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Direct resistance heating pdf

Electric heating means the production of heat energy from electrical energy. This type of heating can be generated by several methods. Classification of Electric Heating Methods The classification of electric heating methods is shown in the following figure. Fig. 1 Electric Heating Methods In general, Electric heating can be classified as power frequency heating and high frequency heating. Power Frequency heating Power frequency heating can be classified into 2 types i.e. resistance heating and arc heating. (1) Resistance Heating Resistance heating is based on I²R effect. It can be classified into 3 types i.e. direct resistance heating, indirect resistance heating and infra-red heating. (a) Direct Resistance Heating In this type of heating, electric current is passed directly through the body to be heated. Since the body has resistance, current causes heat generation in the body. Hence, it raises the body temperature. Applications electrode boiler for heating water resistance welding (b) Indirect Resistance Heating In this type of heating, electric current is passed through a resistive element. The power dissipated as I²R loss is delivered to the body to be heated by convection or radiation. Applications resistance ovens cooking heat treatment of metals immersion heaters (c) Infra-red Heating In this type of heating, incandescent lamp is used for heating the body. The body is heated due to electromagnetic radiations produced by the lamp. Applications used for drying wet paints on an object (2) Arc Heating Arc heating is based on the arc formation between two electrodes causing generation of high temperature. This high temperature is responsible for heating of a body. Arc heating can be classified into 2 types i.e. direct arc heating and indirect arc heating. (a) Direct Arc Heating In this type of heating, the arc is produced between the electrode(s) and body to be heated. Hence, the heat is directly transferred to the body by conduction. Applications (b) Direct Arc Heating In this type of heating, the arc is produced between two electrodes. Hence, the heat generated is transferred to the body by radiation. Applications High Frequency Heating High frequency heating can be classified into 2 types i.e. dielectric heating and induction heating. (1) Induction Heating Induction heating can be classified into 2 types i.e. direct induction heating and indirect induction heating. (a) Direct Induction Heating This method is based on electro-magnetic induction. The currents are induced in the body to be heated by electro-magnetic induction. These current cause heat generation as the material have its own resistance. Applications heat treatment of metals by eddy current heaters, used in furnaces (b) Indirect Induction Heating This method is also based on electro-magnetic induction. The currents are induced in the heating element by electro-magnetic induction.. These currents cause the heating element to heat up. The heat developed in the heating element is transferred to the body to be heated by convection or radiation. Applications heat treatment of metals by induction oven (2) Dielectric Heating This method of heating is used for heating of non-metallic materials. In this method, the non-metallic material is placed between two metal electrodes. When a high voltage having high frequency is applied across electrodes, dielectric losses occurs. This dielectric losses is responsible for the heat generation in the material. Advantages of Electric Heating 1. It is clean since there is no production of ash or dust. Five gases are also absent in this heating. 2. There is accurate and reliable temperature control for such kind of heating. 3. It is economical since system requirement for heating is less. 4. The maintenance cost for such heating system is less. 5. The efficiency of this kind of heating is higher. 6. Electric heating is safe and easy to handle. 7. More reliable heating since various automatic protection devices are available to protect the system in case of any fault. 8. There is a wide range of temperature. 9. Electric heating does not create any noise. 10. The radiating losses in electric heating is less. 11. Uniform heat is produced in electric heating. Lupi, S., Nunes, M.F.: Riscaldamento dei metalli mediante conduzione diretta di corrente, 86 p. CLEUP, Padova, Italy (1990) (in Italian)Google ScholarAliferov, A., Lupi, S.: Direct Resistance Heating of Metals. Novosibirsk State Technical University Publishing House, 223 p. ISBN 5-7782-0475-2 (2004) (in Russian)Google ScholarAliferov, A., Lupi, S.: Induction and Direct Resistance Heating of Metals, 411 p. Novosibirsk State Technical University Publishing House. ISBN 978-5-7782-1622-8 (in Russian)Google ScholarLupi, S., Forzan, M., Aliferov, A.: Induction and Direct Resistance Heating—Theory and Numerical Modeling, 370 p. 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Elektrowärme Int., Bd. 30, B1–Feb., B34–B40 (1972)Google ScholarLavers, J.D.: An efficient method of calculating parameters for induction and resistance heating installations with magnetic loads. IEEE Trans. Ind. Appl. IA-14(5), 427–432 (1978)Google Scholar© Springer International Publishing Switzerland 2017 PrintInstead of generating heated air or water at a central location and then distributing it throughout the home, some systems generate heat where it is needed locally. The most common method is electric baseboard heat. Other ways include kerosene heat; wood-burning stoves; and fireplaces burning wood, coal, or natural gas. These systems can heat the whole house, part of the house, or a single room. Electric Resistance Heat Electric resistance heating converts nearly 100 percent of the energy in the electricity to heat. However, most electricity is produced from oil, gas, or coal generators that convert only about 30 percent of the fuel's energy into electricity. Because of electricity's generation and transmission losses, electric heat is often more expensive than heat produced in the home with combustion appliances such as natural gas, propane, and oil furnaces. Electric resistance heat can be supplied by centralized forced-air furnaces or by zonal heaters in each room, both of which can be composed of a variety of heater types. Zonal heaters distribute electric resistance heat more efficiently than electric furnaces because you set room temperatures according to occupancy. Zonal heaters have no ducts (unlike electric furnaces) that can lose heat before it reaches the room. Electric furnaces can accommodate central cooling more easily than zonal electric heating because the air conditioner can share the furnace's ducts. Electric resistance heat can be provided by electric baseboard heaters, electric wall heaters, electric radiant heat, electric space heaters, electric furnaces, or electric thermal storage systems. Electric Direct Heating Systems Type of Heater Description Method of Heating Installation Advantages / Disadvantages Baseboard Heaters Zonal heaters controlled by thermostats located in each room. Contain electric heating elements encased in metal pipes, which are surrounded by aluminum fins to aid heat transfer and run the length of the baseboard heater's housing, or cabinet. Convection and radiation. As air within the heater is warmed, it rises into the room, and cooler air is drawn into the bottom of the heater. Some heat is also radiated from the pipe, fins, and housing. Usually installed underneath windows where the heater's rising warm air counteracts falling cool air from the cold window glass. Seldom located on interior walls because the standard heating practice is to supply heat at the home's perimeter where the greatest heat loss occurs. Should sit at least three-quarters of an inch (1.9 centimeters) above the floor or carpet, to allow the cooler air on the floor to flow under and through the radiator fins so it can be heated. Should also fit tightly to the wall to prevent the warm air from convecting behind it and streaking the wall with dust particles. The quality of baseboard heaters varies considerably. Cheaper models can be noisy and often give poor temperature control. Look for labels from Underwriter's Laboratories (UL) and the National Electrical Manufacturer's Association (NEMA). Compare warranties of the different models you are considering. Wall Heaters Consist of an electric element with a reflector behind it to reflect heat into the room, and usually a fan to move air through the heater. Convection and radiation. Usually installed on interior walls because installing them in an exterior wall makes that wall difficult to insulate. ----- Radiant Heaters Several types, including electrical heating cables (most common), gypsum ceiling panels and metal radiant panels (provide radiant heat faster than other types because they contain less material to warm up. Radiation - radiate heat to the room's objects, including its people. For example, you can feel a ceiling-mounted radiant heating panel warming your head and shoulders if you stand underneath it. Electric heating cables are embedded in floors or ceilings; gypsum ceiling panels are already equipped with factory-imbbed heating cables; and metal radiant panels are ceiling-mounted. Offers draft-free heating that is easily zoned. It occupies no interior space, allowing you complete freedom to place furniture without worrying about impeding air flow from registers or baseboard heaters. Manufacturers claim that radiant heat can provide comfort similar to other systems at lower indoor air temperatures, saving around 5 percent of space heating costs. Critics say that it can be difficult to control air temperature with a thermostat. The large heat-storage capacity of the concrete or plaster surrounding the heating cables may result in greater-than-normal fluctuations in the room air temperature, since it takes quite a while to heat up the storage mass. Also, some occupants complain about their heads being too warm in rooms that utilize ceiling radiant heat. Supplying heat at the ceiling or floor, which are locations that typically border the outdoors or unheated spaces, can result in greater heat losses. For example, if there are any flaws in a heated concrete slab or gaps in the ceiling insulation above heating elements, a large percent of the electric heat may escape to the outdoors without ever heating the home. Space Heaters Electric space heaters come in a wide variety of models, either built-in or portable. Portable space heaters, as well as many built-in space heaters for small rooms, have built-in thermostats. Larger rooms heated with built-in electric space heaters should have low-voltage thermostats installed in an area that maintains the room's average temperature. These heaters may have fans to circulate heated air, and may also be designed to transfer some of their heat by radiation. All of these heaters must be given adequate clearance to allow air to circulate safely. ----- Fireplaces Fireplaces are very commonly used in family rooms and other living areas to give a warm and cozy feeling. These fireplaces can be wood or natural-gas fired. Generally, fireplaces transfer the heat by radiation, and hot combustion gases (carrying a lot of thermal energy) go out through the stack. Hot gases are lighter and rise up the chimney; a natural suction created by this flow draws the heated warm air from the room. Most of the time, the warm air heated in the room by the main heating fuel is also drawn into the fireplace and goes up the chimney, resulting in a net loss of energy. It is estimated that about 75 percent of the heated air is lost through the chimney. However, many people still use fireplaces inefficiently. Advantages and disadvantages of direct heating systems Advantages and disadvantages of direct heating systems Advantages Disadvantages Generates heat at the point of use; no transmission losses. Heats only certain parts of the home. Inexpensive to purchase and install. Cannot be used for cooling. Easy local control in each room. Takes up living room. In well-insulated houses, it may be cheaper than other systems. Generally less efficient than other central heating systems.

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