

that if 140 to 150 lbs. was considered a standard for a new mill in America, the corresponding practice would be 200 lbs. in England, 180 in Elsass, and 140 to 150 in Belgium and Germany. In all countries I found occasionally higher pressures than the above, and, of course, the immense majority were lower.

ECONOMIZERS.

The use of economizers is more general in Europe than in America, and the type known as the "Green," now made by several good firms, is the standard. Occasionally on the continent one of the bouilleurs of the elephant boiler was used as an economizer. The most general practice was to put one economizer for each battery of boilers, making the economizer heating surface and the boiler heating surface the same. In Belgium, however, they were recommending one small economizer to each boiler. Scrapers are used to keep the fire surfaces clear of soot. The water surfaces are subject to scaling if the water be bad, and it is chiefly in the bad water districts that economizers are not used, though they are not much, if any, worse in this respect than water tube boilers. But when the economizers are taken out, the heating surface of the boilers must be more than doubled to get the same economy.

HEAT STORAGE.

An advantage claimed for the Lancashire boilers and the economizers was that the large amount of hot water in them afforded a reserve of heat for a sudden call. An interesting application of this principle were the feed storage and the steam storage systems of D. Halpin, Esq., London. The first is applicable to all plants, and consists in providing tanks in which the feed is heated to the steam temperature by steam from the boiler during light demand, so that during the heavy demand the feed water is supplied hot (360° F.) instead of 100° or 200°. The steam storage consists in having very high pressure boilers, which pressure is reduced at the engine. Water is heated to boiler pressure during light load and stored in tanks, and during the heavy load expands into steam and relieves the demand of the engines on the boilers proper. The steam storage system did not impress the writer favorably. If you are going to go to the expense of high pressure boilers anyway, then it seems to him that you will be as apt to save coal by using high pressure steam at your engines as by reducing the pressure in order to equalize the load on the boilers. But the feed storage system, particularly where economizers are not used, seems a very practicable method of reducing the net first cost by a few per cent. (the boiler plant saved would cost more than the feed storage), and at the same time probably increasing the economy. Both the feed and steam storage systems are especially available with bad water.

SUPERHEATERS.

The use of superheated steam is very much in the air all over Europe, and in Elsass (Alsace) it is fairly general, about 500 superheaters being in use. There has never been any doubt that it saved from 10 to 20 per cent. of coal, but the difficulty has been in the lubrication of the engine cylinder and the keeping the large number of superheater joints tight. The Schoerer superheater, which is much used in Elsass, consists of a small number of very heavy ribbed cast-iron pipes placed in a very hot portion of the flue, as, for instance, between the tubes and the drum of a Babcock & Wilcox boiler. The cast-iron is made thick enough so that it may become red-hot without injury, and by being in the hot portion of the flue only a small superheater is required. The trouble with lubrication is overcome by using a high grade mineral oil. In England and on the continent, several forms of superheaters using thin steel pipes were under test. I did not hear of their sale in any number as yet. The superheaters are also placed above a separately fired furnace in some plants.

GRATES.

The grates in ordinary use did not noticeably differ from those in use in America. In Germany some of the under fired boilers were provided with grates that inclined downwards to the rear as much as a foot or a foot and a half, which was thought to be easier for the firemen and to give better combustion. The ash-pits of these boilers were unusually deep. The coal is frequently very soft and bituminous, but in their internally fired boilers they had no trouble from having the furnace top only 18 inches or less from the grates; in fact the Lancashire boiler enjoyed a better reputation for smokelessness than many others.

MECHANICAL STOKERS.

In England several forms of mechanical stokers were in use, perhaps over one-quarter of the boilers being equipped. They may be divided into two general classes, the coking and the sprinkling stokers. The coking stokers feed the coal at the front, where it cokes and is then carried to the rear by the reciprocating motion of the grate bars. The Vicars stoker is the best known of the class.

It is represented in this country by the Roney, Wilkinson, Murphy, Brightman and other types; the chief difference being that on account of the internally fired boilers the Vicars grate bars are level. The sprinkling stokers throw the coal over the grates by means of revolving or oscillating shovels; but they generally use as well a reciprocating motion of the grate bars to carry the ashes to the back end. The Bennis stoker is perhaps the most widely used of this class, but there are several good firms who make stokers of each class.

Opinion is, of course, widely divided on the merits of mechanical stokers. What seemed to the writer to be the general drift of opinion of those best fitted to judge, was as follows: No stoker absolutely prevented smoke, but both types very largely diminished it. In this respect the coking stoker had a decided advantage over the sprinkling. Neither stoker kept up the steam pressure on a sudden call as well as hand firing: in this respect the sprinkling stoker was considered to act more quickly than the coking.

The sprinkling stoker was being sold at about three-quarters the price of the coking. The cost of the Vicars stoker was about \$500 for two stokers, each 2 feet 9 inches or 3 feet wide, and 4 or 5 feet long.

The opinion as to whether the stokers saved coal was evenly divided. The most general reasons for their adoption was the diminution of smoke, the smoke laws being very strict in England, and the use of a cheaper fuel. The use of a cheaper fuel undoubtedly saved money, but when compared on the same grade of fuel, the best opinion, so far as the writer could judge, was that they saved some coal, but not enough to show a net saving after paying the interest and repairs. The saving in labor was not generally considered, and did not amount to very much in small plants, or in plants where no coal-handling devices were adopted. The use of stokers and coal-handling appliances together was thought to save about one-third of the boiler room labor in large plants.

DUST FIRING.

In Germany, grinding the coal to a powder and blowing this dust coal mixed with air into a hot combustion chamber was a method that was being experimented on in several plants and was meeting with considerable favor. The "Wegener" process is used in England; the "Camp," the "Schwartzkopf" and others in Germany. Fig. 10 shows one of these arrangements. The fine dust (almost as fine as flour) is, however, not only a very dirty stuff to handle, but is also exceedingly liable to spontaneous combustion, and the problem of grinding and storing it had not yet been commercially solved so far as the observation of the writer went.

BOILER FITTINGS.

In boiler fittings several differences were noted. All fittings were noticeably heavier and stronger than with us. The use of spring-loaded safety valves is looked on as yet with a great deal of distrust, and those in most common use are the lever valve and also the dead-weight valve.

The use of try-cocks has been entirely given up in every plant that I visited, and two gauge-glasses are used instead, having been found not only nearer but safer. On the Continent one glass and a mechanical lever indicator were sometimes used.

The dampers on the smoke flues are almost always of the sliding and not of the butterfly type. This may be because the flues are almost always underground. The dampers are always regulated by hand, damper regulators being practically unknown. Forced, induced, steam-jet, and other artificial drafts are no more and no less in use than with us; that is they are not infrequent in special cases where the ordinary draft is insufficient, but they are in no sense general.

The use of guards on the water-gauges is very common to prevent pieces of broken glass from injuring the fireman. This is peculiarly necessary since in most of the foreign boilers the water glasses are on a level with the fireman's face.

PIPE COVERING.

The average quality of the boiler and pipe coverings did not seem to the writer as good as those in general use in this country. Occasionally he saw wood and even rope covering on high pressure piping, some of which was already distinctly charred. Some plants, of course, had very good coverings, and there was a custom of covering the top of the boilers very thickly with some cheap covering, with the result that nine times out of ten the space over the boilers was noticeably cooler than it is in America.

CHIMNEYS.

In regard to chimneys, the variety of sizes and of theories is just as great as it is here. The few of which the writer obtained both the dimensions and the amount of coal they were intended to burn were larger than those given in the tables in American books of reference for the same capacity. This may be because in Eng-