SCIENCE

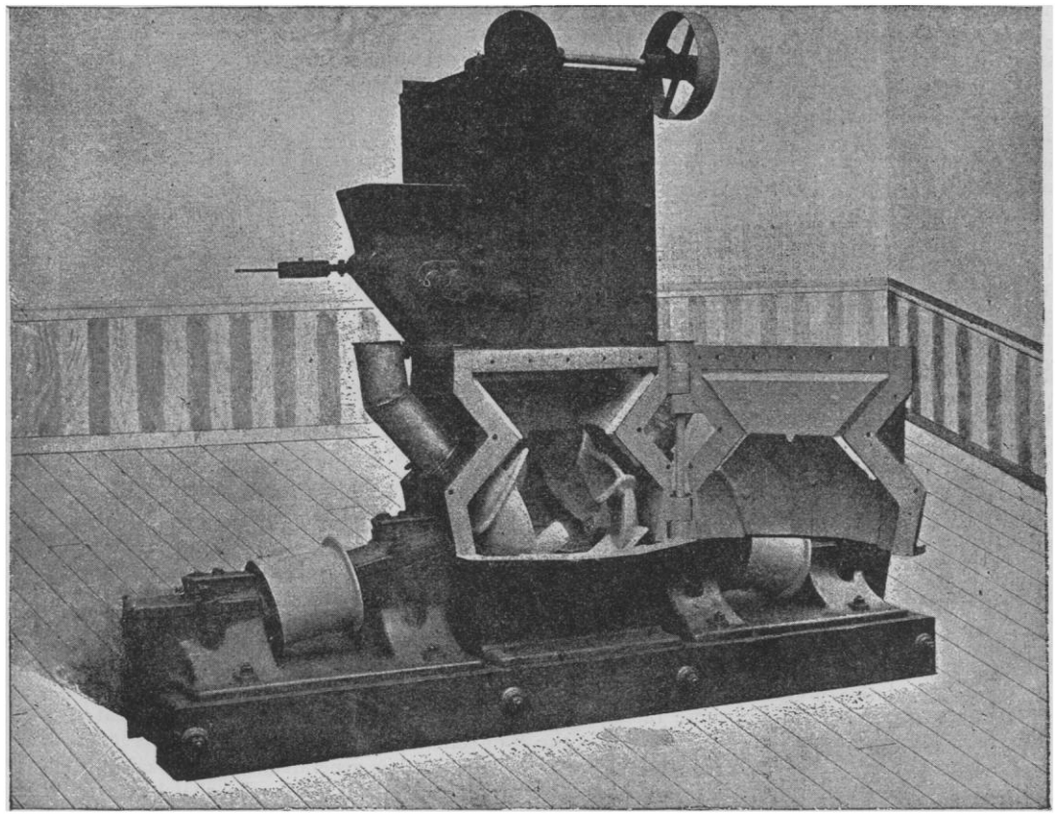
FRIDAY, DECEMBER 28, 1888.

THE McAULEY PROCESS OF BURNING PULVERIZED FUEL.

ONE of the most important problems of the day is that of the economical use of fuel, and much ingenuity has been expended in attempts to find its best solution. We are all interested in this matter, for we are all in some way connected with the fuel question. Iron and steel furnaces, factories, locomotives, steamships, and the domestic hearth, — one and all are most lavish users of fuel. When it is considered that it is theoretically possible to generate one horse-power by the consumption of a quarter of a pound of coal per hour, and this is compared with the results of actual practice, an idea is obtained of the room for improvement. An ordinary non-expansive, non-condensing engine requires commonly from ten to twelve pounds of coal per hour, while in our best expansive and condensing engines the same amount of work is accomplished with only two pounds per hour. But the latter figure represents excellent practice rarely reached by the majority of even large fuel-consumers. The average consumption of coal may be taken as at least four pounds per horse-power hour.

At the present day nearly all efforts to further economize fuel are being exerted in the direction of better boilers and furnaces, more efficient engines, a higher grade of workmanship, and more skilful management; in fact, in the more economical use of the heat after it has been obtained. Many inventors have, nevertheless, with varying degrees of success, attempted the solution of the fuel problem by attacking it from the other end; i.e., by endeavoring to secure the more perfect combustion of the fuel itself, as well as the burning of cheaper fuel than ordinary coal. All manner of patent fuels have been tried, and some with a fair degree of success. Mechanical firing has also been resorted to, but in all such processes there seem to have been objectionable features of great magnitude.

It has long been recognized that if coal could be very finely pulverized, and each little particle of coal could be surrounded with a film of air on its way to the furnace, the combustion ensuing would be very much improved. Many have been the devices to burn pulverized fuel in such a manner; but the success achieved has usually been small, and the difficulties besetting the problem have appeared insurmountable. A very promising effort in this direction is that of Mr. J. G. McAuley of Lansing, Mich. Vague mentions of his method have from time to time reached the public, but it is only within a short time that his process seems to have been brought to practical perfection. In order to satisfy certain capitalists of its merits, the process was applied, some time ago, to one of the puddling-furnaces of the Chester Rolling Mills of Chester, Penn., and the writer enjoyed the advantage of being present for several days during this test. The idea underlying this process is that of the automatic delivery into the combustion-chamber of a regular supply of finely pulverized coal, each little particle of the latter being surrounded by a film of air while on its way to the combustion-chamber; so that, on arriving there, combustion may be nearly instantaneous and practically perfect.



THE CYCLONE PULVERIZER.

The manner of obtaining this highly desirable result is ingenious and extremely simple. The combustion-chamber of the furnace is

tightly closed, having neither grate-bars nor ash-pit. Into the front of this chamber, and on the same level, there enter two short horizontal pipes, or *tuyeres*, about two feet apart. The outer ends of these *tuyeres* are connected to a main air blast-pipe, which is kept filled with air under a slight pressure by means of an ordinary blower. Simple valves permit the ready and accurate adjustment of the amount of air passing through the *tuyeres* into the combustion-chamber. Between and slightly above these *tuyeres* is a small rectangular hopper, into the top of which the finely pulverized coal is fed by screw-conveyers. The coal is fed out of the hopper by means of an ordinary screw of about two inches diameter, which passes horizontally through the lower portion of the hopper, issuing from its opposite sides through holes just large enough to loosely fit the outside of the screw. The pulverized coal lodges between the threads of the screw, and, on revolving the latter, the coal is fed out through the side of the hopper. One end of the screw is right-handed, and the other is left-handed, though both ends are of the same pitch. It follows, therefore, that the coal will be fed out of both ends of the hopper at exactly the same rate, this rate depending on the speed of revolution of the screw. The coal is kept from packing or becoming solidly wedged in the hopper by means of an agitator kept in motion immediately above the feeding-screw. On issuing from the hopper, the pulverized coal drops into the *tuyeres* directly below, and is carried to the combustion-chamber by the blast of air passing through the *tuyeres*, becoming intimately mixed with this air at the same time. Only enough air is admitted to secure complete combustion, thus avoiding the great loss due to the excessive amount of air necessarily admitted when burning lump-coal on an ordinary grate. The feeding-screw is operated by gearing driven from a convenient line of shafting, such arrangements being made as will secure a readily and accurately adjustable motion of the screw, and hence a readily and accurately adjustable feed of the fuel.

As the relative as well as absolute amounts of coal and of air can thus be adjusted at will, and with any desired degree of precision, it follows that the character and intensity of the flame are completely under control. The ability to thus produce, and maintain for any desired length of time, a flame of any desired intensity, and either reducing, neutral, or oxidizing in character, carries with it, for metallurgical purposes, many advantages too well known to need more than a passing allusion.

In the Chester Rolling Mills the apparatus was attached directly to the combustion-chamber of one of their regular puddling-furnaces, though greater economy would probably have been obtained by the use of a special form of combustion-chamber devised for this purpose. The coal was the same as that used for all the other puddling-furnaces, except that it was pulverized. No conveyers were fitted to feed coal into the hopper, the coal being furnished in bags of one hundred pounds each, which were emptied into the hopper as required. As thus applied, this process realized a very large measure of success. The furnace was heated more rapidly after charging than the other furnaces, which were being worked in the ordinary manner, though with the same iron. More heats were obtained per day with the new process, less fuel was consumed per ton of iron produced, less iron was wasted in puddling, and the iron produced proved to be of slightly superior quality. There was no smoke, and the ashes was carried out of the top of the chimney in the form of fine dust, invisible from the ground. While charging the furnace, the supply of both air and fuel was completely stopped, thus preventing waste, and enabling the men to work more quickly. In considering the superior economy of this process, it must be borne in mind that the actual economy in the production of heat from any given fuel does not represent the total gain; for by this process very cheap and otherwise comparatively useless slack coal and coal-dust will answer nearly all purposes, thus presenting another material advantage.

It is of course impossible to give exact figures, except from observations extending over a much longer period of time than was at my disposal at Chester. There can, however, be no question that the McAuley process effects a considerable and substantial gain in economy of fuel-consumption. There remains simply the determination of the exact amount of this gain by means of accurately conducted experiments by scientific and practical experts.

The process has very recently been applied to the puddling-furnaces of the Warren Iron and Steel Company at Warren, O., and the success obtained seems to have been very great. A report of the trial there given this process has just reached me, and reads as follows: —

"The results of the trial just completed at the works of the Warren Iron and Steel Company, Warren, O., with the McAuley pulverized fuel system, are remarkable. The trials covered forty-six on two of the puddling-furnaces. The furnaces were charged with 23,000 pounds of iron during the trial. The amount of pulverized coal used was 12,260 pounds (a little over six tons). The cost of this fuel was $5.43. The amount of iron drawn from the furnaces was 24,029 pounds, an excess of 1,029 pounds over the amount put in the furnaces originally. This is what the McAuley system accomplished.

"By the old process, now in use, during the same heats, the amount of coal required was 36,920 pounds (over eighteen tons), the cost of which was $16.50: in other words, the McAuley process saved nearly 75 per cent of fuel. The McAuley process increased the amount of iron 5½ per cent; that is, there was 5½ per cent more iron taken out by the new process than was charged. This gain is worth $15.45: in other words, the gain in iron alone pays for nearly three times as much coal as is required by the McAuley process. The iron-men who witnessed the trials were astonished at the remarkable results. The iron gained by the McAuley process comes from the 'fix' which is used to protect the pan and sides from the intense heat, and also from the cinder, containing 50 per cent of iron, which is put in the furnaces to flux the iron. By the old process this is all lost, and in addition there is generally over 5 per cent of waste. This means practically an actual gain of 10 per cent of iron by the new system."

The puddling process makes specially severe demands on any such automatic fuel-feeder; and hence even better results may be expected from the application of the new process to steam-boilers, both land and marine. It should prove especially valuable in marine boilers; for not only would the required speed be developed at less expense, but less coal would have to be carried for any given trip, and the space and weight so gained would, of course, be available for carrying paying freight.

Without going into any further details, it may be broadly stated that there are very few cases in which fuel is consumed in large quantities, where it could not be burned more advantageously in the pulverized form; and, as there can be no question that the McAuley economizer is the best apparatus yet invented for this purpose, it seems as though it were destined to work a great revolution in the manner and economy of consumption of fuel.

In conclusion, it may be of interest to state that the coal is pulverized for this process by means of the Cyclone pulverizer, the principle of which is fairly indicated by its name. Within a closed chamber a pair of wheels resembling three-bladed screw-propellers revolve very near each other at a great velocity, but in opposite directions. Two powerful currents of air in opposite directions are thus generated, their joint effect being to produce a miniature whirlwind within the chamber. Into the vortex of this enclosed cyclone the coal is regularly dropped, and is rapidly ground into the finest powder by the mutual attrition of its particles. There is no grinding or pulverizing by the direct action of any of the metal parts of the machine, so that the machine does a great deal of work with extremely little wear. X.

PROFILES OF THE NICARAGUA AND PANAMA CANALS.

THE failure of the Panama Canal Company makes the uninterrupted continuance of work on the canal very doubtful, and thus the chances of the Nicaragua Canal being the first to be completed have materially increased. The profiles on p. 323 show a comparative statement of the amount of excavating to be done in both canals; and it will be seen at a single glance, that, even considering the amount of work already accomplished at Panama, the Nicaragua route is by far the less difficult. The profiles do not show the works necessary for protecting the canal, such as dams