soldered to the core or by both pressure and soldering. An extended surface heating unit is usually placed within an enclosure and therefore functions as a convector.

**Fan Furnace System:** See *Warm Air Heating System.*

**Force:** The action on a body which tends to change its relative condition as to rest or motion. $F = (WV) \div (gt)$.

**Free Enthalpy:** A thermodynamic property which serves as a measure of the available energy of a system with respect to surroundings at the same temperature and same pressure as that of the system. No process involving an increase in available energy can occur spontaneously. (See example on *Free Enthalpy* in Chapter 1.)

**Fumes:** Particles of solid matter resulting from such chemical processes as combustion, explosion, and distillation, ranging from 0.1 to 1.0 micron in size.

**Furnace:** That part of a boiler or warm air heating plant in which combustion takes place. Also, a fire-pot.

**Furnace Volume** (*Total*)*:* The total furnace volume for horizontal-return tubular boilers and water-tube boilers is the cubical contents of the furnace between the grate and the first plane of entry into or between tubes. It therefore includes the volume behind the bridge wall as in ordinary horizontal-return tubular boiler settings, unless manifestly ineffective (*i.e.*, no gas flow taking place through it), as in the case of waste-heat boilers with auxiliary coal furnaces, where one part of the furnace is out of action when the other is being used. For Scotch or other internally fired boilers it is the cubical contents of the furnace, flues and combustion chamber, up to the plane of first entry into the tubes. (*A.S.M.E.* Power Test Codes, Series 1929.)

**Gage Pressure:** Pressure measured from atmospheric pressure as a base. Gage pressure may be indicated by a manometer which has one leg connected to the pressure source and the other exposed to atmospheric pressure.

**Grate Area:** The area of the grate surface, measured in square feet, to be used in estimating the rate of burning fuel. This area is construed to mean the area measured in the plane of the top surface of the grate, except that with special furnaces, such as those having magazine feed, or special shapes, the grate area shall be the mean area of the active part of the fuel bed taken perpendicular to the path of the gases through it. For furnaces having a secondary grate, such as those in double-grate down draft boilers, the effective area shall be taken as the area of the upper grate plus one-eighth of the area of the lower grate, both areas being estimated as previously defined.

**Gravity Warm Air Heating System:** See *Warm Air Heating System.*

**Heat:** Heat is that form of energy which transfers from one system to a second system at lower temperature by virtue of the temperature difference, when the two are brought into communication.

**Heating Medium:** A substance such as water, steam, air, or furnace gas used to convey heat from the boiler, furnace or other source of heat or energy to the heating unit from which the heat is dissipated.

**Heating Surface:** The exterior surface of a heating unit. *Extended heating surface (or extended surface):* Heating surface having air on both sides and heated by conduction from the prime surface. *Prime Surface:* Heating surface having the heating medium on one side and air (or extended surface) on the other. (See also *Boiler Heating Surface.*)

**Heat of the Liquid:** This can usually be interpreted as the specific enthalpy of saturated liquid.

**Hot Water Heating System:** A heating system in which water is used as the medium by which heat is carried through pipes from the boiler to the heating units.

**Humid Heat:** Ratio of increase of enthalpy per pound of dry air to rise of temperature under conditions of constant pressure and constant humidity ratio.

**Humidify:** To add water vapor to the atmosphere; to add water vapor or moisture to any material.

**Humidistat:** A regulatory device, actuated by changes in humidity, used for the automatic control of relative humidity.

**Humidity:** Water vapor when mixed with dry air or other dilutent gases. *Absolute humidity* is the weight of water vapor per unit volume of moist air, pounds per cubic foot. It can be calculated by dividing the humidity ratio, weight of water vapor per pound of dry air, by the volume of the mixture per pound of dry air. *Relative humidity* is the ratio of the partial pressure of the water vapor in the air to the saturation pressure of pure water corresponding to the actual temperature. (See Chapter 1.)

**Humidity Ratio:** Weight of water vapor per pound of dry air. (Formerly called specific humidity.)

**Hygrostat:** Same as *Humidistat.*





**Inch of Water:** The pressure due to a column of liquid water one inch high at a temperature of 60 F.

**Insulation** (*Heat*)*:* A material having a relatively high heat-resistance per unit of thickness.

**Isobaric:** An adjective used to indicate a change taking place at constant pressure.

**Isothermal:** An adjective used to indicate a change taking place at constant temperature.

**Latent Heat:** The most general interpretation is heat absorbed at constant temperature. More specifically the *latent heat of vaporization* is the difference between the specific enthalpies of saturated vapor and saturated liquid at the same temperature (and, for a pure substance, the same pressure). *Latent heat of sublimation* is the difference between the specific enthalpies of saturated vapor and saturated solid at the same temperature. *Latent heat of fusion* is the difference between the specific enthalpies of saturated liquid and saturated solid at the same temperature.

**Laws of Thermodynamics:** The Law of Conservation of Energy states that energy, in any of its forms, can neither be created nor destroyed. As a corollary to this, the *First Law* of Thermodynamics states that in any power cycle or refrigeration cycle the net heat absorbed by the working substance is exactly equal to the net work done. The *Second Law* of Thermodynamics states that a power cycle which absorbs heat at a single temperature and converts it wholly into work, as required by the First Law, is impossible; hence it is absolutely necessary to reject heat at some lower temperature if any work is to be done. The Second Law further prescribes the least possible quantity of heat that must be so rejected depending on the two temperatures involved.

**Manometer:** An instrument for measuring pressures; essentially a U-tube partially filled with a liquid, usually water, mercury, or a light oil, so the amount of displacement of the liquid indicates the pressure being exerted on the instrument.

**Mass:** The quantity of matter, in pounds, to which the unit of force (one pound) will give an acceleration of one foot per second per second. $m = W \div g$.

**Mb, Mbh:** Symbols which represent, respectively, 1000 Btu and 1000 Btu per hour.

**Mechanical Equivalent of Heat:** The conversion factor from Btu to foot pounds; $J = 778.26$ foot pounds per Btu. This is also referred to as Joule's Equivalent.

**Micron:** A unit of length, the thousandth part of one millimeter or the millionth of a meter.

**Mol** (*Pound Mol*)*:* A weight in pounds numerically equal to the molecular weight of a substance. In the case of gases, and at not too high pressures, the volume of 1 mol is approximately the same for any gas at the same temperature and pressure. At 32 F and standard atmospheric pressure this volume is 358.65 cu ft.

**One-Pipe Supply Riser** (*Steam*)*:* A pipe which carries steam upward to a heating unit and which also carries the condensation from the heating unit in a direction opposite to the steam flow.

**One-Pipe System** (*Hot Water*)*:* A hot water system in which the water flows through more than one heating unit before it returns to the boiler; consequently, the heating units farthest from the boiler are supplied with cooler water than those near the boiler in the same circuit.

**One-Pipe System** (*Steam*)*:* A steam heating system consisting of a main circuit in which the steam and condensate flow in the same pipe, usually in opposite directions. Ordinarily to each heating unit there is but one connection which must serve as both the supply and the return, although separate supply and return connections may be used.

**Overhead System:** Any steam or hot water system in which the supply main is above the heating units. With a steam system the return must be below the heating units; with a water system, the return *may* be above the heating units.

**Panel Radiator:** A heating unit placed on or flush with a flat wall surface and intended to function essentially as a radiator.

**Panel Warming:** A method of heating involving the installation of the heating units (pipe coils) within the wall, floor or ceiling of the room, so that the heating process takes place mainly by radiation from the wall, floor or ceiling surfaces to the objects in the room.

**Plenum Chamber:** An air compartment maintained under pressure and connected to one or more distributing ducts.

**Potentiometer:** An instrument for measuring or comparing small electromotive forces.

**Power:** The rate of performing work; usually expressed in units of horsepower, Btu per hour, or watts.