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BUREAU OF MINES

VAN. H. MANNING, DIRECTOR

WASTE AND CORRECT USE OF NATURAL GAS IN THE HOME

BY

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FOREWORD.

Much has been said by the Bureau of Mines and by others about the criminal waste of natural gas that is taking place in our gas fields. Natural gas, one of the most valuable mineral assets of the country, has been permitted to dissipate in such a manner that the public has derived relatively small value from it. In recent years the public has demanded that efforts be made to minimize this waste.

But, although possibly the most flagrant and the largest wastes have been in the fields and along the transmission lines of the gas companies, there have been great wastes in the household of every consumer, and the public, therefore, has been a party to this crime. Investigations as to the efficiency with which the domestic consumer uses the gas supplied to him have disclosed that perhaps two-thirds of the gas that has been metered into his house has been wasted and only one-third of the gas has been consumed usefully. The following figures contributed by Mr. Wyer show how such wastes occur:

"Domestic consumers waste more than 80 per cent of the gas received. The efficiency of most cooking and heating appliances could be trebled. By making natural gas worth saving the 2,400,000 domestic consumers in the United States could get the same cooking and heating service with one-third of the gas—that is, make 1 foot of gas do the work of 3—and greatly delay the day when the present supplies will be exhausted and consumers must go back to more expensive manufactured gas."

It is time for the public to take a new viewpoint on the waste of natural gas. It is time for the domestic consumer to realize that his duty is not done when he cries out against the flagrant wastes occurring in the gas fields, and demands of his Government that such wastes be abated; he must realize that he himself is likewise at fault and that it is time for him to set his own house in order. Furthermore, the domestic consumer must realize that these wastes do not concern him alone, and consequently he has not the right, merely because he pays for the gas, to employ it in any manner that pleases him, no matter how wasteful. Natural gas is a natural resource in which every inhabitant of this country has an equity. Those who waste the gas do so at the expense of others who would use it efficiently. Natural gas is not replaced by nature, and in comparison with the life of the nation the duration of the supply will be brief.

The public has a right, therefore, to demand that this natural asset be used to the greatest advantage of all and that no one be allowed to waste it. Natural gas in each city is a community asset and every consumer has a right to demand that wasteful use shall be prohibited in the interest of the public service. This is particularly important during cold spells in the winter when the supply is insufficient and actual suffering may occur. Clearly, it is not right that any consumer suffer at such times because of the extravagance and waste of other consumers, even though they are willing to pay for the gas wasted. Nor can the citizens justify demands for better service from the public utility companies without making provision to correct abuses in their own homes. It must be recognized that the public has been and is to-day, just as much a party to the crime of wasting this natural resource as are the companies that produce and market it.

Van. H. Manning,
Director.

WASTE AND CORRECT USE OF NATURAL GAS IN THE HOME.

By Samuel S. Wyer.

PART I.—CORRECT USE OF NATURAL GAS IN THE HOME.[a]

SECTION 1.—CONSUMERS' METHODS OF GAS UTILIZATION DETERMINE QUALITY OF SERVICE PRODUCED.

Gas service is radically different from every other kind of public utility service in that the gas can not be used by the consumer as received, but—

First, must be mixed in proper proportion with another substance (atmospheric air);

Second, this mixture must then be completely burned;

Third, the flame must be so directed that the heat generated will effectively get into the food, air, water, or mantle that is being heated, with a minimum loss.

The results obtained will depend primarily on the gas utilization appliance and the consumers' skill and care in operating. All these operating features are beyond the gas company's control, but are vital in determining the quality of the service produced by one consumer and the effect on the service of other consumers.

SEC. 2.—COMBUSTION OF NATURAL GAS.

The combustion—that is, the burning of natural gas—can take place only by first mixing the gas with the proper proportion of atmospheric air. About 9½ cubic feet of air must be mixed, by the gas consumer at his burning appliances, with each cubic foot of natural gas in order to insure perfect combustion. If not enough air is mixed with the gas, the combustion will be imperfect and wasteful.

SEC. 3.—WHAT MUST HAPPEN WHEN NATURAL GAS IS BURNED.

When natural gas is burned by complete combustion, each cubic foot of the gas will form 1 cubic foot of carbon dioxide and 2 cubic

[a] For further discussions of gas use, see Bulletins of the Department of Home Economics, Ohio State University, Columbus, Ohio, as follows: Bulletin 28. "Effect of gas pressure on natural gas cooking operations in the home," May, 1918; Bulletin —, "Kitchen tests of relative costs of five fuels for cooking." Reprinted October, 1918.

feet of steam. This carbon dioxide is the same substance that is exhaled from the lungs.

The combustion of 1,000 cubic feet of natural gas will form 2,000 cubic feet of water vapor or steam, which, when condensed, will make approximately $10\frac{1}{2}$ gallons of water. This production of vapor is not peculiar to natural gas, as ordinarily manufactured gas of the same heating value will form about the same quantity of water vapor. It is this water vapor that causes the bakers and broilers of stoves to rust, and, when gas is used in open fires without flues, may make the walls and windows "sweat."

SEC. 4.—WHAT MAY HAPPEN WHEN NATURAL GAS IS BURNED.

If the combustion of natural gas is not complete, carbon monoxide will be formed instead of carbon dioxide. This carbon monoxide is a deadly poison and, therefore, dangerous, and for this reason a room in which gas is burned must be ventilated. The poisonous action of carbon monoxide gas is so marked that one-tenth of 1 per cent is enough to in time produce fatal results. This gas is especially likely to be formed when a flame suddenly strikes a cold surface, as, for instance, during the first few minutes' operation of a hot-water heater.

SEC. 5. COMBUSTION PRODUCTS OF NATURAL GAS CAN NOT BE ABSORBED OR DESTROYED.

The inevitable products, carbon dioxide and water vapor, can not be destroyed, although the water vapor when it is cooled will condense to a liquid. There have been many claims made by manufacturers of heating devices that their devices absorb the combustion products, but all such claims are untruthful.

SEC. 6.—BLUE AND YELLOW FLAME BURNERS.

If natural gas is forced out through a small hole, about the diameter of a pin, enough air can be mixed with the issuing gas to insure perfect combustion. This is the principle of the yellow or luminous flame burner. The flames must not be suddenly permitted to come in contact with any solid body, because if they do they will deposit carbon and probably produce carbon monoxide. Only very small quantities of natural gas can be burned in such burners. In this yellow or luminous type of flame the production of the light is due to the incandescence of momentarily existing carbon particles furnished by the decomposition—by heat—of the gas itself, before coming in contact with the air.

Natural gas, to be burned in large volume, must have some of the air mixed with the gas before the gas reaches the flame. This is the fundamental principle of the Bunsen or blue-flame type of burner. The air taken in to form the mixture is called the primary air, and will usually be only a small part of the total air required. The rest of the air necessary for complete combustion, called the secondary air, will be taken from the atmosphere surrounding the burning flame. Such a blue flame does not smoke or deposit free carbon on a cool surface, although if the flame is sufficiently chilled some of the gas will escape unburned.

SEC. 7.—ACTION OF GAS MIXER.

The action of the mixer is shown in figure 1. The gas, at a pressure above atmospheric air, is forced through a small hole or orifice by the gage pressure in the gas pipe, and thus acquires a

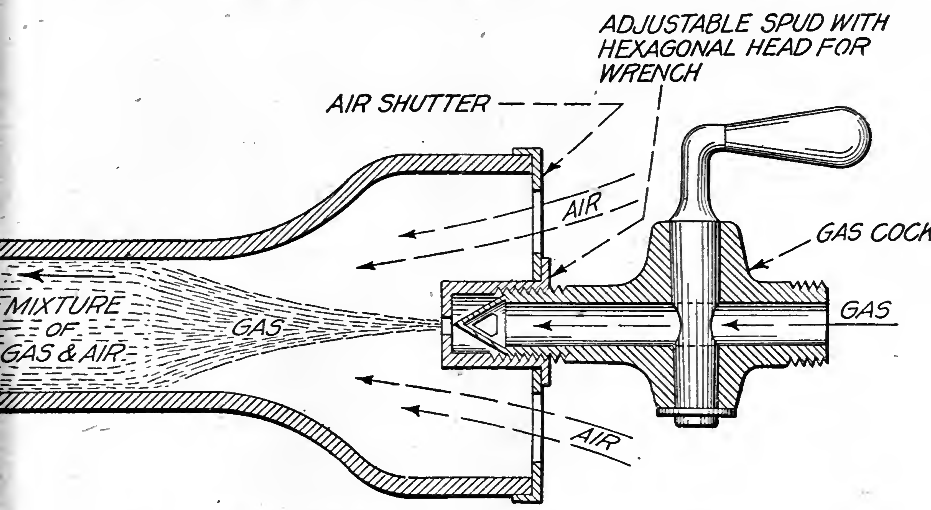

FIGURE 1.—Diagram showing construction of gas mixer, with adjustable spud.

relatively high velocity in passing through the small opening, as shown in the figure. In this way an asperating or sucking action is produced around the orifice, and this draws in atmospheric air from the room so that it will mingle with the gas. A gas mixer is, therefore, in effect merely a small air injector. The mixer shown in figure 1 has a stationary cone, and by turning the adjustable spud with a wrench placed on the hexagonal head of the spud, the effective area of the orifice may be made larger or smaller, thus changing the velocity of the gas, and, therefore, its asperating action. This is known as the adjustable type of spud.

By opening up this adjustable spud when the gas pressure is low, more gas can be gotten to the burner, and, therefore, more satisfactory operating conditions can be secured during the inevitable low pressure period in extreme cold weather.

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There are many mixers in use that have merely a stationary spud opening, which can not be adjusted.

The amount of air going in may be varied by adjusting the air shutter.

The mixer shown is of the type generally used on cooking stoves, but the same principle is employed in heating stoves and incandescent mantle lamps. In many burners a needle valve is used instead of the gas cock shown for controlling the gas going to the orifice.

SEC. 8.—IN BURNING GAS FOR COOKING THREE DISTINCT STEPS ARE NECESSARY.

(*a*) The gas must be properly burned; that is, it must be properly mixed with air so as to burn with a pale blue nonluminous flame. A luminous flame will be wasteful and will deposit soot on the cooking vessel.

(*b*) The flame must be properly directed; that is, the tip of the flame must come close to the cooking vessel. If the flame is too short to reach the cooking vessel, or is blown to one side by a strong draft of air, gas will be wasted, a longer time will be required, and if the flame tip is too far away it may be impossible to cook, although the short improperly directed flames may be kept burning a long time.

(*c*) The heat generated by the burning gas must be delivered through the cooking vessel walls and into the food, and grid or open stove tops are necessary for good service. Natural gas should never be used under a solid stove top because such use is always wastful and under low-pressure conditions may make cooking impossible.

SEC. 9.—WRONG BURNER POSITION.

Wrong positions are shown in A and B of figure 2. At A, which represents a typical natural gas stove condition, high pressures are necessary, and although the flame with such high pressures will be effective, it will always be wasteful of gas. When the pressure is low so as to produce the short flame shown at B, the cooking vessel is so far away that the short flame can not reach it. This results in waste of gas, longer time being required for cooking, and often inability to cook at all, even though the gas may be burned for a long time.

SEC. 10.—CORRECT BURNER POSITION.

Merely lowering the cooking vessel or raising the burner, as shown at C in figure 2, will result in satisfactory cooking in the usual length of time, with low-pressure gas in the same stove and with the same burner. In fact, with a properly directed short flame at low pressures, as shown at C, the amount of gas used will be less than one-half of the amount needed with the usual high pressure and long flame shown at A.

SEC. 11.—HOW TO GET COOKING BURNERS IN CORRECT POSITION.

When purchasing a new stove, get either a manufactured gas stove or a natural gas stove with burners properly raised for short-flame service. The burner should be about $1\frac{1}{4}$ inches below the bottom of the cooking vessel.

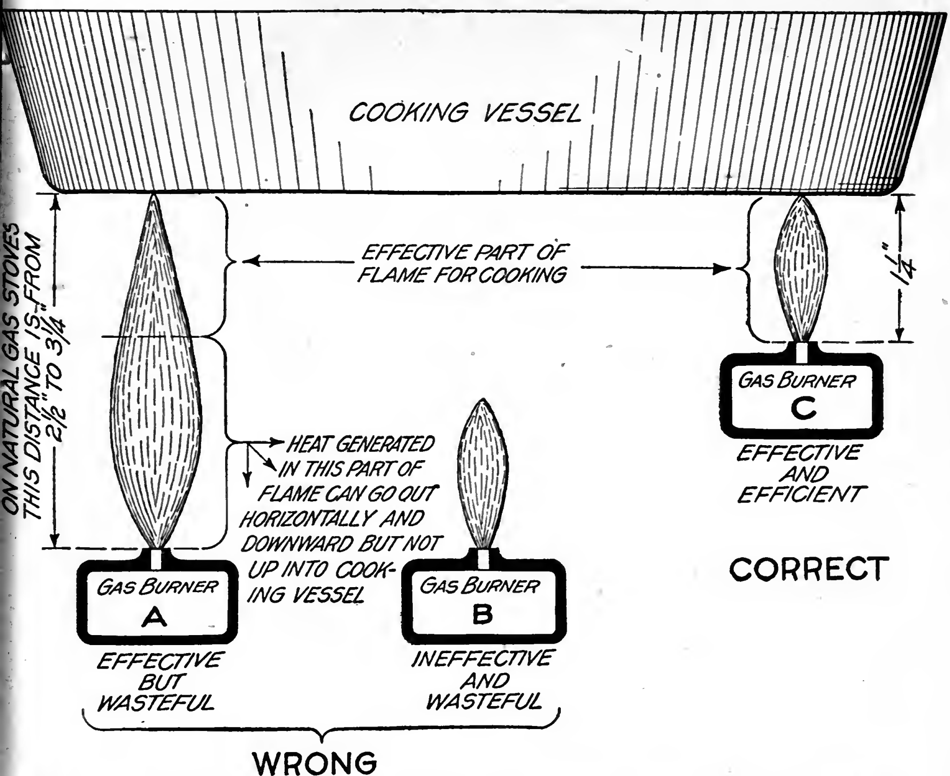

FIGURE 2.—Diagram showing wrong and correct position of gas flame under cooking vessel.

Old stoves worth remodeling may be changed by:

(*a*) Raising the manifold and burner supports so as to bring the burners to the proper height below the cooking vessel.

(*b*) In some stoves the manifold may be turned one-half way around so that valves that are at the bottom will then come on the top. By altering the burner supports, the burners can then usually be brought to the proper height. In some stoves where cocks similar to the one shown in figure 1 are screwed into the manifold, turning the manifold one-quarter way around, removing the cocks, screwing a nipple and elbow into the upturned opening, placing the cock in the elbow and raising the burner supports, will usually bring the burners to the proper position.

(*c*) In some stoves it will be preferable to cement a new burner casting on top of existing low burners, so as to bring the burner top to the proper height.

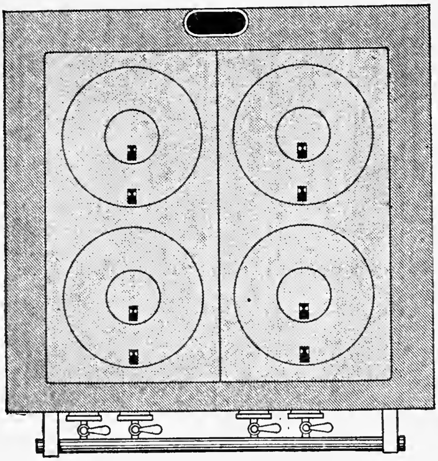

FIGURE 3.—Usual solid top for natural gas cook stove. Such a top is wasteful of gas and should not be used.

Closed tops, as shown in figure 3, should not be used, and in all stoves where the burners are raised, skeleton lids, grid, or open tops, as shown in figure 4, must be used with the short flames.

A larger sized spud opening—that is, the small opening immediately in front of the gas cock through which the gas passes into the mixer—should be used with low-pressure service. Some stoves have adjustable spuds; others must have either new spuds or have the old small openings reamed larger.

Baker or oven burners need not be raised, because the heat from the burning gas is already inside of the chamber to be heated. The spud and mixer must, however, be adjusted so as to give a pale blue nonluminous flame.

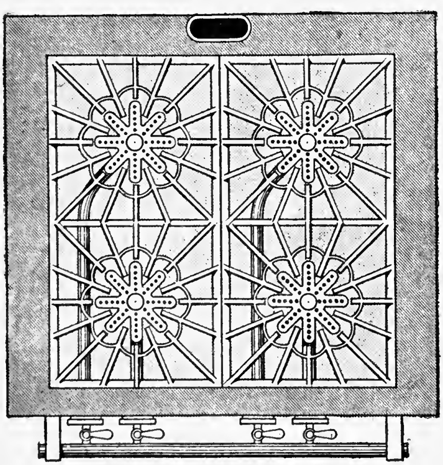

FIGURE 4.—Grate or grid top for gas cook stove. This top is official and should be used with natural gas.

SEC. 12.—HOW TO COOK WITH VERY LOW GAS PRESSURE.

In cold weather, when the demand for natural gas is greater than the supply and the pressure is therefore low, lowering the cooking vessel down to within one-half inch of the burner top may be desirable. This may be done by placing three or four nails in drilled burners, or three or four pieces of thin sheet iron in slotted burners, as shown in figure 5, and then placing the vessel on these nails or sheet-iron supports so that the very short flames from the low-pressure gas will reach the bottom of the cooking vessel. If this is done, satisfactory cooking results can be obtained with pressures as low as three-tenths of an inch of water pressure, which produces a flame about three-eighths of an inch long. That is, with this close position of the vessel the cooking can be accomplished in about the normal time and with less gas than would be used with the long flame and high pressure necessary to produce the condition shown in A of figure 2.

SEC. 13.—HOW TO COOK EFFICIENTLY WITH HIGH PRESSURES.

First raise the burners so that the vessel will be about 1¼ inches above the burner openings, then efficient short-flame combustion conditions may be obtained by partly opening the gas cock. Never

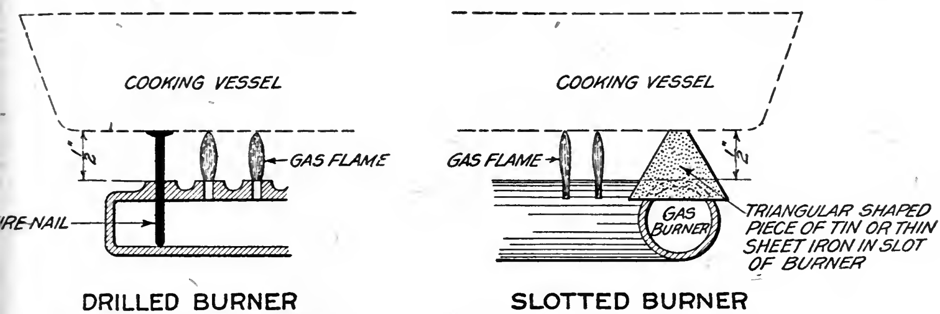

FIGURE 5.—Diagram showing how nails or pieces of sheet iron may be used to support cooking vessels close to gas burner for effective service at low pressure.

let the flame lick up along the side of the vessel. If the full pressure is turned on, it may be so high as to actually blow out the flame and give the erroneous impression that the gas will not burn.

SEC. 14.—WHY MORE GAS IS USED FOR COOKING IN WINTER THAN IN SUMMER.

The heating value of the gas in winter will not be any lower than in summer, because the heating value is increased 1 per cent for each 5 degrees of decrease in temperature of the gas, and will actually be higher during the low-pressure period in winter than it is in summer. However, the starting temperature of the food and water that must be heated in cooking will be much lower in winter than in summer, therefore a larger quantity of heat will be needed to bring the food or water to the boiling point. The radiating loss from the cooking vessel and burner, because of the low temperature of the surrounding air, will also be much higher in winter than in summer, and thus will increase the gas consumption.

SEC. 15.—RUSTING OF OVENS AND BURNERS.

Rusting of ovens can almost be eliminated by opening the oven door slightly for a few minutes after the burners are lighted. This permits escape of the greater part of the moisture, which is produced by combustion, and prevents too rapid condensation.

Oven linings and burners are best protected from rust by the application of oil or grease, free from salt. This should be done while the oven is warm, as often as may be necessary.

SEC 16.—STEPS NECESSARY IN CORRECT HOUSE HEATING.

(*a*) The gas must be burned with perfect combustion. However, this is merely the first step.

(*b*) The combustion products must be made to deliver the most of their heat into the air or water that is to be heated, and before leaving the heating device should be cooled to within 100 degrees of the air or water that is heated. Failure to appreciate the importance of this second step, rather than merely obtaining perfect combustion, is responsible for the gross waste of natural gas in many heating devices.

SEC. 17.—FLUELESS HEATING STOVES.

There are many so-called "odorless," "smoke-consuming," and "chimneyless" natural-gas heating appliances in use. These are always dangerous and a positive menace to health, and ought never to be used.

SEC. 18.—WHY FLUELESS HEATING STOVES ARE MUCH MORE DANGEROUS THAN A FLUELESS COOK STOVE.

In the kitchen the cook stove is seldom used for more than one hour at a time. The volume of steam from the cooking food will be much greater than the volume of the combustion products from the gas, and the steam alone will make ventilation necessary.

The person in the room will be constantly moving about, with head 4 or 5 feet above the floor level, and in all probability the kitchen door will be opened several times during the cooking, thus increasing the ventilation.

In contrast with this condition, when a heating stove is used in a bedroom or bathroom, the period of use is much longer, the ventilation is less, the person in the room will be quiet with head closer to the floor, and the doors will probably, at least in the bedroom, not be opened or closed. Furthermore, a flueless stove properly adjusted at 9 o'clock in the evening, when the pressure is low and when the person goes to bed may become a carbon monoxide generator at 3 o'clock in the morning, when the person is asleep and the gas pressure has greatly increased.

Hoods over open-top kitchen stoves, of course, are always desirable.

SEC. 19.—NATURAL GAS CHIMNEY TROUBLES.

The water vapor in the combustion products of natural gas, when turned into the ordinary brick, mortar-lined, or fire-clay-lined chimney, will in time cause the mortar to disintegrate; also the condensed water will work through the porous brick and frequently discolor the walls on the inside of the room, as well as disfigure the exterior of the chimney. The best way to handle the combustion products of natural gas is to have a metal or vitrified pipe in the chimney.

SEC. 20.—WHY THE HEATING VALUE OF NATURAL GAS MAY SEEM LOWER ON WINDY DAYS THAN ON EQUALLY COLD STILL DAYS.

The wind has no effect on the heating value of the gas, but may affect the consumer's use as follows:

(*a*) A strong wind may deflect the flame from under the cooking vessel and thus lower the efficiency of the gas for cooking. Protection of the flame from a strong draft will correct this difficulty.

(*b*) For heating stoves an excessive draft caused by a high wind may take a larger amount of the heat produced up the chimney, thereby greatly increasing the chimney loss, and of course, depriving the room of that much heat. Cutting down the draft with a damper will correct this.

(*c*) Most houses are rather loosely constructed and are more susceptible to a high, cold wind than to merely a cold, quiet atmosphere, even though the quiet atmosphere may be much colder than the rapidly moving wind. The practical effect of this is that a high wind will bring an excessive proportion of cold air into the house and thereby increase the heating demands on extremely windy days.

SEC. 21.—INCANDESCENT MANTLE LAMPS.

The incandescent gas mantle lamp is simply a Bunsen burner where the burning gas heats the material in the mantle to incandescence, thereby producing light. The lamp must be closely adjusted if efficient and satisfactory results are to be obtained. Hissing or roaring sounds are indicative of excessive gas consumption. Adjust the lamp by adjusting the air shutter and gas needle valve of the burner—if the burner has one—so as to obtain a maximum illumination and a quietly burning lamp.

PART II.—FORMS OF NATURAL GAS WASTE IN THE HOME.

SEC. 22.—WASTE FROM GAS LEAKAGE.

The various gas cocks, fittings, and piping on the consumers' premises are seldom tight, and will frequently waste a large amount of gas in a year through leakage. Even a leakage of only 1 cubic foot per hour will mean 8,760 cubic feet of gas per year, or about one-twelfth of the average consumer's annual domestic consumption. The average leakage will be more nearly 15 per cent of the gas passing through the consumer's meter. Most gas meters have a small dial indicating either 1 or 2 cubic feet of gas per revolution. Shutting off all the burning gas in the house and noting the movement on this small dial for a period of two or three hours will give a good indication as to leakage.

SEC. 23.—WASTE FROM HIGH PRESSURE.

High-pressure gas; that is, gas under a pressure of 4 ounces per square inch, will frequently cause the blowing of the burners, usually indicated by a hissing sound. Partly opening the gas cock will remedy this.

SEC. 24.—WASTE FROM IMPERFECT COMBUSTION.

With the Bunsen type of blue-flame burner, a showing of red or yellow in the flame is an indication of imperfect combustion and, therefore, waste. Unburned gas will cause smoke and the depositing of soot on the cooking vessel. Adjusting the air shutter and gas supply is the remedy.

SEC 25.—WASTE FROM LOW BURNERS IN COOK STOVES.

The long flames necessary for low burners always require more gas than those from the burners in proper position about 1¼ inches below the vessel bottom. Raising the burners to the proper height will correct this.

SEC. 26.—WASTE FROM IMPROPERLY DIRECTED FLAMES.

A strong draft or the opening of doors may frequently deflect the flame under cooking vessels so that the heat will not get into a vessel. Cutting down the chimney draft or protecting the flame from side drafts will correct this.

SEC. 27.—WASTE FROM SOLID TOPS ON COOK STOVES.

If cooking operations are on top of the stove, more gas and a longer time are required. The use of skeleton lids or grid tops will eliminate this waste.

SEC. 28.—WASTE FROM USING GAS BEFORE AND AFTER COOKING.

Most persons do not appreciate that the burning gas can do no good before the vessel is over the fire or after the vessel is taken away. Therefore, the gas should not be turned on until after the vessel is ready to place over the fire, and should be turned off as soon as the vessel is removed.

The gas can be turned down after boiling begins, and the vessel can be kept boiling with a smaller quantity of gas. It is important to bear in mind that when a cooking vessel boils it can not be made any hotter and any use of gas other that merely to keep it boiling is a waste.

SEC. 29.—WASTE FROM USING GAS IN COAL STOVES OR COAL FURNACES.

In coal stoves or coal furnaces the path traveled by the flame is short and the radiating surface is relatively small. For this reason, the use of gas in such stoves is always wasteful and will require about three times as much gas for the same heating service as would be required if the gas were used in a properly built natural-gas furnace. Even with perfect combustion in the fire pot of a coal stove or coal furnace the waste will usually be about 75 per cent, as shown in figure 6. Properly built natural-gas furnaces have a longer fire travel and much more radiating surface than coal furnaces, and are, therefore, much more efficient.

SEC. 30.—WASTE FROM EXCESSIVE HEATING.

Rooms are more healthful if kept at about 68° F. with proper humidity, yet much gas is wasted by keeping room temperatures higher. A thermostat control will greatly aid in controlling waste from this source.

A thermostat on the baker of a cooking stove is also desirable, because it will use just enough gas for the particular baking operation, without waste.

SEC. 31.—WASTE FROM USELESS RADIATION.

The baker of the ordinary natural-gas range is very poorly insulated and the radiation loss is large. Use of proper insulating material will greatly improve the efficiency.

The heat radiated into furnace rooms from the furnace, the furnace piping, and hot water and steam piping does not enter the room that is to be heated and therefore is wasted. Proper insulating of furnace piping will greatly curtail this loss.

In any gas-heating device the temperature of the combustion products where they go into the chimney should be within 100° of the air or water that is heated.

SEC. 32.—WASTE FROM DAYLIGHT BURNING OF LAMPS.

One incandescent mantle lamp burning all of the time, or 8,760 hours in the year, will consume 43,800 cubic feet of gas. Three such lamps will waste enough gas to supply an average of one domestic

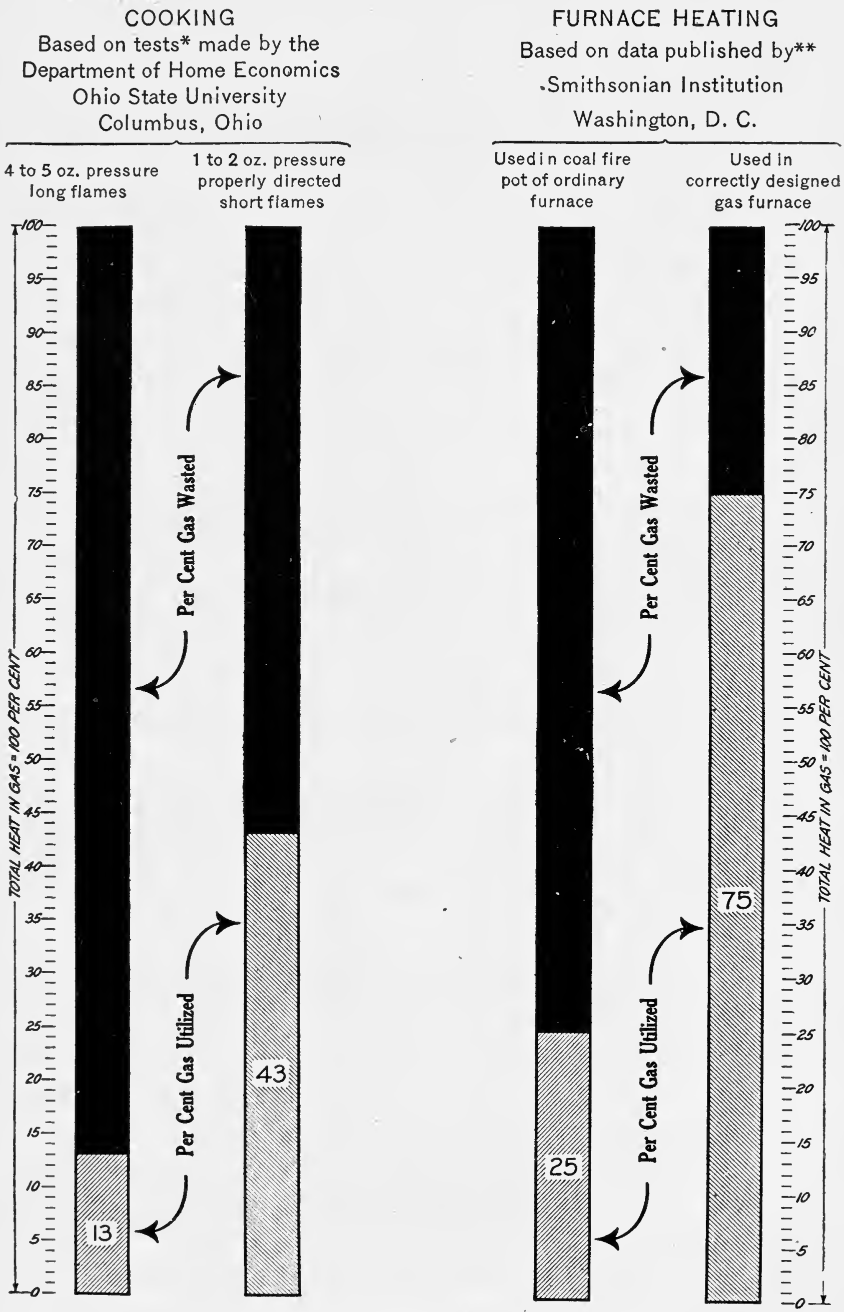

FIGURE 6.—Home wastes of natural gas.

*Ohio State University Bulletin No. 28. Effect of Gas Pressure on Natural Gas Cooking Operations in the Home.

**Smithsonian Institution Bulletin No. 102, Part 7, on "Natural Gas: Its Production, Service, and Conservation."

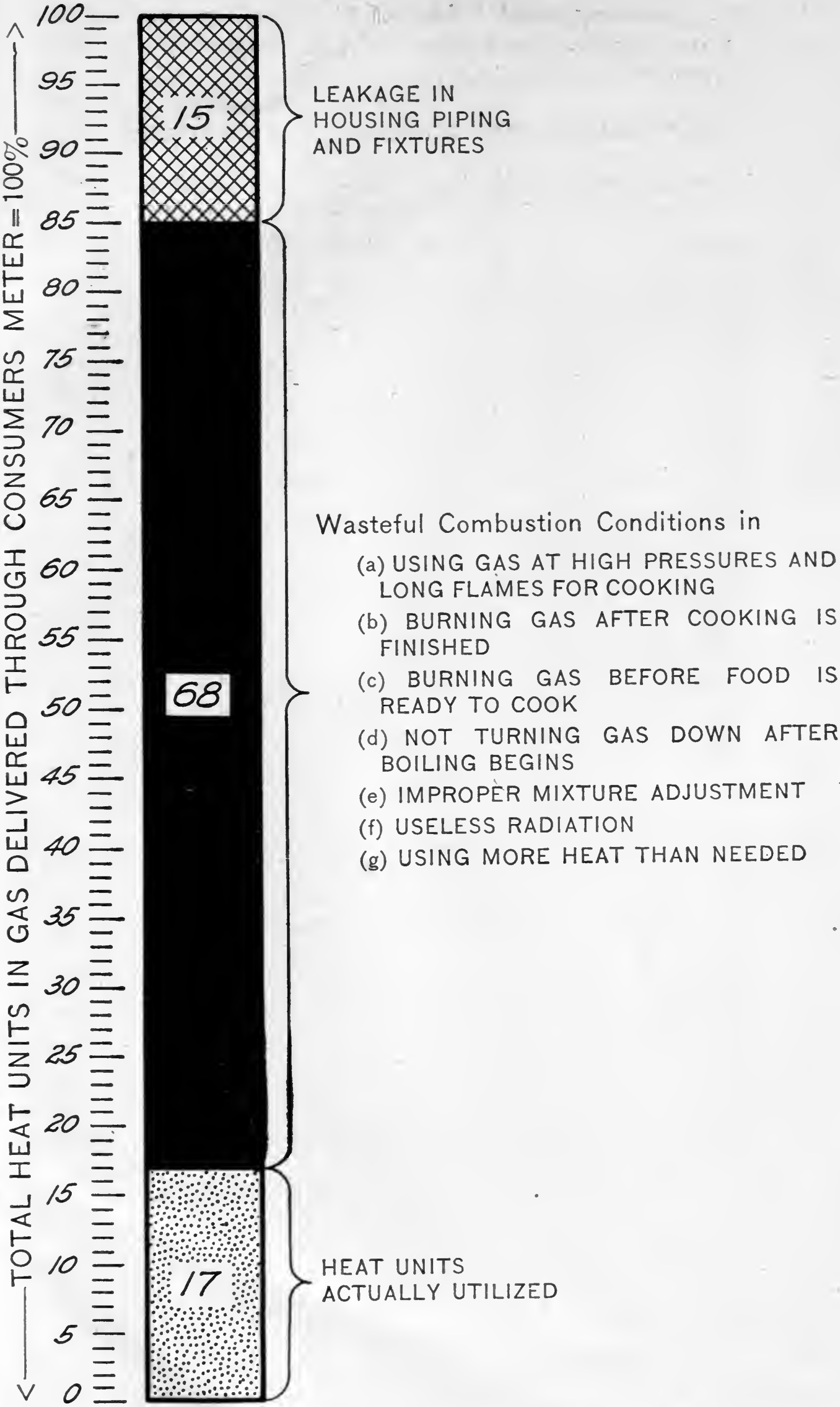

FIGURE 7.—Analysis of home wastes of natural gas.

consumer. As many street lights are fitted with three mantles per post and are kept burning continuously, the waste from this source is much greater than is ordinarily appreciated.

SEC. 33.—WASTE FROM IMPROPER LAMP ADJUSTMENT.

Most incandescent mantle lamps are not properly adjusted and use much more gas than is necessary, usually 50 per cent to 75 per cent more than would be required with proper adjustment. A hissing or roaring sound from the lamp is a sign of excessive consumption. This not only wastes gas but shortens the life of the mantle.

SEC. 34.—WASTE OF GAS IN NOT USING MANTLE.

Many people still attempt to get illumination by using gas in the ordinary open-flame burner. For a given amount of illumination a flat burner will require 2½ times as much gas as an incandescent mantle.

SEC. 35.—WASTE OF GAS WITH DIRTY APPLIANCES.

Cooking burners if not properly cleaned will give imperfect combustion and will, therefore, waste gas. Lamps if not properly cleaned will likewise be inefficient.

Hot-water heaters having the heat applied at the bottom of the tank, or any of the forms of coil or circulating heaters, require frequent cleaning. The deposition of soot, produced by the chilling action of the cold water on the flame, increases the gas consumption.

The use of grid or open tops on cook stoves, so that the burners are entirely visible, will result in more frequent cleaning of the burners and, therefore, more efficient stove operation.

SEC. 36.—WASTE IN HOT-WATER HEATERS.

Water that precipitates scale or sediment will frequently build up a thick coating on the inside of a hot-water heater and greatly increase the amount of gas necessary to heat the water. In a great many cases this scale in time will entirely close the water passage.

Most coil or circulating heaters do not have enough radiation surface and the combustion products leave the heater at a much higher temperature than they should.

In the tank type of heater, where the flame is applied at the bottom of the tank, it is necessary to have an outer jacket of galvanized sheet iron, about No. 30 gage and about 2 inches larger in diameter than the tank, so as to leave an annular space between the tank and it. This jacket should extend several inches below the bottom of the tank and should have a tight head or end at the top, which in turn should be connected to a chimney. If such a jacket is not provided the gas consumption will be excessive. However, with such an outer jacket the efficiency can be kept as high as with a coil heater.

With instantaneous heaters improper adjustment of the pilot light frequently results in excessive consumption of gas.

SEC. 37.—WASTES THAT OUGHT TO BE PROHIBITED.

(*a*) Improper adjustment of appliances, resulting in imperfect combustion.

(*b*) Low burners—that is, burners more than 1¼ inches away from the cooking vessel on cook stoves.

(*c*) Solid tops on cook stoves. Grid tops or skeleton lids only should be used.

(*d*) Use of gas in coal furnaces and stoves. Especially built gas-heating appliances, giving an efficiency of at least 75 per cent should be used.

(*e*) No hot-water heater should be used that gives an efficiency of less than 75 per cent.

(*f*) No tank heater, that is, tank with burner underneath, should be used without an outer jacket and flue connection.

(*g*) All daylight burning of lamps ought to be prohibited.

The prohibition of the foregoing wasteful uses of natural gas would—

(*a*) Greatly improve the quality of the service.

(*b*) Immediately convert low-pressure conditions into usable service for cooking.

(*c*) Cut down the needed consumption during the cold-weather period—where the demand is now greater than the available supply—so as in effect to make more gas available for all.

(*d*) Add 15 to 20 years to the period that natural gas will be available for domestic use.

(*e*) Because of the greatly increased efficiencies obtained—even with decidedly higher prices per 1,000 cubic feet—would permit the domestic consumer to get the same service without a greater annual outlay of money.

(*f*) Permit the many small towns that are too small for the introduction of manufactured gas to have gas service for a much longer period.

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