Machinery and Appliances.

A NEW SMOKE CONSUMER.

The problem of how best to perfectly consume fuel, and the gases liberated or generated during combustion in boiler furnaces, is one of very old standing, dating at least from the days when Watt invented his steam engine and the factory system of industry began to give strong evidence of its future large development. At first the volumes of carbon thrown into the air were regarded with surprise, but their quick dissipation, and the comparative fewness of furnaces contributing to the pollution of the air, hardly made sufficient impression upon public sentiment to educe any opposition to the practice. Another powerful factor in disarming objection to the blackening of the skies, the soiling of the landscape, and the destruction of vegetation that was steadily increasing, was the profitable nature of the pursuits in the course of which smoke and deleterious gases were evolved. "It's the smoke that makes the money, sir!" as the pert child said to the new parson, who, coming from a truly rural district, looked with some degree of apprehension upon the atmospheric surroundings of his future home under the smoke-stained skies of a busy manufacturing town. Though not strictly accurate, the remark of the child contained a substratum of truth. The evil has since continued to grow, both in extent and intensity, with our expanding industries, until it may properly be said to have become simply unendurable. Many endeavours have been made to devise a satisfactory method of abating or preventing the formation of smoke, or otherwise of preventing its emission from our furnace chimneys. The problem has been attacked at almost every point where it admitted of approach, but hitherto failure, or a very qualified degree of success, has been the only result attained.

In our issue of September 21st, Dr. F. H. Bowman, of Halifax, a thorough scientist and practical cotton spinner, stated the present condition of matters in relation to the question with great clearness and ability. We cannot do better in this place than reproduce a few extracts from Dr. Bowman's admirable paper, which it will well repay those of our readers who may not have seen it to obtain and peruse:—

"The production of smoke," says Dr. Bowman, "is the result of imperfect combustion. Combustion is a chemical change, by means of which, so far as the burning of ordinary coal is concerned, the carbon and hydrogen contained in the coal are united with the oxygen of the air, and during the continuance of this change, which is attended by the evolution of heat, the carbon and hydrogen are changed into carbonic acid and water vapour or steam, both of which are invisible gases. It is clear, therefore, that when perfect combustion occurs there will be no production of smoke, which is simply uncombined or unburnt carbon. As such, it represents a direct loss to the producer, because if the carbon had been united with its equivalent of oxygen, it would have produced its equivalent of heat, which is lost when the carbon is uncombined."

"In almost all our industrial processes we use solid fuel, such as coal, coke, &c., and no solid can enter into combination, or undergo combustion, without first assuming the gaseous state. For perfect combustion a gaseous condition is indispensable, as in this state alone can perfect

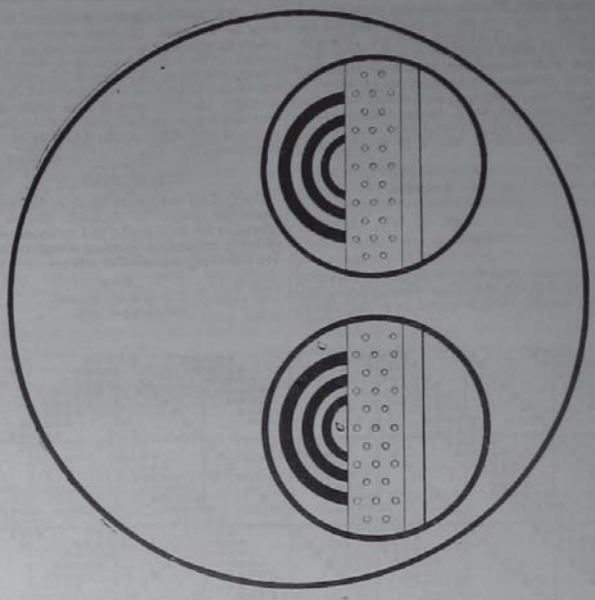

FIG. 2.—CROSS SECTION DITTO, THROUGH LINE A B.

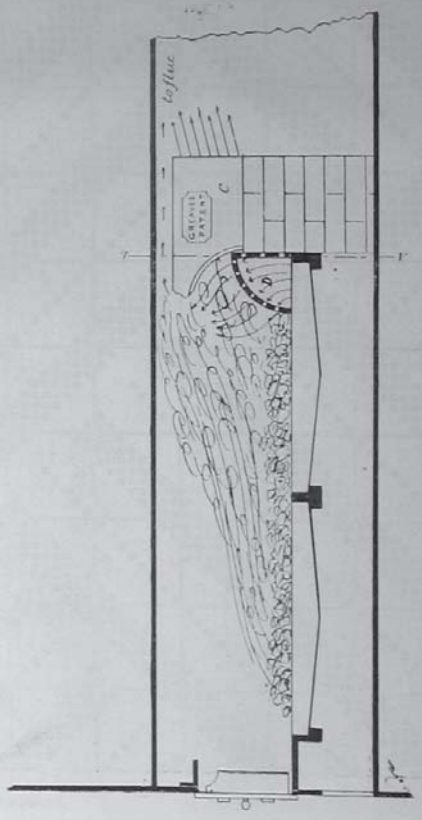

FIG. 1.—LONGITUDINAL SECTION OF FURNACE WITH SMOKE CONSUMER.

mixture with the air necessary be attained. Hence, in any fire or furnace fed with solid fuel, the first stage in the process is to convert the solid into a gas, and this can only be attained at the expense of a loss of a certain amount of heat, which is always absorbed when solid hydrocarbons are changed into gases."

"In an ordinary furnace, where solid fuel is used, the changes which the fuel undergoes, or rather which each individual piece undergoes, are not simultaneous, but successive. When the piece of coal is thrown into the furnace it breaks up into smaller pieces by the action of the heat derived from the fire already burning, and thus is rendered more easily convertible into the gaseous state."

"Unfortunately for us as coal consumers, the air we have to use is cold, and the oxygen it contains is diluted with about four times its volume of nitrogen and water vapour, and other constituents which are of no service in combustion, and, indeed, only serve to retard it and absorb a very large amount of heat, because the whole of the air has to be raised to the temperature necessary for combustion before it can take place, and all but the oxygen is of little service to steam users. This points to one radical defect in all our furnaces, either mechanical or otherwise, as at present constructed. There is no method of using up the waste heat in our chimneys by warming the air on its way to the furnace. The furnace of the future, when it is finally elaborated, will certainly, whether solid or gaseous fuel is used, be on the regenerative principle, and use the waste heat to warm the air before combustion, as is now done by the hot blast process in iron furnaces. In addition to all this, our present furnaces derive their draught from a chimney, and this draught varies with the atmospheric conditions. In dull heavy weather, it is often insufficient to draw in the necessary air to feed the furnace, and when this adverse condition is coupled with the fact that this is most frequent in wet weather, when the coal used is often soaked with water, it renders smoke consumption additionally difficult."

"For perfect combustion an elevated temperature of the combining gases is absolutely essential, because if the temperature falls below a certain degree, combustion will not take place. This indicates that whatever furnace is used, and however perfect its construction, at times, when the furnace is being lighted, or has been checked in its action, as always occurs at night, or at meal times, or when boilers have been re-started, it is impossible for a time to prevent the making of a certain amount of smoke, until the temperature of the furnace and its surroundings have reached the requisite degree of heat."

The above extracts from Dr. Bowman's article exhibit some of the difficulties that have to be overcome before the problem can be perfectly solved. But as progress is generally accomplished step by step, we must be content to attain the goal in that manner.

We have, therefore, great pleasure in bringing before the notice of our readers a simple, practical, efficient, and cheap device that can be easily applied to all boiler furnaces for the consumption of smoke. It is the invention of Mr. Wallace McGuffin Greaves, of Manchester, who is a chemist and practical man, familiar with the problem to be solved and the means hitherto tried for solving it.

The practicable method of dealing with the problem is to admit the impossibility of preventing the creation of smoke in the combustion of coal in boiler furnaces. Having done this, the only thing that remains is to consume it before it can escape into the atmosphere. In order to accomplish this it is necessary that the smoke made should pass through another furnace, the heat of which should be so great that, of the carbonaceous matter forming the black smoke, not a particle should escape combustion. How to obtain and maintain this economically is the gist of the problem. The idea of an independent supply of heat cannot be entertained; therefore the heat generated by the furnace for use in producing steam must be utilised and delivered to the boiler for making steam without diminution, or loss will result. This renders it necessary that the second furnace, whatever might be its form, or the material of which it is composed, shall be placed in the boiler flue in order to obtain the heat at its maximum point. This dictates its position behind the furnace and upon the bridge. But to place anything there, if great care is not taken, means a serious interference with the draught. Experiments have revealed the fact that the plan selected and described below obstructed it the least of all that were tried, and led to its adoption as the best. To obtain and maintain the heat required to consume the smoke on its passage through the short space available for the purpose, also necessitated that the material of which the appliance was made should be as nearly as possible an absolute non-conductor. It was further required that it should be as nearly indestructible as possible, either by the intense heat to which it is subjected, or by alternations of that with comparative cold.

Mr. Greaves has invented a means of doing this, which, so far as it has been applied, has proved exceedingly satisfactory. The appliance consists of one, two, or three blocks of segmental form, so that when they are placed one over the other a space will be left between them, as shewn at c in fig 2. These blocks are 21" in length from front to back, and are arranged upon the bridge at the back of the furnace, as shewn at c in Fig. 1. The material of which they are composed is a special preparation, the two chief qualities of which are—1st, its being an almost perfect non-conductor of heat; and 2nd, its indestructibility, or nearly so, under incandescent heat, and the alternations of heat to which it is subject when in its place in the furnace. It will be seen that this form gives more surface area than could be obtained from any other arrangement, as both the upper and lower surfaces of the blocks are effectively utilized. The heat from the furnace quickly renders these blocks incandescent, and maintains them so. The fresh coal having been thrown upon the fire dense volumes of black smoke are given off, and this having to pass between the incandescent surfaces of the combustion blocks in thin streams, all the carbon they carry is immediately consumed. Combustion, of course, requires oxygen, and as the atmosphere is the ordinary source of supply, and that admitted through the furnace doors and bars having been used in the combustion that has already taken place, provision is made for introducing more by the curved and perforated plate, D, at the back of the furnace, and immediately in front of the bridge, as shewn in both figures. This provides an adequate supply of heated atmospheric air for the combustion of all smoke produced. Instead, therefore, of a dense mass of black smoke being thrown into the atmosphere continuously for several minutes, and extending for long distances over the landscape after stoking, all that is now seen is a thin film of brown smoke, which is given forth for from a half a minute to one minute according to conditions. This does not contain one tenth the carbonaceous matter of the usual heavy volume of black smoke, and can rarely be seen for more than thirty or forty yards from the top of the chimney. It would not be seen at all were it not in stoking necessary to open the furnace door and admit a large amount of cold air, which momentarily chills the combustion blocks c, which then allow a portion of the smoke to escape. Immediately the doors are closed, the blocks begin to regain their heat, and in the time mentioned above, all smoke is again perfectly consumed.

The above statements we make on the authority of our own observations at three different establishments where the invention has been applied. At all of these, great satisfaction was expressed with its efficiency in preventing smoke and in saving fuel. Regarding the latter, conditions had not been favourable for making a strict comparison with previous periods, owing to alterations in the character or weight of the work being performed at the different times. Confidence was expressed, however, that the saving of coal could not be less than from 15 to 20 per cent.

It will be obvious that this must be so, even if it be not larger; because, in the first place, the loss represented by the discharge of black smoke into the air is prevented by its combustion, and the consequent development of heat which is immediately utilised in the generation of steam. The amount of gain on this score is evident by the increased ease and rapidity with which steam is got up after being allowed to run down, a fact which we tested. By the combustion of the smoke the draught in the furnace is increased, which reacts upon the furnace, and causes a more perfect combustion of the fuel with which it is supplied. Again, by the combustion of the smoke in this manner the pipes of fuel economisers are always kept clean, and the water they contain is raised to a much higher temperature before delivery into the boiler, thereby needing less coal to generate an equal quantity of steam. Hence, it is economical all round. Mr. Greaves is, we think, to be congratulated on not only having achieved the main object he had in view, but on having, at the same time, secured such important collateral advantages. We heartily commend an inspection of it to all our steam-using friends. It is simple, cheap, and easily applied, and will, we believe, render many costly appliances now in use quite unnecessary. The inventor will be pleased to shew the arrangement, as applied to a boiler, on application at 6A, Fountain-street, Manchester, and if desired will shew it at work in the city.

WANTED, FINISHING MACHINERY FOR ELASTIC WEBBING, COTTON, AND SILK.—Makers of this class of machinery are requested to communicate with the editor of the *Textile Mercury*, who has an enquiry for same from the Continent.

TELEPHONE CHARGES.—The *Financial News* says "We called attention a few weeks ago to the prospect of opposition which the National Telephone Company would probably have shortly to meet in Manchester. The new 'Co-operative Telephone Association' has secured so large an accession of promised subscribers, among them some of the leading mercantile houses, that there seems every prospect of the early establishment of the rival company. We expressed the opinion that, even if the movement did not succeed, it would result in the reduction of the telephone charge. The National Company is apparently not willing to see its present monopoly passing out of its hands, and the announcement is therefore made that from April 30 next the rate of the exchange subscription in Manchester 'will be reduced from £20 to £15.' The latter figure even seems far too high for telephonic privileges when compared with the lower tariff ruling in other places. If the National Company intends to retain its subscribers, the subscription, we fancy, will have to be still further reduced.