chord B C, which is assumed to be the radius of the force in equation (4).

However, for approximate practical calculations it is scarcely necessary to go into such refinements, and the first step towards attaining greater accuracy in the solution of this problem must be in the direction of careful research into the resistance to crushing of the various metals and alloys under varying degrees of compression, and thus of obtaining the necessary data without which no very close estimate of the power required by a rolling mill for any given duty is possible.

The line of reasoning employed in the foregoing article has been chosen to emphasise the fact that the reduction of metal in a rolling mill is due mainly to a compressive action, and also to find a convenient expression for the resultant vertical compressive force, which is the reaction on the rolls. This quantity is not only of great importance in calculating the frictional losses in a rolling mill, but also in design work in estimating the stresses to which the mill frames and rolls are subjected. An alternative and equally reliable result may be deduced by following a different line of reasoning, based upon the primary active force, viz., the pull due to the friction between the roll surfaces and the metal which draws the strip through the rolls. This method gives a resultant expression for the horse-power absorbed in actually effecting the reduction of the metal, which is identical with that arrived at by the first method employed.

ELECTRIFICATION ON THE CHICAGO, MILWAUKEE, AND ST. PAUL RAILWAY.

No. I.

We have on several occasions, notably in our issues of August 13th and November 12th last, referred to the huge scheme of electrification on the Chicago, Milwaukee and St. Paul Railway. At the time of our last article on the subject the electric trains had not begun to run regularly; or, to be more exact, at the date when our article was written they had not begun to do so, though, as a fact, three days before our article appeared, that is to say, on December 9th last, the first electric locomotives were put into service. During the month of April in this year the length of line over which electric working had extended was 220 miles, and by the first of November next it is expected that steam locomotives will have been entirely superseded over the entire distance of 440 miles from Harlowton in Montana to Avery in Idaho. The present time would, therefore, appear to be a suitable occasion on which to take a comprehensive survey of this big undertaking, and we propose in what follows to review it at some length. In doing so we shall have occasion to repeat some things which have already been discussed in these columns, but we do so in order to make this article complete in itself.

At the outset some few words may be devoted to the railway which has carried practically to completion this epoch-making scheme—for it does create an epoch, for though the high voltage of 3000 has been tried experimentally over a short length of line, it has never been used in main line working, and, further, such a length as 440 miles—exactly the distance from King's Cross to Perth, *via* the Forth Bridge—has never before been approached. The Chicago, Milwaukee and St. Paul Railway has a total length of more than 10,000 miles of line, and passes through nearly 1000 cities and towns of commercial significance. The direction it takes westward from Chicago to the Pacific coast is shown in the map, Fig. 1. It was the first railway to link Chicago with St. Paul and Minneapolis, and it claims to have been the first railway to light electrically and steam heat its passenger trains. We are not sure that this claim could be substantiated, especially so far as concerns the electric lighting of trains, for, unless we are very much mistaken, the London, Brighton and South Coast Railway was ahead of any other line in the world in this respect. Possibly the claim would hold good for the United States, but whether it holds good or not, the line has earned for itself a reputation for go-aheadness which is certainly deserved.

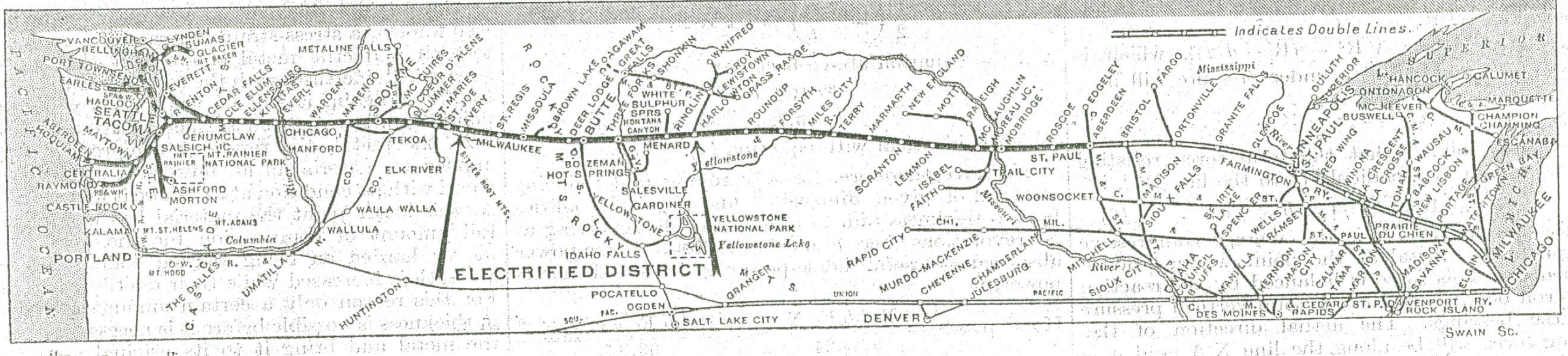

Fig. 1—MAP OF THE CHICAGO, MILWAUKEE, AND ST. PAUL RAILWAY

The section of its system which it has chosen for electrification is a particularly heavy piece of line. We reproduce in Fig. 2 the profile which we gave in our issue of November 12th last, which shows the three main summits that have to be surmounted. The nature of the country traversed, however, is more clearly to be realised from the panoramic sketch which we give in Fig. 3. Three separate ranges of mountains have to be crossed. Starting from Harlowton, which itself stands at 4163ft., the Belt Mountains are first met with and passed by a tunnel at Summit with a rail level of 5789ft. above the sea. Then, after a descent to just below the 4000ft. level the climb up the Rocky Mountains proper begins. In a run of something over 70 miles, the highest point, 6352ft., is reached at Donald, where the range is crossed in Pipestone tunnel half a mile long. Of the total climb of 2365ft., some 2000 are mounted in the final 21 miles or so, this representing an average of some 100ft. to the mile or about 1 in 57. It is generally referred to as "the 21 miles of 2 per cent. gradient." Two hundred and fifty miles further on, the Bitter Root Mountains are crossed at an elevation of 4169ft., and there are very heavy inclines on both sides of the range, the average gradients being 1.288 per cent. on the eastern slope, and 1.39 per cent. on the western slope, the maximum in each case being 1.7 per cent. In the 440 miles there are, in addition to the foregoing, numerous gradients of 1 in 100 and steeper than that. There is, for example, a continuous stretch of 49 miles of 1 per cent. gradient on the west slope of the Belt Mountains. As might be expected, too, the curvature is heavy, the maximum being 10 deg. There are in all 36 tunnels, the longest being the St. Paul Pass tunnel, over a mile and a half in length, through the ridge of the Bitter Root Mountains. For working the traffic on this part of the line, before the electrification, heavy "Mallet" type engines were used, which weighed 555,700 lb., or 248 tons, were employed. We shall have occasion later to give some further particulars of these engines and of the electric locomotives which are taking their place.

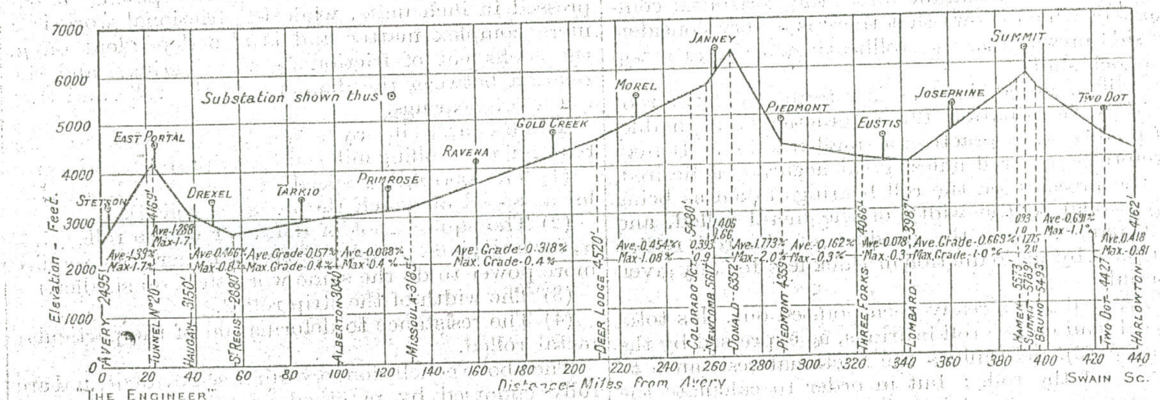

Fig. 2—PROFILE OF THE LINE BETWEEN AVERY AND HARLOWTON

The order for the electrification of the line, including the provision not only of the overhead, sub-station and switching arrangements, but also the locomotives, was given to the General Electric Company of New York in September, 1914, and it says much for the energy displayed by this firm, that in 15 months trains had begun to run over a length of 115 miles. The achievement is all the more noteworthy in that during December, 1915, such low temperatures were experienced that "Mallet" engines were frozen up at different points on the system, and that even under such trying conditions the work of electrification was carried out rapidly so that the steam engines might be dispensed with. In all, including shunting yards and sidings, an aggregate of about 650 miles of single track have been electrified.

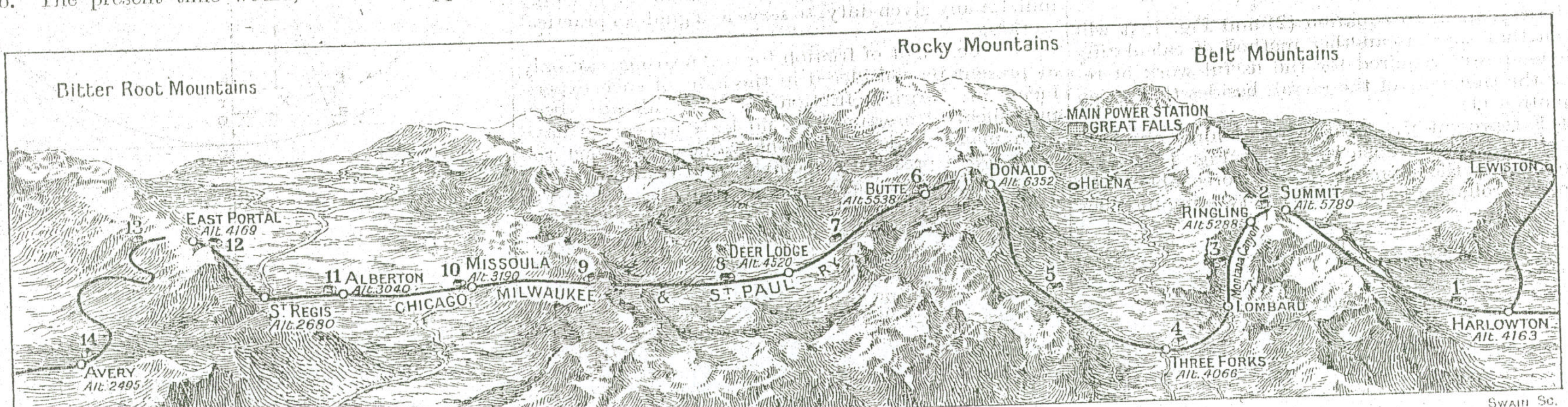

Fig. 3—PANORAMIC SKETCH OF THE LINE BETWEEN AVERY AND HARLOWTON

The question of obtaining the necessary current to work the electric trains did not offer any great difficulty, and the Montana Power Company undertook to supply the necessary energy. As can be imagined, the district is rich in water powers. In addition to the large hydro-electric station at Great Falls, on the Missouri River, in which there is at present installed plant with a total capacity of

60,000 kilowatts, and which may be extended so as to contain 85,000 kilowatts of plant, there are scattered about the district, but all within efficient transmission distances, eleven other hydro-electric stations containing an aggregate of some 93,530

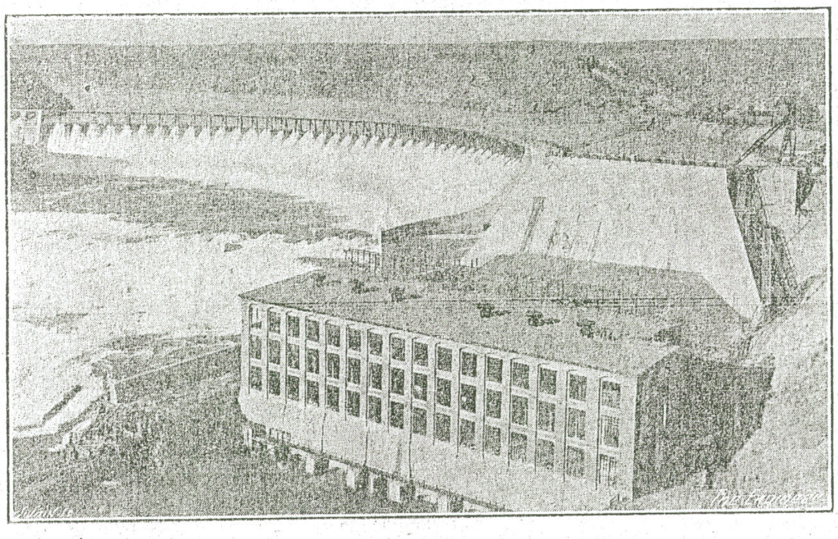

Fig. 4—VOLTA POWER STATION AT GREAT FALLS

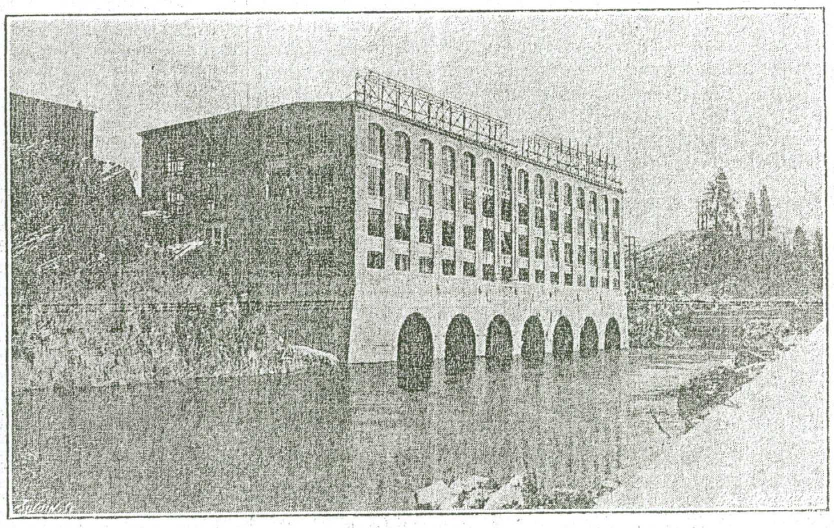

Fig. 5—THOMPSON FALLS POWER STATION

kilowatts of plant, as well as four steam stations holding 5920 kilowatts. The total power at present available is, therefore, 159,450 kilowatts. This is not all, however, for two other hydro-electric plants with a combined capacity of 50,000 kilowatts are in course of development and there are, in addition, six sites at which hydro-electric plants might be installed and from which a total of some 121,500 kilowatts might be obtained. As a total, therefore, should these latter plants be erected, as much as 330,950 kilowatts would be available. The power plants at present in service are situated at widely separated points, so that there is only the very remotest chance of a total failure in supply.

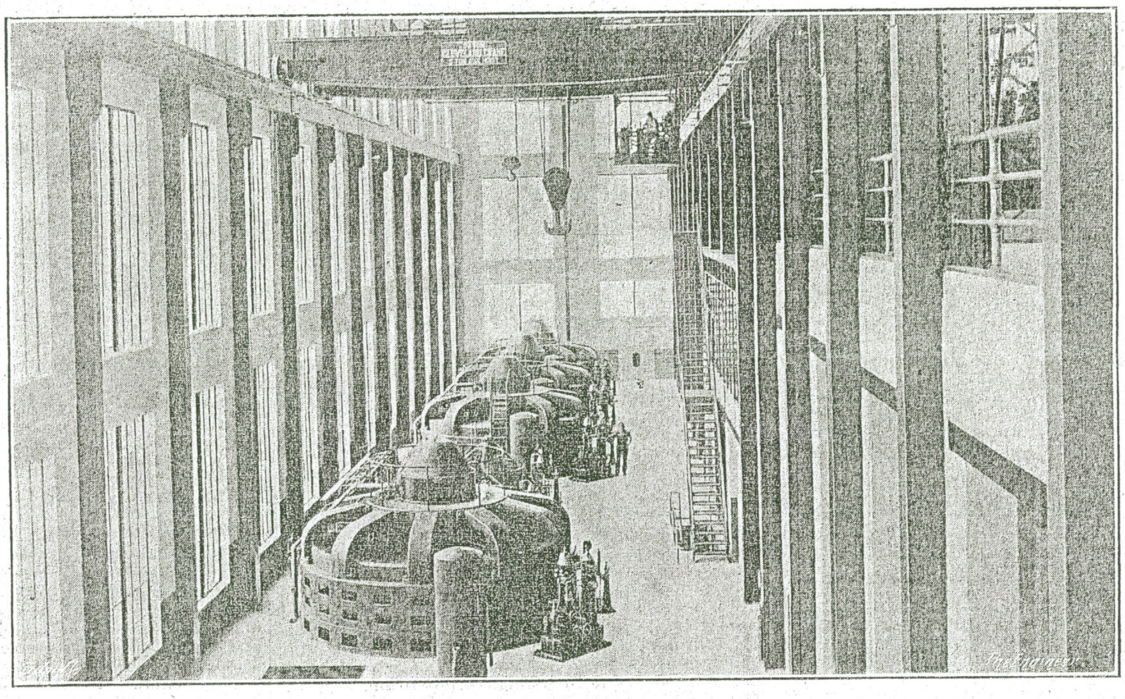

Fig. 6—INTERIOR OF VOLTA POWER STATION

There were a great many considerations which influenced the company in adopting this important scheme of transformation from steam to electric working. First of all it was calculated that there would be a marked reduction in the cost of electricity as compared with the cost of coal. Indeed, the enterprise has been entered upon with the full expectation of effecting such a reduction on the cost of operation as to return what is referred to as "an attractive percentage" on the investment. The estimated cost of the alterations is twelve million dollars—say £2,400,000—and supposing the saving were such

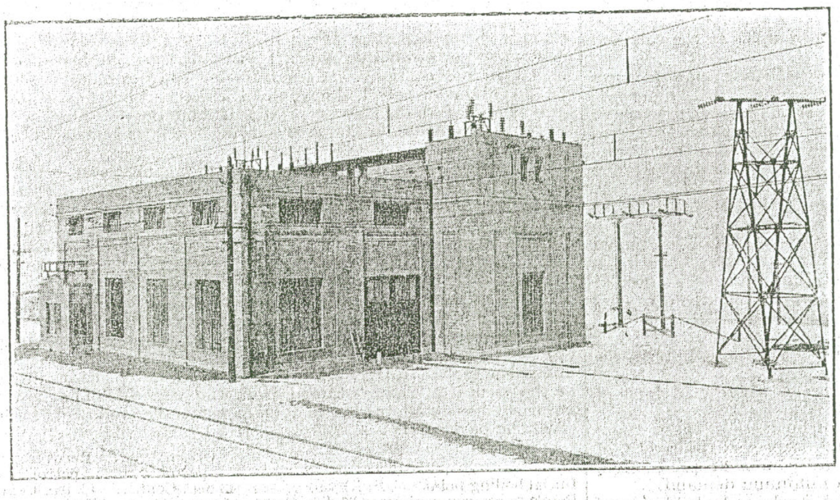

Fig. 7—SUB-STATION No. 6 AT JANNEY

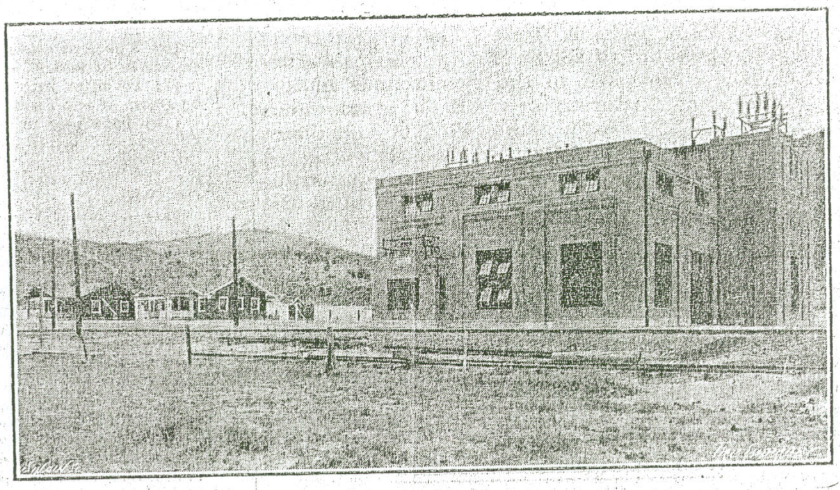

Fig. 8—SUB-STATION No. 4 AT EUSTIS

as to represent say 5 per cent. on this sum, this would amount to £120,000 a year. But the saving in cost of energy is by no means all that will be achieved. There will be reduction in the maintenance cost of the locomotives; elimination of delays due to coaling, taking water, oil fuel, &c.; elimination of delays due to freezing of locomotives, loss of steam in cold weather, &c.; elimination of non-revenue trains hauling coal and water for steam locomotives; increased tonnage per train; greater reliability and certainty of maintaining running times; reduction in train *personnel* per ton-mile; reduction in damage to rolling stock due to rough handling by steam engines; greatly increased safety of operation owing to the employment of regenerative braking, as well as a saving in power and a reduction in wheel and rail wear for the same reason; absence of the grinding of brake shoes on gradients; and, finally, improvement in tunnel conditions because of the absence of smoke, gases, and cinders.

The question of regenerative braking may be usefully referred to at greater length. On the long sustained gradients encountered in crossing the three mountain ranges great skill is required in handling, with steam locomotives, either the varied mineral and goods trains, or the high-speed passenger trains fitted with the usual air brakes. The problem of braking is rendered all the more difficult because the larger part of the traffic is *through* goods freight. The trains are made up of an assortment of "foreign" cars, including box and flat cars, coal and ore hoppers, stock cars, refrigerators, &c. These vary in weight from 11 to 25 tons empty, and may weigh as much as 70 tons loaded. Being owned by many different railway systems, the cars and wagons are equipped with brakes for different conditions of operation, and in accordance with different standards as to braking power and type of equipment. It is easy to understand that the task of holding long trains made up of numbers of such differently equipped vehicles is by no means easy. It is to be remembered that the entire energy of the descending train, saving only that amount necessary to keep it running at the desired speed, has to be dissipated by the friction of the brake shoes on the wheels. With a 2500-ton train running at 17 miles per hour down a two per cent. gradient, this energy may amount to 4700 horse-power, and it is easy to realise why under such conditions brake shoes may frequently become red hot and other serious damage done. The annoyance to passengers, too, descending a long, steep gradient with the brake shoes grinding on the wheels the whole time has to be experienced to be fully realised. Regenerative braking, of course, does away with all this. Our readers are familiar with its general operation. The motors, instead of being driven by current received from the overhead wire, become for the time being generators driven from the wheels of the train, and they return current back into the line instead of drawing it from it. The quantity of current returned to the line can be graduated at will, and so, in consequence, can the speed of the train. The more current returned the slower the speed and *vice versâ*. In this way it is possible to make smooth and easy descents, which are in marked contrast to the periodical slowing down and speeding up of a train controlled by air brakes alone.

The usual speed of an electrically worked mineral or goods train is 15 miles per hour when it is ascending the maximum gradient and 17 miles an hour when running down it, but half the latter speed can be easily maintained with series connections of the motors should conditions require it. The energy returned to the line by trains running down hill is either utilised automatically to work trains running up hill, or, if there are no other trains between the sub-stations to absorb the power generated by a descending train, the energy passes through the sub-station machinery, is converted from direct to alternating current, and is fed into the distribution system connecting all the sub-stations. The Power Company's lines are so extensive and the load of such a diversified character that any surplus power returned by regenerating locomotives can readily be absorbed by the system, and credit is given to the railway company for all current so returned. The actual saving in power is estimated at 15 per cent. of the total consumption.

We mentioned above that the current to work the line is obtained from various power stations of the Montana Power Company. Two of the principal supply stations of this company are those at Great Falls on the Missouri River and at Thompson Falls on Clark's Fork of the Columbia River. From these two stations alone there is, at present available, a capacity of 80,000 kilowatts, and, very shortly, this capacity is, we understand, to be raised to 115,000 kilowatts. The exteriors of these two stations are shown in Figs. 4 and 5, while the interior of the first named, which has been called the "Volta" plant, is shown in Fig. 6. It will be observed that the generators are of the vertical spindle type. Each has a rating of 8000 kilowatts at .8 power factor, and each generates at 6600 volts three-phase, the periodicity being 60. Each generator is direct coupled to its own exciter. The generated pressure of 6600 volts is stepped up to 100,000 volts for transmission.

The power company delivers current to the railway company's transmission line at seven feeding-in points where the demand for current will be heaviest, the charge made for the energy at these points being .26d. per kilowatt hour. The transmission line runs for the most part over the railway company's right of way, but there are points where distance is saved by taking it over short cuts. There are, in all, fourteen sub-stations, and their positions are shown by the numbers in the panoramic engraving. The first sub-station westward of Harlowton is at Two Dot, a distance of 12 miles. The distances between the remaining thirteen sub-stations varies between 23.7 miles and 42.7 miles, the average being just under 33 miles. The capacities of ten out of the fourteen stations is 4000 kilowatts, each station being equipped with two units each of 2000 kilowatts. Three of the remaining four stations, namely, those at Piedmont, at the foot of the twenty-one mile 2 per cent. climb on the eastward slope of the Rockies; at Janney, to the west of the Rockies Tunnel; and at Avery, the westernmost point at present electrified, there are three units of 1500 kilowatts each, this representing 4500 kilowatts installed at each sub-station. Finally, at East Portal, at the top of the climb up the eastern slopes of the Bitter Root Mountains, the sub-station contains three units each of 2000 horse-power. Each sub-station can be fed from either direction, and also at the tie-in points from a third source of power. All the stations are equipped for converting alternating current at 100,000 volts into direct current at 3000 volts, and each is provided with step-down static transformers, motor generator sets, switchboard, and the necessary controlling and switch gear. The transformers reduce the pressure to 2300 volts, at which pressure the current is supplied to the synchronous motors of the motor generating sets. Each synchronous motor drives on the same shaft two 1500-volt direct current generators, which are permanently connected in series so as to produce the 3000 volts required for working the locomotives. The fields of both the synchronous motors and the direct current generators are separately excited by small direct current generators direct connected to each end of the motor generator shafts. It will be seen, therefore, that there is a total number of 32 units installed in the fourteen sub-stations, and that the combined capacity of the whole of them is 59,500 kilowatts. Exterior and interior views of several of the sub-stations are given in Figs. 7 and 8 and in Figs. 9 to 14 inclusive on page 144.

THE dispute between the railways of the United States and their 300,000 trainmen has reached a very serious stage, which may at any moment lead to an unparalleled strike. They demand an eight-hours day, and time and a-half for overtime. The men refuse arbitration because they have, they say, no confidence in the impartiality of anyone. President Woodrow Wilson is giving the matter his personal attention.

LETTERS TO THE EDITOR.

(*We do not hold ourselves responsible for the opinions of our Correspondents.*)

THE EXPANSION AND DEVELOPMENT OF BRITISH INDUSTRIES.

SIR,—What steps are we taking to reorganise our industries and sale methods in order to profit by the lessons the war has taught us and to place the future well-being of our commerce upon a permanent, progressive basis, enabling it to meet on at least equal terms the bitter attacks of the well organised competition of our rivals in the world markets?

We know that the Associated Chambers of Commerce of this country are striving to remedy many defects in our commercial system by legislative methods, governing such matters as the carrying of British goods under the Empire flag, discrimination against alien vessels in port dues, preferential tariffs, compulsory registration of alien trading concerns, reforms of the consular service, revision of railway rates, encouragement of inventions, holding of exhibitions, &c. &c. Whilst appreciating to the full the importance of all these proposed changes providing, as they do, the necessary shelter so long required for the successful initiation of new industries and the protection of trade which has suffered from the want of such legislation in the past, I would earnestly call attention to the lamentable fact that it is not the particular province of any association, either of firms or individuals (nor is it yet possible for them) to investigate fundamentally and to remedy the absence of sale or decline in sale of our manufacturers' products in overseas markets. The holding of exhibitions, the foundation of banks, the establishment of Information Bureaux, the persuasion of the public to purchase British goods, the gathering together of erudite gentlemen to consult upon these matters, the offers of Government to support various industries, though all excellent, will not prove to be, in my opinion, the remedy we now seek to overcome the difficulties confronting British industry, so as to place it upon that firm basis which will be indispensable in the years to come.

A time has now arrived when, in addition to existing outlets for the goods of our manufacturers, either by direct sale through their own representatives or through export firms, a national commercial organisation should be called into being, which will not content itself by leaving unsold that for which the demand is being more adequately met by foreign competitors, but will patriotically penetrate into the causes why such articles are not sold from this country, and will through organisation at home and abroad bring back to this country the trade in such articles.

I propose that a national organisation should be immediately established in the form of a commercial company, having for its object the reorganisation of British sales and manufacturing methods and the extension of our commerce overseas, working independently of, yet closely associated with our Chambers of Commerce at home and abroad, the Board of Trade (Commercial Intelligence Bureau), Colonial Institutes, and other trade organisations at present in being. This National Commercial Company would carry out in the form of a limited liability company in a practical way, amongst others, the suggestions herein contained so far as relates to the hardware manufacturing, engineering and allied industries. I suggest that only a limited dividend would be payable upon the shares, sufficient to keep the value of the shares at par. Any profits remaining after payment of dividend, directors' fees, &c., to be utilised in further benefiting the country's commerce. If effective work is to be done on behalf of our commerce, commercial organisations must be self-supporting, and those employed must be responsible for the faithful and efficient discharge of their duties, and a permanent career opened to those whose personal abilities can best find their widest expression in important patriotic work of this nature. It is not, in my opinion, possible to congregate and attract that combination of talent, experience and energy for the prosecution of the work on any bureaucratic basis or as a spare-time occupation.

Amongst the objects to which the proposed National Company would give immediate attention would be:—

(1) The inducement of co-operation between manufacturers in the production of different parts of one article.

(2) Complete reorganisation of sales methods to face the well organised foreign competition, commercial and financial.

(3) The exhibition of British and foreign made goods constantly brought up to date, together with tabulated information as to comparative prices, demand, process of manufacture, &c.

(4) The solution of difficulties confronting manufacturers in extending their business overseas and the prevention of further encroachment by foreign competition.

(5) The establishment and nursing of a demand for British goods in countries or markets at present in foreign hands.

(6) The study of the methods of our principal competitors, and particularly the commercial side of German enterprise.

(7) In view of the various operations indispensable to the proper working of all matters connected with the successful and cheap handling of British products, the company would organise departments for specialised dealing on business lines with insurance, freight, packing, information and subscription, chartering, import, export, catalogues, manufacturers' agencies, consignment, finance, codes and telegraphic matters, correspondence in various languages, representation and sales, samples, exhibition and showrooms, advertisements and publications in foreign languages.

(8) Where necessary, to act as principles in the sale and purchase of goods.

(9) To enter into arrangements with any manufacturer or group of suppliers for their direct representation abroad.

(10) To study in detail the particular foreign class of goods in demand in overseas markets, as to patterns, types, qualities and prices and to co-operate with manufacturers for the production of suitable articles for competition therewith.

(11) To assist the smaller manufacturer to extend his business abroad, either (*a*) in the form of an amalgamation with others, who combined would be capable of producing all the different parts of one product, or (*b*) by fostering a demand for his products, or (*c*) financial assistance, if necessary, to enable him to execute work which the company would put into his hands.

(12) To bring the overseas purchaser into touch with the most suitable source in this country for the supply of his needs.

(13) To act as purchasers of articles where contributory manufacture is necessary, &c.

(14) To organise a continuity of business in cases where extensions of plant or new and improved processes of manufacture are necessary in the course of production, and, if necessary, to guarantee a minimum demand.

(15) To organise and arrange for stocks to be held abroad of articles for which a regular and large demand can be built up, thus economising for importers the heavy charges on small shipments.

(16) To obtain early information of all impending contracts for public works, of municipalities and Governments overseas.

(17) To negotiate concessions for the carrying out of the developments of public works or natural resources and to advise the different trades in regard thereto.

(18) To investigate the processes of manufacture adopted by competitors abroad in cases where underselling is taking place.

(19) Where underselling is not warranted by cheaper production, but is in the nature of competition designed to oust British goods in certain markets, to afford assistance to the trades affected.

(20) To supplement the information at present obtained through our sonsuls with the more precise and exact details required by manufacturers and to obtain authentic and comprehensive information as regards cost, terms of sale, and the like.

(21) The compilation of a special catalogue in a variety of languages, and in regard to measurements, weights, and all particulars to be in the metric system; this catalogue in series with removable pages, arranged to meet the occurrence of improvements of patterns, introduction of novelties, changes of prices, &c.

(22) Also to assist manufacturers in the preparation of their own special catalogues.

(23) The engagement of competent men abroad whereby a great saving to manufacturers may be effected, such representatives to be engaged only in the sale of British manufactures.

(24) To organise a department for the expert, technical and scientific study of competitors' patterns, goods and processes of manufacture.

(25) Compilation of figures facilitating the calculation of duties in countries of destination payable on different classes of goods on the basis of their weight or composition, as the case may be.

(26) The facilitation of prices for goods delivered, cost, insurance, freight and duty paid to importers' own stores.

(27) The regular publication of a trade paper in different languages containing information of commercial utility to overseas buyers, such as lists of stocks, notices of new inventions, reports of metal markets and standard goods, also containing leading articles on British trade and British goods together with a scheme of advertisement for British manufacturers in any or all the languages in which the publication is issued.

(28) The compilation of an up-to-date telegraphic code book in varied languages.

A proper understanding of the objects of this organisation will show that it is not competitive to our existing export houses, but that by its initiative and energy in the national interest, on the lines indicated, it will unlock many doors now closed to such merchant shippers, and will largely increase the number of British articles saleable by them. But it will certainly be competitive where British goods are being undersold by re-exported articles.

In the above suggestions I have but briefly touched upon some of the activities of the company proposed to be formed under the direction of the National Commercial Organisation, and I have refrained from giving detailed proposals for carrying out each particular section mentioned in order not to prolong this article unduly.

In conclusion, as will be seen from the above, if our industries are to combat the serious encroachment of their trade rivals, it is necessary, in my opinion, to have a thoroughly enlightened, up-to-date, scientifically aided reorganisation of our means of production and distribution by means of a National Trade Organisation, embracing every aspect of its many sided and complex duties, yet so co-ordinating and correlating them that each separate division works in harmonious and constant touch with the wants, needs, discoveries and activities of its fellows.

Sheffield, August 15th. PERCY A. REUSS.

THE PETROL QUESTION.

SIR,—Your article on the above subject in your issue of the 4th inst. is of very general interest. It may also be of interest to your readers if a brief sketch of another side of the question be given. Everyone knows that petrol is a volatile liquid, but what this means in figures is not generally known. I beg a portion of your space to bring this matter to the front and to suggest a remedy.

The imports of petrol for 1914 were about 144 millions of gallons, the growth over preceding years having been very rapid. It is safe to say that 5 per cent. of the total is lost by evaporation in transport, storage, use and re-distillation, or over seven millions of gallons. Some of the cleverest men in the country are seriously concerned in economising our resources of coal, an article which sells at about 6 lb. for one penny, but one does not hear of any effort being made to economise petrol, which sells at about 4d. per pound, or about twenty-four times the price and one and a-half times the heat value.

The manufacturers of sheet rubber—to mention only one branch of this business—use petrol to make the rubber more plastic, and then spread out the sheets over hot tables to evaporate the petrol—an absolute waste, as the vapour is passed to the atmosphere by fans in the roof of the building.

French dry-cleaning takes up very large quantities of petrol in which the fabrics are washed, and after being treated in a hydro-extractor are dried in an enormous volume of dry hot air. The re-distillation of spirit into the various qualities in demand in this country, owing to the low boiling point of the lighter fractions and the method generally adopted, involves a considerable loss. When it is remembered that one consignment of petrol from the time it leaves its country of origin to the time it arrives at its ultimate destination may be transferred from vessel to vessel as many as eight times, it will be clear that the loss by evaporation must be great.

I have only very briefly sketched the principal losses involved, which are shared by the three businesses referred to and which amount to no less than seven millions of gallons a year. To economise your valuable space, I will only give one instance of actual trade conditions. A small business buys annually about 27,500 gallons of petrol, the whole of which is wasted as vapour. This is one of about twenty in and around London alone. To diagnose the disease without specifying the cure is useless, but the cure is at hand.

This subject has interested the writer for some years, and the results of experiments have been most promising. An air pump draws a mixture of air and vapour left in a storage tank, 50ft. diameter by 30ft. high, a distance of approximately 700ft. through an iron pipe. I should state that the tank has been void of all spirit for several months, and in any case the pipe is about 10in. above the bottom of the tank. The mixture is compressed to a moderate pressure and then cooled. The capacity of the compressor is about 120 cubic feet per hour, and the result of one and a-half hours' work was 1.81 lb. of petrol, or just over two pints, the specific gravity being .708. Particular interest attaches to the distillation tests of the spirit originally in the tank and that obtained from the vapour. The power absorbed was about one brake horse-power. The following table gives the particulars:—

	Original petrol.	Recovered petrol.
Initial boiling point	43 deg. Cent.	42 deg. Cent.
Percentages coming over at 60 deg. Cent.	1 per cent.	Drop
,, ,, ,, 70 ,,	9 ,,	12 per cent.
,, ,, ,, 80 ,,	22 ,,	39 ,,
,, ,, ,, 90 ,,	41 ,,	67 ,,
,, ,, ,, 100 ,,	60 ,,	84 ,,
,, ,, ,, 110 ,,	77 ,,	93 ,,
,, ,, ,, 120 ,,	87 ,,	96 ,,
Final boiling point 130 ,,	93 ,,	124 deg. Cent.
,, ,, 140 ,,	96 ,,	
,, ,, 150 ,,	98 ,,	
,, ,, 153 ,,	Dry	

A spirit which gives 84 per cent. of the whole at 100 deg. Cent.