Rates of Combustion in Locomotive Furnaces. By R. A. Smart.

The following brief comparisons of the rates of combustion in locomotive and stationary furnaces, based upon data of tests made at the Purdue University Locomotive Testing Plant, will show some of the effects of the heavy duty which the limitations of space and the requirements of portability impose upon locomotive boilers.

In stationary boiler plants, the usual rate of combustion is between the limits of 8 to 20 pounds of coal per square foot of grate surface per hour. From the record of the rate of combustion of over half a hundred boilers tested by Geo. H. Barrus, a well known expert, an average of 11.5 pounds per foot of grate was found, which may be taken as representing good practice. Under certain conditions of speed and cut-off, it has been found that the Purdue locomotive, "Schenectady," which is a fair representative of its class, consumes 2,670 pounds of coal per hour, while developing 520 indicated horse power. To consume this quantity of coal economically at the rate given above would require a grate area of 232 square feet. Taking 8 feet as the extreme allowable width, this would give a furnace 29 feet long, which is of course much beyond the limits of available space. As the furnace of the Purdue locomotive has, however, only 17.5 square feet of grate surface, instead of 232, the rate of combustion under the conditions mentioned above reaches the abnormal figure of 153 pounds per square foot per hour.

It has been stated by Isherwood that the evaporative efficiency of horizontal return tubular boilers of ordinary design decreases as the rate of combustion increases, and if this holds in stationary practice it may be taken, in a measure, as applying to locomotive practice. From this it is apparent that where only 17.5 square feet of grate surface are provided to consume a quantity of coal requiring over 200 square feet for economical combustion, thereby raising the rate of combustion from 11.5 to 153 pounds per square foot, the evaporative efficiency will necessarily be low.

This extraordinary rapidity of combustion is still more striking when compared with the conditions existing in an open fireplace. For instance, the rate of combustion in an ordinary parlor grate is about 4 pounds per hour to the square foot. At this rate it would require a grate equal in area to that of a room 26 feet square to consume the coal burned during the tests mentioned.

Other comparisons may be made as follows: Stationary boilers are usually allowed about 12 square feet of heating surface per horse power developed, while the total heating surface of "Schenectady," about 1,200 square feet, allows, under

ordinary conditions, 4 square feet to the horse power, and under extreme conditions, but 2 square feet.

The draft in a stationary plant having a chimney 50 feet high is less than 0.5 of an inch of water. The locomotive frequently runs under a draft as heavy as six inches, making it necessary for the fireman to keep a very thick fire on the grates.

With such great differences existing between the conditions apparently required by economy and those actually found in locomotive practice, it would be expected that the evaporative efficiency of the latter would be small by comparison. It is interesting to note, however, that in spite of the disadvantages under which the locomotive labors, its evaporation is seldom less than 50% of the best evaporation given by stationary plants.

The Influence of Heat, the Electric Current and Magnetism Upon Young's Modulus. Mary Chilton Noyes.

A series of experiments were carried out in the physical laboratory of Western Reserve University to determine the effects of heat, of an electric current and of magnetism upon the elasticity of piano wire, and of copper and silver wire. The wires were heated by means of an electric current from a storage battery, the current sometimes going through a magnetizing helix surrounding the wires, sometimes through a non-inductive coil, and sometimes through the wires themselves. The methods of heating were used in different order with different pieces of wire, in order to detect, if possible, any temporary or permanent effect which was not due to the heat, but no such effect could be found.

The thermal co-efficient of elasticity for the piano wire was found to be 4.6% for 100°. For the silver wire it was about 8% and for the two specimens of copper wire tested 13% and 7%. The permanent change in elasticity produced by repeatedly heating the wires was from one to two per cent.

With the silver and copper wires the effect of heat upon the elastic limit was determined. The limit was found to decrease quite rapidly and regularly as the temperature was raised. The two specimens of copper wire tested were found to give quite different results for the thermal co-efficient of elasticity, the co-efficient of expansion and the co-efficient of decrease in the elastic limit with rise of temperature.