CHAPTER 2

# Fuel Oils

When gasoline is removed from petroleum, a hydro-carbon results which may be further distilled into the various fuel oils. Oil is made up almost entirely of the two elements, carbon and hydrogen. Other elements such as oxygen, nitrogen and sulphur may be present in traceable quantities. Commonly used heating oils contain approximately 86 per cent carbon and 14 per cent hydrogen.

Carbon and hydrogen form as much as 99 per cent of the total weight of oil. Those conditions which support efficient combustion of carbon assure satisfactory combustion of the hydrogen.

A chemical analysis of oils of various weights, ranging from the heavier fuel oils on up the scale to even a very light gasoline, shows a very close parallel.

There is a great diversity of color, weight, burning point, flash point, etc. (A decided similarity in chemical analysis but a wide variety of physical differences).

The table on the next page shows the range of oils.

The lightest is shown at the top, stepping down to the heavier. Through this scale a line has been drawn. The oils listed above the line are of such physical characteristics that they may be burned with varying degrees of success by the vaporization process.

Oils below the line are of such characteristics that they must be

sprayed by some mechanical means before the required conditions for efficient combustion can possibly be established.

This spraying process, it should be noted, is commonly and ridiculously called *"atomization"*—good sales talk, but erroneous.

## RANGE OF OILS

| | | |
|---|---|---|
| SUCCESSFULLY BURNED BY VAPORIZATION | NAPHTHA | |
| | GASOLINE | COOKING AND OTHER SMALL FIRES |
| VAPORIZATION METHOD NOT GENERALLY-SUCCESSFUL- | KEROSENE | |
| | CLEAR DISTILLATE | DOMESTIC HEATING |
| MECHANICAL ATOMIZATION | NO.1 OIL | |
| | NO.2 " | |
| | NO.3 " | |
| | NO.5 " | INDUSTRIAL HEATING |
| | NO.6 " | |

The very light oils at the top of the scale vaporize readily at relatively low temperature. It is only necessary to effect the proper mixture of oxygen with the vapor, and complete combustion follows because oxygen is brought into intimate contact with the exceedingly fine bits of oil which make up the vapor.

With these light oils vaporization takes place without leaving objectionable residue. The heavier oils yet above the dividing line do not vaporize so readily, hence heat must be applied to induce *"vaporization."* The heavier the oil, the more heat required.

At the dividing line, a point is reached where the application of heat and burning by vaporization is no longer practical. The reason for this is that when adequate heat is applied to induce vaporization, disintegration—*"cracking"*, takes place, the lighter vapors passing off, leaving free carbon and residue behind. Consequently, the heavier fuel oils must be sprayed (so called atomized) for burning, by some mechanical process which transforms the oil from the liquid to a very fine fog in order that the oxygen necessary for supporting combustion may surround and be brought intimately into contact with the fog-like sub-divisions of the liquid.



# Definitions of Terms

**Baume.**—A scale which indicates the weight of oil per unit volume at 60° Fahr.

**Viscosity.**—An indication of the readiness with which an oil may be sprayed.

In tests: The number of seconds required for a definite quantity of oil to drain through a standard orifice at 100° Fahr.

**Flash Point.**—The temperature of the oil at which a jet of flame passed near the surface of the oil will cause the oil vapors to flash.

**Pour Point.**—The minimum temperature in degrees Fahrenheit at which the oil will flow.

**Conradson Test.**—Apparatus in which oil is burned, the readings indicating the percent of carbon residue.

**Grades of Fuel Oil.**—As adopted by Underwriters Laboratories and the American Petroleum Institute. The listing of fuel oils by number and name is as follows:

| | | |
|---|---|---|
| Oil No. 1 | Furnace oil. | Light domestic. |
| Oil No. 2 | Furnace oil. | Medium domestic. |
| Oil No. 3 | Furnace oil. | Heavy domestic. |
| Oil No. 4 | Fuel oil. | Light industrial. |
| Oil No. 5 | Fuel oil. | Medium industrial. |
| Oil No. 6 | Fuel oil. | Heavy industrial |

The heat value of these oils is as follows:

| | |
|---|---|
| Oil No. 1 | Average 136,000 *B.t.u.* per gal. |
| Oil No. 2 | Average 138,500 *B.t.u.* per gal. |
| Oil No. 3 | Average 141,000 *B.t.u.* per gal. |
| Oil No. 4 | Average 145,000 *B.t.u.* per gal. |
| Oil No. 5 | Average 148,500 *B.t.u.* per gal. |
| Oil No. 6 | Average 152,000 *B.t.u.* per gal. |

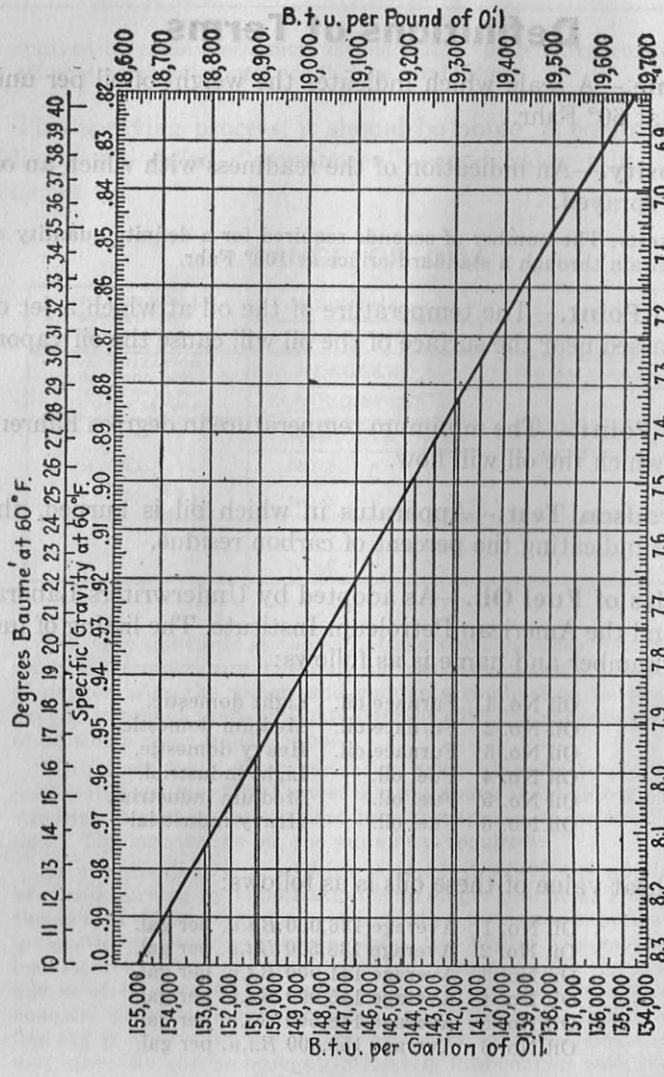


FIG. 1—Baume readings with corresponding weights and *B.t.u.* per gallon of oil, and per pound of oil.