## COMPLETE COMBUSTION IN BOILER FURNACES

The theory of the complete combustion of fuel has been so thoroughly expounded by capable engineers and chemists, and the means of effecting this are so simple, that it is difficult to understand why modern power stations are still in trouble concerning it; and are continually in the law courts for causing a smoke nuisance. The greatest offenders have undoubtedly been boilers of the water-tube type: although if the conditions necessary for complete combustion are carefully considered when designing the furnace, there need be little doubt about attaining satisfactory results from water-tube boilers, even with low-grade bituminous coal. Furnace designers, although fully alive to these necessary conditions, appear to have had difficulty in applying them, hence, the offensive clouds of smoke which are continually descending from boiler chimneys upon our cities and townships. It has often been a surprise to train-ed engineers that the famous firm of Babcock and Wilcox, Limited, have not hitherto applied an effective smoke prevention appliance to their well-known water-tube boilers.

perature zone through which they have to pass, readily absorb additional oxygen, and burn to  $CO_2$ , thus completing the combustion of the hydrocarbons; getting the full heat energy out of the fuel; increasing the volume of steam generated, and effectively preventing the emissions of smoke.

This form of furnace can be hand-fired, though it is obvious that the results will not be as satisfactory as when working with a chain grate coking type of stoker; for the volatile gases given off intermittently and in large volume are not so easily dealt with as they are by means of the latter device; since the gases are given off more continuously and in smaller volume. It has been urged as an objection against chain-grate stokers that they allow an excess of air to pass through the fire; the over-fire, high temperature zone, however, provided by the new "Babcock" furnace, effectively takes care of the unconsumed oxygen; for it is claimed that analysis of the flue gases from several batteries of boilers equipped with the new refractory arch furnace



It is, however, the unexpected that is always happening. This month, through the courtesy of the above mentioned company, we have pleasure in setting before our readers a new arrangement of furnace and stoker recently introduced in connection with their boilers, which it is claimed "is absolutely smokeless, even when running 50 per cent. overload."\*

It consists essentially of a refractory arch or lining, which is fitted in front of the boiler, and covers more than half the grate area, the whole grate being brought further forward than in the old design. The result of this arrangement is, that the volatile constituents of the fuel, such as hydrocarbons, which formerly ascended directly to the water tubes, and were there split up by the comparatively cold surfaces into fine particles of solid carbon and soot, or passed along to the chimney as CO, an unburnt gas; are now—immediately they leave the green fuel—brought in contact with the incandescent arch, and, due to high tem-

## POWER COSTS.

Before the Canadian Society of Civil Engineers, W. H. Laurie recently gave the relative costs per brake horsepower per year developed by means of gasoline, steam and gas engines as follows: Gasoline engines, 78.00; gas engine with illuminating gas, 46.80; steam engine, 37.44; semiwater gas from anthracite, 7.80; semi-water gas from gas shows an average of 12 per cent.  $CO_2$ , with an entire absence of CO., which is indicative of complete combustion.

One of the chief advantages of this stoker is, that it can be withdrawn from the boiler at any time for examination or repairs, without disturbing the brickwork or setting. The tracks are provided for it to run on as shown in the sketch.

This type of furnace can be fitted to any type of watertube boiler, and would, no doubt, be efficacious in considerably abating the smoke nuisance.

\*[While we consider this apparatus a distinct advance in modern boiler furnace construction, we hesitate to assent to the claim that it is "absolutely smokeless." When using anthracite it may be; but in the order of things, the terms "absolute" and "perfect" can not be predicated of the results attained by any open grate furnace. At the same time, for all *practical* purposes the combustion in this furnace may be *complete.*—Editor.]

coke, 5.74; water and producer gas from bituminous coal, 5.00. These costs were based on the assumption of 312 days of ten hours; one-eighth gallon of gasoline at twenty cents for a brake horse-power; 15 cubic feet illuminating gas at \$4 per ton; one pound of \$5 a ton anthracite coal for semi-water gas; .92 pounds gas coke at \$4 a ton for semiwater gas; and .8 pound bituminous coal at \$4 per ton for producer gas.