CHOOSING A HEATING PLANT WISELY

By

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"A comfortable house is a great source of happiness. It ranks immediately after health."

So said Sydney Smith, noted English philosopher and publicist, in a letter to Lord Murray.

This statement is as true today as when it was made in 1843. Indeed, with the advances in house design and equipment that have been made in recent years, particularly the years immediately before the beginning of the war, the public has become more severely critical and therefore dissatisfied with uncomfortable houses.

It is doubtful if there is anything that contributes so much to comfort as good heating -- reliable, uniform, and economical heating.

Any one of a half-dozen methods of heating will maintain the temperature necessary for living conditions in the home during the winter. A log in a fireplace or stove will serve such a purpose, just as they served for our forefathers.

But there is a vast difference between merely satisfying the basic requirements for heated living quarters and, on the other hand, supplying measured, uniform, and dependable heat so that dwellers may move freely and comfortably in a home radiant with warmth. This achievement has been brought about only after centuries of development in living standards. Scientific research has succeeded in making modern heating methods as different from obsolete ones as night is from day.

What Is Good Heating?

You should expect these things from the heating system for your new postwar home:

It should heat all rooms and maintain a comfortable, uniform temperature on the coldest days of winter and the mildest days of spring.

It should distribute heat near the floor, where it is felt, and not up at the ceiling.

It should warm the home without creating drafts.

It should be easy and convenient to operate.

It should be clean in its operation.

It should be durable, with low maintenance cost.

It should be economical to operate.

These are some of the things you have a right to expect from your heating plant. But the choice is up to you -- you must give careful thought and study to the subject of house heating if you wish to be sure that your heating plant will produce the results you desire.

One factor is worthy of special emphasis because of its basic importance: Don't be misled by low first cost of the equipment. The heating plant which costs least to buy may actually turn out to be the most expensive in the long run. In selecting heating equipment for a new house or for the modernization of an old house, the homeowner should remember that there are two costs -- original cost and operating cost -- to be considered. The cheapest heating system from the standpoint of original first cost is very likely to be the most expensive to operate.

The few dollars difference between dependable, well-made equipment and something which will have to be replaced in a few years is very small when compared with the annual expense of fuel. Therefore, the only prudent way to select heating equipment is to consider carefully your own individual requirements and then purchase only that equipment which will meet them exactly.

Get The Advice Of An Expert

But how is the family which is now making its plans for a postwar home to know which heating plant will provide all of the essential requirements of good heating, especially which heating plant will be economical in cost of operation and upkeep?

There is only one answer to this question: Get the advice of a heating expert -- the heating contractor or dealer who has been in the heating business for a number of years and who has the reputation in his community for having installed a large number of heating plants which, over a period of years, have given good service to their owners.

Talk over your plans for a heating plant for your postwar house with a good heating contractor or heating dealer -- preferably the type of man who thinks enough of his business to belong to the national association in his particular field of heating.

There is another suggestion that will save you money and help assure you of lasting satisfaction: Give preference to heating equipment made by manufacturers of national standing in the heating field. Limit your choice to manufacturers who have been in business for a large number of years -- manufacturers of stability and integrity -- manufacturers who are sure to be in business years from now when you may want repairs.

The importance of this fact was demonstrated during the fuel oil crisis when many homeowners were confronted with the necessity of converting their heating plants from oil to coal or from gas to coal. They needed grates that would fit their boilers or furnaces. Some owners had boilers that were made from 25 to 50 years ago because cast iron boilers, with proper care, will last a lifetime. Those owners who had the good judgment years ago to buy their boilers from reliable manufacturers were able to get grates and shaker equipment without trouble. Those with "orphans" in their basements were not in such a fortunate position.

The reliability of the manufacturer will be even more important after the war when many factories now making war goods will be converted to the manufacture of heating equipment. Let somebody else do the experimenting with new brands of heating equipment. Heating is too important to take a chance. Play safe: stick with the known brands -- the manufacturers who have made heating equipment for years and who know what it is all about.

There is only one test for building materials, and that goes for heating equipment as well -- that is the time test.

Laboratory tests, no matter how accelerated or by whom conducted, cannot begin to provide the proof of satisfactory operation which is provided by actual use of equipment in the field under varying conditions of use, and, unfortunately, sometimes of abuse.

Three Is a Magic Number in Heating

There are three kinds of heating systems in general use. There are three kinds of fuel. And there are three basic new developments in heating.

The three kinds of heating systems are: Hot water, steam, and warm air.

The three kinds of fuel are: Coal, oil, and gas.

The three significant new developments in heating are: Zoning, modulation, and the use of the heating plant as a means of supplying domestic hot water.

There are three keys to heating plant efficiency: Good equipment properly installed, reasonable care and maintenance, and correct firing methods.

There are three general ways of conserving heat: Insulation of the entire house, insulation of the heating plant, and care in the elimination of heat leakage through open fireplaces, ventilators, or poorly fitting doors.

Kinds of Heating Systems

a. Hot Water

There are several types of radiator heating systems in general use today. These are: Hot water, steam, vapor and vacuum.

In the case of a hot water system, water is the medium for transmitting heat. In the case of all other radiator heating systems, steam is the medium for transmitting heat.

Tremendous strides have been made in the improvement of hot water heating systems in recent years. In fact, so remarkable have been the advances in hot water heating that it may be said that the postwar heating plant is here today, this being the modern automatically fired hot water heating plant with forced circulation, zoning, the latest types of controls, and recessed or concealed radiation.

Whereas, formerly hot water was circulated by gravity, today in a modern system hot water flows from the boiler, through the pipes, to the radiators under the sure and compelling power of an electric pump -- not a large pump that is expensive to operate but a small pump operated by a fractional horsepower motor.

The advantage of this system of circulation is obvious. When the thermostat calls for heat, the pump starts, and almost immediately the radiators begin to warm the rooms -- not merely the radiator nearest the boiler but all radiators, because there is only a split second interval between the distribution of water to different radiators.

The temperature of the boiler water is regulated by a temperature control. Thus the water in the boiler is always at a predetermined temperature. This temperature is relatively low for the mild days of fall and spring and higher for winter weather.

The flexibility of hot water heating lies in the fact that water can be circulated at temperatures between 75 degrees and 240 degrees. The equipment is simple. The largest job, or additions to an existing installation, simply call for a multiplication of the simple units used on the smallest. The installation of dual controls (inside-outside) on existing forced-circulation hot water systems provides substantial fuel savings.

Hot water is widely used for the heating of residential buildings because it is economical in original cost and in upkeep, and because hot water radiators give off a mild, even heat. If properly fired and controlled, a hot water system will never overheat a house and thus rob the air of its natural humidity. This is an important advantage of the hot water system over the old-fashioned stove and furnace methods of heating which virtually kiln-dried the air which came in contact with cast iron heated to a very high temperature.

A hot water heating system is especially well adapted to those states in northern latitudes where there are several months of winter weather. Yet the system is sufficiently flexible, so that homes may be comfortably heated in the milder days of spring and fall.

Hot water heating plants are available as package units with the boiler, controls, tank, pipe, radiators, and valves assembled and sold in one complete package. Savings in installation cost as well as material cost of the prefabricated assembly have placed automatic hot water heating within the means of builders of low cost homes.

Kinds of Heating Systems

b. Steam and Vapor

The simplest kind of a steam system is a one-pipe heating system. It is so-called because only one pipe leads from the boiler to the risers and radiators. This one pipe carries both the steam and the condensation. This system costs less for materials and installation than any other kind of radiator heating system. While it supplies an abundance of clean heat and is economical to operate, the fact that it is a one-pipe system makes it difficult to modulate the amount of steam entering the radiators. The shut-off valves must be either entirely on or entirely off.

By the use of special vacuum valves on the radiators and another type of vacuum valve in the basement, the ordinary one-pipe steam system can be converted into a partial vacuum system and thus become much more economical in its operation. When vacuum valves are used, air is kept out of the radiators after the steam has pushed its way into the radiators. Thus, the steam will remain in the radiators

after the fire has gone down.

While the air valve is a small and almost inconspicuous part of a steam heating system, it is vital to efficient operation. It is important, therefore, to use the best air valves.

Good air valves will save fuel, reduce complaints, prevent water spitting, speed up steam distribution, and help to effect more uniform temperature. This is the job the air valve does. It first allows a free, uniform, and unhampered escape of air. Then it closes off at a predetermined temperature so that steam will not escape. As the heat is dissipated from each radiator, the valve must then open when the temperature falls. This is enough for one valve to accomplish, but a very important function still remains. Should the radiator fill with water, a good valve must also be constructed so that a positive shut off will occur, regardless of the function the valve is performing at the time water enters the valve.

Manufacturers of air valves have designed valves that can be individually adjusted to take care of the requirements of each radiator. The valves are provided with an adjustable cap which when turned regulates the size of the air vent, thus the heating system may be much more accurately balanced than heretofore, and the radiator in each room may be adjusted so that it receives its proper proportion of steam, preventing overheating in rooms nearest the boiler, and assuring adequate heat in rooms farthest from the boiler.

The venting port can be adjusted to any one of approximately ten different openings, which control the speed at which air escapes from the radiator. Since the rapidity with which a radiator heats is in direct proportion to the rapidity of air escape, it is obvious that a slow-heating radiator can be speeded up by using a vent port opening larger than normally used.

How a heating system is brought into perfect "balance" by air valves is best illustrated by a typical example. When the valves are installed, the vent port of each valve is set at the normal opening. If, with the system in operation, it is discovered that a radiator at a considerable distance from the boiler is heating slowly, the vent port of the valve is set at a larger opening. A radiator close to the boiler may be overheating, so the vent port is adjusted to a smaller opening, thus restricting the ratio of venting and heating.

A few simple adjustments of this kind will regulate steam flow so that all radiators will heat equally within a given time, regardless of size or distance from the boiler. Because of this even distribution of heat, fuel economies result, along with better comfort conditions.

Modern production methods have lowered the cost so much that even good air valves are inexpensive. Years and years of faithful operation can be expected, all of which means that the best air valves cost but a few cents a year.

A still further extension of the vacuum principle is found in the vapor, the vacuum, and the vapor-vacuum systems. All are based on the principle of excluding air from the system. A vapor system is so-called because it utilizes steam at very low pressure, i.e., a vapor.

An ordinary steam heating system generates steam at a pressure of approximately two pounds. The vapor, vacuum, and vapor-vacuum systems utilize steam at low pressures. In other words, they are improvements

on the ordinary steam heating system because they are more economical.

The principle upon which all these new and improved steam systems operate will be immediately apparent when one remembers the high school physics lesson on the difference between water boiling on the mountain and at the seashore. Water boils at a lower temperature on the mountain because of the decreased air pressure. In the same way, the water flashes into steam at a lower temperature in a steam system in which the air has been to a large extent excluded.

The vapor system is well suited for residences and apartments. It is somewhat more expensive than the hot water system because of the special air traps required. However, many prefer it because of its almost instant responsiveness to demands made upon it. It has a quick pick-up in the morning and the comparatively air-tight system holds the heat for a long time. This results in economy of fuel which is one of its most attractive features. In many ways, it is ideal for the residence although it must be remembered that it naturally operates at a higher temperature than the hot water system.

Kinds of Heating Systems

c. Warm Air

The warm air heating plant consists basically of a fire-pot or combustion chamber in which the fuel (either coal, gas, or oil) is burned and creates heat. This chamber has a direct connection to the chimney through which the gases and smoke created by the fire, are carried off. Around this combustion chamber is a hollow shell or jacket through which air circulates, becomes heated by contact with the hot surface of the fire-pot, and rises as all warm air will. It passes through ducts or pipes to grilles opening into the various rooms of the house.

This is a description of the simplest type of warm air heating plant, known as gravity installation. It is comparable to the gravity hot water heating system previously described.

Just as the circulation of hot water has been speeded up by the introduction of a device for mechanical circulation, so the circulation of warm air, too, has been mechanized by the use of a fan operated by a motor. The result of the blower as in the case of the hot water circulator is quicker and more positive heating effects.

There is another analogy, too, between the effects of mechanical circulation on warm air and hot water plants. This is the sizing of the piping or ducts. The use of a pump enables contractors to reduce the size of hot water heating piping. Similarly the use of a blower permits a reduction in the size of ducts. Since the war, prefabricated duct work has come into general use.

How Research and Standards Benefit The Builder

It wasn't so many years ago when the beginning of zero weather saw all reputable and upstanding citizens snugly encased in red flannels, ankle and wrist length. Thus clad, these worthy folk were set to laugh derisively at winter. An excess of clothing made up for the glaring deficiencies of home heating.

Changing times and technical improvements brought better heating and less clothing. Modern hot water and steam heating equipment is able to maintain a constant temperature of 70 degrees in all rooms regardless of wind velocities or outdoor temperature conditions.

America has the advantage which comes from the finest heating equipment and almost unlimited supplies of fuel.

Postwar builders will benefit from the research work and standards begun before the war and carried on, for the most part, during the war years. Basic research work in heating has been fostered by such groups as the American Society of Heating and Ventilating Engineers, The Institute of Boiler and Radiator Manufacturers, and technical schools, notably the Engineering Experiment Station of the University of Illinois.

Known as the I-B-R research program, the work at the University of Illinois is carried on in the laboratories of the Engineering Experiment Station, the School of Medicine, and at the I-B-R Research Home. The latter is a six-room brick veneer structure built in 1940.

Generally regarded as the most completely equipped laboratory house in the world for the scientific study of the efficiency of heating plants under actual operating conditions, the I-B-R Research Home is an important factor in the development of better heating through research.

In the construction of the Research Home, more than eight miles of fine wire were imbedded in the walls. This wire connects approximately 200 thermocouples and 80 moisture indicating points with automatic recording instruments.

Each day during the heating season more than 600 readings are taken in the I-B-R Research Home by the staff of research engineers -- readings that help to establish new standards of health and comfort for users of hot water and steam heating. At the same time the research work at the University of Illinois has shown that the heating plant of tomorrow is here today and will be available as soon as the armistice whistle blows. The research work at Illinois has shown that a modern automatically-fired hot water heating plant with forced circulation will provide heating so even and uniform that the temperature will not vary more than a fraction of a degree from the thermostat setting.

The Choice of a Fuel

The most generally used fuels are coal, gas, and oil. The choice of a fuel should be decided on the basis of cost, availability, and dependability of a sure supply.

Each has certain advantages. In localities where house heating rates are maintained, gas may be burned at a very reasonable annual cost. If your home is in a district where coal is cheap and readily available, there is no reason to consider anything else because boilers can be fired automatically today, thus eliminating all manual labor.

Oil, is quite a favorite in modern heating. Insofar as the efficiency of the three fuels are concerned, many improvements have been made and are constantly being made in each.

Boilers

While boilers may be classified in various ways, the most important groups from the standpoint of the homeowner are those designed for special fuels and those which can be used for any fuel.

As a convenience to the builder and as an economy, a number of boilers are sold as package units -- that is, the controls, firing equipment and accessories are sold with the boiler. In the small house field, the package units include the necessary radiation, valves and piping, as well as the boiler and controls.

The better oil-burning boilers have a fire travel three times the length of the boiler itself. Extra long flues, baffles and fins trap the gases of combustion so they cannot short-circuit to the chimney. When the burner shuts off, the baffles tend to hold the hot gases in the boiler until they have given off all their heat. Lower stack temperatures and smokeless combustion are assured with modern boilers correctly sized for the heating load.

Several models of wet-base boilers have been introduced in recent years. Water is circulated entirely around the firebox. Heat cannot escape through the base, sides or floor. The boiler can be placed on the wooden floor of a utility room with perfect safety. In all oil-burning boilers, the greatest possible hot surface is backed by water thus giving the fullest opportunity for the transfer of heat units.

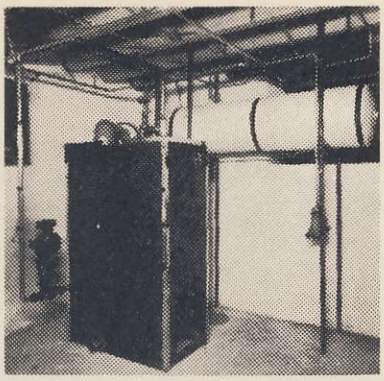
Similarly, in gas boilers there are many new economy features which help the homeowner reduce his climate bill. High efficiency is attained in one type of gas-burning boiler through a staggered fin construction which throws hot gases backward and forward and sidewise, setting up a swirling or spiral motion that scrubs every square inch of heat-absorbing surface.

Another type of gas-burning boiler has a valve which reduces the gas consumption gradually as the boiler temperature rises. Room temperatures are thus accurately maintained. This valve operates from a room thermostat, so that the supply of gas to the main burners can be completely shut off when the desired room temperature has been obtained.

Boilers made for stoker firing meet the demands for effortless home heating with coal. These are designed to reduce the accumulation of fly-ash in the boiler flues, an undesirable conditions which acts like insulation on the flue surfaces. Thus these boilers can be run for longer periods without cleaning.

Also available are all-purpose boilers which operate on any of the three fuels, and with which the change from one fuel to another can be made quickly and at nominal cost by an experienced heating piping contractor. This type of boiler is built with a high combustion chamber for the burning of oil or coal. It also has a large ash pit required for successful operation with coal. If desired, the boiler can be equipped with a built-in heater for the year-round heating of the domestic hot water supply. The boiler is sold completely equipped with grates, shaker handle and damper regulator.

Because boilers are water-backed, the flames and hot gases of combustion will not burn through or destroy the heat-absorbing surfaces of the boiler. Cast iron is highly resistant to corrosion. With proper care, a cast iron boiler will give more than half a century of service.



Split-second pick-up in this hot water heating system is provided by the small but powerful electric pump at left of boiler.

The modern stoker-fired boiler provides dependable automatic heat and makes possible a clean basement workroom.

The modern slender tube, free-standing radiator may be recessed to blend with the decorations.

This new style radiator provides both convected and radiant heat because the front and grilles are part of the unit. Suitable for use with steam or hot water.

Ideal for the bathroom is the small radiant front convector, a heating unit which may be installed under the window and out of the way.

Not only has efficiency of boilers been greatly increased, but the size of boilers has been reduced, thereby contributing to the more economical use of space. This reduction in size is particularly important where utility rooms are substituted for basements, for in these condensed service rooms of today, inches are of utmost importance and every cubic foot of space that can be saved, whether it is in size of boiler or what, may mean a reduction in completed cost of the house.

Safety Devices

Various safety devices are available to protect boilers, domestic water heaters, and hot water storage tanks against the hazards of excessive pressure and temperature and a dangerously low water level.

Every device for the heating of water should be protected against excessive pressure. Explosions of boilers and tanks due to overheating not only may involve damage to expensive mechanical equipment but also may destroy property and menace life.

Nothing is more dangerous to a boiler than a low water condition. A cracked section is almost sure to be the inevitable result of failure to keep the water level in the boiler up to the height required. Homeowners cannot afford to let an oil burner, a gas burner, or a stoker run with a low water condition. Uncontrolled hand-firing of boilers is equally hazardous.

While all boilers are equipped with gauge glasses so that those firing the boiler can watch the water line, experience has shown that boiler operators cannot be depended upon to watch the water line. This is true even when homeowners themselves are firing boilers by hand.

Devices which offer protection against run-away temperatures and dangerous pressures in domestic water heaters are required by many municipal ordinances. Massachusetts is the first state to make such equipment mandatory by a low which became effective on September 24, 1941.

For the protection of automatically-fired steamboilers two types of devices are available. While one type relieves the pressure before it reaches the danger point, another device protects the boiler and the property by automatically stopping the burner when the water in the boiler reaches a dangerously low level. This device, known as a low water cut-off, should be used with every steam boiler fired with a stoker, oil burner, or gas burner.

For additional protection it is desirable to use with the low water cut-off another device which automatically feeds water into the boiler when necessary. The two units may be installed as a combined device.

Twenty-six cities have ordinances requiring the installation of a low water cut-off on every automatically fired steam boiler.

Automatic Heating Equipment

a. Controls

Your heating plant is automatic when your coal is fed by a stoker, or your oil is sprayed, or gas turned on mechanically. The operation is regulated by a thermostat which starts the apparatus in action when the temperature falls below a certain point, and stops it when the temperature has risen to where you want it.

The thermostat is the brains of the heating system inasmuch as it detects the need for heat, and relays the message to the heating plant -- in the case of a hot water heating plant, to the pump or circulator.

There are a number of facts the prospective homeowner should know about thermostats. The main thing is the fact that the best of them cost but little more than the inferior ones. By all means, insist on a thermostat made by a reliable manufacturer. A good thermostat will maintain an even, pre-determined temperature throughout the house providing the heating system has been properly balanced, so that when the temperature is satisfactory at the thermostat location it is satisfactory elsewhere as well. Boiler heat has the advantage of permitting a high degree of distribution balance which is less affected by wind direction and velocity than are other forms of heating.

The part that a thermostat plays at night is very important. Tests over a period of years prove that a clock thermostat that will reduce the night temperature properly, and start it up again in the morning, will save as much as 15 per cent of the fuel bill during a normal heating season. What the apparatus is really doing is banking your fire as you used to do by hand before automatic controls were available.

Automatic Heating Equipment

b. Oil Burners

Oil burners are of vaporizing or atomizing types, depending on how oil is broken up into tiny particles for combustion. Vaporizing burners pre-mix the air and oil by means of blower and control valves.

Atomizing burners are divided into gun and rotary types; the former shooting the atomized oil vapor into the firebox, usually from the outside, while the latter is customarily installed inside the boiler base and employs a revolving disc for atomizing.

One of the postwar trends in oil burners will be in the direction of smaller burners for the more efficient heating of the smallest types of houses. Possibly the trend toward utilization of the heavier oils which began before the war will be accelerated. A closer coordination between the oil burner and the boiler is also being developed now.

Automatic Heating Equipment

c. Gas Burners

Gas burners are of conversion or integral-with-heater (recommended for new buildings) types, the burner unit consisting of a casting supporting a radiant, usually of china clay, the purpose of which is to radiate heat to sides of firebox; mixer chamber; adjustable gas orifice and air shutters; and automatic pilot to provide ignition. In the event of pilot failure, the automatic pilot immediately shuts off the gas burner.

Automatic Heating Equipment

d. Stokers

One of the most significant developments in the heating industry in recent years is the introduction of small coal stokers for the automatic firing of coal. While stokers have been used with great success for many years for the automatic firing of large boilers in schools, hospitals, factories, and other buildings, the application of the stoker principle to residential installations is a comparatively new development.

Nearly one million stokers are in use today. The total is increasing daily. Ultimately virtually all coal will be fired mechanically. The advantage of stoker firing is not merely that it does away with all manual labor in tending the fire but also the fact that it makes possible a better utilization of fuel. Stokers burn smaller and cheaper sizes of coal. Through more scientific firing and better control of combustion, further savings are effected. A stoker fired heating plant is virtually smokeless. A stoker provides automatic banking when not in operation, thus lessening room air stratification.

There are two types of stokers -- hopper and bin. The former consists of a hopper with space for about 15 hours coal supply, fan for properly apportioned draft, screw conveyor extending from hopper to firebox, and a small motor for power. Ashes sift over sides of burner heads.

Bin-type stokers are almost identical with the exception that a screw conveyor runs directly from coal bin to firebox. With the bin-feed type it is unnecessary for the householder to do anything more than see that there is an ample supply of fuel available in the bin at all times. Although it never was considered a chore of any consequence to see that the stoker hopper was always filled yet it is granted that the bin-feed device eliminates even that necessity.

An important engineering problem of the stoker -- that of seeing that there is a proper distribution of air and coal to give good combustion -- has reached a new standard of efficiency with the improvement in the feeding mechanism and automatic air control. Extensive research has revealed new burner head designs which enable a proper fuel bed condition to be maintained at all times under all conditions.

Refinements of automatic heat control mechanisms in stokers make them even more sensitive to heat demands in homes. Steadier temperatures now can be maintained with these improved "minds" of the

heating unit.

In addition there are the automatic pilot fire control to keep fires from going out in mild weather, the safety heat shut-off to avoid overheating of the boiler, silent operation, elimination of danger of jamming due to foreign substances in the coal, and greater protection to stoker motors. The net result of these refinements is more economical heat, steadier heat, and a degree of comfort and convenience never attained before.

Zoning

One of the innovations made possible by the modern application of controls is the zoning of houses. Heating and cooling buildings by zones is not a new idea. Almost every large school built during the past decade has been zone controlled. By the use of this system, the amount of heat going to the sunny side of a building is less than that going to the shady side. Yet temperatures throughout the buildings are healthfully warm.

Zone control has been applied to residential buildings. A house, for instance, can be divided into two zones: one the living and the other the sleeping quarters. Larger dwellings can be broken up into three or more zones, depending entirely on the size of the structure and the temperatures to be maintained in the various portions. Thus, an average house built in 194X might well have three separate and distinct temperature zones and give the effect of having three completely independent heating plants. The sleeping portion could be one zone, the service portion another, and the living quarters a third.

Completely automatic, the temperatures in each of these zones can be maintained at the various selected levels throughout the heating system. For example, the sleeping zone can probably be held around 70 degrees during the early morning hours and be permitted to drop to 65 or 60 degrees during the rest of the day when it is unoccupied and return to 70 just before retiring. Temperatures in the service portion can be held around 65 degrees, because the physical activity usually associated with the kitchen or laundry makes a higher level both uncomfortable and unhealthy. The dining and living rooms can be warm throughout waking hours, probably 70 degrees, and cool during the night.

Temperatures in all zones can be lowered at night when occupants of this postwar home are asleep.

In addition to comfort, zone control offers another distinct advantage. Heat is only directed to those sections of the home where it is required. Precious fuel is not wasted in overheating the service portion of the home or the bedrooms during the daytime. In these days of fuel scarcities, the advantages of zoning can be seen by any householder who has watched his diminishing fuel supply all winter long and pleaded with his ration board for a few extra coupons.

Modulation

To prevent "on" and "off" heating and to provide a continuous flow of the heating medium, either hot water or steam, to the

radiators and convectors is the purpose of a new control system. The system is known as modulating because it measures or meters or adjusts the heat input. There is an even flow of just the right amount of heat, constant and continuous, to replace the heat loss of the house. Here's how the modulating system works in the case of a hot water plant: When the thermostat calls for heat, it sends a message to a three-way mixing valve. The valve opens its gates to admit hot water, the cooler return-water from the radiators, or a combination of both -- mixing it to the exact needed temperature before it goes to the radiators.

Domestic Water Heating

The modern boiler not only heats the house but heats the water for the kitchen, laundry and bathroom -- and it heats it the year round. This double duty which the boiler has assumed saves the homeowner the cost of a separate domestic hot water heating system.

Domestic hot water is heated by coils which transfer heat from the water or steam in the heating boiler to the domestic hot water. Hence the term built-in or indirect heater.

Indirect heating is one of the most economical methods of providing domestic hot water. During the winter, when the boiler is in constant use, only a small fraction of the heat generated is used in heating the domestic hot water. When a storage tank is used on coal-fired boilers, hot water is accumulated during the banked firing period at night and during the day when steam pressure in the boiler is down. In the summer a similar economy is achieved. Once the boiler is brought up to the proper temperature for domestic hot water heating, it can be maintained at that point with very little fuel.

Radiators and Convectors

There are various types of radiators and convectors and combinations of the two. A radiator is a free-standing unit which gives off most of its heat by radiation. A convector is a unit which gives off most of its heat directly to the air instead of through heat rays. There are other units which heat partly by radiation and partly by convection. In addition, the postwar period is very likely to see major developments in so-called floor-line radiation.

The trend in radiator design in recent years has been toward the simple and inconspicuous. Modern radiators with slender graceful lines and thin tubes take up 40 per cent less space then the units made a few years ago. These radiators are so small as to be veritable midgets and their slender columnar design makes them very attractive. The gracefulness and classic beauty of the newest radiators blend with the finest furniture.

The slender, graceful lines of the small tube radiators and their minimum space requirements make them particularly adaptable to recessing under windows, with or without grilled fronts. The radiators are no deeper than the length of a forefinger. They can be recessed between the studs in a wall without extending beyond the baseboard. When recessed under windows the effect is to conserve floor space while

at the same time preventing drafts from windows, cold floors, and wide temperature differences between the floor and ceiling.

The principal advantage of the radiator is that it provides radiant heat which sends its warmth by direct rays into the lower portion of the room, thus building up temperatures in the occupied zone. Radiators give off heat by direct radiation -- heat waves that are like the infra-red rays of the sun. At the same time, a radiator also conducts heat to the surrounding air and this heat is then distributed by natural circulation or convection within the room.

Placing of radiators or convectors under windows is a well established practice and conforms with the need for maximum heat output where heat loss is greatest. It is a mistake to build windows so low that radiators or convectors cannot be installed under them.

Where cost is the chief factor in heating installations, free-standing radiators are most economical. Recessed radiators or convectors increase total cost of the heating installation approximately 8 per cent, a cost which is often justified by the saving in floor space that is obtained. In some cases, recessed installations are made in the living room and dining room only, with free-standing radiators used in all other locations. The cost of convectors and recessed radiators with metal frames is approximately the same.

Radiant Heating

Radiators and convectors are a means of distributing heat. There are likely to be many new and interesting developments in heat distributing media after the war. Some of these media may bear little resemblance to prewar radiators or convectors. Many companies, for instance, are now experimenting with different types of low-level or baseboard radiators, that is, heating units which run around the outside walls of a room at the baseboard level.

Another innovation is the use of the floors, walls, or ceilings as a large radiant panel. Heat is transmitted by means of pipe coils imbedded in the floors, walls, or ceilings. The coils may be made of steel pipe, copper tubing or wrought iron pipe. The heating medium may be steam or hot water. A conventional type of room thermostat actuates either a pump in the case of hot water or a motor operated valve in the case of steam. In some installations, circulation of low temperature hot water is provided.

What About Air Conditioning?

Possibly no term in common use is so generally misunderstood and misused as the words "air conditioning." The engineer defines air conditioning as "the scientific preparation and simultaneous control of the atmosphere within a structure." The Federal Trade Commission has ruled that "the words air conditioning signify the simultaneous control by a mechanical device of various factors affecting both the physical and chemical conditions of the atmosphere within a given structure as a room, building, and the like, said factors including temperature, humidity, and motion or circulation of the air within the structure. A device which does not control each and all of the designated factors is not properly represented, designated, or referred to as an air conditioner."

Although people often associate the term "air conditioning" with cooling, heating is easily 90 per cent of the operation. In the case of a warm air furnace, the heating and winter conditioning functions are centered in one unit. In the case of steam and hot water heating plants, air circulation and humidity controls are separated from the heating units so that they may operate when no heating is required, or vice versa. A high degree of flexibility and rigid control of all functions may be obtained with this "split" system.

The heating plant cannot be used for summer cooling without special equipment. The mere circulation of basement air through the upper rooms by means of the furnace fan does not give effective cooling. Research shows that a temperature change of only one degree can be effected by circulation of basement air. In a short time the basement air becomes warmed and further cooling is impossible.

For effective cooling, some cooling agent such as ice, well water, or mechanical refrigeration must be used. Wherever well water at a temperature of 58 degrees or less can be obtained, it is by far the most economical cooling agent. Instead of attempting to cool an entire house either with well water or mechanical refrigeration, many people after the war will be content with cooling only one or two rooms, say, several bedrooms or a bedroom and the living room.

Attention is called to the importance of good insulation as a means of providing summer comfort as well as reducing the cost of cooling and heating. Also in this connection mention should be made of the cooling effect of an attic fan which can be used at night to exhaust hot air and pull the cool night air into the house. The attic fan, because of its low operating cost, has been called "the poor man's air conditioner" although the term air conditioner, as applied to this device, is, as previously indicated, an over-statement. Nevertheless the attic fan does provide a very satisfactory job of house cooling.

Basement vs. Utility Room

One of the questions that comes up in connection with the selection of a heating plant is that of the relative advantages of a basement and a first-floor utility room or service room. There has been a trend toward the basementless house in recent years. It is likely that this trend will continue after the war.

Actually the decision as to whether to have a basement or not depends more on the choice of fuel than on the heating plant. Any kind of a modern heating plant -- forced hot water, forced warm air, and steam -- will operate from a utility room. Basement storage space, however, is essential if coal is to be burned. Even oil requires storage. While a storage tank for oil may be buried in the ground, many owners prefer to have their tanks in the basement.

Here are some of the pro's and con's on basement vs. utility room.

Advantages of a basement: Provides storage space for screens, storm windows, canned fruit; provides, recreation space and rooms for hobbies; room for laundry and extra bathroom or shower room. In addition, having the heating plant in the basement helps keep the floor of the first floor warm.

Advantages of utility room: No stairs to climb; all equip-

ment handy to the kitchen where the housewife can hear the doorbell and telephone and keep an eye on her children.

Home builders who plan to put a boiler in a utility room may be interested in having boiler dimensions. A boiler for an eight-room house may take up only a space 29 inches by 24 inches -- not much more space than the refrigerator.

Heating plants are so compact today that it is entirely practical to place the heating unit in the kitchen, if it is so desired. The boiler takes the place of a radiator. The volume of heat given off by the boiler can be increased or decreased by varying the amount of insulation on the unit.

So flexible is modern hot water heating that the system will work wherever the boiler may be placed, even if it should be desirable to place it in an attic. The fact that boilers can be purchased with a wet base makes it possible to place them on a wooden floor with perfect safety.

The Chimney

Many people make the mistake of thinking about their chimney as merely a piece of masonry. Actually the chimney is a very vital part of the heating plant. Heating engineers have found that a majority of complaints made by homeowners about their heating plants are due to faulty chimney design.

For efficient and safe heating, the chimney should be absolutely smoketight through its entire length, it should extend more than three feet above the roof, and preferably should be lined with fire-clay flue lining not less than 3/4 inches thick.

Every chimney has two main functions. The first and more important is to create a draft that will cause the fuel used to burn at the desired rate. The second is to carry out of the house the fumes and other unconsumed gases that result from combustion.

Satisfactory operation of any heating plant is dependent on proper draft. And proper draft is dependent wholly on the chimney flue. Therefore, a properly built flue becomes the very foundation upon which is built the efficient operation of any heating plant. The better the flue, the better the fire.

The most common error found in chimney construction is failure to coordinate area and height. A chimney may be high enough yet have too small an area to carry the proper volume of gases.

Or the area may be sufficient but the height too low to produce a draft that will draw the air through the fuel bed at the proper rate. Either fault will result in unsatisfactory operation.

The most efficient chimney is one built perfectly straight. Square flues are preferable to oblong from the efficiency standpoint.

It is dangerous to "underflue." In building a house, it is advisable to specify a chimney suitable for any type of fuel. In recent years there has been a tendency in some sections of the country to build flues suitable only for use with piped fuels. This is a serious disadvantage in case the owner desires to change to a solid fuel later on.

The combustion of coal, either by stoker or manual firing, requires a chimney and flue somewhat larger than the combustion of

piped fuels. Heating contractors invariably advise the construction of an all-fuel type of chimney, so that a change from one fuel to another may be made without rebuilding the chimney. The old adage that an ounce of prevention is worth a pound of cure is doubly true in chimney and flue engineering.

While a chimney may be on an outside wall or an inside wall, the latter is preferable from the standpoint of fuel economy. Research work in the I-B-R Research Home at the University of Illinois has shown that a chimney placed near the center of the house will radiate heat into the house, thus effecting substantial economies in fuel.

Heat Conservation

Up to this point we have considered the various factors involved in the economical production of heat. Equally important is the conservation of heat after it is produced.

Storm sash and weather-stripping are absolutely essential to economical heating and comfort. They pay for themselves in fuel saving. Insulated houses are easy to heat.

Precautions should be taken against heat wastage inside a house as, for instance, openings under bedroom doors that are too large so that heat is lost when windows are open at night. Fireplaces should have dampers that can be closed when they are not in operation.

Cracks around the outside of windows and doors should be calked.

The heating plant itself, too, should be well insulated so that the heat will go where it is wanted and not be dissipated in the basement. If it is desired to heat certain parts of the basement, it is best to have radiators installed in these rooms.

Importance of Proper Installation

In nearly everything that has been said up to this point the emphasis has been on the function of the manufacturer in developing new and improved heat equipment.

Equally important is the function of the designer of the heating system and the installer. No one manufacturer makes everything required for a complete industrial heating installation, either steam or hot water. This fact, highlights the importance of the man who has the responsibility for designing the system so that all component parts will produce the results desired and who assumes the responsibility for the entire installation.

Heating and piping contractors have been as active in the development of better methods of installation as the manufacturers have been in the development of equipment. The rapid progress in welding has been due to the efforts of the Heating, Piping and Air Conditioning Contractors National Association. This group is also sponsoring an active apprentice training program through which a constant influx of qualified men into the industry is provided.

The knowledge and skill of the installer is the priceless ingredient in any heating installation. Being impartial as between different types of systems, the heating and piping contractor is in a position to advise and guide the owner in the choice of equipment to

meet varying conditions.

The Investment Value of a Good Heating System

No doubt you are building your new house for yourself. You are not building it for re-sale. Fine. At the moment, the re-sale value of your house is not a primary factor. Can you be sure, however, that you may not wish to sell the house sometime in the future, no matter how remote?

All of this is by way of introduction to the fact that the relation between the heating plant and the eventual re-sale value of the house should be given careful consideration. The wartime fuel crisis is likely to have a permanent effect in making future purchasers of heating equipment more keenly aware of the importance of good heating and sound house construction. Buyers in the postwar period will be less price conscious and more quality conscious as a result of the fuel oil crisis. More people today realize that it is not wise to skimp on the heating plant when building a house. The wisdom of paying a little more to insure a fuel-conserving heating installation is today appreciated by thousands of people who previously had taken heating plants more or less for granted.