The automatic feeding of the American type of producer has accomplished such satisfactory results that it has been adopted abroad in a number of instances. In England the cupola type of gas producer developed by Mr. Thwaite has sought to reach this same end in another way, and it has received a good deal of popularity abroad. It is reported that in the Thwaite cupola type the combustion or gassification of the fuel is complete, and also in the Duff-Whitfield type.

In the American Morgan type of producer, the coal is dumped into an upper reservoir from whence it falls automatically through an inclined spout to slowly revolving discs. The fuel is thus allowed to work through gradually, and the coal is uniformly distributed throughout. Water seals have to be provided to prevent the revolving part of the producer from leaking so the gas cannot escape.

A Korting blower with steam jet supplies the air blast to keep the fuel in an incandescent state. The jet of steam passes through the lower bed of ashes, and serves to reduce the clinkers and absorbs a large proportion of the heat of combustion. The result of this latter process is that the gas is rendered cooler and richer through the process of breaking up the heat of combustion into oxygen and hydrogen, so that the oxygen thus freed can more readily combine with the carbon.

The gas from such a producer is supplied in immense volume, each pound of coal yielding from 65 to 75 cubic feet. This volume of gas, however, is not all immediately available for engine purposes. About half of it is nitrogen, and this carries no combustive energy because it is too heated. The recovery of this waste heat for raising steam has been one of the questions involved in the development of the gas producer. In the Dellwick-Fleisher water gas producer from 15 to 20 per cent. of the total fuel used is said to be utilized through the recovery of waste heat.

The removal of the ashes and clinkers in the gas producer is an important item of trouble and expense. Where the air blast is accompanied by a steam jet this is greatly simplified, for steam coming in contact with the clinkers in the hot zone soften and break them so they gradually descend. Easy access is had to every part of the water basin in which the Morgan type of gas producer stands, and the ashes falling here are conveniently removed. The soft, wet ashes can be taken out with little difficulty at certain intervals, and the fire itself can be partly regulated by digging them out or permitting them to remain.

Engineers are tolerably familiar with gas engines of small and large units to-day, and their perfect operation has made them of general use; but the combination gas producer and gas engine has introduced some new problems in the subject. This is particularly true in making estimates of the plant required to operate electrical generators or other machinery. The gas engines have no overload capacity, such as the steam engine, and in making preliminary estimates the total or maximum of power needed must first be carefully ascertained. In designing a steam engine or electrical dynamo, the overload capacity always leaves a margin of safety that figures prominently in the original estimates. This factor, however, must be entirely eliminated when the gas engine and producer are considered.

The other problem that requires satisfactory solution before estimates are requested or designs made is the nature of the fuel to be used. An exhaustive study of this question at the beginning ensures satisfactory returns in the end. It may not always be the cheapest fuel, but it is always the fuel that will give the highest returns for a given expenditure. An engine designed for a low grade gas can never give the highest results on gas of a much richer quality. In designing the producer, the question of the grade of coal to be used must be considered along with the quality of the gas to be produced. With several types of gas producers designed and adapted to different needs, it is not difficult to find a satisfactory solution for these questions. The cost of the producer and engine will vary considerable according to the grade of fuel to be employed, and generally the cheaper that the fuel is the more expensive is the initial construction of the plant. A producer adapted to hard coal is thus much less expensive to construct than another built for utilizing bituminous coal. On the other hand, gas producers for soft coal have been built at a slight increase over those for hard coal, and their economy of operation and efficiency have proved eminently satisfactory.

The cost of removing the hydrocarbons in the gas by washers varies considerably. The condensing of the tar and gum in the gas engine is one of the worst troubles that can happen. This is sure to occur from producer gas made of soft coal fed to plants not provided with mechanical washers. A great many devices have been employed to break up and destroy the tar. The formation of this tar occurs under certain temperatures, and if slightly changed it can sometimes be broken up into permanent gases. Excessive temperatures will furthermore disintegrate the tar and cause it to be deposited in the form of lamp-black.

Gas scrubbing and cleaning devices have developed gradually into the centrifugal scrubbers, which apparently give the best results; but they have not yet reached the point of perfection when low grades of soft coal are used as fuel.

For an electrical central station, the gas producer and engine possess advantages under certain conditions over steam, but the cost of installation of the complete producer plant must be much less than that of a boiler plant to secure economical results. It is for this reason that simplicity of design, with little attempt at refinements to produce a higher grade of gas, is essential to success in the industrial field. With this question properly settled, the gas producer and engine gives better results on light loads, showing a considerably higher efficiency than a steam engine of the same size. Quick starting of the gas engine is always a point in its favor, and also the ease of extending equipment. The cost of maintenance is generally in favor of the gas engine, and the less number of parts required is also a factor of economy in making repairs. The use of the waste heat in the jacket water is sometimes of importance in heating buildings, but this is a factor that cannot always be depended upon. However, its consideration in the final comparison of the two systems may in a few cases prove the determining factor. As soon as a gas engine is shut down all heat loss ceases, but to secure this in the combination of gas engine and producer, storage tanks for the gas must be provided. The continuous operation of the producer night and day proves the most economical, and to shut this down whenever the gas engine is thrown out of service causes a loss.

## A CANADIAN DELLWIK-FLEISCHER WATER GAS PLANT.*

Ernst A. Sjostedt, Sault Ste. Marie, Ont.

It should be a matter of some pride and interest to Canadians to know that one of the most important improvements of the age in gas making—the Dellwik-Fleischer water gas process—was early adopted by a Canadian firm; but as this plant still remains the only one of its kind in all America, in spite of its great merits and economic adaptability for many and diverse purposes, I gladly take this opportunity of giving it the endorsement which it deserves.

In looking through the voluminous literature on water gas of only a few years ago, we are certain to arrive at the same opinion as expressed by some of the foremost gas engineers in America and of manufacturers of well known gas producers when they describe water gas as "a gas which never can play any very important part in the industrial field, owing to the large loss of energy entailed in its production, although there are places and special purposes where it is desirable, even at a great excess in cost per unit over producer gas." This, I fear, represents fairly well the general opinion of many should-be users of water gas at the present time, but such a view has long since become obsolete, and it is about time for us to wake up to this fact, and to the realization of the great possibilities in store for the Dellwik water gas.

### The Dellwik Water Gas.

The difference between the old (Lowe) water gas and the Dellwik gas is not one of chemical composition, nor one of application, but is in the simple and economical manner in which it is produced. Water gas making by the old system was an intermittent process in which the gas was made by blowing up

*A paper read before the Canadian Mining Institute. Montreal meeting, March, 1905.