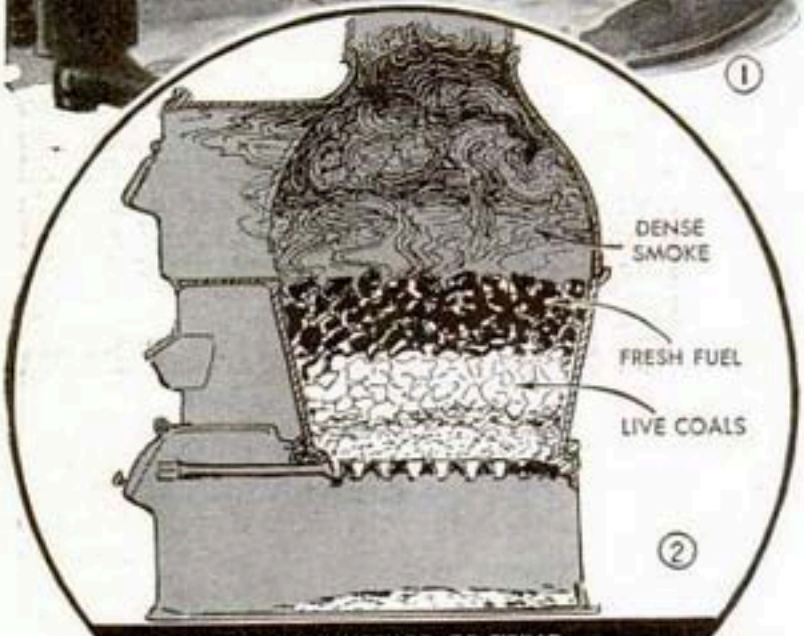
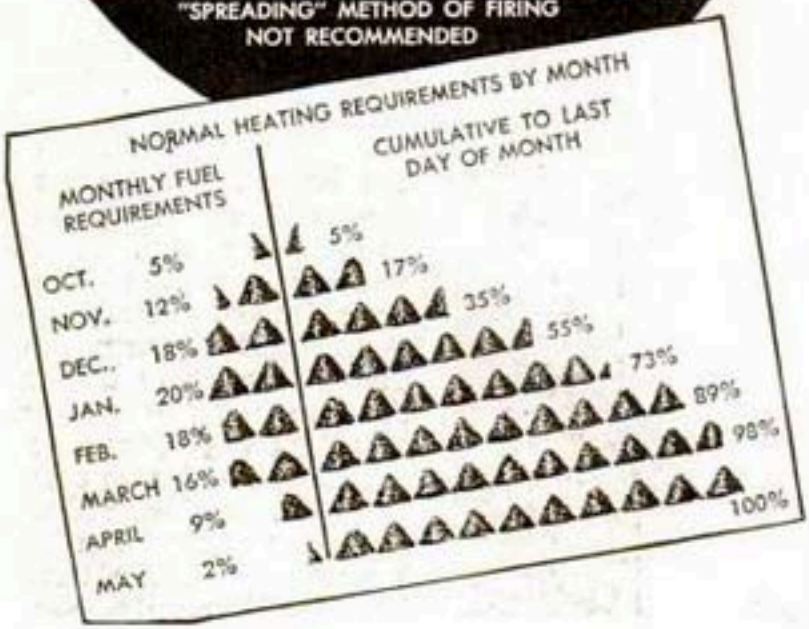
HAND FIRING

Getting at the causes of common Helpful tips that make hand firing your plant at peak efficiency



"SPREADING" METHOD OF FIRING NOT RECOMMENDED



By W. C. Lammey

NO ONE would deliberately throw a shovel or two of coal outside every day, yet the equivalent of this waste is discharged into the air in the form of combustible gases by many home heating plants. A smoky fire consumes fuel but produces insufficient heat, which is one of the most common complaints of home owners. The causes of this trouble are many and varied, and are best found by the process of elimination—starting with the most likely cause, which is incorrect firing, and then proceeding with other causes until the trouble is found and corrected.

Keep the ash pit clean: It should always be nearly empty. Ashes banked up in the pit as indicated by A in Fig. 1, reduce air supply, increase the velocity of what air does reach the fire when the lower draft is open, and result in "live" and "dead" spots here and there over the fire bed. Ashes touching the grates at any point tend to concentrate the heat and warp or break the grates. It's best to clean the ash pit before shaking. the grates. A thin, skimpy fire, B in. Fig. 1, also Fig. 22, is wasteful of both heat and time as it requires more frequent attention. Fuel bed should be level with or slightly above the bottom of firing door.

Spreading method of firing causes slow "pickup": Spreading fresh fuel over the whole fire bed as in Fig. 2, "blankets" the fire, shuts off the heat, and results in the release of great quantities of valuable gases, which escape unburned up the chimney. In firing soft coal, a dense smoke is produced when a bed of live coals is covered with fresh fuel. Before ignition can take place over the whole fire bed the furnace and the house cool down. As a result, there is a tendency to force the fire with full draft, which speeds

with COAL

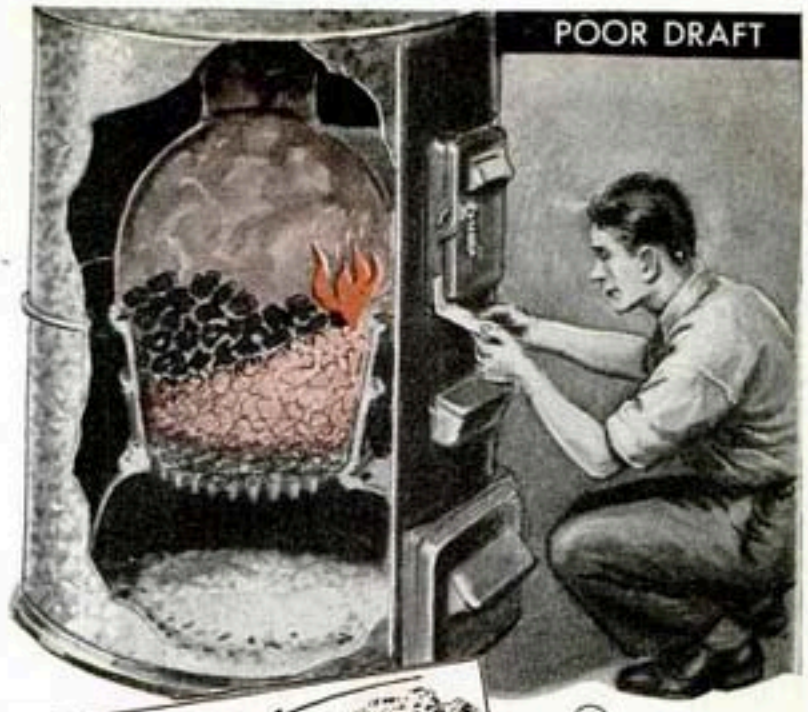
troubles in home heating plants. easier and enable you to operate and greatest economy

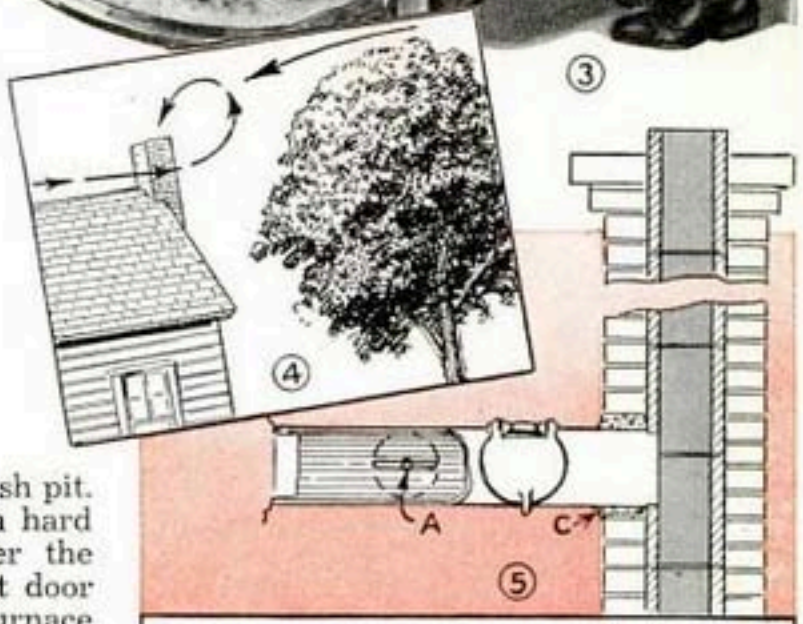
up the rate of ignition and makes the fire wasteful and difficult to control.

House cold in the morning: This condition can be due to many causes and to defects in the heating plant. The chart in Fig. 9 is the result of a study of reasons for the unsatisfactory operation of home heating plants. Banking the fire with ashes is one of the causes. Ash placed on live coal gradually stops the burning. The heat is absorbed by the ash which reaches the fusion point and forms a clinker. The latter slows down flow of air through the fuel bed. By morning the fire will be practically out. The remedy is to be sure the equipment is in good condition and then fire by approved methods, leaving a trifle more draft on the fire over night.

Fire picks up slowly or is sluggish: This condition usually is caused by a poor draft. Check the ash pit. Probe the fire bed for clinkers or a hard crust, which sometimes forms over the burned-out ash. Open the cleanout door and examine the interior of the furnace with a flashlight for heavy deposits of soot and fly ash which sometimes collect in sufficient amounts to hamper the draft. Be sure the turn-damper, A in Fig. 5, is open. If correcting these conditions fails to remedy the trouble, then use a strip of tin as a feeler gauge and "feel" along the edges of all doors, as in Fig. 3. Check fire doors, clean-outs on furnace and at the bottom of chimney as at B in Fig. 5. If you can insert the "feeler" and move it a distance of more than 3 or 4 in. along any of these openings, you have an air leak that may interfere with the draft. This can be corrected by filing the edge of the door until it fits.

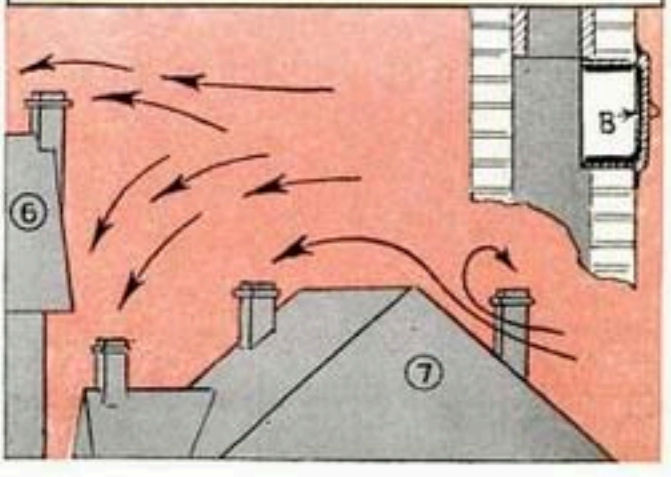
Chimney or surrounding structures reduce draft: A large tree near the house, Fig. 4, with its top higher than the chimney, can be the cause of impaired draft, as it creates an eddy air current, and sometimes a strong down-draft when the wind is blowing. Likewise, adjacent buildings higher than the chimney will cause the same condition as indicated in Fig. 6. If the top of the chimney is lower than the roof ridge you are almost sure to have trouble.

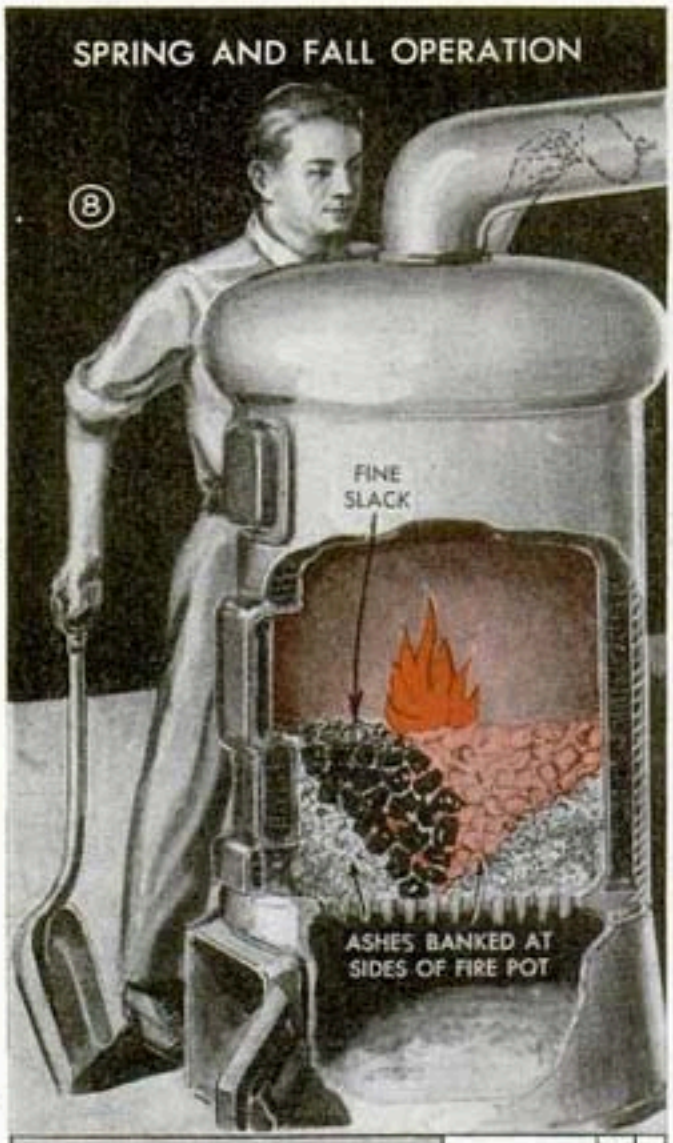


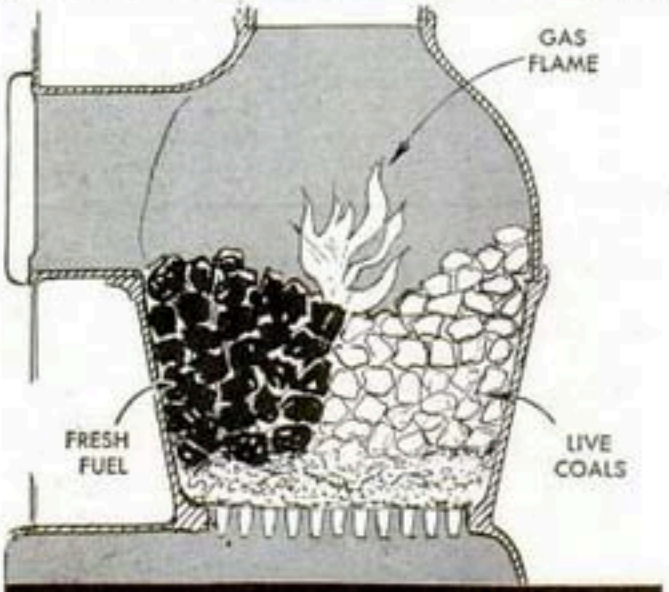


HOW TO FIND YOUR TROUBLE

When your heating plant operates unsatisfactorily there are usually many possible causes for one effect. Generally the causes of insufficient heat, poor draft, excessive consumption of fuel, clinker formation, etc., are easy to discover and remedy if one takes the time to apply a simple process of elimination. As an example, the cause of poor draft may not lie in the heating plant at all. In certain cases it has been found that simply opening the basement door or a window has completely cured the trouble. In these instances the remedy was simply more air circulation in the basement. Often, cures for other troubles are just as simple







⑩ SIDE-BANKING FRESH FUEL BETTER THAN SPREADING (BITUMINOUS COAL ONLY)

Air striking the roof is deflected as in Fig. 7 and the resulting eddy currents create down-drafts in the chimney. In severe winter weather, the cold air in the upper part of the flue of the outside chimney may act as a baffle, checking the free movement of gases from the chimney. The procedure in correcting any of these faults depends, of course, on the conditions. If there is no outside defect, then it's well to examine the chimney itself. Any large cracks in the mortar or at the smokepipe opening, C of Fig. 5, will act as check dampers. Finally, remember that nests of chimney swallows, or swifts, sometimes block the flue. Also, a basement or cellar that is shut up tightly is nearly always "air-locked." Records show that sometimes opening the basement door or a window slightly will cure a stubborn case of poor draft.

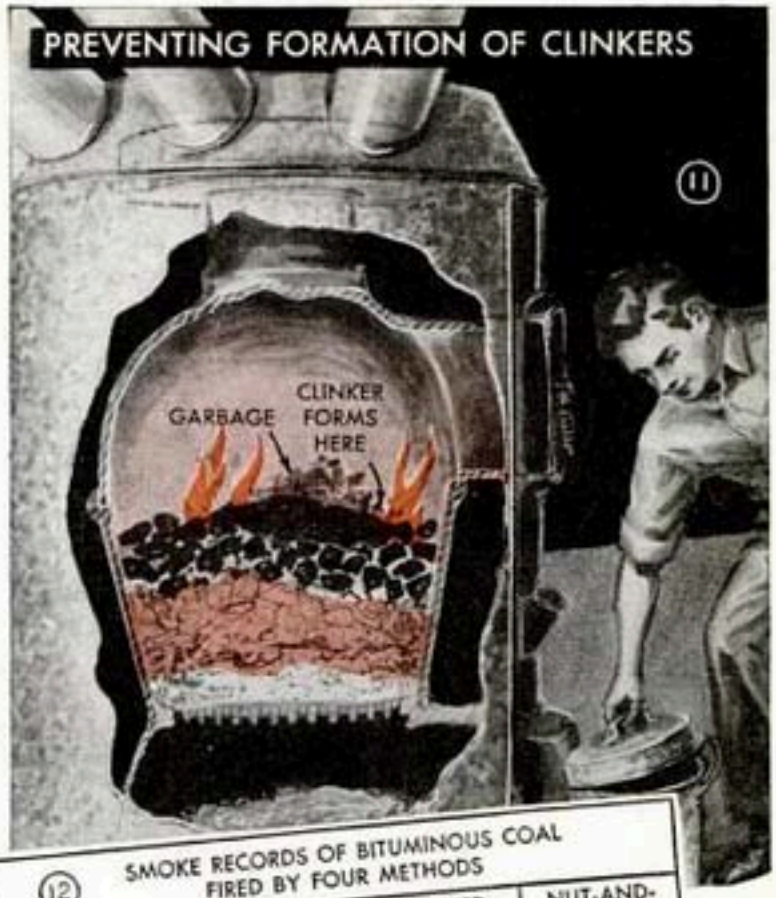
Fuel bed for mild weather: The entire grate area is not needed during mild weather so only the center is kept clear with the poker. The grates are not shaken and ash is allowed to bank up on the sides of the fire pot as in Fig. 8. This cuts down the heat output of the fire bed and, at the same time makes it easy to control. Due to adding smaller amounts of fresh fuel, such a fire will burn low in a shorter time, making it advisable to put on full draft a few minutes before firing so there will be a bright coke bed to receive the fresh fuel. Note in Fig. 8 that the live coals are pushed to one side before firing the fresh charge of coal. To hold the fire longer, cover the nut coal with a shovelful of fine slack as shown. This can be made by breaking up larger pieces of coal to the pea size. Be sure, before leaving the fire, that a gas flame has started, otherwise it will smolder. Also, there is the likelihood that the column of gases from a long-smoldering coal fire will ignite suddenly and cause a serious explosion. See that there is a fairly strong draft just after firing, especially on windless days. Once the gas is ignited, the drafts usually can be closed and the fire checked to conserve the heat.

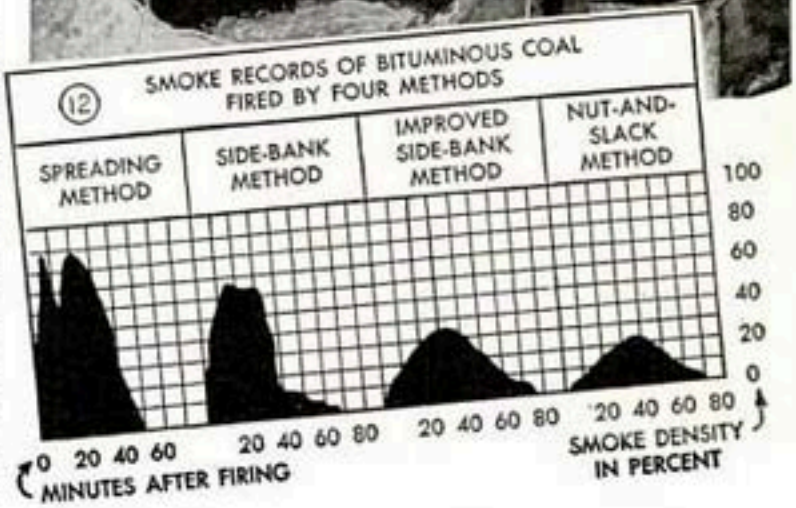
"Side-banking" when firing soft coal: In any weather, side-banking the fresh fuel as in Fig. 10, is a great improvement over the spreading method in that it prevents rapid escape of gases which takes place when fresh fuel is spread over a hot bed of coals. Grates are shaken lightly to remove surplus ash, live coals are worked to the back or side of the fire pot, and fresh coal is placed in the pit or depression thus formed. The charge is not heaped but live coals and fresh fuel are sloped to the center as indicated. By this method ignition of the fresh fuel takes place slowly and the gases are burned as they are driven off. It is essential to remove all live coals from

the bottom of the depression where the fresh fuel is placed, as otherwise ignition will take place from the bottom as well as the side and the value of the practice will be lost.

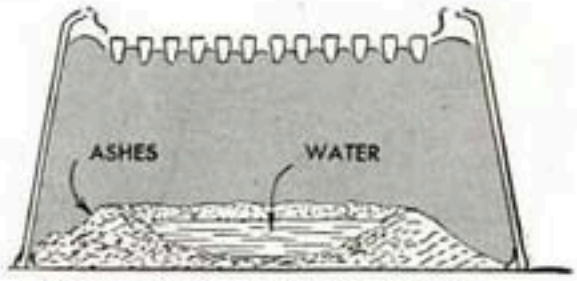
Don't burn garbage in furnace: Garbage thrown on a hot fire, Fig. 11, will immediately cut the heat output by as much as 50 percent, and it will take the fire some time to recover even a part of the loss. Even a small quantity of garbage or other foreign material is almost sure to form a hard clinker when thrown on a hot fire. In addition to the heat loss and consequent waste of fuel, a large clinker is often very difficult to remove. Sometimes the furnace and grates are damaged in the process. A clinker forming in the hot fire also tends to blanket the heat and, in effect, force it downward, sometimes heating grates to the danger point.

Avoid closing drafts on a high fire: Closing the drafts suddenly on a very hot fire often causes a hard clinker to form as the furnace surfaces cannot absorb the excessive heat that is suddenly bottled up and reflected back into the fire bed which quickly fuses or makes clinkers under the excessively high temperature. It's better to close the drafts on a hot fire by stages, leaving the lower draft open just the width of a match stick, and opening the check damper only part way until the burning rate slows down to more nearly normal.





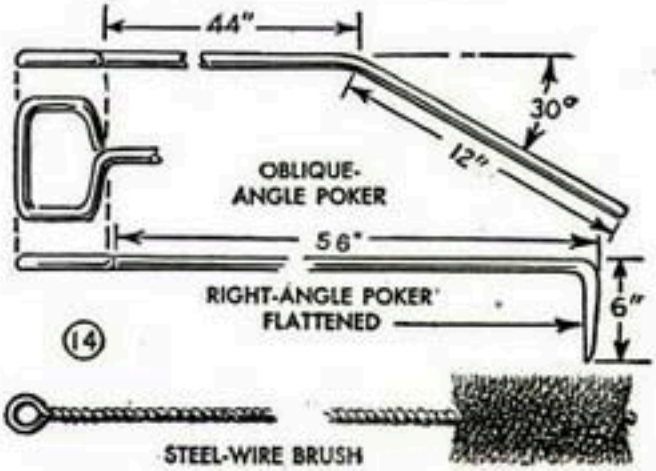
Water in ash pit aids combustion: With certain grades of fuel, clinkering can be prevented and combustion aided considerably by leaving a small quantity of ash in the ash pit and keeping this moist by adding water occasionally, as in Fig. 13. In this connection it's also a good idea to wet or "temper" the fuel. This should not be done immediately before firing but the fuel should be sprayed at regular intervals with water so that the coal particles have a chance to absorb moisture.

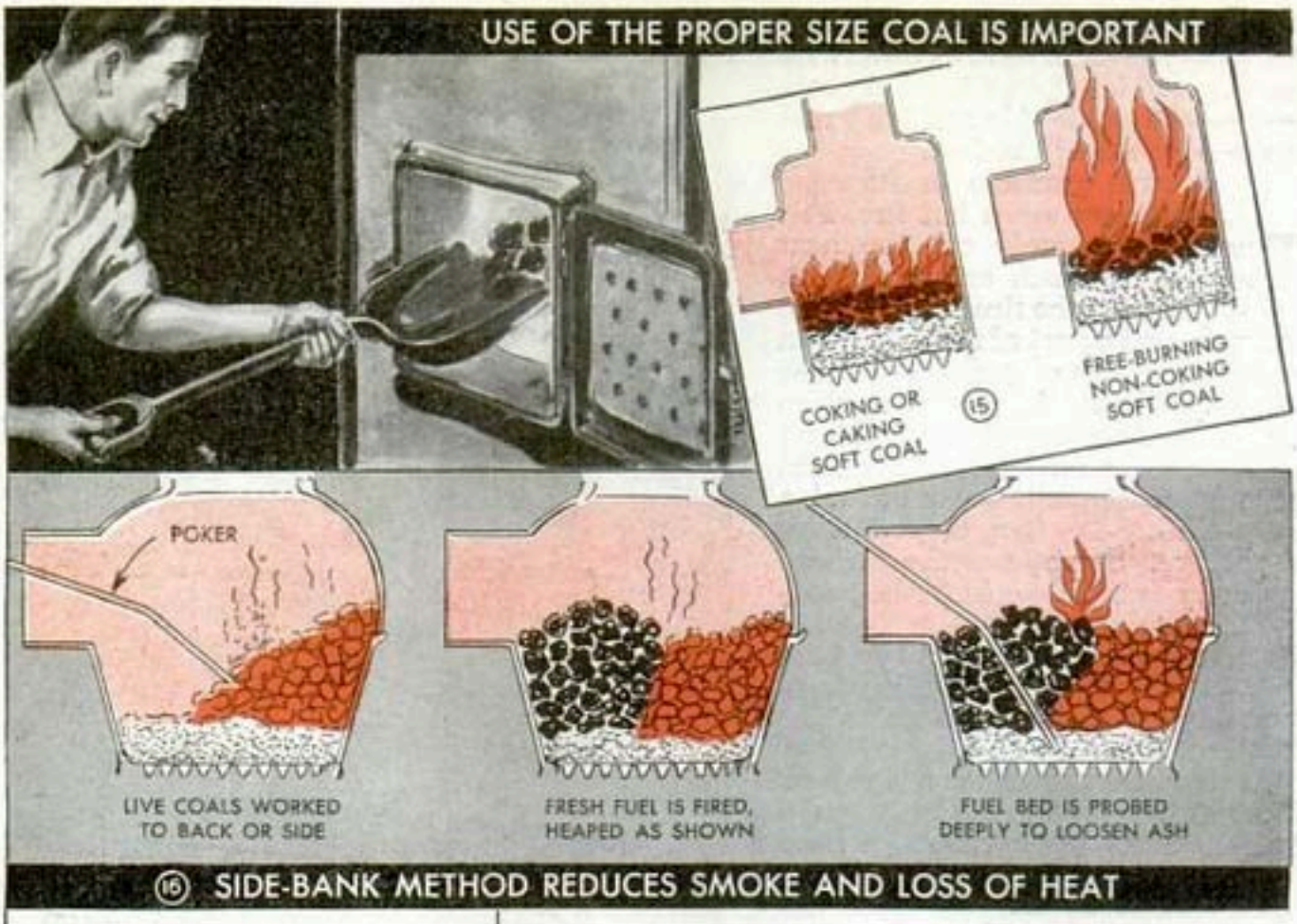


13 WATER IN ASHPIT AIDS BURNING

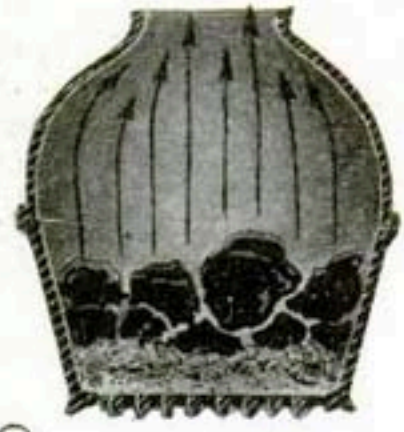
Tools needed in hand firing: In firing a furnace by any of the recommended methods you will need two pokers and the wire cleanout brush shown in Fig. 14. Of the two pokers the oblique-angled type is the more important as it is efficient in probing the fire bed and in working live coals to the side of the fire pot. The wire flue brush is essential for loosening soot and fly ash.

Use the right size coal: Usually this is more important when burning the smokeless fuels, such as hard coal and coke, but it also applies in the extremes to soft fuels.





⑯ SIDE-BANK METHOD REDUCES SMOKE AND LOSS OF HEAT



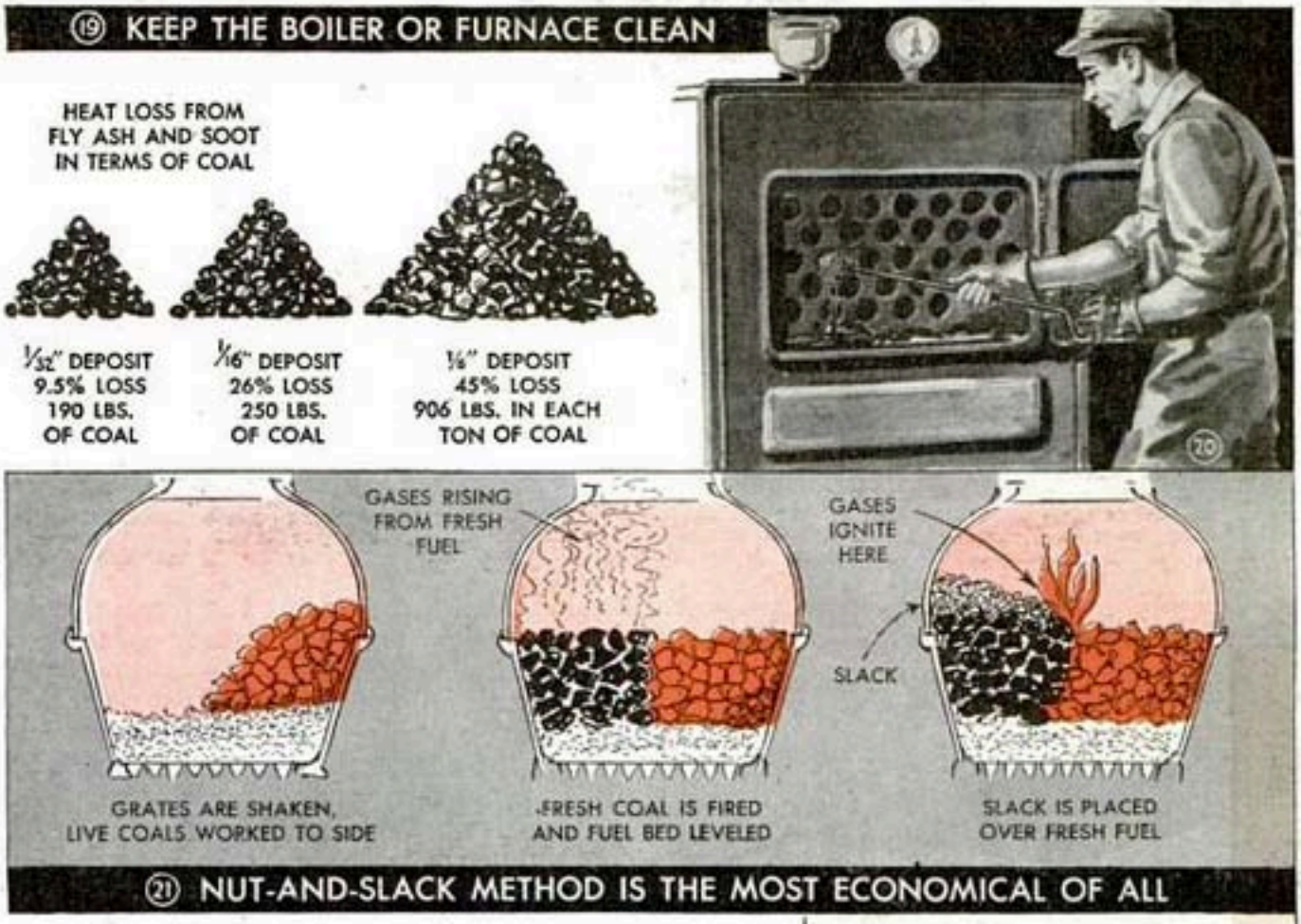
⑰ LARGE LUMP FUEL RESULTS IN EXCESSIVE HEAT LOSS

⑱ SMALLER LUMP SIZES ADMIT LESS AIR, BURN MORE EFFICIENTLY; APPLIES TO ANTHRACITE COAL AND COKE

As an example, fine soft-coal slack and forkings cannot usually be burned successfully in the average home furnace without a forced draft. When firing soft coals by any of the three approved methods the sizes generally referred to as nut, stove and range, usually will be found satisfactory. Most soft fuels are divided into two types known as coking or caking coals and the free-burning non-coking type, Fig. 15. These terms refer to the burning characteristics rather than to the lump size. Also, the two are sometimes referred to as short and long-blaze coals. In the hard fuels, particularly coke, the large lumps bulk up loosely admitting the passage of excess air through the fire bed. This condition moves the heat so rapidly that only a part of it is absorbed and transferred by the exposed surfaces of the furnace, Fig. 17. Loss of heat up the chimney is sometimes excessive. The smaller lump sizes, Fig. 18, admit less air, burn more efficiently in a deep fire, Fig. 23, and produce more useable heat. Where the natural draft is very strong the burning rate can be controlled better if a small amount of fine lump fuel is placed on top of the regular charge.

Improved side-bank method: With two exceptions in procedure, this is the same as the ordinary side-bank method. The sequence of the firing operations is detailed in Fig. 16. By this method the grates are rarely, if ever, shaken. The fresh fuel is heaped slightly as indicated and as the final step the fuel bed is deeply probed over the whole grate area to loosen and sift out the fine ash.

Nut-and-slack method: This method of firing is essentially the same as the side-banking procedure except that two sizes of coal are used. Fig. 21 de-



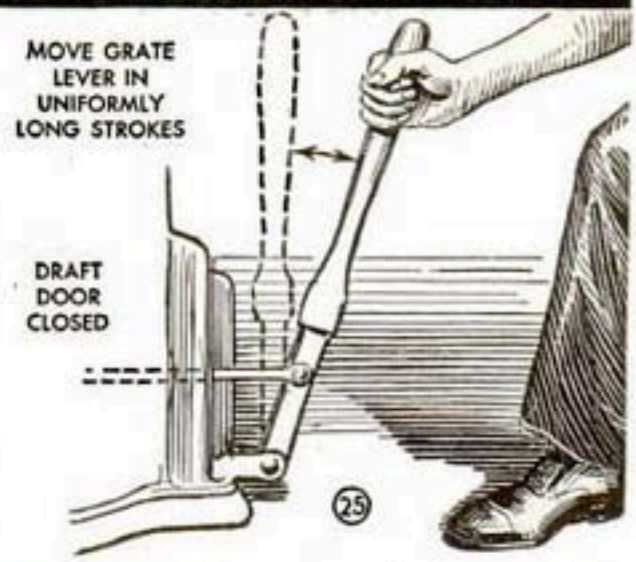
tails the steps. Grates are shaken gently, with only a few long strokes as in Fig. 25. Coals and coke remaining from the previous charge are worked to the side of the fire pot. After firing the fresh charge, the fuel bed is leveled and slack is placed over the fresh fuel. Slack from the same kind of coal should be used if possible. Following the sequence of this method requires somewhat more coal for each fresh charge but actually the overall consumption of fuel is less than that when using other methods because of the greater heat output from a given amount of coal, assuming that the heating plant is in good condition. In addition, the latter method as described produces less smoke than any other as you can see from the smoke chart, Fig. 12. It's important to note that success with any of the three approved methods depends on careful attention to details.

Heat loss from fly ash and soot: Fig. 19 illustrates this loss graphically. One of the essentials to satisfactory operation is that the furnace and flue be kept clean, Fig. 20. On some of the later type hot-water and steam plants, passageways in the furnace can often be cleaned more efficiently by compressed air. Periodically scrubbing the radiator dome and the upper part of the fire pot with a wire flue brush usually will suffice for the average warm-air plant. Three other methods of ridding the furnace of soot as approved by the U. S. Bureau of Mines and the Engineering College, University of Illinois, are shown in Figs. 26, 27 and 28. Common granulated rock salt placed on a bright fire at regular intervals is quite effective. The methods shown in Figs. 27 and 28 also are effective in cleaning the flue but it should be remembered that on wood-shingled buildings there is some danger of a roof fire so it's

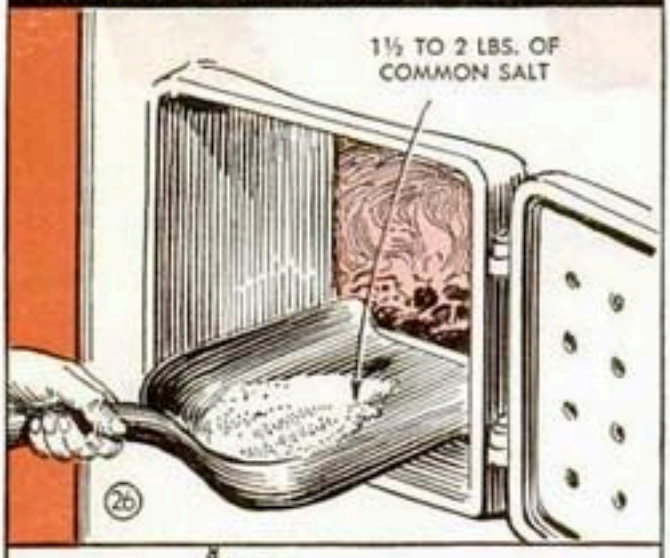
㉒ SHALLOW FIRE WASTES FUEL AND HEAT

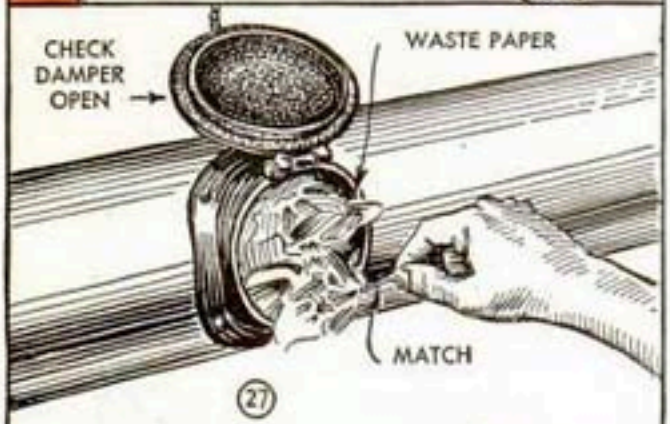
㉓ DEEP FIRE BURNS SLOWLY, CONSERVES HEAT AND COAL. APPLIES TO HARD AND SOFT FUELS

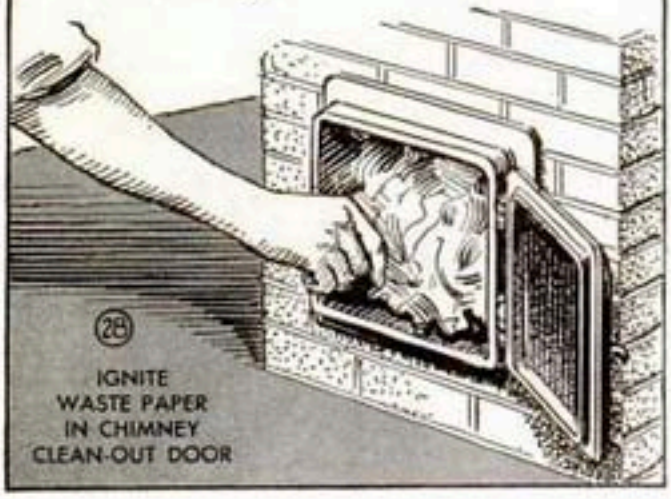
ALWAYS SHAKE GRATES GENTLY



METHODS OF CLEANING OUT SOOT







a good idea to burn out the flue only on damp or rainy days when the roof is wet. It should never be done in a chimney in poor condition or where the soot accumulation is unusually heavy. Clean out the bulk of the soot by other methods, such as dragging a chain up and down in the flue.

Over-draft damper: When burning soft coal the use of the over-draft damper, Fig. 24, in the fire door is important as gases evolved from the fresh fuel will not ignite in the furnace unless mixed with air. Just how much the over-draft should be opened depends somewhat on the fuel and the peculiarities of the individual furnace.

Kindling the fire: Ordinarily, paper is first placed in the furnace, the kindling next, and finally a small quantity of coal. A better method reverses this procedure as in Fig. 29. First, ash is worked through the grates until only about a 2-in. layer remains. Then the coal is placed as shown, with slack on top, leaving a depression at the front near the fire door. Into this is placed the kindling with rolled and twisted waste paper on top, which is lighted.

THE RIGHT WAY TO KINDLE A FIRE