stated as follows by Mr. Shuman, the capacity of the plant being 100 h.p. and its operation to be confined to 8 hours daily for 350 days a year.

The sun power plant will cost $20,000. The interest on this sum at 5 per cent. is $1,000, depreciation at 5 per cent. is $1,000 and an engineer at $5 a day will call for $1,750, making a total of $3,750.

A compound condensing engine and pump will cost $10,000. Interest at 5 per cent. and depreciation at 5 per cent. will amount to $1,000, and an engineer will require $1,750, as before, making a total of $2,750. The minor supplies of oil and other lubricants will of course be similar to a coal heated plant.

THE DIESEL OIL ENGINE.

A paper on the Diesel Oil Engine was delivered to the Engineering Section of the British Association for the Advancement of Science, at their last meeting, by Chas. Day. We publish an abstract of the paper as follows:

The economical generation of power for industrial purposes depends mainly upon the following factors:

1. (a) The attainable economy of working at different loads of the prime mover itself, including boiler or gas producer, and all accessories such as condensers, feed pumps, water pumps, &c.

(b) The degree to which this attainable economy can be practically maintained under the conditions of working, and the load factor.

2. The stand-by losses, i.e., the expenditure necessary to keep the plant ready for work when wanted.

3. Wages of engine-room attendants, stokers and other men employed about the power house

4. Expenditure on lubricating oil, cleaning, waste and sundry stores.

5. Cost of repairs and of the maintenance of all parts of the plant in good working condition.

6. The cost of water for condensing, and for boiler feeding in the case of steam plant, for the engine water jackets, and for the gas producer in the case of gas plant, or for the engine water jackets in the case of Diesel plant.

From the mere enumeration of these items, it is very obvious that tests either on makers' works, or on site, even though the tests extend for a week or so, do not form a sufficient guide as to the real value of the engines for industrial purposes, and that a far safer, in fact, the only safe conclusion, can be formed from a study of results obtained in actual practice. For instance, it matters not how economical an engine may be in regard to fuel if the expenditure in other directions more than out-balances the gain in fuel consumption.

In actual service it is not to be expected that power plant can always be kept and worked at its highest efficiency. The average results actually obtained over a term of years differ considerably from those attainable under the very best of conditions.

The great difficulty most buyers find is in securing reliable figures of power costs from people engaged in trade, except in the case of electric supply stations. The writer does not know of any body of large power users who systematically prepare accounts showing their power costs on a uniform basis and publish them. This practice in connection with electric supply stations fortunately does give an independent and authoritative basis from which valuable deductions can be made. The figures published in the Electrical Times cover practically almost all the supply stations in Great Britain, and this information, combined with information obtained direct from station engineers, has enabled the author to determine the average results obtained in such stations. With different types of plant these averages, for stations having a plant capacity not exceeding 1,000 h.p., are as follows:

Table I.—Average Cost Per B.T.U. Sold.

Type of engine.	Fuel.	Lubricating oil, waste, stores and water.	Wages.	Repairs and maintenance.	Total works cost.	Load factor.
Steam	.45d.	.06d.	.25d.	.26d.	1.02d.	14.7
Gas	.43d.	.09d.	.28d.	.24d.	1.04d.	15.3
Diesel	.23d.	.04d.	.19d.	.07d.	.53d.	14.3

The limit of 1,000 kw. was fixed owing to there being as yet no large electricity supply stations equipped solely with Diesel engines or gas engines. Of course, better results are obtained when driving machinery which gives a better load factor, but the causes which produce loss are, as a rule, the same, though modified in extent. The general conclusion formed from a study of electricity stations holds good for the great majority of power users, though, perhaps, not applicable to some special trades, where engines can be run continuously on almost uniform loads. It is also necessary to point out that the figures include some items which should not strictly be charged against the power plant. For instance, the wages items include figures for men working on cables, street lamps, and in sub-stations, whilst the repairs items include repairs to such parts. Also it is necessary to mention that the figures give the costs per unit sold and not per unit generated.

From the averages it is clear that a substantial gain is obtained by the adoption of Diesel engines, as against either gas or steam engines, the figures being beyond doubt substantially accurate. It is also noticeable that the gain is not only on fuel consumption, but is practically in the same proportion on the other items of expenditure.

The great saving shown by these average figures is confirmed by repeated experiences of the author. In many cases, although the figures guaranteed with Diesel engines have been no better than figures previously guaranteed, and obtained on tests, with existing steam and gas engines, the Diesel engines have shown over extended periods a saving of 50 and 60 per cent., and in some cases an even greater percentage, the result being due to the fact that the Diesel engine's average working results were very much nearer to the guaranteed figures than with gas or steam engines, combined with the fact that the relatively high cost of working at light loads with gas or steam had not been sufficiently taken into account when considering the guaranteed figures.

When going through cost records to prepare the average figures previously given, the author noticed very wide differences of cost per unit, particularly in the case of the steam plant. He therefore had the average cost calculated for steam stations of different capacity, and as the results are interesting, they are given separately in Table II.

The table shows the great improvement which follows increase of size with steam stations, or expressed in the reverse direction it shows how great is the disadvantage of small stations when steam power is used.

It is further to be noted that even with the largest steam stations, the costs per unit generated are no better than for quite small stations using Diesel engines, and this in face of the improved load factor. This is a most important point, and shows that small Diesel stations can profitably supply at prices hitherto thought to be obtainable only in densely populated centres having large power stations.

In all cases the figures which have been given are works cost, and do not include anything for interest on capital and depreciation. It is hardly possible to give a definite statement showing the cost of constructing and equipping power