

through the indiscretion of the manager. The following incident, which came under my personal observation, will illustrate some of the necessary qualifications under consideration: A foreman, holding a responsible position, came to the works under the influence of liquor. The manager complained of work being done; without provocation the man raised a hammer to strike the manager. After a struggle the man was disarmed and made to return to his work. The circumstances were reported to the owners, who gave pre-emptory orders for the man's discharge. The manager refused to do as requested, on the ground that the owners' interests would suffer, from the fact no other man could be secured for this special work; but a good man was immediately put on to learn this special business, and three months after the hammer incident the man was discharged. By this judicious action on the part of the manager the company's interests were protected and the manager gained a victory over himself that was more valuable than gold. Superintendents and foremen should be men of ability, judgment and honor, to whom responsibility can be entrusted. Let them understand that they are to assume all the responsibility of their position, and then hold them accountable for the proper management of the business, and employers will not usually have cause to complain of poor work, or discouraging elements of success. The necessity of keeping machinery in good repair and in perfect running order, is very imperfectly understood by many, but it is a question of vital importance to the manufacturer, and the manager who fails to understand this simply lacks the judgment necessary to run any manufacturing establishment successfully. Such men usually have but little natural or acquired ability, and to make up for this deficiency they usually resort to the pettifogging method of cutting down the wages of men, and trying in this foolish way to make up in unjust oppression what they lack in experience and practical ability. By all means keep your machinery in good repair. The following incident came under my personal observation: A certain man erected a manufacturing plant and ran it successfully for two years; he then took charge of a larger concern. At the end of six months his former employers wrote him, saying that everything seemed going wrong in the mill; the quality and quantity had fallen off greatly, and asking him to come and visit the works and give them a written report, stating the causes which had brought about such a change in so short a time. The request was accepted and the following report made: "The causes leading to the condition of your business, as stated in your letter, are as follows: Under your former superintendent your machinery was kept in first-class repair. When the works were closed for a few days the machinery was thoroughly overhauled and all needed repairs were made. Your present manager says you have not given him facilities for continuing the practice formerly observed, and the result is what can always be expected under like conditions. Your machinery is badly in need of repairs, and in no condition to turn out good work in paying quantities. I advise you to close down your works at once, put on all the help you can conveniently employ, and put your machinery in thorough repair, and then keep it in repair. Give your manager all facilities required to turn out good work in paying quantities, and you will have no cause to complain." These suggestions were carried out, and the next letter received stated that the quality of the goods was fully up to the former stand-

ard, and the output exceeded any former record. Don't fail to keep your machinery in thorough running order. Neglect of this important item has closed the doors of many promising concerns. It is the cheapest, most profitable, and the only way that a manufacturing business can be run with any hope of holding its own, while men and machinery, up to the times, are brought in competition every day. The same principle should be applied to manufacturing interests that prevails in the handling of steamships and railway trains. The safety of the public, the prosperity of the owners, and every interest bearing upon the successful operation of the ship or train, demands that every detail should be observed and every appliance be in perfect working order before the ship leaves port, or the engine leaves the round house. And there is no more excuse for the manager to neglect keeping his machinery in the best possible condition than there is for the captain of the ship or the engine driver to neglect their duty. And a proper realization of this important matter will greatly reduce the danger that has wrecked many bright hopes and promising manufactories.

COMBUSTION.*

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Combustion is the energetic chemical combination between the oxygen of the air and the constituents of the combustible, and the value of any fuel is measured by the number of heat units which its combustion will generate, a unit of heat being the amount required to heat one pound of water one degree Fahrenheit. The fuel chiefly used to generate the heat consumed by steam engines is coal and wood, the component parts of which are carbon, hydrogen and ash, with sometimes small quantities of other substances not materially affecting its value. The combustible is that portion which will burn, and, in the combustion of coal, carbon is the principal substance that unites with oxygen, and the air is the source from which oxygen is derived.

Coal has been divided into two primary divisions, viz., anthracite, or hard coal, and bituminous, or soft coal. Anthracite contains a very small portion of volatile matter, but is nearly pure carbon, ranging from 85 to 94 per cent., and burns almost without flame. The term anthracite is never applied to coal containing less than 82 per cent. of carbon. The usual components of soft coal are bituminous volatile matter, coke and ash, as a mechanical separation, but chemically the constituents of coal, though varying in quality as well as degree, are chiefly carbon and hydrogen gas, combined occasionally with a small proportion of sulphur and incombustible matter. The proportion of carbon in this coal varies; in good coal it is seldom less than 75 per cent. of the whole, sometimes considerably more. Not only do the different kinds of coal differ in their constituents, but coal from the same seam will vary considerably from the normal standard of that coal.

From a scientific analysis, by Professor Liebeg and other eminent chemists, it has been shown that in soft or bituminous coal there is about 80 per cent. of carbon, 5 per cent. of hydrogen, 10 per cent. of azote and oxygen, and 5 per cent. of ash, varying with the different kinds. The principal constituents of all coal, carbon and hydrogen, are united and solid in its natural state, and are essentially different in their character and in their modes of entering into combustion.

* A paper read before the Canadian Association of Stationary Engineers.