CHAPTER 9

How To Cheat The Chimney

In the average oil burning plant the losses are:

1. Losses up the chimney.
2. Radiation and other losses.

Of these, when it is considered that about 50% of the heat lost goes up the chimney, something should be done about it. In many cases nothing is or can be done about it without extensive changes.

Chimney or stack losses may be divided into three classes:

1. Excess air losses.
2. Unburned fuel loss.
3. Excess flue gas temperature loss.

In many cases blame the last mentioned loss on the boiler not the burner, especially in boilers originally designed for coal burning and which were not properly converted to oil burning.

Ques. Describe the excess air loss.

Ans. Air contains about 80% nitrogen which serves simply to dilute the oxygen in the air. This nitrogen is heated up to flue gas temperature and blown into the outside air.

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This loss even if a perfect mixture of the available oxygen and carbon could be secured, would be very large. Accordingly, any unnecessary air increases the loss.

Ques. Describe the loss due to incomplete combustion.

Ans. If the carbon do not burn completely, carbon monoxide is formed which is a loss because carbon monoxide can be further burned to carbon dioxide. This loss sometimes amounts to as much as 25%.

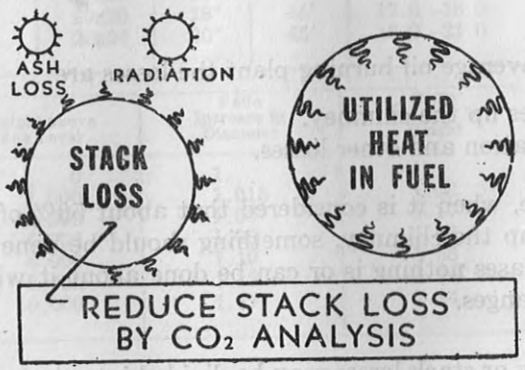

FIG. 1—An idea of stack loss going up the chimney. Excess air is the greatest single loss in burning fuel of any kind.

Ques. How about the excess flue gas temperature?

Ans. This is due to the lack of heating surface in ordinary boilers.

Ques. Give an example.

Ans. If the flue gas temperature be high, say 500° Fahr. there would be 20% heat loss, assuming perfect mixture of air and fuel (no excess air); if the temperature be 800° there would be a heat loss of 40%, etc. It can be seen that with the usual amount of excess air, this loss is enormous.

Ques. Assuming proper burner operation, how is the best way to "cheat the chimney"?

Ans. Put in a boiler with proper amount of heating surface.

There are many basements decorated with boilers in which this requirement is sadly lacking—such junk should be thrown out.

Ques. What is the cause of undue excess of air?

Ans. Leaks, through which outside air will push its way in and cut down the efficiency.

Ques. How do you test for leaks?

Ans. If a lighted candle be held near a leak, the candle flame will be drawn through the opening.

Ques. Why?

Ans. Because the absolute pressure in the combustion space in the boiler is less than the absolute pressure outside.

All leaks should be plugged by some type of asbestos cement.

Ques. How is excess flue gas temperature caused except by the usual cause of inadequate heating surface?

Ans. 1. Sooted heating surface; 2, short circuiting through large flues; 3, excess draught; 4, improper conversion from coal to oil.

Remedies.—For 1, keep the heating surfaces clean; 2, provide baffles; 3, provide additional heating surface or regulate draught with damper; 4, on conversion jobs baffling should be provided — however, this is a makeshift. The real thing to do regardless of cost, is to throw out the cast iron junk with its large and short flues and replace with a 25 to 1 tubular boiler.

Ques. What is the first step in securing fuel economy?

Ans. The first step is to reduce **chimney losses.**

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Ques. How is this done?

Ans. By testing draught, stack temperature and CO_2 and applying proper remedies.

Ques. What equipment should every oil burner man possess and use?

Ans. A combustion testing service kit.

Ques. What instruments are provided in the kit?

Ans. Draught gauge; stack thermometer and CO_2 analyzer.

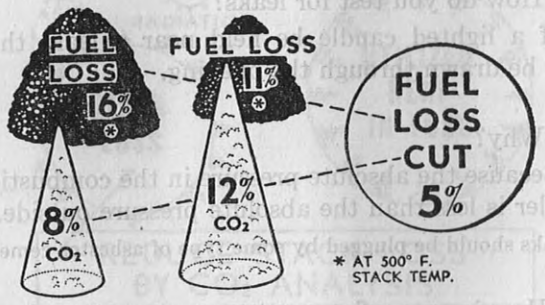

FIG. 2—*First step to fuel economy*—higher CO_2.

Ques. What does the CO_2 test show?

Ans. It shows whether the fuel receives the proper amount of air.

Ques. What does the stack temperature test show?

Ans. It indicates how well the boiler heating surface absorbs the heat of the fuel burned.

Ques. What do both readings combined show?

Ans. They show the loss due to the heat carried away in the flue gases.

Ques. What other use is made of the draught gauge?

Ans. It is indispensable for adjusting the draught so that the products of combustion are carried away under all conditions.

Ques. What should be noted about stack temperature?

Ans. The larger the percentage of heat absorbed by the boiler the smaller will be the percentage of heat wasted up the chimney.

Efficient heat absorption is indicated by low temperature of the flue gases.

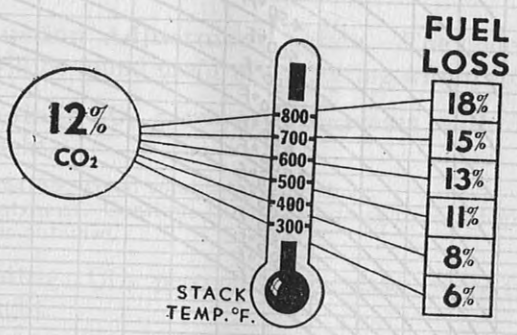

FIG. 3—*Second step to fuel economy*—lower stack temperature.

Ques. Why must the CO_2 test and flue gas temperatures be considered in relation to each other.

Ans. Because the most effective use of any kind of fuel depends upon maximum production of heat in the furnace, combined with the maximum absorption of heat by the heating surface which depends upon stack temperature.

Ques. Why is the use of the CO_2 analyzer important?

Ans. Without a CO_2 analyzer it is difficult for even the most

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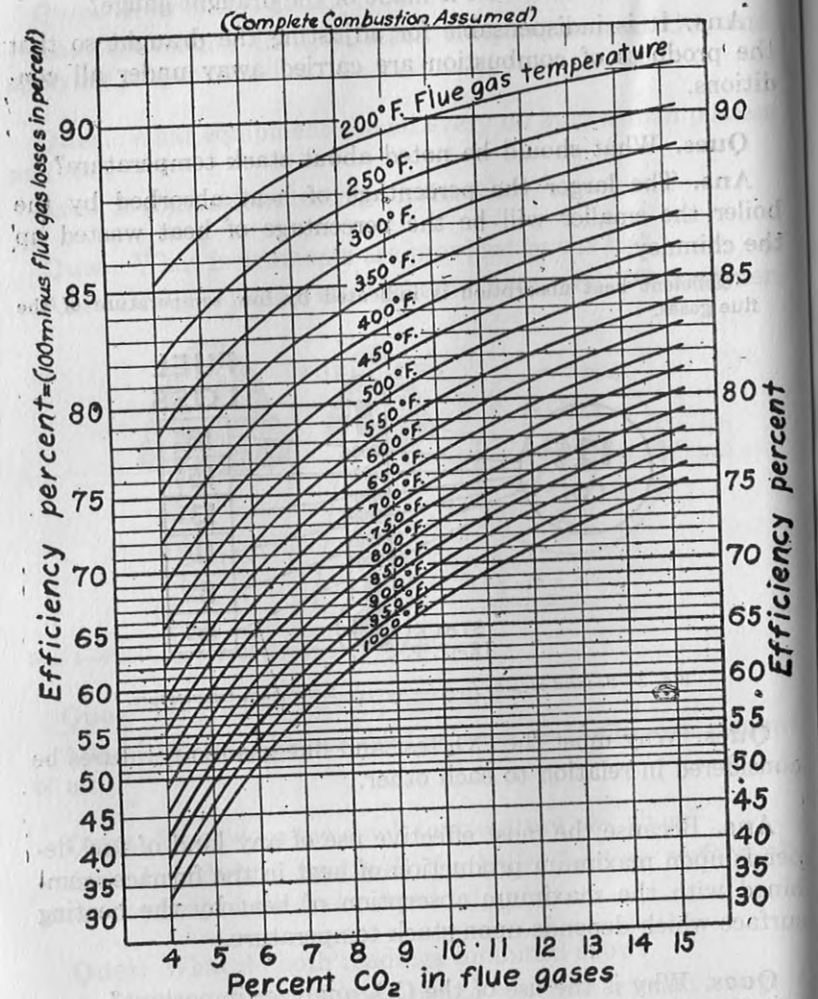

FIG. 4—Efficiency curves for complete combustion of domestic oil burner distillates—Senner.

expert oil burner man to adjust the flame to maximum efficiency and to estimate with any degree of accuracy the per cent of CO_2 being produced.

Ques. How about judging by the appearance of the flame?

Ans. This test is no good as often it is misleading.

Ques. On what type oil burner is the use of testing instruments in adjusting the flame and selecting the most efficient burner nozzle especially important?

Ans. On gun type burners.

Combustion Adjustment Guide.—The following information will be found useful when testing with a CO_2 analyzer:

1. **Reading.** CO_2 percentage increases with increase of draught.

   Indication. Good combustion efficiency.
   Adjustment. Continue to increase draught until highest CO_2 percentage is obtained.

2. **Reading.** CO_2 percentage decreases with increases of draught.

   Indication. Too much excess air.
   Adjustment. Cut back draught to reduce air supply until highest CO_2 percentage is obtained without producing smoky fire.

3. **Reading.** Low CO_2 percentage under proper draught conditions.

   Indication. Air leaks in furnace or boiler setting.
   Adjustment. Seal air leaks and clean out doors, boilers, setting, etc. Keep fire doors closed tight.

4. **Reading.** Normal CO_2 percentage with high flue temperature.

   Indication. Dirty heating surfaces.
   Adjustment. Blow soot frequently and properly.

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5. **Reading.** CO_2 percentage decreases with decrease of air supply.

Indication. Incomplete combustion.
Adjustment. Increase air supply until increase in air supply results in high CO_2 reading.

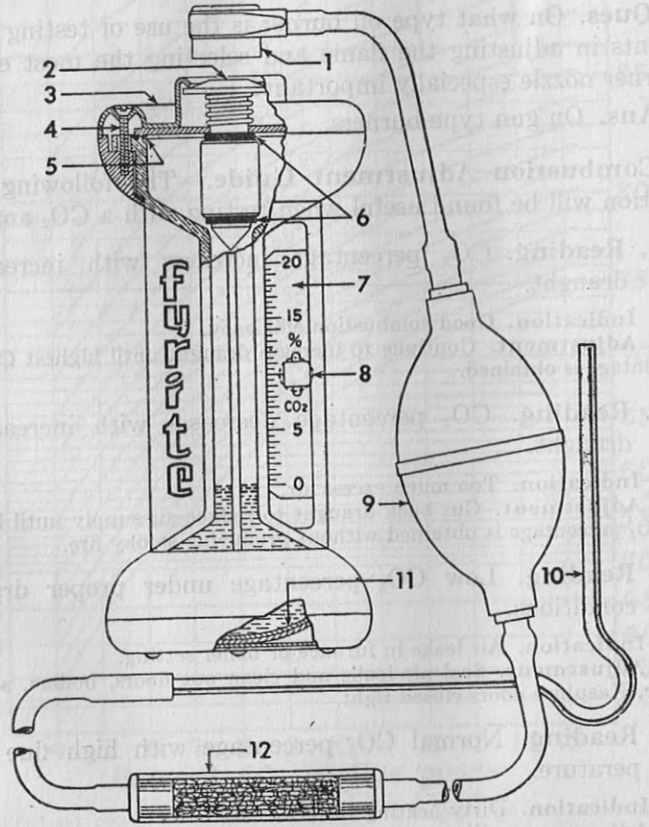

FIG. 5—CO_2 analyzer—Operating instructions are given in the accompaning text.

Instructions for Using CO_2 Analyzer.—The "Fyrite" analyzer (as well as any other gas analyzer) should be at room temperature when used. Refer to figs. **A** to **J**. Insert open end of sampling tube 10*, into hole provided in stack, as far as it will go, as in fig. **F**.

Take connector tip 1, at end of sampling hose and look for hole in one side; place the connector tip with hole facing down on plunger cap 2, holding it down firmly with forefinger of hand, holding the analyzer fig. **G**, leaving the other hand free.

Always hold analyzer upright while connector tip is engaged.

Grasp bulb 9, with free hand and squeeze and release it eighteen times in quick succession, fig. **F**, to purge thoroughly.

Immediately after last squeeze, before releasing bulb, lift finger from connector tip 1, allowing plunger cap 2, to spring back to its original (closed) position, thus locking a gas sample in the analyzer. Lay connector tip and sampling hose aside.

Now hold analyzer upside down, fig. **H**, until all fluid flows down, and then upright so that fluid flows back (for maximum accuracy, performing this operation twice).

Tilt about 45°, fig. **I**, for several seconds to drain excess fluid from walls.

Hold upright again at eye level, fig. **J**, and from graduated CO_2 scale 7, read directly the per cent CO_2 corresponding exactly to level of meniscus of fluid column.

Before engaging connector tip to take another gas sample, depress plunger cap 2, with finger or thumb, thus venting analyzer to atmosphere and allowing fluid level to return to zero.

NOTE.—Numbers refer to fig 5.

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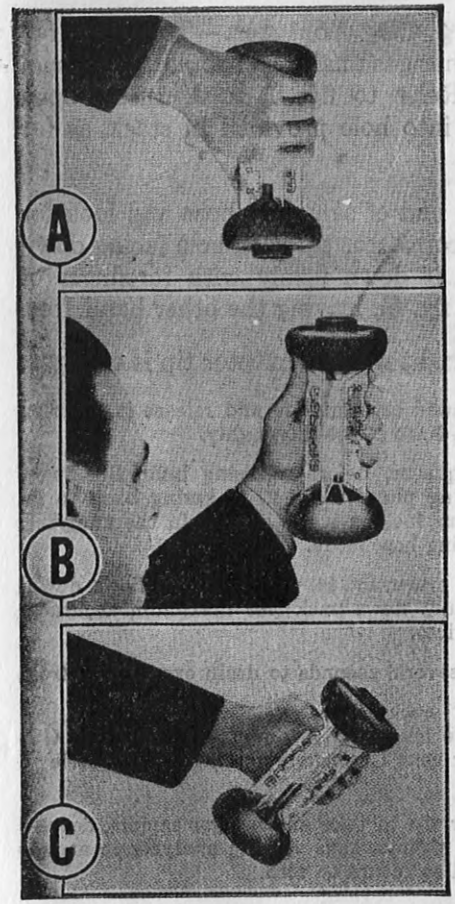


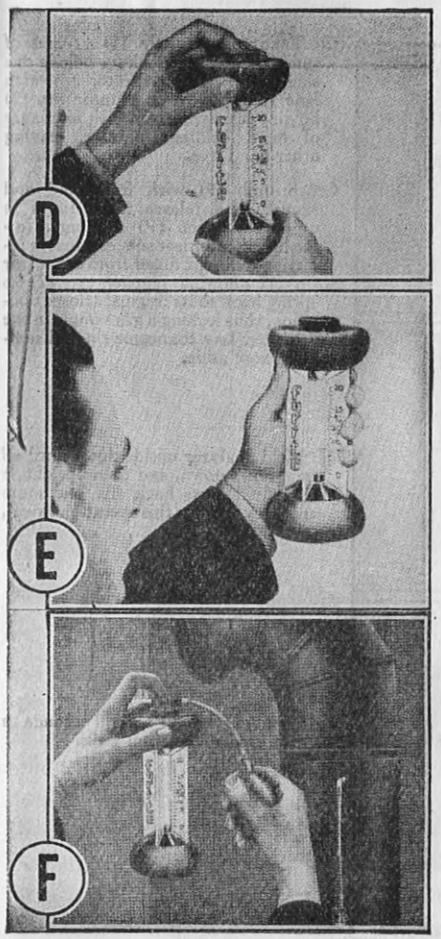
FYRITE

Zero Adjustment

A: Hold analyzer upside down until fluid flows to top end.

B: Return to upright position so that the fluid runs back to the lower well, in order to wet the walls.

C: Tilt the analyzer about 45° for several seconds to drain excess fluid from the walls, then hold upright again.



D: Slowly depress plunger cap (2) with forefinger of the left hand, thus venting to atmosphere, then lift finger.

E: Hold analyzer vertically so that top surface, called the "*meniscus*" of the fluid column and which is colored dark to be easily seen, is at eye level. See that meniscus is level with zero line. If not, loosen lock screw (8) behind scale and move scale up or down to line up. Holding scale in place with thumb or left hand, tighten lock screw.

TAKING A SAMPLE

F: Insert open end of sampling tube into hole as far as it will go, placing open end at center of flue gas stream.

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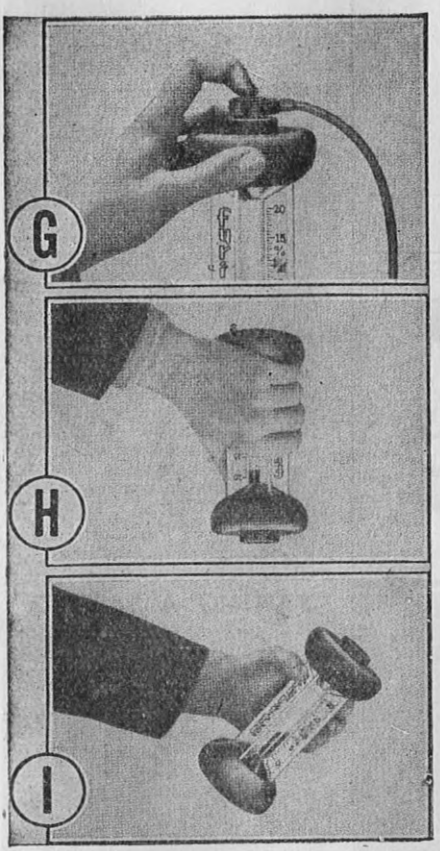

G: Take connector tip (1) at end of sampling hose and look for hole in one side; place this connector tip with hole facing down on plunger cap (2) holding it down firmly with forefinger of hand holding analyzer, leaving other hand free.

Grasp bulb (9) with free hand and squeeze and release it 18 times in quick succession (F) to purge. Immediately after last squeeze, before releasing bulb, lift finger from connector tip (1) allowing plunger cap (2) to spring back to its original (closed) position, thus locking a gas sample in the analyzer. Lay connector tip and sampling hose aside.

H: Hold analyzer upside down until all fluid flows down, and then upright so that fluid flows back (for maximum accuracy perform this operation twice).

I: Tilt about 45° for several seconds to drain excess fluid from walls.

NOTE.—In figs. A to J, the numerals refer to fig. 5.

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Use only analyzer fluid for replacement. When replacing fluid, it is good practice to clean the instrument thoroughly. Use only lukewarm soapy water to clean the analyzer body.

The fluid in the analyzer may tend to increase in volume with use due to condensation from flue gas. To remove excess fluid: Set analyzer upright, remove screws (4) holding top cap (3) and remove top cap assembly. Insert a tube (about size of sampling tube) through analyzer into fluid, place finger over open end of tube, and withdraw. Important: Avoid getting analyzer fluid on skin or clothing as it is harmful to both.

Replace filtering material in filter tube (12) when it becomes wet from condensed moisture or when it appears dirty. Clean out sampling tube with a stiff wire if it become clogged.

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