A continuous flow of water at the temperature required depending on the outdoor condition will aid materially in maintaining a constant room temperature.

To best accomplish this, a control valve of a mixing type, controlled from an outdoor temperature bulb and a water-immersion bulb, have thus far shown the best results. Generally speaking, the outdoor bulb should be located in a shaded spot in the most severe exposure, which is generally on the north side of the building. The water-immersion bulb should be located in the supply main at a point sufficiently distant from the mixing valve to permit the thorough mixing of boiler and recirculated water.

It is also desirable to have a room thermostat to act as a high-limit control.