THE AMERICAN HOME *planning* PRIMER

Bettmann Archives

NO. 6 HEATING

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To provide maximum comfort at minimum cost, the ideal heating system for your home will be determined by many factors. Here's the first of two heating articles to guide you in that choice

WHY DO THE MANY DIFFERENT HEATING SYSTEMS THAT ARE AVAILABLE PROVIDE SIMILAR HOME COMFORT?

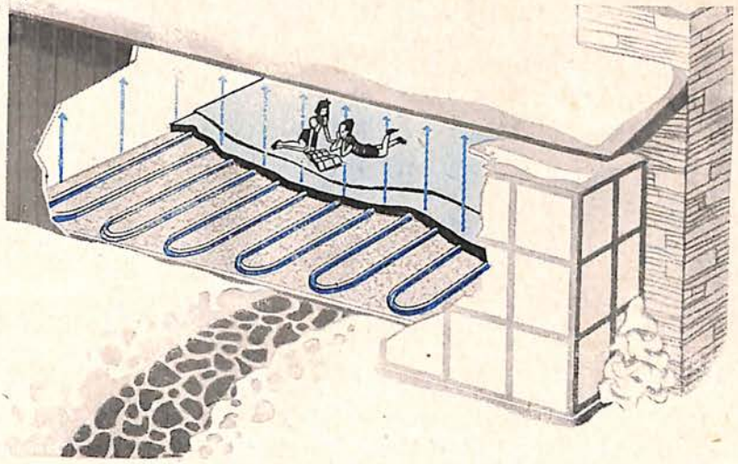
Because heat is transferred from one object or body to another by one or by a combination of two or three basic ways. These are conduction, convection, and radiation. Conduction is the movement of the heat itself, as from one end of a piece of copper or other metal to the other, or by flow between two materials or bodies that are in contact. Convection is the movement of heat by the change of location of the agent conveying the heat. This agent may be either water, steam, or air. Hot air moves, carrying the heat with it, and the same is true of steam and hot water. The water or air is heated by contact with the heat source such as a furnace. Radiation transfers the heat from one object to another without contact being made, and without the air between the objects being heated. Every object with a temperature above absolute zero gives off heat rays which shoot out in a straight line, warming cooler objects. This is true of all bodies, including the sun, a fireplace, a wall, ceiling, or floor. Even human bodies radiate heat.

No one heating system obtains its entire effect by the action of only one of these methods of heat transfer. Radiant heat does not warm the air in a room. True, the air is warmed, but by contact (conduction) with the warm surfaces of the walls, ceiling, floor, or furniture. Convectors, radiators, and panels are all recognized by heating engineers as radiant heating equipment, but each of these provides both radiant and convection heat, the air being warmed by contact with the heating element. A hot-air or warm-air system is classed as a convection type, but it heats the objects and surfaces in the room by conduction from the warm air, and these objects and surfaces in turn radiate heat to cooler bodies that come into the room, such as the people who have been outside the building.

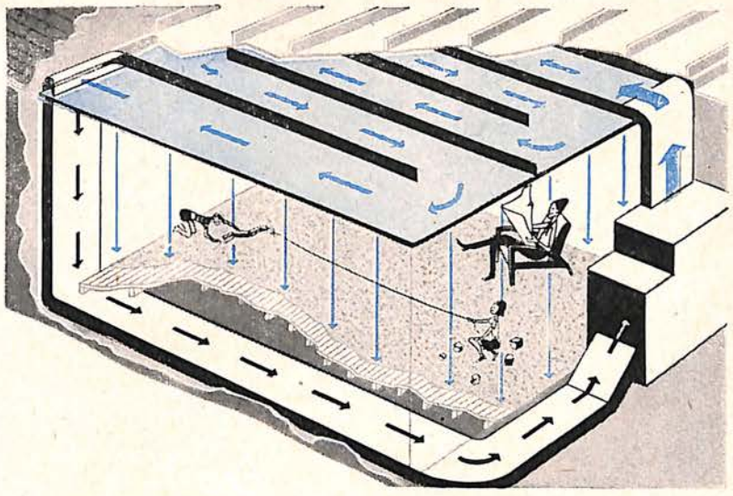
WHAT IS A COMFORTABLE TEMPERATURE IN THE HOME?

It varies because of differences in people and the factors that contribute to body comfort. The human body continually generates heat, and must dispose of some to remain comfortable. Too much heat loss makes a person feel cold, and not enough heat loss makes one feel hot. Body heat is dissipated by evaporation of perspiration, radiation, and conduction to the air where it is moved away by convection currents.

Heat loss by evaporation varies with the humidity in the air. Radiation losses vary with the temperature of the body and the surrounding wall, ceiling and floor surfaces. Losses by conduction are changed with the air temperature. The amount of clothing will also affect the rate of loss for any of these other factors. Obviously, a variation in one means of releasing heat will require compensating adjustment in the other factors to maintain



● Pipes in concrete slab provide a warm floor which radiates heat to ceiling, walls, objects, people. Pipes could be in walls or ceiling

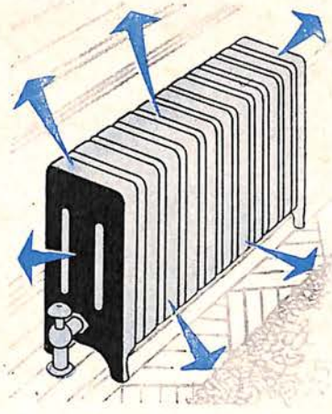


● Air ducts create warm ceiling or floor panel that radiates heat to all parts of room. System can be split to provide some warm air heat

a comfortable rate of heat loss.

In addition, people generate and must lose different amounts of heat, and perspire at varying rates. Since humidity and the temperature of the air and surfaces can only be just right for one person, a variation in clothing is in order for the comfort of others.

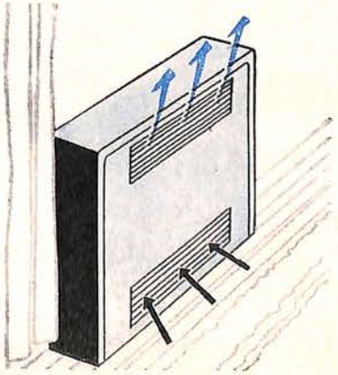
Conditions that have been found comfortable for the average person, in the average indoor clothing and house, are between 69 degrees with 65 per cent humidity, and 72 degrees with 30 per cent humidity.



● A radiator provides the greatest portion of its heat by radiant rays

WHY MUST THE HOUSE TEMPERATURE BE HIGHER DURING COLD DAYS THAN ON WARM DAYS FOR EQUAL COMFORT?

In really cold weather the inside wall surface temperature is lower than during the comparatively warm beginning and ending of the heating season. The body radiates a great deal of heat to the cold wall, and the rate of heat loss to the air must be reduced by a higher air temperature. Warmer winter days leave the walls at a higher temperature, and the heat loss of the body by radiation is reduced as a result. To maintain the desired body comfort, the heat loss to the air must be increased by a



● From a convector, most of the heat is sent out in the moving, warmed air

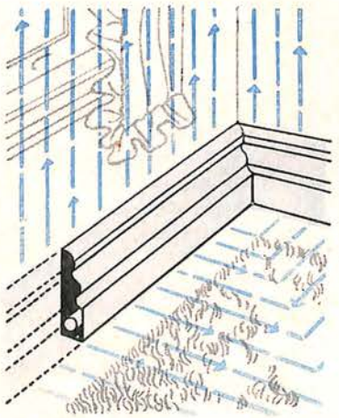
lower air temperature. In this way total heat loss is kept even.

HOW DOES A CONVECTOR DIFFER FROM A RADIATOR?

A radiator provides most of its heat by direct radiation, with a small amount distributed by convection. A convector is always within a cover. Air enters the enclosure through an opening at the floor. This air contacts the hot surface of the convector, which may be a steam or hot-water pipe assembly with thin metal fins. The heated air then rises and passes out into the room by way of an opening at the top of the cover. Though the major portion of the heat is provided by convection, a small amount of radiant heat is provided by the warm surface of the enclosure. Convectors are somewhat smaller than radiators for equal heat output, and can be made less conspicuous in a wall recess. When a radiator is enclosed in a cover, it functions as a convector, but not as efficiently.

WHAT IS PANEL HEATING?

The term "panel heating" is often confused with the term "radiant heating." Actually it is just a form of radiant heating which uses a large area as the heating surface. Floor, ceiling, a wall, or a part or combination of these, may act as radiant panel. Such surfaces need not be heated to as high a degree as the conventional radiator or convector to provide adequate heat. The surface temperature of a floor panel should not exceed 85 degrees, a ceiling panel, on the other hand, may be heated to 115 degrees. Thus a given area of ceiling at 115 degrees will provide much more heat than the same floor area at 85 degrees. This favors ceiling panel heat in a building in which there is not sufficient area in the floor to offset the heat loss. According to the Guide of the American Society of Heating and Ventilating Engineers, a ceiling panel will deliver 70% of



● Baseboards heat by radiation and convection and are inconspicuous.

its heat by radiation and 30% by convection; floor panel, 55% by radiation and 45% by convection; and a wall panel, 65% by radiation with 35% by convection.

HOW IS A RADIANT PANEL HEATED?

The two most common methods are hot water in pipes and warm air in ducts. The pipes can be in concrete, 1½ to 3½ inches below the finished floor surface. Under the concrete is insulation and waterproofing on a bed of gravel or crushed stone. The floor can have linoleum, wood, tile, carpet or other covering that will not materially affect the heat output. Pipes can also be between beams in frame construction, or adapted to other structural types. Ceilings and walls can have pipes in plaster or between studs or beams.

IN WHAT WAY IS A PANEL HEATED BY WARM AIR?

Warm air can be used in ducts in the ceiling or floor, with many details possible, for masonry or wood-frame construction. In the usual system the warm air returns directly to the heating unit, but it can be split to provide ventilation and humidification similar to a forced warm-air system by having a portion of the air enter the room. In one design air passes under the floor in ducts, and then enters the room through grills in the window sills. It then crosses the room and returns to the furnace by a ceiling or a high wall opening.

WHAT SPECIAL EQUIPMENT IS NEEDED FOR PANEL HEATING?

Furnaces and controls for panel heating are the same as those in other hot-water and warm-air systems.

IS BASEBOARD HEATING SATISFACTORY?

Yes, if properly installed. Baseboards can be radiators or convectors, and they are used along the base of the wall for a distance sufficient to provide the heat that is necessary for comfort. This may be along one or more walls, depending on the size and shape of the room.

CAN PANEL HEATING BE INSTALLED IN OLD HOUSES?

Due to the location of the pipes and ducts, this type of heating is almost exclusively for new houses.

However, electric ceiling panels are adaptable for old buildings. Baseboard radiators and convectors provide a wall panel effect and can be installed easily in old houses.

WHAT ARE THE PRINCIPAL TYPES OF HEATING SYSTEMS IN COMMON USE TODAY?

They are one pipe steam, two pipe steam or hot water, and hot or forced warm air, sometimes called air conditioning. Where the heating season is short, and the winters mild, a complete central heating plant is not always necessary, and a floor furnace, a unit space heater, or small separate units can provide comfortable heat. In some instances two or more space heaters or floor furnaces will give adequate heat.

HOW DOES A ONE PIPE STEAM SYSTEM WORK?

The steam is supplied to each radiator, and the condensed steam or water returns to the main line and boiler through one pipe. The installation is economical, but heat cannot be controlled enough for complete comfort. There is a long time between the start of the fire and the arrival of heat at the radiator. Radiators near boiler heat up first. Valves must be completely open or shut, resulting in each radiator having all or nothing. These disadvantages can be overcome to some degree by the addition of equipment to create a partial vapor-vacuum system.

WHAT IS A TWO PIPE STEAM SYSTEM?

It has one pipe for the supply of steam to the radiator and another for the return of the condensed steam to the boiler. More pipe is needed in a two pipe system, but pipe can be of a smaller size. The increased cost is warranted by improved control and flexibility. Individual thermostats can be used to control the amount of heat supplied to each room; the house will not overheat as much in mild weather, and there is no hissing from air valves. A house can be too large for adequate heat from a one pipe system, but a two pipe installation will take care of any size home.

ARE ALL HOT-WATER SYSTEMS TWO PIPE?

There are one pipe hot-water systems, but this always refers to the main supply line. Two pipes, supply and return, are necessary for each

radiator or convector in either one or two pipe hot-water systems. In the gravity system the water circulates slowly by the natural tendency of hot water to rise. The water cools in the radiator and returns to the boiler. The slow circulation results in a long delay between a call by the thermostat and the arrival of heat in the radiator. When the furnace is shut off, the water continues to circulate awhile, overheating the rooms.

The positive action of a pump in a forced circulation hot-water system allows the use of smaller pipes, results in rapid supply of heat to the radiators, and eliminates the circulation and excessive heat after the furnace is shut off. Modulation of the heat by thermostats in individual rooms or zones, with control valves for very complete selection of temperatures to suit room requirements, can be arranged. Either open or closed expansion tanks can be used with gravity or forced circulation systems. The water is usually no hotter than 180° with open tanks, but with a closed tank the pressure will allow the use of water at as high as 240° temperature. With the hotter water, radiators and pipes can be smaller.

HOW DO HOT-AIR AND FORCED WARM-AIR SYSTEMS DIFFER?

The hot-air system depends on the natural rise of heated air for the circulation. It is not flexible or well controlled, and rooms far from furnace are often not well heated.

The forced warm-air system is the modern version of the hot-air plants. The air is not heated to such a high degree, and is circulated by a fan which allows for control and flexibility, and the use of smaller ducts. The air can be cleaned and humidified, providing a very comfortable atmosphere in the house.

WHAT ABOUT AIR CONDITIONING?

According to the Federal Trade Commission, the words "air conditioning" signify the simultaneous control, by mechanical device, of various factors affecting both the physical and chemical conditions of the atmosphere within a given structure, such as a room, building, or the like; and said factors include temperature, humidity, and circulation within the structure. A device which does not control each and all of the designated factors is not properly designated an "air conditioner." When a forced warm-air system includes air cleaning and humidification features, it can be correctly called a "winter air conditioner." A "summer air conditioner" cools, dehumidifies, cleans, and distributes the air. A complete "air conditioner" includes both summer and winter treatment and distribution.