SOME RECOLLECTIONS OF THE COAL ERA

Coal and wood were the main sources of fuel during the development years of the 1920's through to the 1950's. Wood is still widely used as the main fuel in many parts of our country, as a supplement in others, and as a recreational fuel in many places. These recollections, however, are from the coal era and begin in the late thirties. Almost every home, apartment building and commercial building was heated with hand fired coal and wood.

Coal for hand firing comes in various sizes and preparations. For household use it is generally Drumheller lump or lignite lump and cobble. Drumheller is a shiny black coal mined in Alberta. Some lumps are quite large weighing 40 to 50 pounds, with the average lump being 10 to 12" in diameter and weighing about 20 pounds. Lignite is a low heat per ton coal mined in Saskatchewan, high in moisture content and quite high in light weight ash. It comes in lump, cobble, and stoker nut. Some lumps are as large as Drumheller but often smaller because lignite is easily broken when it starts to dry out. Cobble coal is the name for sizes of 6 to 8" diameter.

In instances where a dump truck could back up to a coal chute at a commercial building, coal was delivered loose by the ton in bulk and dumped through the chute or window into a basement coal bin. For household use it was seldom possible to get a truck to the coal chute, therefor coal was carried by the delivery men from the truck in the lane or driveway in bags and hand dumped through a chute or other opening. Really a back breaking job.

For apartments and commercial buildings coal came as a mixture of sizes often mixed with slack or fines called "steam coal", and required some special experience in firing. The sources of these "steam coals" were Canmore, Cadomin and Michel. Canmore was a semi anthracite coal, high in carbon, low in ash, but somewhat more difficult to fire by hand. It was mined at Canmore, Alberta and is still produced today, primarily for shipment to Japan. Cadomin was a bituminous coking type coal, the easiest to fire, and it and Michel came from towns in Alberta with these names. Canmore was the most expensive being semi-anthracite, for commercial use only costing approximately $18.00 per ton in the thirties and forties. Cadomin and Michel coking type coal sold for about $15.00 per ton.

Coal was shipped by rail, either in open gondola cars or box cars. Nearly all coal yards in Winnipeg had rail sidings where the cars were unloaded. One of the largest coal wholesalers was Winnipeg Supply & Fuel Company, who also operated as retailers to commercial and residential consumers. Winnipeg Supply Company Limited was founded in 1904 as a supplier of stone, building materials, wood and coal. They operated a quarry and lime kilns at Stonewall, Manitoba and, by 1912, when they changed the corporate name to Winnipeg Supply & Fuel Company Limited, they had coal and wood yards at three locations in Winnipeg.

By 1916 coal trading activities of the company included buying and transportation of anthracite and bituminous coal from the United States to the docks at Fort William and Port Arthur (now Thunder Bay, Ontario). War time restrictions in the United States reduced these supplies materially, and it was necessary to turn to Alberta to obtain sufficient coal to keep Manitoba warm. The first Alberta coal was obtained from the Star mine at Drumheller and was sold under the trade name Carbonite.

In 1937 when the stoker burning of coal was becoming more popular the company decided to sell coal burning equipment and opened their Heating Equipment Department, and obtained the franchise for Iron Fireman stokers. By 1939 the market for Saskatchewan Lignite coal was expanding and the company became involved in strip mining with the Roche Percee Coal Mining Company Limited in southern Saskatchewan.

The author (left) and an serviceman check out a furnace prior to installing a stoker

In 1943 the Emergency Coal Production Board, a government agency charged with the responsibility of seeing Canadians were supplied with coal during the war, assigned to Winnipeg Supply and Fuel Company Limited property at Castor, Alberta where they established a strip mining operation called the Castor Creek Collieries Limited.

There were many retail coal yards in Winnipeg, some of which were Harstone, Thomas Jackson, Hagborg, Northland and Simkins. Coal, such as lignite would sell for about $8.00 to $10.00 per ton, with Drumheller selling for $12.00 to $14.00 per ton.

There were two types of specially processed coal popular in the thirties and forties. One well known and much used product was coke and the other was briquettes. Coke was manufactured in several locations in the United States and at least two brand name coke products were marketed here in Winnipeg. However coke was also manufactured by the Winnipeg Electric Co. in the Point Douglas area in Winnipeg.

Coke is manufactured from coal which exhibits good coking characteristics, which means that when it is subjected to heat it forms into a crusty carbon product as the volatile or gas is driven off by the heat.

The Winnipeg Electric Co. had coke ovens in their plant. They purchased Cadomin and Michel coking type coal from Alberta. In a pre-heating process in their ovens the gas or volatile content of the coal was driven off the coal, was collected and sold as manufactured gas for heating and processes throughout the central Winnipeg area through an underground pipe system. Manufactured gas was stored in large steel tanks in various parts of the city, one of which was on Lipton Street South and another near the plant in Point Douglas.

The carbon content of the coal which remained in the oven after the process was coke. It was broken up into two or three inch diameter pieces for easy household firing. The trade name for this product was Winneco Coke and it sold for approximately $18.00 to $20.00 per ton at the time.

Briquettes were another interesting and popular product. They were made from pulverized or slack type coal which was incorporated with a binder and pressed into a two and one half or three inch form for easy storage and clean handling. They were very similar to the barbecue coals that we are familiar with today. One trade name from the United States was Heat Glow. The other was Canmore, which was made from Canmore coal from Canmore, Alberta. Both were a popular source of household heating and sold for $20.00 to $22.00 per ton.

Today we have become accustomed to using fuels which produce no appreciable solid waste residues, however this was not the case in the burning of coal. Handling of ash from commercial and institutional firing was a continuous and dirty labor intensive process. Ashes and clinkers from households were simply piled beside your garbage can in the back lane to be later removed by the city garbage men by shovelling them onto their truck.

For special applications, such as Dominion Malting Limited, Winnipeg, who are producers of malt barley used to make beer, anthracite coal was imported from Pennsylvania. It was used to fire the malting kilns because the products of combustion went directly through the malt and this shiny pea size anthracite was very clean burning.

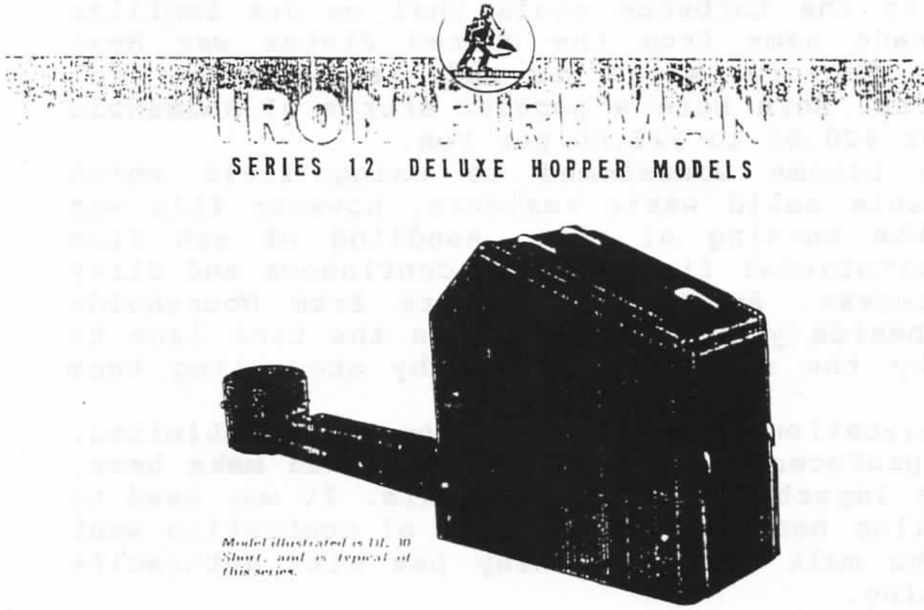
For household use in the late thirties anthracite coal in pea and small nut size was imported from Wales. Welsh coal was very low in ash content and had the highest value per pound of any known coal in the world. Special pin hole grates were designed and cast at a local foundry to be placed over the existing furnace grates. The ashpit of the furnace was sealed and a small thermostatically controlled blower was attached to the ashpit. The method of firing was to bank the Welsh anthracite coal on one side of the grate and because of it's high heat value the very low ash formed into a clinker on the grate and could be removed with tongs. The secret was to keep a banked supply of coal on the grate to prevent the need of a fire restart. This system provided the closest thing to automatic firing in those times.

There was a type of self feeder hot water or steam boiler called Spencer which had a magazine which could be filled with coal and it fed onto a sloping grate. These units used only Welsh or American anthracite coal.

In the late thirties and forties the automatic stoker started to appear in homes and larger buildings. Various types such as the Foster Wheeler kicker type, Babcock and Wilcox spreader types had been used in large packing plants such as Canada Packers and Swifts, also at Winnipeg Hydro power plant, large hospitals, etc. for many years previously. However the real stoker era began in the thirties and forties.

One of the pioneers and the largest manufacturers was Iron Fireman, although there were many others, Fairbanks Morse, Capital, Furnasman, etc. Iron Fireman stokers were invented and originally produced in Cleveland, Ohio, but they soon built a plant in Toronto and all but the very largest sizes came from the Canadian plant. Fairbanks Morse stokers were distributed by Fairbanks Morse Co. who also manufactured many other product lines such as weigh scales, engines, heavy hardware, etc. Furnasman stokers were well known in the forties and early fifties. The first units were copied from Iron Fireman being careful not to infringe on any patents.

Vulcan-Drawz were well known and very successful in the commercial market only. They were designed to burn 100% lignite coal and did so very capably. Lignite is a low heat per pound coal from southeastern Saskatchewan, with much moisture content and quite high in lightweight ash but cheaper than other coals in use at the time.



SERIES 12 DELUXE HOPPER MODELS

Model illustrated is DL 30 Short, and is typical of this series.

SERIES 12 Deluxe bituminous burners are designed for use in warm air, steam, or hot water systems, and industrial applications. They are made in three sizes, and each size is available in two lengths.

These units are distinguished by their modern styling and compact design.

A metering type worm conveys the coal from the hopper to the fire in an unpacked condition, so that the air can easily penetrate the entire fuel bed. The coal is burned on an air-cooled hearth, from which the fused residue is easily removed.

The large hopper is easily filled through a low opening. The operating mechanism is concealed and protected by adjustable and removable hopper base enclosures, which provide easy access to working parts.

Air required for combustion is supplied by a quiet fan, and is automatically regulated by the Volumeter to maintain a constant, predetermined air delivery.

Iron Fireman controls regulate the stoker to provide a constant room temperature or to meet steam, hot water, or other load requirements.

The firing principle was a motor and gearcase driven auger feeding coal from a hopper or bin to a specially designed burning retort set in the ashpit of the furnace or boiler. The electric motor was also connected directly to a fan or blower and drove the transmission or gearcase with a belt or series of step pulleys to vary the coal feed rate.

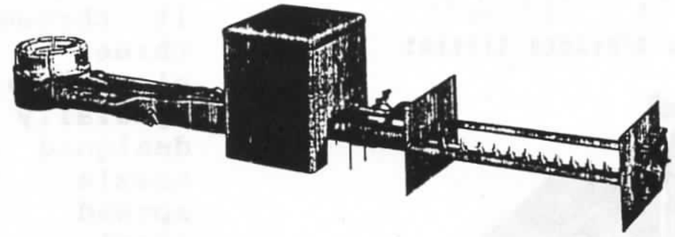
Special coal was prepared and sized for stoker use. One of the most popular was "Elkhorn" from Virginia. It was often mixed with our Canadian Western Lignite in varying percentages dependant on the size of the heating unit. Ash was removed in the form of clinkers.

Iron Fireman also manufactured a very successful anthracite burning ash removal stoker. The ash was augured out of the burning area to a container. This model was not as widely used as the conventional underfed stoker because of it's cost and due also to the much higher cost of anthracite coal.

Stokers were manufactured in many sizes and types for commercial use. The underfed principle was most popular. Drawz was a lignite burning stoker invented and produced in the Dakotas where lignite coal was also mined. When Drawz came to Manitoba it was manufactured, except for the transmissions, by Vulcan Iron Works in Winnipeg, thus came the stoker named Vulcan Drawz, most likely under license.

IRON FIREMAN

SERIES 11 COAL FLOW MODELS



SERIES 11 Coal Flow bituminous burners are designed for use in warm air, steam or hot water heating systems, and for industrial applications.

This unit automatically conveys the coal directly from the bin to the fire. The driving unit is located between the coal bin and the furnace or boiler. This model is available in stoker lengths ranging from five to twenty feet. The "stoker length" is the distance between the center of the retort and the coal bin.

The operating mechanism is concealed and protected by an enclosure which provides easy access to working parts.

A metering worm delivers the coal to the fire in an unpacked condition, so that the air can easily penetrate the entire fuel bed. The coal is burned on an air cooled hearth, from which the fused residue is easily removed.

Air required for combustion is supplied by a quiet fan.

Iron Fireman controls regulate the stoker to provide a constant room temperature, or to meet steam, hot water, or other load requirements.

Vulcan Drawz designed a unit with a conical type system of round burning rings which was very successful in the burning of the low heat high moisture high ash lignite coal from Saskatchewan. Many of these commercial type stokers were capable of firing up to 2,000 lbs of coal per hour.

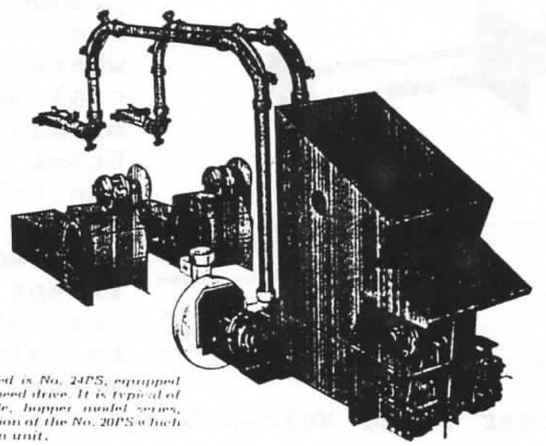
In early World War II the Allies realized that a vital component of the armed forces was development of a strong Air Force, however the greatest problem was a lack of trained fighter and bomber pilots and crew. Accordingly the Commonwealth Air Training Command was formed and air bases were hastily constructed across the prairies and airmen from all over the world were given training in the necessary skills. Vulcan Drawz fired nearly all of the large boilers in these Air Force stations during the war years, all using 100% Canadian Lignite coal. Lignite was used in large quantities in nearly all of the large plants, Universities, Canadian Forces central heating plants, packing plants, etc. Almost always fired with large rotary kicker stokers and in some cases pulverizers and specially equipped boilers which burned the pulverized coal in suspension. One such plant was the Hudson's Bay Company main store building on Portage Avenue, Winnipeg.

Iron Fireman stokers were successful in firing almost all of Manitoba schools and colleges using underfed stokers either feeding from large coal hoppers or directly from the coal bin.

Many hundreds of apartment and commercial buildings were fired in this way using Iron Fireman, Vulcan Drawz, and in a few cases Fairbanks Morse. As there was a limit to the amount of coal that could be fed to a boiler by the underfed method, especially in being able to distribute it evenly over a large enough burning area when boilers of 500 HP and higher were involved, Iron Fireman designed a pneumatic spreader stoker which augured the coal from a hopper or bin to a high speed high pressure fan which would pick up the nut size coal and feed it through a three inch pipe to a specially designed nozzle that spread it evenly over specially designed grates. In very large boilers the grates were designed to be dumping type or the ash was removed partially in the form of clinkers or raked by the fireman into a pit at the front of the burning area.

IRON FIREMAN

SERIES 52 PNEUMATIC SPREADER STOKERS



Model illustrated is No. 24PS, equipped with variable speed drive. It is typical of this dual nozzle, hopper model series, with the exception of the No. 20PS which has a duplex fan unit.

SERIES 52 Pneumatic Spreader Stokers are used in all types of industrial power boilers, large heating boilers, and special industrial applications. They are made in three sizes, nominally rated at 2000, 2400 and 3200 pounds of coal per hour. Multiple installations are made in boilers requiring greater coal feeds.

These stokers have wide limits as to the type, quality, and size of coal burned. They burn many coals that cannot be satisfactorily used with other type stokers.

The coal is metered from the hopper by two worms and is conveyed to the transfer sections, where it is picked up and carried to the boiler on two streams of high velocity air.

The fine particles of coal are burned in suspension, and the heavier particles are evenly distributed by the adjustable nozzles to form a shallow fuel bed on the grates.

Stationary, high resistance grates or the optional dump grates give even distribution of the underfire air required for combustion. The conveying air not only delivers the coal to the furnace, but also provides overfire air and creates the cross-current turbulence necessary for efficient combustion.

The undergrate air for combustion is supplied by separate, low pressure fan units and is automatically regulated by Volumeters to maintain a constant air fuel ratio, independent of varying fuel bed resistance.

Various types of standard control systems can be used with these stokers to automatically meet the load requirements on the boiler.

The first installation of an Iron Fireman pneumatic speader stoker was at Gypsum, Lime and Alabastine Limited, now Domtar Limited at Sargent and St. James Street. Many others followed at Tech Voc School, Sheas Brewery, Kiewels Brewery, Winnipeg Transit Fort Street Plant, etc. The largest pneumatic spreaders installed in this area were at Stony Mountain Institution boiler plant. These six units were installed in the basement auguring coal from a rail car delivery coal supply to the pneumatic fans which lifted the coal up to the firing floor using three inch coal pipes each 200 feet long with two stoker and two nozzles per boiler, each stoker firing lignite at 4,000 pounds per hour or 8,000 pounds per hour per boiler.

All coal had to be analyzed regularly as it was a requirement that it's BTUs per pound, volatility, moisture content, etc. be published. Therefore, if a coal had a BTU content of 12,000 per pound, and could be burned with an efficiency of 60 per cent, one pound would produce 7,200 BTUs. Since a BTU is the amount of heat required to raise one pound of water one degree Fahrenheit, the heat value of coal can be translated to boiler horsepower.

Some very special and very unusual applications were made over the years. Some bin fed underfeed installations required exceptionally long auger assemblies. Some of the longer feed units reached distances of 35 to 40 feet.

One Iron Fireman was specially designed to auger sawdust and shavings in a woodworking plant. This application was designed by the local Iron Fireman dealer and included a separate gearcase which drove a reel in the sawdust bin to prevent the material from arching over the pickup auger.

Coal is now used only in specially designed applications in large power generating plants and very large industrial installations in North America, natural gas and fuel oil having taken over almost all other heating and process requirements. The writer does not know of a single stoker installation still in existence. However the use of coal through the years is a fascinating study and it's proud history should not be lost.

William J. Atkinson — February, 1993
Winnipeg, Manitoba

ABOUT THE AUTHOR

William J. Atkinson was born in Saskatchewan, coming to Winnipeg in 1937. He shortly after gained employment with Winnipeg Supply and Fuel Company Limited where he sold coal and Iron Firemen stokers, becoming the Service Manager in 1940.

Bill joined the Canadian Army in 1940, went overseas in 1942. He served in Italy in 1943 and when the war ended was in Holland. He returned to Winnipeg to the employ of his former company. When the ownership of Winnipeg Supply and Fuel Company Limited changed in 1972 Bill left to found a new mechanical and electrical contracting business called Abco Supply and Service Limited with four of his executive associates and sixteen of his best electricians, plumbers, steam fitters and gas fitters. Bill retired as President in 1985.

Bill joined ASHVE in 1946 and was President of the Manitoba Chapter in 1952.

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The following pages are a copy of a booklet printed in 1942 by Coal-Heat Magazine entitled "Stoker Heating Guide". It is reproduced here to help illustrate what it was like to live with coal heating.

Stoker Heating Guide

by K. C. Richmond

Editor, Coal-Heat

(Wartime Edition)

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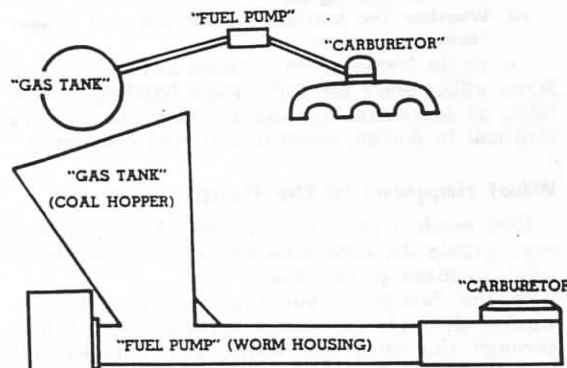
To Improve Results

THIS WARTIME booklet for the household stoker user tells how to improve heating results, protect health, reduce heat losses, save fuel and cut costs. Its careful study will be worth a great deal to you and to the members of your family.

Written in answer to many requests, it summarizes in non-technical terms the various factors that affect heating results, the operation and maintenance of a heating system.

In your stoker, you have a great device; it is to your heating system what the self-starter and the carburetor are to your automobile. Yet de-



spite the functions or advantages of a stoker or a carburetor, neither alone assures you heat or transportation. In thinking, then, about heating, several things must be kept in mind.

Factors That Affect Comfort

How satisfactorily our homes are heated depends on:

1. **The way they are built; their age, size, condition, location and exposure; the presence or absence of insulation, weatherstripping, and storm windows.**

2. The type, design, age, character, condition, and maintenance of the heating system as a whole.
3. The way the heating system is operated.
4. The adjustment and operation of the stoker.
5. The choice of fuel used.
6. The weather, wind velocity, relative humidity.
7. The amount of clothing worn by the occupants.
8. The health, physical condition, activity, metabolism, and age of the occupants; "the capacity of the heat regulating system as a whole to make prompt adaptive changes in the distribution of blood to the skin and thus preserve heat balance under changing environmental conditions," as Dr. Yaglou has pointed out.
9. Our contacts with the stoker dealer, fuel merchant or heating man.
10. Whether the heating system has had proper "summer service."

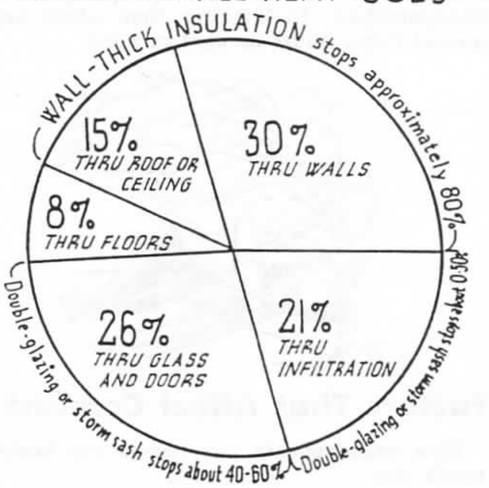
No single factor alone governs heating results. Many affect one's comfort. Each building constitutes an individual heating problem; no two are identical in design, construction, and occupancy.

What Happens to the Heat?

How much it costs to heat one's home and how comfortable the occupants are, depend largely on what happens to the heat.

In the "average" building, too much heat is wasted through (1) direct transmission of heat through the roof, side walls, and windows, (2) air leakage, infiltration, open windows, and ex-

WHERE FURNACE HEAT GOES



The entire area of the circle represents the total heat supplied to a home. The slices show how this heat is lost from the "average" house, and the brackets illustrate how most of this waste can be prevented.

cessive ventilation, (3) faulty distribution, (4) overheating, and (5) improper operation of the heating equipment.

The size and pitch of radiators with a steam or hot water heating system, the type and condition of the vents, valves, traps, piping, affect the distribution and circulation of heat just as the number and size of air ducts and cold air returns do with a warm air system.

The increasing age of the heating system, failure to take care of it properly, excessive draft, careless operation, lack of insulation and storm windows waste fuel—increase cost and deprive the occupants of the comfort that comes only through living in a properly heated building.

What the Situation Is

Many a home owner might well find out:

1. **Where the heat he buys is going.**
2. **How much overheating is being done—how much heat is going to rooms that do not need it, while others are underheated?**
3. **What unnecessary ventilation costs?**
4. **How much heat is going up the chimney through lack of control?**
5. **Whether the heating system is being properly operated?**
6. **How he can take advantage of such fuel, heating and building services as are available?**

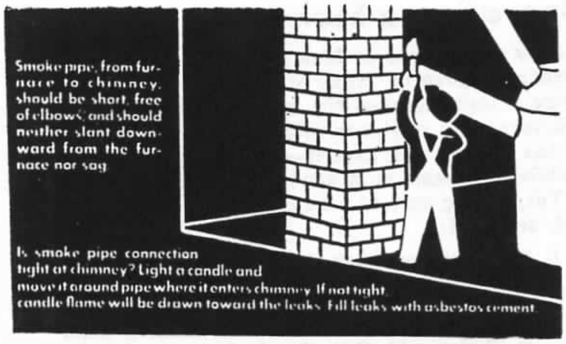
Inspection of the Heating System

Just as we have someone look over our car now and then, so, too, it is a good idea to have an experienced man examine the heating system in our home at least once a year. A heating system, like an automobile, may be in excellent condition, but some "little thing" can keep it from performing the way it should.

The attendants at the filling station check the oil, the air in the tires, the water in the batteries, the strength of the anti-freeze solution, and answer our questions when the car isn't running just right. The heating system needs some of the same attention.

To have some of the occasional, yet necessary adjustments or repairs made on our car, we take them to the dealer's service department or to some convenient garage. If our heating system and stokers got a tenth of the same "professional" service, we would enjoy much greater heating satisfaction.

Our heating system must work an average of 225 days a year, 24 hours a day to keep the building warm—365 days if we use it also to maintain an ample supply of hot water. When you com-



pare this to the few hours a week you use your car, you realize how unjustified neglect of the heating system is.

Some Questions for the Furnace User:

(Turn to the next section if you have a steam or hot water boiler.)

1. **What kind of shape is your furnace in—today? Is it clean and in good order?**
2. **Is the system balanced?**
3. **Are some rooms colder than others?**
4. **Is each room getting the amount of heat in it that you would like to have?**
5. **How are the cold air returns, the warm air ducts, the registers?**
6. **How are the dampers?**
7. **Does the furnace need recementing? Cast iron furnaces must be re-cemented or they will leak.**
8. **How is the smokepipe? The chimney?**
9. **How are the filters?**
10. **Is the humidifier working?**

Some Questions for the Boiler User:

1. **What kind of shape is the boiler in? Is it clean?**
2. **Is the system "balanced," the circulation of heat what it should be?**
3. **How about the pitch of the main and return lines in the basement?**
4. **Are radiators pitched properly?**
5. **Are air vents in return lines properly located?**
6. **How are the radiator vents?**
7. **Does the boiler need sealing between sections, between base and bottom sections, around the door frames, or other points where air infiltration and gas leakage may occur?**
8. **Are the doors warped so that they do not fit tightly?**
9. **How is the smoke pipe? The chimney?**
10. **Is the water in the boiler clean?**

11. **Are the boiler and the piping properly insulated?**
12. **Has the boiler had proper summer care?**

Some of these questions you can answer at once. Others can be answered promptly by the competent heating contractor, coal man or stoker dealer if you ask him to look over your heating system. His suggestions or comment will be as valuable to you as anything your radio service man or automobile mechanic would say about things in his field. Get expert advice; it pays.

To get your plant in "apple pie" order, if it isn't now, will prove one of the best investments you have ever made. What could add more to your comfort and health, and at the same time save money?

Need Cleaning

Furnaces, boilers, and stokers, like the spark plugs in our automobiles, need cleaning now and then.

While coal can be used more efficiently than the gasoline in your automobile, there is a small percentage of non-combustible material to be removed periodically.

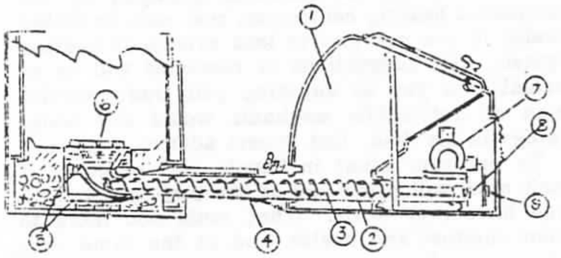
Most furnaces or boilers have an accessible clean-out—for use, not just a decoration. During the winter, it is a good idea once a month or so to give it a good going over. Cleaning the plant gives it a chance to work better—gives you more heat with less fuel. Insulation belongs in the attic or side walls of the house; not on the inside of the furnace.

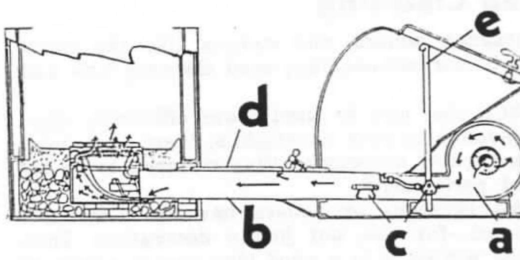
If you are too busy or not inclined to bother with cleaning the plant, phone your dealer to take care of it for you. It pays. Most plants (and chimneys) should be cleaned and inspected professionally at least once a year. If you do not do this, you have no alibi about how the coal works, or your cost of heating. Plants must be kept clean to insure satisfactory results.

It may be advisable periodically to clean the water passages of a boiler due to formation of scale or sludge. In sections of the country where unusually hard water is used, this is necessary.

Where hard scale has formed, it will be necessary to use some good boiler cleaning compound.

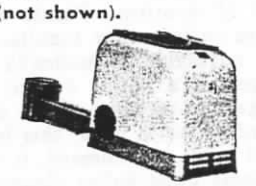
A reputable heating contractor in the vicinity should be consulted regarding the best compound for the locality in question. Soda ash is a common cleaning agent, but in some cases, this compound might produce unsatisfactory results.





Your Stoker Has—

1. A hopper to hold the coal.
2. A hopper base to guide the coal to the feed worm.
3. A feed worm to move the coal from the hopper to the fire pot.
4. A tube or feed worm housing.
5. A retort to direct the flow of coal and air to the fuel bed.
6. Tuyeres (pronounced "tweers") with suitable openings to direct the flow of air into the fuel bed.
7. A motor, located at the rear of the machine to provide power to drive the machine.
8. A gear case containing a set of speed reducing gears to transmit the power from the motor to the worm.
9. Gear case safety devices.
A. Forced draft fan.
B. Air duct.
C. Dampers.
D. Anti-smoke back tube.
E. Hopper vent.
F. Controls (not shown).



Operating a Stoker

How we operate or look after the stoker in our basement governs what we get out of it, to a large extent, because the one thing that no manufacturer can engineer into a product is the skill of the person who uses it—whether it is an automobile, a stoker, or a sewing machine.

Yet, taking care of a household stoker is easy if you see that:

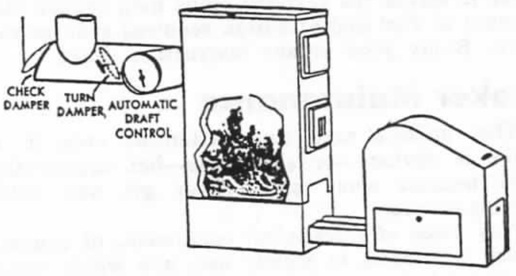
1. The manufacturer's instructions on the use of your stoker are followed.
2. There is coal in the hopper.
3. The air and coal flow into the heating plant is "balanced"—that the draft is regulated.
4. Too much "experimenting" or "playing with" the controls or thermostat isn't done.
5. The clinkers are removed periodically (the frequency depending on the weather, the kind and amount of coal used).
6. The proper kind and size of stoker coal is used.
7. The heat losses from the building are not excessive.
8. The stoker is cleaned, inspected, and serviced every summer as it should be—and that the heating plant is kept clean—brushed out every month.

Obviously, the stoker's primary function is to feed coal and air into the furnace automatically—when called on to do so by the thermostat or hold-fire control. This, like combustion, is very simple in some ways, but as complicated in others as the digestive processes through which the food we eat goes.

Controlling the Air

To control the flow of coal and air is the essence of proper firing. With each pound of coal burned, you use from 12 to 20 lbs.—180 to 300 cubic feet of air. Since a pound of air at room temperature occupies 670 times as much space as a pound of coal, the importance of controlling the amount of air that goes through the furnace in a given time becomes self-evident. Hence, to "balance" the amount of coal and air put in the furnace, or to maintain the proper depth of fuel bed, is most important because such factors as space, time, temperature and the proper mixture of air and fuel govern the chemistry of combustion or what you get out of the heat you buy. Too much air means waste.

If the flames are very bright or white in color and sparks are being thrown, too much air is being used—or the fuel bed is too thin. So reduce the air—and get a thicker fuel bed. Flames should be bright orange. If the fire is dull or yellow with smoky streamers running through it, you need more air. You cannot change the air setting or feeding rate, however, and see the results in less than two to three hours, possibly longer, depending on the thickness of the fuel bed, the weather or running time of the stoker.



Where automatic draft control is installed, keep check damper closed. Otherwise adjust draft by manipulating check damper. (The view of the fire box shows one aspect of correct cold weather fuel bed. The appearance constantly changes; no one picture is representative.)

Stack Draft

If you have too much draft, you burn more coal than you need, during the "off" periods, increase fly-ash, and waste heat. Your stoker operates only about one-sixth of the time, so the control of the stack draft is most important.

When your stoker is running and the fuel bed is the proper depth, the pull of the chimney draft should be not quite strong enough to hold a piece of newspaper (the size of your hand) against the opened slots in the fire door. The paper will stick tightly if there is more draft than you need. So open the check damper until the pull of the draft is just insufficient to hold the paper against the door—which indicates that you have all the natural draft you need. Except for such a test, keep the slots in the fire door closed—if you are using a low volatile coal, partly open if you are burning other coal.

After making any adjustment be sure to check the results within 8 to 12 hours to insure proper regulation.

Ordinary hand or check dampers don't meet the need — automatic controls are essential in nine out of ten buildings. (Note section on barometric controls.)

Stoker Fuel Beds

Do not worry about the looks of the stoker fuel bed—some of the pictures you may have seen were probably drawn by a fellow who never saw one.

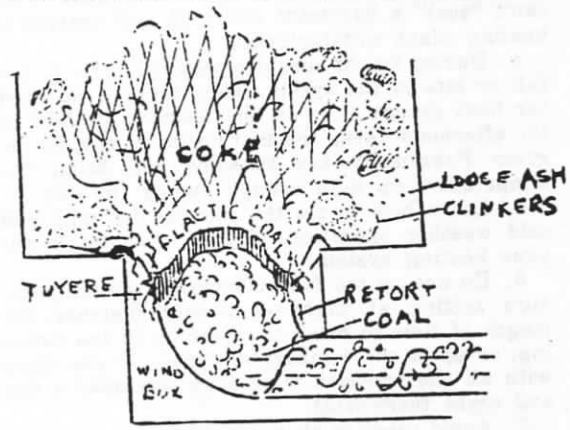
What you want—most of the time—is a balanced fuel bed—one that is about as deep as the retort is wide—say, 8 to 10 inches. It does not have to be a perfect mound. Thermostatic control gives you a thin fuel bed in mild weather—a thick fuel bed in cold weather.

If the fuel bed is too thin too much air goes through it and vice versa—so try and arrive at a happy medium, depending on the inside diameter of the heating plant, the presence or absence of refractories, the diameter of the retort, the heating requirements, the feeding rate, and the air setting. Keep a fairly deep porous fuel bed —one that helps keep your house warm with least possible effort.

Suppose you do have some big pieces of coke —that shows that you are getting the heat value out of the coal. The fact that the fuel bed is a little irregular does not make any difference. Stoker fuel beds are self-correcting, if you leave the clinker tongs hanging on the wall and let nature take its course.

As to some "coke trees" now and then, forget them, unless they come out the fire door. (If so, get the chimney draft and coal feed adjusted.)

If the weather was always the same, you could have "perfect fuel beds" all the time. Most of the changes in fuel bed conditions are due to sudden changes in the temperature outside, dif-



This shows the condition of the fuel bed when fuel feed and air supply are correct. The thickness is correct; air distribution—uniform; temperature—high; clinker formation—good; plastic zone level—at tuyere top.

ference in the amount of heat called for inside, or because you haven't several hundred dollars worth of fancy controls—such as they use in a large utility plant.

Cleaning the Fire

When it comes to the clinkers, do not be in too big a hurry to get them out unless you have a a very small heating plant. Why disturb the fuel bed before the clinkers are ripe?

Take care of the stoker regularly but do not try to keep the fuel bed too clean—give the ash a chance to fuse or form into fair sized clinkers which are much easier to remove. Don't disturb the fuel bed any more than necessary.

Do not mix unburned small particles of coal and coke with ash. Don't rake ashes over the fire. Don't puddle the fire when looking for or removing clinkers.

Don't take clinkers out when the stoker is running. If you pull the switch, flip it back before you leave the basement.

Put clinkers in an appropriate container—not on the floor.

Some Operating Suggestions

1. Don't "play with" the stoker too much; "monkey" with the controls, the air setting, or flip the thermostat too high or too low.

2. If, through experimenting, the controls get out of balance, have your dealer adjust them so that they function correctly.

3. See that your heating system is not starved for air. Fresh air—oxygen—is just as necessary to a heating plant as it is to an individual. You can't "seal" a basement air-tight and operate a heating plant satisfactorily.

4. During bright sunshiny weather early in the fall or late in the spring, when there is no need for heat except early in the morning or late in the afternoon—keep the thermostat at say, 65 degrees Fahrenheit—the sunshine will bring the temperature up high enough during the day.

5. Learn how to set the controls for mild and cold weather operation, if this is desirable for your heating system.

6. Do not go too far in lowering the temperature setting at night—you only increase the length of time to bring the heat up in the morning, or upset the combustion cycle. If you sleep with all the windows wide open you need a day and night thermostat.

7. Avoid needless changing of feeding rates or air controls unless you are sure just why either or both should be increased or decreased.

8. Don't make a blacksmith forge out of your stoker—you only waste heat by forcing too much

extra air through the fire chamber. Study the sections on controlling the air and stack draft and learn how to adjust the air.

9. Above all—learn what happens to the heat after it leaves the furnace—thus help reduce the amount of fuel and attention required even more.

10. Study your stoker instruction chart.

Stoker Maintenance

That stokers need some attention once in a while is obvious—or should be—but apparently isn't because some units never get any until trouble occurs.

Any piece of mechanical equipment, of course, which is subject to steady use, and which must be depended upon for continuous, efficient and uninterrupted operation, should be given at least one thorough mechanical servicing, inspection and lubrication each year, as William Rees has explained.

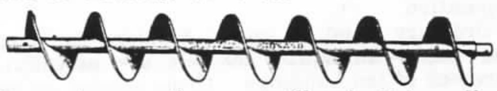
So, "summer service" is particularly important. If anything should ever happen to your stoker and you did not have "summer service" on it—you have no alibi. Be protected.

When an electric motor revolves 1,725 times a minute, it needs oil periodically. The transmission or gear case, likewise, needs a change of oil. too, every year—which isn't nearly as often as your automobile, but no less important.

The wind box needs cleaning because some small particles of ash or coal may fall through the air openings in the retort, pile up and sooner or later restrict or prevent the passage of air into the fuel bed.

To see that the air openings in the tuyeres (the holes at the top of the stoker retort) are open, is advisable also.

V-belts should be checked periodically. The proper tension is important. If it squeaks get a 10c stick of belt dressing at a hardware store. A small piece the size of a pea will stop the squeak immediately. Don't put it on when the motor is running, however.



In most cases, the user will gain if he calls on the dealer from whom he bought the stoker to have it cleaned, inspected, and serviced at the end of each heating season. This, usually, is the best means of assuring proper maintenance, long life, and the maximum in satisfaction.

Summer Service

Since stoker manufacturers and their dealers are interested in having you secure the maximum satisfaction from your stoker, they offer "Summer Service Plans" every spring and summer. One such plan provides the following:

1. **Painting inside of hopper to retard the rusting action.**
2. **Cleaning air openings in tuyeres, checking dead plates and retort.**
3. **Inspecting and cleaning feed worm. (If stoker is not to be used during the summer, feed worm will be greased to prevent rusting.)**
4. **Cleaning auxiliary air line.**
5. **Cleaning and inspecting fan blades.**
6. **Flushing out gear case and filling with proper lubricant.**
7. **Testing fan and worm gear bearings.**
8. **Oiling motor, cleaning commutator, checking motor bearings, and inspecting brushes.**
9. **Testing and examining electrical apparatus and cleaning all electrical contacts.**
10. **Adjusting and inspecting belts and pulleys.**
11. **On domestic jobs, where possible, a vacuum cleaner will be used to clean the boiler or furnace.**

Too much emphasis can't be placed on the importance or necessity of such service. See that your stoker gets it!

How to Avoid Service Calls

A large percentage of service calls prove to be a matter of minor adjustments of the stoker itself or its controls. Should you encounter trouble, study of the following points may save you the inconvenience of being without heat as well as save you the expense of a service call:

THE TROUBLE THE REMEDY

Stoker will not run:
(1) Be sure main switch is in the "On" position.
(2) Be sure fuse is not blown or loose.
(3) Be sure thermostat is set higher than room temperature.
(4) Be sure boiler or furnace control is set higher than boiler temperature.
(5) Be sure low water cutoff, if installed, is not holding stoker "Off" due to low water level in boiler.
(6) If time clock is on job, be sure it is set for correct time.

No heat, fire out or low:
(1) Check to see if pin is sheared (see instruction chart for replacement instructions).
(2) Be sure feed worm turns and is not out of coupling.
(3) Be sure hopper is filled with coal.
(4) Be sure clinkers have been removed from firebox. (This is the most common cause of sheared pins.)
(5) Be sure refueler is set two to three minutes out of every hour.

If stoker smokes back through hopper or fire door:
(1) Be sure stack damper is not closed too much.
(2) Be sure hopper is filled with coal before removing clinkers.
(3) Do not fill hopper while stoker is running (always shut off stoker while filling hopper or cleaning fire).
(4) Be sure coal is not wet and sticking to sides of hopper.
(5) Be sure fuel bed is not too low and stoker fan open too much.
(6) Be sure you do not have an excessive amount of clinkers in firebox.
(7) On bin feed stokers, be sure feed worm is covered with coal.
(8) Always keep hopper lid sealed tight.

Stoker stops before the room temperature is reached:
(1) Set limit control on the boiler or furnace for a higher temperature or pressure. In severe weather it is usually necessary to set your limit control to a higher setting.

Stoker runs continuously:
(1) Increase coal feed to higher setting and increase air adjustment to accommodate higher coal feed.

Choice of Stoker Coal

In buying stoker coal it is easier to get what you need when you turn to the well known dealers. It is their business to serve you. They know the best sources of supply, the differences in quality, performance. Their future depends on how they take care of you and other customers. So put the problem's in the dealer's lap.

There is a big difference in fuel, even more in heating equipment and how it is used, but your coal man can help you get that stoker coal that should work best in your particular heating system. Do not get involved in technicalities. Coal values cannot always be predicted by the relative B t.u. content alone. A fuel analysis may not mean nearly as much as the name or number on your heating plant. Get a well known brand of stoker coal—one that is popular locally. This is the best bet.

Naturally, you get just about what you pay for in fuel as with so many things you buy. To buy on price alone is seldom wise. By paying a little more for a superior product, you usually save money in the long run. It is not the first cost that counts—it is the cost of heating per season. Buy on results value.

Having found the right stoker coal for your plant, stick to it. Don't experiment all the time. Benefit by your dealer's experience.

How to Cut Heat Losses

Insulation

Few things can contribute more to one's comfort than insulation—either winter or summer.

From the tests made in the famed Research Residence at the University of Illinois, it has been found that:

"1. The installation of insulation resulted in an average saving of approximately 30 per cent in the actual fuel consumption.

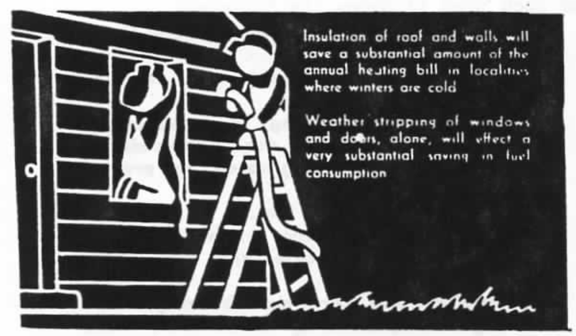
"2. The installation of storm sash on the insulated house resulted in an additional average saving of approximately 15 per cent in the actual fuel consumption.

"3. The electrical inputs to the stoker and fan motors per day were each decreased from 25 to 30 per cent after the house was insulated, as compared with the results obtained in the uninsulated house.

"4. The estimated reductions in heat losses indicated that a greater benefit was obtained from the insulation of the second and third stories than from that of the first. . . ."

Where the side walls are insulated you get a marked improvement in comfort resulting from the large increase in the inside surface temperature of the exposed walls.

Beyond question—the use of insulation will (1) increase comfort, (2) reduce fuel bills, (3) give one a cooler house during the summer, (4) reduce noise—give one a quieter house, (5) reduce decorating expense by preventing lath



marks and streaked walls. (6) enable better humidity control, (7) provide more livable space in the attic or other waste areas, (8) reduce drafts caused by uneven house temperatures, (9) guard against sudden weather changes outside and give more uniform inside temperatures, (10) reduce strain on heating system during "cold spells," (11) make possible higher resale or rental values, (12) make it easier, more economical to install summer air conditioning.

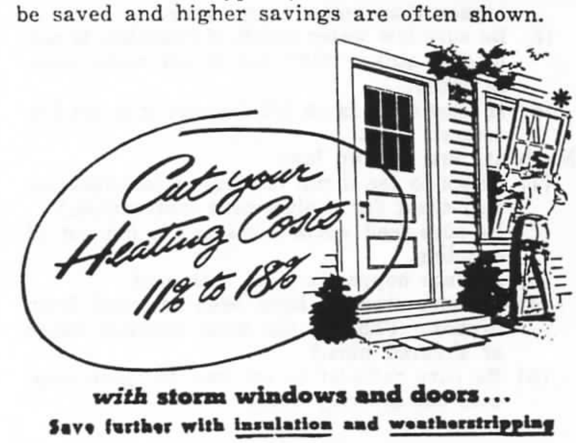
To take advantage of the possibilities insulating the attic of one's home, possibly the side walls (depending on the construction) is one of the first and most important steps toward comfort, and more satisfactory heating.

Floors over unexcavated sections of a house should be insulated; comfort is out of the question otherwise.

Window Conditioning

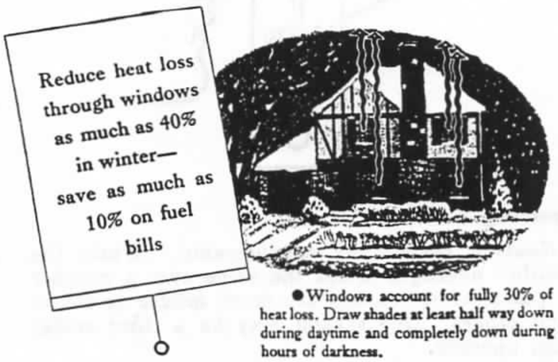
"Window conditioning"—the use of double glass insulation—is another major step to winter comfort.

Through the use of tight-fitting, properly constructed storm windows and doors, 20 per cent of the fuel used in typical, uninsulated houses can be saved and higher savings are often shown.



More than this, they check cold drafts, prevent fogging, banish dripping window sills, keep windows dry and clear in zero weather, enable one to sit next to them in comfort; even Grandma can sit by her favorite window and knit or read without a shawl around her shoulders or a footstool to keep her feet off a drafty floor. "Double windows—double comfort—double thrift."

Double glass makes possible a wall of captive air—invisible insulation—which keeps the inner windows warmer, prevents drafts due to chilled air from cold glass dropping to the floor to cool one's ankles.



● Windows account for fully 30% of heat loss. Draw shades at least half way down during daytime and completely down during hours of darkness.

Fully drawn cloth window shades will cut heat loss through the windows about 40 per cent—double shades about 54 per cent during the hours of darkness. During the summer they will reduce heat intake even more.

Weatherstripping

From the way the wind whistles in around the doors and windows of so many homes, it isn't surprising that fuel savings in uninsulated buildings of 15 per cent or more are usually secured through the use of weatherstripping.

Comparatively few windows and even fewer doors fit tight, hence, objectionable drafts across the floor are common. That weatherstripping is desirable, therefore, is obvious.

Caulking

In many older homes, caulking the cracks around the doors and window frames is often advisable. Wood shrinks and leaves openings that should be filled. Plastic caulking materials are available for this.

Keeping the walls of the house weather-tight is important. With brick, mortar joints sometimes loosen. Rejointing is advisable. With stucco, cracks occur. Brushing with cement will fill small cracks. With frame houses, defective or loose boards should be replaced or nailed in place.

Finishing the Attic

In many homes, particularly bungalows, the attics haven't as yet been floored, nor the side walls sealed against the flow of air between the studding, hence considerable heat is lost. To get some insulation in the attic is, of course, a good investment.

Flooring and finishing such space as is available in the attic reduces heat loss, makes the house cooler in the summer, and often provides another needed bedroom.

Door Closers

Where there are young children around the home, doors are often left open as the youngsters dart in and out—which creates uncomfortable, sudden drafts, and also wastes heat. Automatic door closers, therefore, are frequently desirable—and a good investment.

Insulation or Non-Insulation of Leader Pipes

The smoother, the brighter the finish of bare warm air ducts—the more efficient they are—unless they are wrapped with eight layers of 10 lb. asbestos paper. The least efficient of all is a very rusty black-iron pipe. Such are the findings of extensive authoritative investigations at the University of Illinois. Once, of course, it was thought advantageous to "insulate" warm air pipes, but it is no longer being done, in general.

Owing to the dampness of many basements in some sections of the country, the humidity, lack of air circulation, the tendency to corrosion during the summer, the asbestos paper covering of warm air pipes in older homes is often in bad condition. Under such circumstances, recovering the pipes is desirable—preferable to an uncovered rusty pipe with pinholes or loose connections. Covering improves the appearance, provides protection against corrosion, excessive air leakage and heat loss, costs very little and can be done easily.

Insulating the Furnace

"Marked increase in furnace efficiency may be obtained by insulating the furnace front, the bonnet, and the ashpit bottom," as James B. Hoffman reports in "Gravity Warm Air Heating," a digest of research, Engineering Experiment Station, University of Illinois. For the same combustion rate, substantial increases in capacity and efficiency resulted from the insulation, and higher register air temperature obtained."

Cover Hot Water Tank

Insulating the hot water tank (if it isn't already) and the pipes is a good idea; it saves heat, provides more hot water at less cost, helps prevent overheating the basement.

See that hot water faucets don't leak—thus save both fuel and water.

Boiler and Piping Insulation

Most boilers are well insulated, but all too many feet of piping are not adequately covered, hence overheat the basement. Tests show that proper pipe covering may cut heat loss 20 per cent or more.

Far more hot water tanks could be insulated to advantage, also, to retain the heat, to lower costs, and prevent over-heating the basement.

Painting the Radiators

Use of an aluminum or bronze paint on radiators cuts heat emission approximately 9 per cent. Avoid the use of such a finish in favor of oil paint. Finishing coats of oil paint have no detrimental effects; neither has the color. It is the finishing coat that counts, not the undercoat. Thus painting over a bronze radiator with an oil paint will increase the heat output.

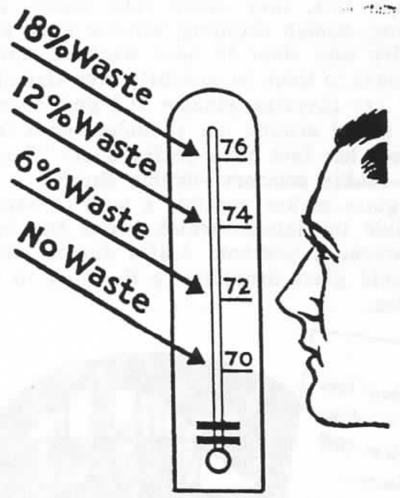
Barometric Controls

With all the changes in the direction and velocity of the wind, barometric pressure, humidity, and the temperature differences between the outside and inside of a chimney, it isn't particularly surprising that far too much heat is being wasted in many buildings, owing to the lack of draft control.

Such fluctuations in chimney draft affect the temperature in the combustion chamber, the exit gas temperature, the volume and weight of the gases produced, the time gases remain in contact with heating surfaces of the plant, and the velocity of the gases passing through it—thus have a marked influence on the rate of coal consumption and the combustion efficiency.

The variations in chimney draft can be controlled through the use of automatic barometric draft controls. These are simple, automatic devices that can be installed in the smoke pipe, breeching, or chimney—no wiring or piping being required. Once set, no further adjustment is necessary.

Through the use of a barometric draft control, you will save the heat now being wasted through excessive flue gas temperatures. Savings of 10 to 20 per cent are not uncommon. Control draft automatically under all conditions; decrease stack or chimney temperature, thus reduce fire hazards; reduce fly-ash; and improve operating conditions materially.



Heating Costs

Heating costs vary considerably. While the weather averages about the same over a number of years, some seasons are much milder or colder than others. One season may be a third colder than another.

By months,. there is a big difference. For a normal year, the heating requirements per month, in percentages, may run as follows:

September	1.2	February	16.6
October	5.5	March	14.9
November	11.6	April	8.6
December	17.8	May	3.8
January	19.2	June	.08

—depending, of course, on one's geographic location.

In addition to the temperature, the amount of sunshine, shadows; the amount of wind, its direction and velocity, account for sizeable differences in heating demand.

Comparisons in heating costs between one building and another may vary "all over the map," due to the differences in the cubical contents; the temperature maintained; building construction, exposure; the type of heating system, the number or size of radiators, registers and air ducts; number, age, health, and activity of the occupants, and what has been done to keep the building and heating system in good condition. Costs are not comparable unless you measure the differences.

Even adjoining buildings, identical in size and construction, will show big differences in heating costs, due to some of the personal factors, such as: number of occupants, the amount of heat wanted, the number of hours daytime temperatures are maintained, and hot water requirements. Some people go to bed early, others late; some do a great deal of entertaining, others very little. Some women are stout, others are slender; some are comfortable at 65 degrees of temperature; others prefer 75 to 80. Yet each degree the temperature goes above 70, increases heating costs approximately 3 per cent.

Miscellaneous Suggestions

In listing various ways of saving heat and fuel during the war the American Society of Heating and Ventilating Engineers suggests:

1. **Do not heat unused rooms.**
2. **Turn off the heat in the garage for the duration of the war.**
3. **Sun rooms are generally difficult to heat; so shut off from the balance of house if possible.**
4. **Keep doors tightly closed to attic spaces and unused rooms.**
5. **When bedroom windows are opened for sleeping, turn off the heat.**
6. **Fireplace opening should be sealed or damper should be closed tightly to prevent loss of heat up chimney.**
7. **Avoid overheating.**
8. **Reduce temperatures at right.**
9. **When away for a weekend or several days set the thermostat at about 50° F., which will prevent damage from freezing.**
10. **See that radiators or registers are not obstructed—that air can circulate around them freely.**

Insulate the hot water heater.

"Good Housekeeping"—keeping the basement or boiler room clean—is one of the first indications of an efficient fireman.

Reconstruction and relocation of the coal bin is often a good idea. The bin should be separate, dust-tight. Sloped bottoms, guillotine or sliding doors increase convenience.

Become a friend of your coal merchant, the stoker dealer, and the heating engineer-contractor. Your heating problems are his problems. He can help you or tell you where you can get the answers. It is his job or business to be your home heating advisor. Some of the responsibility for what you get is his; part of it is yours.

Comfort and heating costs are what you make them.

Have the heating system inspected regularly.

Keep the heating system in first-class condition. Proper maintenance and operation are all-important.

Take advantage of the possibilities of modernization and cost reduction.

Base costs on the long-run—first costs being secondary.

Know your building.

Acknowledgments

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