AUTOMATIC STOKERS.

BY A. W. BENNIS, *Member.**Chairman : Mr. DANIEL ADAMSON, Member of Council.*[*Abridged.*]

The Author confined himself to *thermal efficiency*, as affected by automatic stokers. The adoption of this principle has given increased efficiency; the fire is maintained in a uniform condition as to rate of combustion, air supply, and every other factor governing the efficiency. Uneven thickness of fire, usual with hand-firing, concentrates air supply just where it is not wanted. Mechanical firing remedies this. The cleaning out of fires is also the cause of a serious loss in hand-firing which is eliminated by mechanical stoking.

Flexibility of Operation.—The flexibility of automatic firing enables boilers to run on light load when required, as in power-houses, with the least possible drop from full-load efficiency. A sudden rise in the load can be met by a correspondingly rapid increase in the steam output of the boiler. The fireman can increase immediately the three main factors of output, namely fuel feed, speed of furnace bars, or chain, and draught. Where mechanical firing is combined with forced draught, and perhaps hot-air supply, this quality of flexibility is further improved. Included also under this head is the ability to burn satisfactorily a wide range of fuels, due mainly to the fact that the ash (the large percentage of which renders many low-grade fuels unsuitable for hand-firing) is continuously discharged; also the best combustion conditions for a particular fuel, when once determined, can be steadily maintained.

Maximum Steam Output.—This is due to the higher rate of combustion possible with mechanical firing, especially with the addition of mechanical draught. The running of boilers at a higher individual rating reduces the number needed for a given load, and
[THE I.MECH.E.]

thus reduces the stand-by losses. The average thermal efficiency of a plant may be improved by a judicious sacrifice of thermal efficiency during times of momentary high loads.

Centralized Boiler-House Control.—This means that the ultimate control of boiler-house conditions is vested in a specially qualified individual, the firemen working to detailed directions. With the aid of suitable instruments, he can control fuel and water feeds, air supply, and speed of machines. This system of control can be adequately exercised only in a machine-fired boiler-house; the expert, having determined the best working conditions for the boilers under the loads demanded of them, gives his directions accordingly, and he is able to verify, by recording instruments and personal inspection, that his orders have been obeyed.

The choice of the best system of air-supply is an important factor. In many cases natural draught is fully adequate, but with the very large boiler units now being adopted, it becomes necessary to supplement it by induced or forced draught, or both, in order to burn the required weight of fuel on the grate area available.

Many successful types of automatic stokers have been introduced. For use with internally-fired boilers, the most successful types are the throwing stoker and the coking stoker. As regards thermal efficiency, there is very little to choose between these two types; choice would be governed by the output required, in which the advantage lies with the throwing type, and by the type of fuel to be burned, when the coking type would be more suitable, if highly bituminous and nutty coal is to be burned.

For externally-fired boilers of large capacity, the choice lies between chain-grates and underfeed stokers. The chain-grate can be used with either natural or forced draught, whereas forced draught is essential with the underfeed type. In order to ascertain the thermal efficiency of properly designed automatic stokers, operating results extending over a considerable time are necessary.

Discussion.

MR. CHARLES ERITH said everywhere the tendency was towards large boiler units, so as to get high over-all thermal efficiency and produce power at the lowest cost. As the Author had said, forced draught was a necessity of the underfeed type, and proper mechanical control of air, whether at high or medium rates of combustion, was essential to thermal efficiency. The working cost of draught fans

should not exceed one per cent of the boiler-house costs, and that outlay was repaid many times over in the higher efficiency obtained. The great advantage of the underfeed method was that the maximum theoretical temperature of combustion could be maintained.

Mr. DAVID BROWNLIE said the big advantage of the mechanical stoker was that it did away with laborious hand-firing. He did not agree that mechanical firing was more flexible than hand-firing. When discussing efficiency, the total costs must be taken into consideration. Not enough importance was attached to the cost of running mechanical stokers. He had found in a case in which the whole cost of a mechanical stoker had been calculated that it was at least 10 per cent. If the saving was calculated at 15 per cent, then the real saving would be about 5 per cent.

Mr. H. C. APPLEBY remarked that in spite of the fact that heavy expenses had to be met in running a mechanical stoker, the point was whether money was saved and earned by using them. No one who had seen both systems in operation would have any doubt as to which was the better method. The great need for keeping the apparatus in good condition had not been sufficiently emphasized. His firm found that, by changing the nozzles occasionally, the consumption of steam for the blowers was brought down from 8 per cent to 3 per cent.

Mr. V. R. CHADWICK said a mechanical stoker had no brain or conscience, a fireman had; and it was necessary to pay some attention to the apparatus if it was to work properly. The Paper appeared to surmise that one always worked with the same class of fuel. As long as they got one class of good fuel all went well, but if it was obtained from another colliery the fireman did not notice it, and conditions changed. That was brought prominently before their notice during the War. Many engineers had their boilers fitted with mechanical stokers, but they had to go back to hand-firing again, and many of them were doing very well.

CAPTAIN S. C. BULLOCK said he had had a little trouble with mechanical stokers in South Wales in 1919. He tried to secure efficiency with as cheap a class of coal as possible, but it caked too much unless he had an excessive draught, when a good deal went up the chimney. He would be glad to know if it was possible to burn fine coal in any type of mechanical stoker.

The CHAIRMAN said the mechanism of firing had been improved during the last ten or fifteen years, and it was now a matter as to which type was the most suitable for given conditions ; and having chosen the apparatus, to see that it worked properly and efficiently. Having a machine to do the work eliminated some of the troubles due to the human element. It enabled them to employ a different type of man in the boiler-house. It was difficult to find men strong enough for the arduous conditions of hand-firing and at the same time possessing special intelligence to understand the intricacies of combustion, and it meant that more attention would have to be given to the physiological aspect. No machine would ever wholly take the place of the human element. There was, no doubt, a tendency to depend too much upon the machine, and to give less thought and attention to it than it required.

Mr. BENNIS, in reply, said Mr. Erith had picked out a point which should have been included in the Paper, and that was the mechanical control of the air. It was not always necessary to use a large amount of air, but it should be seen that the proper pressure was applied in the right place. The question of labour costs raised by Mr. Brownlie was outside the scope of the Paper. He entirely agreed as to the necessity of keeping mechanical stokers in condition. His own firm had introduced a service system, and had inspectors going round from plant to plant looking at machines that had been installed, in order to see that they were kept in order, and point out to those concerned where they had gone wrong.

With regard to steam-jets, nearly all mechanical stokers that were being used on internally-fired boilers used jets in one form or another, and his firm had long made it a practice to ask that the jets be changed at least once a year. If one firm could reduce the jet consumption to 3 per cent, other firms could do the same.

Mr. Chadwick surmised that he had gone on the assumption that the same kind of fuel was always used. To his mind the power of using various fuels was one of the main features of the mechanical stoker. One Liverpool firm said they could not burn the fuel received from the Coal Controller. They installed mechanical stokers and burnt it—18,000 tons of it—and kept steam. It was about the worst sample of coal he had ever seen. It had about 50 or 60 per cent of ash, but still they were able to burn it and still keep steam. It might be necessary to change the fuel feed, or the air supply, or the speed of the stoker, but a modern mechanical stoker enabled engineers to take their coal from any market, and they were not tied down to any particular coal. That was one of its main advantages.

The various adjusting mechanisms of a mechanical stoker were provided for use, and capable men in the boiler-house paid for themselves over and over again. There were advantages in chain-grates and overfeeds, and no man could say that one machine was better than the other under all circumstances.

With regard to the burning of fine Anthracitic fuel it could, of course, be done, but it would mean forced-draught stokers or underfeed machinery. It was obvious that the air spaces would have to be very fine, but there were hundreds of machines all over the country burning nothing but dust, and had been doing so for years.