### PUSHING THE SALE OF ELECTRICITY.

“WANTED! A Commercial Assistant.” Advertisements headed thus and emanating from electric light and power supply companies and municipal electrical departments are becoming more frequent. It is a development that is already well overdue, but now that it has arrived we will not waste time weeping over what might have been had it come earlier, for practically everybody agrees that commercial energy and initiative in pushing the sale of electricity have been sadly lacking in far too many places until recently. Now there appears to be an awakening in progress which seems to be more or less general, and we have to see that there is no further slumbering or lazing.

Some weeks ago, in some references to the importance of this question, we remarked that as electricity supply undertakers on both sides of the Atlantic had both alike been stirred up to greater business-getting activity, though the conditions prevailing in the two countries differed widely in many respects and called for different procedure, it would be as well for us to watch the various ideas put forward there, and to see whether they could be profitably applied to English conditions. We have noted that some of our American exchanges have regarded the papers on the commercial development of electricity supply that were read before the Municipal Electrical Association meeting as being of interest on that side of the Atlantic, and we now take the opportunity of placing before English readers an American view of the new position of affairs, and some suggestions as to the best methods for dealing with it. This will be found in later pages of this issue in the form of a paper prepared by Mr. M. S. Seelman, jun., under the title “Organization and Conduct of a New Business Department Suitable for Central Stations of Cities of 50,000 Population and under.” This paper was submitted in competition to the Co-operative Electrical Development Association of Cleveland, Ohio, which last March invited all central station managers and their commercial employés to compete for prizes of £100, £60 and £40 respectively. Mr. Seelman wrote his paper prepared by Mr. M. S. Seelman, jun., under the title “Organization and Conduct of a New Business Department Suitable for Central Stations of Cities of 50,000 Population and under.” This paper was submitted in competition to the Co-operative Electrical Development Association of Cleveland, Ohio, which last March invited all central station managers and their commercial employés to compete for prizes of £100, £60 and £40 respectively. Mr. Seelman, who is engaged with the Edison Electric Illuminating Co., Brooklyn, was the winner of the first prize, and we are indebted for our reprint to our New York namesake, which congratulates the author upon the simplicity of his treatment of the subject, and the practical nature of his suggestions. The Association, we understand, intends to give full publicity in the Press to the other prize-winning papers, and also to four which received honourable mention; later on, the whole will be distributed in pamphlet form. In view of the present interest centring round the movement there is certain to be a demand for these pamphlets in this country as well, as soon as they are available.
In a paper presented to the Western Society of Engineers, Mr. C. E. Sargent deals with the status of the gas engine in the United States in a manner which shows the interest now being taken in the subject.

- The first cost of a large gas engine plant, all included, is not less than that of a complete steam plant, but the large gas engine is practically as durable as the steam engine, while stand-by losses are less; and the case is quoted of two producers of 200 H.P. belonging to the Erie Railroad Co., in one of which the fire has never been out for seven years.

Why, it is asked, when a given quantity of energy can be generated by the use of 10,000 B.Th.U. in gas engines, should 10,000 B.Th.U. still be used? Why continue burning 400 ch. ft. of waste gas under boilers when the same work can be done by 100 ch. ft. in gas engines? The answer is, and it applies unfortunately with greater force in Great Britain, that manufacturers have not kept pace with gas engine progress.

With tandem construction on the two-cycle system a single crank will receive as many impulses as in a single-cylinder steam engine, and with twin tandem as many as in a cross connected. With this twin tandem type the problem of driving polyphase electrical generators in parallel is considered to be solved.

The author seems to advocate heavy fly-wheels to secure the minimum angular velocity variation demanded for the parallel running of alternators, but he does not refer to the difficulty of synchronising, which is held by some to attach to heavy wheels. He illustrates an angle-meter for the purpose of showing the variation of angular velocity of a fly-wheel, each degree of departure being multiplied 360 times, so that the needle of the instrument swings through a complete circle for each degree of irregularity of the engine driving it. This instrument consists essentially of a fly-wheel driven by an inelastic belt from the engine through the medium of a hair-spring.

In the course of the discussion, a speaker suggested that the large gas engine had been born 10 years too late, and that the steam turbine would practically stop it. Undoubtedly the steam turbine has done much to check the gas engine, but there is little present hope or prospects of utilising the turbine principle for gas engines. But the steam turbine has by no means the fuel economy of the gas engine, and the existence of a huge output of waste blast furnace gas cannot fail to keep in men's minds the problem of using it. Fuel economy will keep alive the reciprocating engine, for this is the only one that can yet use gas as its source of heat by way of internal combustion.

The same speaker considered that the gas engine, however, was ahead of the producer. Mr. Thwaite's latest producer is of considerable height and is blown like a blast furnace, and with this tandem type the problem of driving polyphase electrical generators in parallel is considered to be solved.

This instrument consists essentially of a fly-wheel driven by an inelastic belt from the engine through the medium of a hair-spring.

In the course of the discussion, a speaker suggested that the large gas engine had been born 10 years too late, and that the steam turbine would practically stop it. Undoubtedly the steam turbine has done much to check the gas engine, but there is little present hope or prospects of utilising the turbine principle for gas engines. But the steam turbine has by no means the fuel economy of the gas engine, and the existence of a huge output of waste blast furnace gas cannot fail to keep in men's minds the problem of using it. Fuel economy will keep alive the reciprocating engine, for this is the only one that can yet use gas as its source of heat by way of internal combustion.

Thus the gas producer is now continuously workable, exactly like the blast furnace, with liquid slag, and the trouble of clinkerings is abolished, together with the resulting irregularity in quality and quantity of the gas. Needless to say, the giving of height to a producer is for the purpose of enabling the fuel to consolidate more perfectly, and thus avoiding gaps, cavas and short circuits of the air supply which are almost inevitable with shallow producers, especially when coke is employed, the specific gravity of which is too small to effect proper consolidation of the fuel.

Hamilton, Ohio!

"Many failures and few successes" are the words in which an over-sea contemporary sums up American municipal electrical experience. Investigations instituted in this country by the Local Government Board and by philanthropes have led to remarkable exposures regarding the practices to which the representatives of the public will stoop in their pretended safeguarding of the interests of the ratepayers. The tendency towards extravagance and corruption, with the consequent increasing burden of high rates, have had an educative effect upon men of business, who venture to believe will show itself when all municipal enterprises are unsatisfactory as much of our municipalisation has been, we do not think we can point to an example where "mismangement, extravagance and unbusinesslike methods" have exceeded those which have been permitted in the case of an American city where our contemporary singles out as one of the latest instances of failure. It appears that Hamilton, Ohio, with a population of 25,000 to 30,000, has had a $200,000 electric lighting plant in operation for 12 years. The State auditor has made a report, and he finds that inexperienced men have been called in to superintend important work "where both mechanical and electrical skill were necessary," faulty construction has led to enormous waste of energy, and the raising of the cost of production to an abnormal figure—above that charged to the public. So far stated the record might be due to ignorance and municipal mismanagement. But there is something more than "officials, ex-officials, prominent citizens and others were enjoying free service . . . . no effort had been made toward collecting the accounts." Indeed, at the beginning of the year some $27,000 was outstanding for such accounts—an amount equal to a full year's gross revenue! This sort of
procedure we need not characterise, but it would need a stronger term than ignorance or incompetence. Hamilton, Ohio, provides a strong argument for Americans against municipal electrical enterprise, and it also serves to emphasise the necessity of a most efficient system of State inspection and account auditing in connection with public works wherever carried out with public moneys. But for the intervention of the State auditor, Hamilton might have exhibited itself up in corruption for many a long day. Hamilton’s Councillors must shrink before the light of publicity!

The system of producing steel by the Héroult process, as practised at the works of R. Lindenberg, at Remscheid, is expected to have an important influence upon the German iron and steel industry. At present most qualities of special steels and alloys of steel which are intended for the manufacture of tools, knives, saws, arms, &c., are produced in Germany on the crucible smelting process, which consists in the smelting in graphite crucibles of very pure raw material in quantities of from 66 lb. to 1 cwt., which is largely obtained from Sweden or Styria. The steel produced in this way is very dear, as the raw materials alone are stated to represent a value up to £17 10s. per ton, and the smelting expenses of from £4 to £5 per ton have to be added. The Héroult process is, however, less dependent upon the quality of the raw materials, as it is possible with existing metallurgical methods to reduce the injurious phosphorus and sulphur contents to less than one-hundredth of 1 per cent. As practised at Remscheid, scrap iron and steel are melted in one furnace and then transferred in a liquid condition to the electric furnace, which has a capacity of from 1½ tons to 2 tons, and in which the metal is treated with two different kinds of slag, which mainly contain lime. After the purification has been carried out in this way, the materials are added which are necessary for the production of the particular quality of steel required, as, for instance, carbon, manganese, silicon, nickel, chromium, tungsten, and so forth. The purification and making ready occupy from two hours to two and a half. The consumption of energy in the case of a furnace of 1½ tons capacity amounts to 360 Kw.-hours per ton of finished steel, but with a larger furnace of 10 tons capacity, it is assumed that it would only reach 150 Kw.-hours per ton of steel. It is considered that if worked on a large scale under the labour conditions prevailing in Germany, it would be possible to manufacture steel equal to the average quality of crucible steel for the small sum of £5 per ton. The German technical view of the question is that the process will not only render the country independent of others in the matter of special steels, but will also allow of the production of an article which will meet all requirements at less than half the cost of equal qualities hitherto produced, while the almost complete elimination of sulphur at the works at Remscheid is said not to be possible by any other electrical method now in operation.

"The Electrical Bulletin."—We have been favoured by the Editor of the "Electrical Bulletin," of London, with an advance copy of the first number of this publication, which is a penny quarterly bulletin of information for electrical users. It is the intention that the various uses and applications of electricity shall be treated in some detail in a popular style appealing to the general public, and at the same time imparting useful information for all classes of consumers. We hope that it will find its efforts rewarded by the greater prosperity of the London electricity supply companies on whose behalf it is published, and that, by the wholesale bringing on of new consumers who at present, for reasons over which they have control, are groping in the dark.

ACCURATE SPEED, FREQUENCY AND ACCELERATION MEASUREMENTS.

(Concluded from page 365.)

Acceleration Tests.—These may be taken with the greatest accuracy and convenience by noting the instants at which the successive figures become stationary when the diagram in fig. 3 is observed through the slits of the fork. Fig. 6 shows curves representing the variation of speed with time on switching off a 4-h.p. Langdon-Davies motor running at 3,000 r.p.m., both when light and when various torques are applied to it by a brake, and it will be seen that the observations lie on the curves with remarkable regularity. This is probably the only method which would enable such curves to be accurately obtained, owing to the fact that other speed indicators either introduce sufficient friction appreciably to affect the machine when running light, or, on the other hand, lag behind variations of speed when these are at all rapid. Fig. 7 shows the curves of rise of speed in starting the motor light and on a brake, and is of interest as
the above value of the moment of inertia, implies a starting torque of 1-5 lb. ft. This torque is fairly constant up to about 1,800 revolutions, after which it rapidly rises to about 3 lb. ft. on nearing synchronism.

Observation of Cyclic Irregularity or Hunting.—Another valuable application of the stroboscope is in all cases of irregularity of speed. These variations are of two classes—those which take place during a single revolution, and those which extend over a period of several revolutions. The former are expressed by the term cyclic irregularity, and in this case the shaft does not travel through equal angles in equal times. By means of a roller stroboscope, in which the time between the flashes may be made any exact fraction of the time of a revolution, and using a single radial white line on a black background attached to the shaft of the machine under test, an appearance will be seen like the spokes of a wheel, which spokes are at regular intervals if the speed is uniform. This appearance can be photographed, and if any cyclic irregularity exists, the angles between successive spokes will be unequal, and the amount of the irregularity can be ascertained by a protractor.* Hunting, on the other hand, is indicated by oscillation of the figure when the flashes are a definite fraction of the mean speed, and may be readily expressed by the periodic time and amplitude of the oscillation of the figure. As the conical device enables the mean speed to be exactly balanced, the oscillation can be readily measured.

Frequency Measurement.—The most convenient of the devices for measuring frequency are those depending on the principle of resonance. The first practical instrument on this principle was the well-known frequency meter of Mr. A. Campbell, while the Hartmann, Kemf or Frahms arrangement, in which a number of tuned reeds are actuated by a magnet fed from the a.c. mains, is likely to become the standard commercial instrument for frequency measurement. An ingenious device in connection with the Hartmann-Kemf instruments, which does not seem to be well known, is that known as the transmission circuit which doubles the range. This is effected by a second winding which can be fed with d.c., thus polarising the magnets and causing them to attract the reeds only once instead of twice per period.

Of other frequency meters the only one worthy of mention is the Westinghouse, which takes advantage of the dependence of the glowing-coil effect upon frequency. A light aluminium disk is revolved in the fields of two shaded pole magnets. One of these circuits is practically non-inductive, the other as inductive as possible. Each of these magnets alone would drive the disk round, and they are set so as to oppose one another, while one side of the disk is cut eccentrically. The disk, therefore, takes up a position for which the two forces balance, but if the frequency is increased the force due to the inductive circuit becomes less relatively to the other, and the disk moves to another position. One would, however, expect such an instrument to be considerably affected by wave form.

The roller stroboscope is again very convenient for accurate frequency measurement. If the roller is running in synchronism with the standard fork, all that is necessary is to provide the rolling disk with a figure of the correct number of arms (usually six), and to illuminate it with a thin filament glow lamp from the source of supply. The disk has then only to be traversed along the roller until the cross appears stationary, and the frequency can be read off directly to an accuracy of \(\frac{1}{2}\)th per cent. Frequency meters can also be accurately calibrated either by measuring the actual frequency, or by observing the vibrating reed through slits in the rolling disk, and traversing the latter until the reed appears to be stationary.

Measurement of Slip.—This again can be done with the greatest ease, and using the roller device. The roller is only to be run in synchronism with the source of supply, and the figure on the motor shaft viewed through the slits in the rolling disk. On traversing the latter until the figure appears stationary, the percentage slip can be directly read off.

* The maximum amount of cyclic irregularity can also be seen by the amount of blurring of a radial armed figure, provided that the amount of displacement due to the cut-off of the fork not being instantaneous is known.
also the operation of signals, track circuits, signal lights, indicators and interlockings from the same general supply as that for traction, and is of a most interesting character.

The power supply for the operation of the signals, &c., along the lines is single-phase alternating, transformed by special transformers in the sub-stations, and delivered to special signalling mains at 3,000 volts. Each sub-station gives supply to points half way between it and the adjoining sub-station, and the supply to each section is independent of all other sections. The 3,000-volt signalling transmission line is of bare copper, carried on the pole line used for the main supply. For the operation of the signals, their lighting, &c., the pressure is reduced from 3,000 to 50 volts, the transformers being fixed on the signal bridges, or on the poles of the transmission line, as may be most convenient. For the operation of the track circuits the pressure is further reduced, to values varying between 1½ and 8 volts, according to the lengths of the track circuits. The transformers for the track-circuit supply are constructed with four tappings by which the various pressures required may be obtained without the necessity of providing more than one type of transformer. In order that failure of the alternating supply shall not cause a breakdown of the signalling arrangements, special d.c. to a.c. motor-generators, taking their supply from the storage batteries, are provided in the sub-stations, and furnish an alternative a.c. supply to that obtained from the transformers.

The block sections vary in length from 1,200 ft. for speeds of not more than 45 miles an hour, and 2,500 ft. for speeds not exceeding 60 miles an hour, to 3,000 ft. for speeds exceeding the latter figure. The average length of the longer sections is about 3,200 ft. Distant signals are provided for each of the sections named above, and there will be about 1,400 track circuits, aggregating nearly 250 miles.

The type of signalling to be installed is the "Young system", and the work is being done under the direction of the General Railway Signal Co. Probably the chief feature of this application of the system is the double duty obtained from the track rails, which may, partly or wholly, be used for carrying the direct return currents for the traction supply, and at the same time carry alternating currents for the operation of the track circuits, without interference. This object is attained by the interpolation of reactance bonds between the track rails, which offer very little resistance to the direct currents, but oppose the passage of the alternating currents for the track circuits. Two arrangements of the track circuits are made use of. For track circuits of 500 ft. or less, and where the "drop" in the track rails due to the d.c. traction currents is less than 50 volts, one of the track rails is sectionised and given up to signalling purposes, the traction currents being carried by the other rail, which is continuous. This arrangement is shown by fig. 1, which is self-explanatory. The insulated joints in the track rail rubbing contact is made with a steel angle plate in the inside.

The track circuit relay controlling the signals is of the induction motor type and has two field coils, one of which is fed from the 50-volt supply, and the other, in which is connected a reactance coil for obtaining a displacement of phase, is fed from the alternating supply in the track rails. The rotor of the relay turns through an angle of 37½° when under operation, and the break between the contacts of the relay is 23½°. As contact is made during 14° of revolution of the rotor a good rubbing contact is made. The rigid contact is of a very hard carbon, and the moving contact is of platinum. Sparking at the relay contacts is very slight, notwithstanding the fact that the power required to operate the signals is from $\frac{1}{4}$ to $\frac{1}{2}$ h.p.

For track circuits more than 500 ft. in length, where both rails are used as the return for the traction currents, the arrangement of the reactance bonds shown by fig. 2 is made use of. For sections of not more than 1,600 ft. the reactance bonds are fixed at the ends of the sections, as shown by fig. 2. As the engineering department of the railroad company requires cross bonding of rails at distances of not more than 1,600 ft., track circuits exceeding this length have to be provided with additional bonds. In these cases an ironless reactance bond is preferred. The construction of the bonds is shown in fig. 3. The water-tight cast-iron boxes containing the bonds are filled with oil, and each bond is designed to permit of the continuous passage of 3,000 amperes for each rail of the track without injurious heating.

The signals will be operated by single-phase alternating-current motors wound for 50 volts, and developing about $\frac{1}{2}$ h.p. The signal lamps are 50 volts, 4 c.p., with the filament wound in a small circle to bring the point of maximum illumination within the focus of the lens. In Park Avenue tunnel, the signals will consist of lights, operated by the track relays, without any moving parts whatever. The lamps themselves will be coloured, and give appropriate signals when lighted. A similar arrangement will be made for the signals in the Grand Central Station, but in this case the circuits for the signal lamps will be completed by the levers for the signals.

The operation of interlocking and the switch and signal movements at points under manual control, are made by direct currents furnished by storage batteries of 55 cells, and having capacities of from 80 to 320 ampere-hours, according to the amount of work to be done, placed in separate battery houses near the signals. These batteries are charged by special d.c. to d.c. motor-generators, fed from the 3,000-volt signal line, and furnishing direct current at 150 volts. The batteries will be charged, on the
average, every fourth day. The release of the lock of the lever is obtained by the motor of the switch or signal movement running as a generator immediately after completing its stroke.

Short track circuits controlling the locks of the switch levers are being substituted for the ordinary detector bars in all except a very few cases. Advantage is taken of the circuits thus provided between the tracks and the signal boxes controlling them, to illuminate corresponding sections of a track plan hung in the signal box, so that the signalman may have complete information of the condition of all parts of the track under his control. The track plan is painted on ground glass, and divided into sections at the back, corresponding to the sections of the track which are to be separately shown. When any section is occupied a red light is shown on that section of the track plan; when clear, a white light is shown. A similar arrangement is in use on the District Railway in London.

The undertaking is of a most interesting character, and the difficulties of combining the automatic track circuit system of signalling, which has now obtained so strong a hold on American railways, with the use of the track rails for the return currents for electric traction have been met in a characteristically bold manner. Details of the estimated cost of the signalling installation are lacking, so that no comparison with a similar installation of the ordinary character is possible, and information respecting the cost of operation can only be obtained after the installation has been in use for some time. The ultimate success, however, of the system will depend upon the financial and operative results obtained, and there seems to be no reason why these should not be favourable. At first sight the number of transformations seems formidable, and the electrical efficiency, so far as the signalling is concerned, must undoubtedly be low. The consumption of electrical energy for the operation of points and signals is, however, extremely small, and in this case will be an almost infinitesimal part of the consumption for all purposes, and the low efficiency cannot appreciably increase the cost of distribution of the whole supply.

OERLIKON SINGLE-PHASE LOCOMOTIVES.

We have received from Mr. G. Wiithrich, manager of the British Department of the Maschinenfabrik Oerlikon, particulars of some new alternating-current locomotives, constructed at Oerlikon for experimental trial on the Seebach-Wettingen line near Zürich. The principal object was to test a new mechanism for taking current from an overhead conductor, with the secondary object of trying a new general design for alternating-current locomotives. The general appearance of the locomotive is shown in fig. 1. The pressure of the overhead line is 15,000 volts at 15 cycles. This is reduced by transformers in the locomotive to 600 volts, at which pressure, subject to regulation by apparatus in the cab, the current is supplied to the motors. The locomotive is carried on two four-wheel bogies. Each bogie carries a single-phase series motor geared with a reduction of 1 : 21 to an intermediate shaft lying between the axes of the wheels, and a little above them. This intermediate shaft and the four wheels are coupled together so that every wheel is driven. Moreover, the bearing of the crank-pin of the intermediate shaft can move vertically in its seat in the coupling link, so that the wheels can rise and fall vertically while travelling, without communicating shocks to the gears and motors.

The construction of the collecting apparatus, which is the principal novelty in the locomotive, is shown in figs. 1 and 2. The locomotive carries two sets of collector gear on opposite sides of the roof, and fore and aft of one another. The actual collectors are pairs of curved steel tubular rods, with brass rubbers, of a form easy to replace when worn. These rods, provided with springs to give the necessary pressure, swing in planes at right angles to the track, and are mounted on insulators on a hinged system of parallel links, so that they and the axes on which the collectors turn can be moved outwards from or inwards to the centre line of the roof. In fig. 2 the system on the right hand side is pushed as far outwards as it will go, that on the left as far inwards. The movements of the hinged links are controlled by pneumatic cylinders inside and under the roof of the cab, shown in dotted lines. The frames or links \( \text{fig. 3} \) turning on \( \text{o} \) are used to hold down the collectors over the middle of the roof when not in use.
and are manipulated by chain gearing between \( o \) and \( p \). The collectors on the right-hand side are resting on the line wire, their controlling link \( l \) being dropped clear. The collectors on the left, which are not in use, are shown held down by their controller \( l \). This arrangement allows collection from a line wire in any position over or on either side of the locomotive that is within reach of the collectors. When the line wire is at the side, the collector rubs on the top of the wire. When it is overhead the collector rubs underneath. The collectors on the left-hand side of fig. 2, supposing the link \( l \) were released, would be in a suitable position for a line wire placed over the locomotive, and if necessary very close to it. The system is said to have worked in these trial experiments very well and satisfactorily.

The compressed air used for working the collector mechanism and the brakes is obtained from an automatic electrically-driven pump in the cab. The lighting is by 20-volt lamps, whose filaments are so thick that they keep their incandescence sufficiently steadily to be tolerable at the very low periodicity used, 15 cycles. The weight of the locomotive is 43 metric tons, of which 23.5 tons are the main circuit \( m \), as shown. The main poles are provided with compensating windings in grooves, these windings being either short-circuited on themselves, as shown, or in series with the main circuit. The motor has eight main poles, and runs normally at 650 r.p.m., which is about three times the speed corresponding to synchronism; it operates equally well with a frequency of 25 cycles. The characteristic curves obtained with this motor are given in fig. 5.

The mechanical parts of the locomotive were built by the Swiss Locomotive and Engine Works in Winterthur, while the electrical equipment was designed and made by the Maschinenfabrik Oerlikon. The locomotive is claimed to be the first to be equipped with a single-phase motor of 200 H.P., and has been running nearly a year. Fig. 6 shows the locomotive on the track, with the method of carrying the overhead conductors.

The Oerlikon Co. has also in operation a single-phase locomotive of the Ward-Leonard type, of which a view is given in fig. 7. The collector is in this case practically the same as its the former, which it really preceded in point of time. The equipment consists of a single-phase motor driving a direct-current generator, which supplies energy to
D.C. traction motors, the D.C. voltage being regulated by hand to control the speed. As is well known, this is the most economical method of control, and gives high efficiency at all speeds, with starting torque limited only by the heating limit of the motors.

These considerations, it is pointed out, justify the use of the Ward-Leonard system in spite of its complication, in cases where severe gradients exist, rendering the recuperation of energy desirable, or where the utmost economy of energy is called for. Fig. 7 shows a locomotive of 44 metric tons weight, the whole of which is available for adhesion, and developing a tractive effort of 600 to 4,000 kg. at speeds between 70 and 36 km. per hour.

The frequency recommended is 25 cycles per second, at a working line pressure of 6,000 volts, which can be employed in the A.C. motor without a transformer; if a higher voltage (up to 20,000 volts) is employed, a transformer must be used, increasing the total weight to 46.5 tons.

The frequency, however, can have any desired value whatever, and in this respect this system is superior to that in which a commutator A.C. motor is used.

The electrical equipment, including the controlling gear, air pump and all accessories, weighs 25.1 metric tons; the two bogie-trucks, frame, cab, etc., weigh 19 tons, making a total of 44.1 tons.

The motor-generator (figs. 8 and 9) consists of an induction motor with short-circuited rotor, a D.C. generator with auxiliary poles, and an exciter, all of which are mounted on a common shaft running at 730 r.p.m. The average load on the shaft is 820 H.P., and the maximum 1,100 H.P. The traction motors are separately excited, for pressures from 0 to 900 volts, and speeds from 0 to 1,200 r.p.m.; each of them has a normal output of 95 H.P. and a maximum of 200 H.P., and drives through gearing with a ratio of 3:1:9:3. The motors (and the transformer, if there is one) are artificially cooled.

The motor-generator is started by using the exciter temporarily as an A.C. series motor, for which purpose it is specially designed. When full speed is attained, the main motor is switched on, and the exciter is connected up as a shunt-wound dynamo, energising the fields of the generator and traction motors. The direction of motion of the locomotive is determined by the connection between the brushes of the motors and those of the generator; the speed is controlled by resistance in series with the generator and motor fields. Regeneration is effected by exciting the fields of the motors so that their E.M.F. exceeds that of the generator and runs the latter as a motor, and increasing the speed of the motor-generator beyond synchronism.

All these operations are carried out by simple barred controllers. Fig. 10 shows the characteristics of the combination when running free, the terminal pressure of the generator being kept constant at 900 volts (the most economical condition for normal running), and the speed varied by means of the excitation of the motors.

This locomotive has been in use on the Wettingen-Affoltern section of the Swiss State Railways for two years, and has given satisfactory results, with a working pressure of 15,000 volts, at a frequency of 15 cycles per second.

We understand that the Oerlikon Co. has orders in hand for both of the above-described types of single-phase locomotives.

**CORRESPONDENCE.**

Letters received by us after 5 p.m. on Tuesday cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address on our possession.

The Woolwich Appointment and Municipal Muddling.

I observe that the letter signed "Once Bitten Twice Shy," which appeared in your issue of 24th ult., has evoked a reply from the Mayor of the Borough, and as another of the "Once Bitten" coterie I also would like to offer some remarks.

It is something to know that the Establishment Committee has felt some regret at being unable to select the required assistant from the six applicants recommended by the Electricity Committee: and I, for one, hope that it has caused no sleepless nights.

The "very careful consideration" given to the recommendations of the chosen six must have been half-hearted, seeing that only three out of the six were called, and the others dismissed. Would it not be better to have seen the whole six, or rather the whole five, as one of the applicants is already on the staff? Admittedly, the vacant post requires to be filled by one fully conversant with the duties appertaining thereto, but how could the committee arrive at the conclusion that out of the six applicants not one was suitable, when only three were interviewed? Again, how is it possible to test the "natural gifts" of a likely candidate without interview? Apparently the members of the committee at Woolwich have unnatural gifts which permit them to examine through the thick stone walls, and fine oak panelings of what is really a most gorgeous town hall, the candidates who wait their pleasure. It must be so, as a further conclusion arrived at was that the salary offered (£200 per annum) was inadequate to tempt the best talent. There are so many posts now open in the electrical trade at £200 per annum, that the seeker of a new post can afford to be particular.

The remark that only one applicant could have the post is worthy of a Daniel, and I think the fact must have been overlooked by every one of the applicants.

As to the taking up of references, it is news to me that in applying for a post it is necessary to state that information
as to present employment is only given in confidence. I have always understood that to take up a reference is the very last step before making an appointment. Had I known that it was necessary to state this in my application, it would probably not have caused me to have recourse to the use of the title of Zoppy’s table.

The Dog and the Bone.

As an applicant for the above and a commercial assistant of many years’ experience in the electrical profession, will you kindly allow me to say, in justice to myself, that the explanation why no appointment was made, as stated by Mr. Gilbert Slater, the Mayor of Woolwich, in his letter of September 5th, cannot possibly be correct. Mr. Gilbert Slater must know perfectly well—though he does not mention it—that, of the six candidates who were requested to meet the Establishment Committee, three of the number, including myself, although in attendance, were not interviewed by those gentlemen.

His statement, therefore, that, after very careful consideration, none of the six candidates were found suitable for the post, does not represent the true facts of the case; further, to brand as incompetent men whom they had never seen, is monstrous, and little short of a libel, and moreover, is calculated to seriously imperil the future prospects of the men in question.

If Mr. Gilbert Slater possesses a single atom of an Englishman’s love of justice and fair play, he will withdraw his statement at the earliest possible moment, and apologise for having published it.

Commercial Assistant.

September 10th, 1906.

I have seen the reply which the Mayor of Woolwich sends to my letter, and I am glad to notice that we are in agreement as to most of the facts. The Mayor, however, omits to refer to, or to express any regret for, the manner in which the candidates were kept waiting about—surely a bad example for those from whom business qualifications were expected. He also states that present employers were not written to in any case in which the candidate indicated that he desired that his candidature should be treated as confidential.

For the Mayor’s edification I should like to state that it is the usual practice in business circles in every case to treat an application for a position as confidential and only to refer to the sister institution, from which so many of us have arisen such a keen interest that it was unanimously decided to adjourn the discussion. Wherefore—say out of respect the municipalities and business know not each other. As it is, it may interest the Mayor to learn that one of my colleagues who kicked his heels with the rest outside one municipal sanctum, has, in consequence of the Establishment Committee’s action, lost his post with his present employers.

Once Bitten, Twice Shy.

Free Wiring by U.D.C.‘s.

Could you assist me, either by information that you may at present possess, or through your “Correspondence” columns, in placing myself in communication with resident engineers of Urban District Councils, not Corporations, who are at present carrying out lamp renewal schemes for consumers, and, better still, if they are also working assisted wiring schemes, also hiring out of motors, arc lamps, &c.?

This is an undertaking that would be greatly assisted by any of the above schemes, and my Committee are agreeable, but the Clerk states that there is no account recognised by the L.G.B. and that the expenses of the above can be placed to.

Whitby, September 8th, 1906.

L. H. King.

Long Hours in Government Dockyards.

I have just seen particulars of the appointment open for station supervisors (shift engineers) at H.M. Dockyard, Portsmouth.

The candidates are informed that they will have to work seven shifts of eight hours each per week all the year round (unless they like to get leave without pay).

As at all respectable stations give their staff at least one shift off a week and 14 days’ holiday in the year on full pay, I think that the Government can at least afford to treat their shift engineers as well, as other employers, especially as the hours of the workmen employed in the dockyards are so short.

I hope you will call Mr. Wordingham’s attention to this, so that he will at least see that his assistant at Portsmouth treats shift engineers as human beings. How can anybody expect a shift engineer to be bright and ready for emergencies if he works 365 days in the year, and extra when breakdowns occur!

Not Having Any.

The Penetrating Properties of the Arc Light.

Mr. Bastian is his letter of August 27th on this subject makes certain statements which are quite in opposition to the accepted theories on the same. The red colour at sunset is not due to refraction, and cannot be so, as a little consideration will show. The blue light after sunset certainly is due to refraction, but the red rays from the same refraction never reach the earth, and are only seen in the copper colour of the moon during eclipse.

When the sky appears violet-blue to us during the day, the complementary red rays are giving people away to our east a red sunset. The reason for this is that the tiny particles of suspended solid matter in the atmosphere reflect the short violet and blue waves but are too small to reflect the longer red ones. In like manner a pebble will reflect a ripple but not a wave. A pretty illustration of this action is seen on sending a strong beam of white light through a clear liquid in which precipitation is beginning to take place. An observer at right angles to the beam will see at first no light, then a pale violet, gradually changing to blue as the solid particles coalesce and increase in size. The final colour, of course, is that which the precipitate has in bulk. Similarly the sea, smoke, fog, &c., appear blue, as also do the first tiny water particles of an escaping steam jet, which get whiter as they increase in size. The blue colour of distant objects is due to the same cause, and Mr. Bastian will perceive the correctness of this when he recollects that it is distant dark objects rather than white which appear blue. Any photographer will tell him it is not a question of absorption, since distant hills always appear far too light on account of the blue rays from the intervening atmosphere.

From the above it is clear that a yellow or red source of light will penetrate fog better than a blue source.

Railway Engineers and Electricity.

Without entering into matters controversial, would it not be as well for your correspondent to remember that the discussion on the paper by Mr. T. Hurry Riches and Mr. S. B. Haslam stands adjourned until the next meeting of the Institution of Mechanical Engineers in London.

At the Cardiff meeting the time given for the discussion of papers was extremely limited, and, as your apparently nameless and homeless correspondent must be aware—he says he was present at the meetings—the paper referred to aroused such a keen interest that it was unanimously decided to adjourn the discussion. Wherefore—say out of respect to the sister institution, from which so many of us have sprung—let us wait and hear what we shall hear.

Theodore Schontheil.

Cardiff, September 10th, 1906.

Rail Corrugations.

Upon the principle that one original idea, however absurd, is worth a dozen old ones, however wise, I beg to submit another theory as to the cause of “roaring rails.” Most of your readers will be conversant with the process by which the “milled” or “knurled” edges are formed upon ter-
EverShed's Patent Bridge-Megger.

We recently paid a visit to the Acton Lane Works, Chiswick, of Messrs. Eversheds & Vignoles, Ltd.—a restless, uneasy firm, like the Athenians, always running after some new thing, and trying to beat 5,000 ohms to a fraction of 1 ohm, thus filling in a part of the Athenian calendar. The Megger itself is modified externally only by the addition of four insulated terminals, a ratio switch, and a change-over switch. Internal modifications are more extensive, as the connections are radically altered by the change-over switch; but this does not affect the working of the Megger as such in the least; the simple operation of turning the switch to "Megger" completely and instantly restores it to its ordinary function of measuring insulation resistance from 5,000 to 40 million ohms by direct reading. A full description of the Megger was given in our issue of December 9th, 1904, page 937, and fig. 1 shows its appearance as modified.

Turning the change-over switch to "Bridge," the ohmmeter of the Megger becomes a galvanometer, and the two windings of the generator are put in parallel, so as to secure a larger current-carrying capacity at a lower voltage. The ratio arms of the bridge, which are enclosed in the Megger, are at the same time brought into circuit. The resistance box is next connected to the appropriate terminals by flexible leads, and the resistance under test to the remaining pair. The Wheatstone Bridge is then complete. The whole of the connections, internal and external, are shown in fig. 2.

The resistance box is illustrated in fig. 3, and is of the direct-reading dial type. It contains four sets of coils, from 1 to 9,999 ohms, each set being controlled by a multiple-contact rotary switch carrying a figure dial, which shows the number of units, tens, &c., in circuit, at a little window in the top plate. The complete range of each switch is included within half a revolution, and a mechanical device ensures precision in the setting of the switch for each contact. The figures being in their correct order and position, it is easy to read off the resistance and difficult to make a mistake.

D. Evans.

Cardiff, September 8th, 1906.
connections and instructions for testing are pasted into the lid of the resistance box, and the leads are so made for easy stowing the leads in the box when they are not in use.

It will be observed that the following advantages are secured:

- There are no plugs to insert or lose, no keys to map, no scattered figures to add up and no levelling to do. To take a reading, the handle of the comparator (which takes the place of a battery) is turned, and the resistance is varied until the pointer of the diam-eter is brought to the point marked "Infinity." This operation is facilitated by the instructions "Increase R," "Decrease R," which are permanently inscribed on the scale, the direction of the deflection being always the same under given conditions of departure from balance.

The range of resistances which can be measured with the Wheatstone Bridge thus formed extends from one million ohms to one-hundredth of an ohm; in each case a result is obtained accurate to four figures, which, of course, is ample sufficient for practically all the measurements that the workaday engineer is called upon to make. The pointer is always steady, and a change of one unit in 10,000 is distinctly observable upon the scale. The rate of turning the handle does not affect the reading, unless the unknown resistance is highly inductive, such as a dynamo-field coil, or has a high capacity; in such event, the speed of turning the handle must be above the value at which the constant-speed device comes into play. When commencing a test, however, and until approximately approximate balance is attained, the handle is turned slowly. The whole process of balancing can be carried out in a remarkably short space of time; but the coils are so constructed that they can be left in circuit for a long period without being overheated.

**ORGANISING THE SALE OF ELECTRICITY.**

**ORGANISATION AND CONDUCT OF A NEW BUSINESS DEPARTMENT SUITABLE FOR CENTRAL STATIONS IN CENTRES OF 50,000 POPULATION AND UNDER.**

By M. S. Selifman, Jnr.

I HAVE been recently in a number of cities, not alone of 50,000 and under, but of 100,000 and over, where the central station had not only no organisation for securing new and retaining old business, but no sense or appreciation of the lack of it. These companies do no advertising, make no attempt to educate their public to a knowl-edge of the superior advantages of an electrical service, have no special propositions, employ no canvassers. Some of them do not even follow up the permits for new buildings. They give no sugges-tion to the customer in the most general and ordinary methods of lighting his home or store or factory—that is left to the wiring contractor, who in all likeliness has an exceedingly primitive and limited idea of illuminating engineering. The attitude of such a central station may be thus expressed: "Here we are. If you really want to buy current from us, you must apply to our general agent." These are their words, not mine.

Obviously, the Bridge-Megger can be used for localizing faults and for measuring resistances up to 10,000 ohms.

**Brandon Lighting.—** The U.D.C. has refused the application of the County of Durham Electric Light Co. for permission to use overhead mains.

**FIG. 4.—CONNECTIONS FOR MEASURING RESISTANCES UP TO 10,000 OHMS.**

**FIG. 5.—CONNECTIONS FOR VARLEY'S LOOP TEST.**

109, 10, or 1 as required. For higher resistances the bridge and the resistance are interchanged, and the ratio switch used on 10 or 100; in this case the words "Increase R" and "Decrease R" must be read in the converse sense. Resistances above 10,000 ohms can also be measured with the Megger alone, but, of course, the bridge test is the more accurate.

**Brandon Lighting.—** The U.D.C. has refused the application of the County of Durham Electric Light Co. for permission to use overhead mains.
The common method of window lighting by means of projectors is something like the stage lighting in a theater, or by chandeliers, may also be shown; but in this case the object of the lighting is to display the goods, then one of the three first-mentioned systems of reflected light from hidden sources is the more desirable, while the visible lamps, projecting or in a straight line, must be taken to explain to customers that wherever the object is not so much to draw attention to the goods as to attract the eye to the window itself, as with a salon.

In the show window itself should be placed an exhibit of electric fans, ventilators, water and air heaters, coffee percolators, tea urns, water heaters, etc. Adjacent to each appliance place a neatly printed or painted card, naming the article and a definite price for its use, thus:

**THIS ELECTRIC IRON Can be used for one hour FOR SIX CENTS.**

Don't talk volts & amperes. Talk dollars and cents.

And this brings us to the subject of canvassers. The general agent must make clear, take steps at once towards securing the aids required in his campaign for new business, the principal questions that must be asked of any man he engages are: In what manner shall he secure them, and how much ought he to pay them?

The solution of the first question must be governed to a considerable extent by the size, personnel, and general location of the town. Roughly speaking, I should say that, other things being equal, a city with a population of 50,000 or less, which is alive and fairly prosperous, would require one canvasser to about every 12,500 population. This is an elastic rule, however, and must be freely interpreted. For instance, I have in mind a factory town in New England, with a population of 100,000, of which 35,000 are mill hands, comparatively few of which are likely our general agent knows one or two men of the type he wants for his campaign, and whose services he can secure. It may be possible to take an employé from some other company and to train him, but the pay of canvassers would be, I should say, about $12 per week salary and a commission of two cents per 16-c, lamp equivalent for all over 250 equivalents a month the canvasser turns in. In addition the general agent must, of course, see that his man is a little more than a canvasser. Now then, let us suppose we have gathered our selling force together, or at least disposed of the best men. Then we must equip them for the fray, get them ready for business. It is advantageous, I believe, to give the new men the run of the office for a day or two, so that they may become familiar perhaps with the location of switches and outlets, painting and decorating of houses and stores to produce the best and most economical lighting effects, types of motors in general most suited for special classes of power work, ideas and methods of apportioning the units in a power installation. It is well if these instructions, together with the special propositions offered by the company, be gotten up compactly in small book or pamphlet form and handed to each canvasser. Of course the canvasser must be told to refer at once all propositions that he finds himself unable to adequately or competently handle, to the general agent. If he starts such business he is entitled to his commission thereupon, even if the deal has to be consummated by the general agent or some expert or specialist. In connection with this talk of the general agent to his men, it may be said in passing that it is excellent business to secure from time to time and as frequently as possible experts in various lines to address the members of your business department—in illuminating engineers, power men, Nernst, Meridian and high-efficiency representatives, appliance manufacturers and others who would help a great deal.

In this way you give each man a portion of business section, of residence locality, and probably of power territory. Later on you may find that one canvasser has a special talent in aiming at bulky business, another for business or for power propositions, and it is then easy to redistribute in accordance with the special qualifications of your men. The canvasser, taken on—on the way the system—occasionally one man may be given one line of business—the printers or the butchers, or jewelry manufacturers, or whatever line may be selected—and then, if the canvasser does not do up his business right straight through, giving a report upon each one interviewed.

Now then, we are nearly ready to canvass. Our general agent gives each canvasser a list of his business or power propositions, with enthusiasm, but to give them the last word of information as to how to approach and handle various light and power propositions as they may present themselves, so that the man may be competent to advise prospective customers as to matters involved in their installation, such as wiring, selection of lamps and glassware, location of switches and outlets, painting and decorating of houses and stores to produce the best and most economical lighting effects, types of motors in general most suited for special classes of power work, ideas and methods of apportioning the units in a power installation. It is well if these instructions, together with the special propositions offered by the company, be gotten up compactly in small book or pamphlet form and turned to each canvasser. Of course the canvasser must be told to refer at once all propositions that he finds himself unable to adequately or competently handle, to the general agent. If he starts such business he is entitled to his commission thereupon, even if the deal has to be consummated by the general agent or some expert or specialist. In connection with this talk of the general agent to his men, it may be said in passing that it is excellent business to secure from time to time and as frequently as possible experts in various lines to address the members of your business department—in illuminating engineers, power men, Nernst, Meridian and high-efficiency representatives, appliance manufacturers and others who would help a great deal.
the newspapers and the corporation, but because it certainly has a very real educative value. In the average big city, however, the character of the population is such that, out of a circulation of, say, 100,000 that some newspaper may have, only one or two thousand 
man is a lazy and improvident creature by nature, and that patience is a virtue that may be possible to customers. In advertising, the company must pay to reach the $9,000 unprofitable one along with the $3,000 prospects, and if the margin is low, the return therefrom is too small for all that surplus publicity. In the average small city conditions are different. Consider this city of 50,000, where the margin is less; the advertising two charges are not so heavy, and a larger proportion of readers are likely to be prospects. So that, for advertising in the city of 50,000 or less would seem to be a better plan. And right here I want to say that if you want to get a big share of the ad\

there is the free sign proposition for instance; it has proven "good business" everywhere, it has caught the public off guard so far as the sign is concerned. Advertiser may consider the sign as a way of disposing of his extra capacity. At other times use an advertisement each week in the paper and send out a lighting circular each month. This can be done by selecting the right kind of lamps and glass-

the size of these advertisements, of course, depend on the number of and factor in a new business campaign, and that is the special purpose—as, for instance, a sign list composed of present store customers and stores not yet using the service, but whom you hope to station capacity. At other times use an advertisement each week in the paper and send out a lighting circular each month. This can be done by selecting the right kind of lamps and glass-

A fundamental law of political economy is that man is a lazy and improvident creature by nature, and that patience is a virtue that may be possible to customers. In advertising, the company must pay to reach the $9,000 unprofitable one along with the $3,000 prospects, and if the margin is low, the return therefrom is too small for all that surplus publicity. In the average small city conditions are different. Consider this city of 50,000, where the margin is less; the advertising two charges are not so heavy, and a larger proportion of readers are likely to be prospects. So that, for advertising in the city of 50,000 or less would seem to be a better plan. And right here I want to say that if you want to get a big share of the ad\

there is the free sign proposition for instance; it has proven "good business" everywhere, it has caught the public off guard so far as the sign is concerned. Advertiser may consider the sign as a way of disposing of his extra capacity. At other times use an advertisement each week in the paper and send out a lighting circular each month. This can be done by selecting the right kind of lamps and glass-

A good many companies are ready to make extensions, even in cases where it takes quite some time to get back the original investment. 
A panel sign costs you about $15, with a frame in the top portion for a placard advertisement for outside lamps, they will find this proposition a potent factor in securing new and profitable customers. Only one or two thousand postal cards without the charge for printing and addressing them, while his sign, for example, a lighting sign, will keep on using the sign far beyond the two years of his contract. It is right and other things being equal, to a continuous and often successful advertising by letters, circulars, booklets, &c., distributed through the news-stand. This can be done by selecting the right kind of lamps and glass-

There's the free sign proposition for instance; it has proven "good business" everywhere, it has caught the public off guard so far as the sign is concerned. Advertiser may consider the sign as a way of disposing of his extra capacity. At other times use an advertisement each week in the paper and send out a lighting circular each month. This can be done by selecting the right kind of lamps and glass-

This can be done by selecting the right kind of lamps and glass-

A panel sign costs you about $45; with plan postcard for this return work, and find that while the cost is as six to one, the latter is nearer as effective as the former. This return postcard method gives you a fair chance to estimate the interest your advertising is arousing, and leads, if the advertising is right and other things being equal, to a continuous and often successful advertising by letters, circulars, &c., distributed through the news-stand. This can be done by selecting the right kind of lamps and glass-

The newspapers and the corporation, but because it certainly has a very real educative value. In the average big city, however, the character of the population is such that, out of a circulation of, say, 100,000 that some newspaper may have, only one or two thousand 
man is a lazy and improvident creature by nature, and that patience is a virtue that may be possible to customers. In advertising, the company must pay to reach the $9,000 unprofitable one along with the $3,000 prospects, and if the margin is low, the return therefrom is too small for all that surplus publicity. In the average small city conditions are different. Consider this city of 50,000, where the margin is less; the advertising two charges are not so heavy, and a larger proportion of readers are likely to be prospects. So that, for advertising in the city of 50,000 or less would seem to be a better plan. And right here I want to say that if you want to get a big share of the ad\

A good many companies are ready to make extensions, even in cases where it takes quite some time to get back the original investment. 
A panel sign costs you about $45; with plan postcard for this return work, and find that while the cost is as six to one, the latter is nearer as effective as the former. This return postcard method gives you a fair chance to estimate the interest your advertising is arousing, and leads, if the advertising is right and other things being equal, to a continuous and often successful advertising by letters, circulars, &c., distributed through the news-stand. This can be done by selecting the right kind of lamps and glass-

There's the free sign proposition for instance; it has proven "good business" everywhere, it has caught the public off guard so far as the sign is concerned. Advertiser may consider the sign as a way of disposing of his extra capacity. At other times use an advertisement each week in the paper and send out a lighting circular each month. This can be done by selecting the right kind of lamps and glass-

This can be done by selecting the right kind of lamps and glass-

A panel sign costs you about $45; with plan postcard for this return work, and find that while the cost is as six to one, the latter is nearer as effective as the former. This return postcard method gives you a fair chance to estimate the interest your advertising is arousing, and leads, if the advertising is right and other things being equal, to a continuous and often successful advertising by letters, circulars, &c., distributed through the news-stand. This can be done by selecting the right kind of lamps and glass-

There's the free sign proposition for instance; it has proven "good business" everywhere, it has caught the public off guard so far as the sign is concerned. Advertiser may consider the sign as a way of disposing of his extra capacity. At other times use an advertisement each week in the paper and send out a lighting circular each month. This can be done by selecting the right kind of lamps and glass-
wore and arranging them to advantage. One of your canvassers could perhaps be authorized to do this class of work. Once the plans are drawn, the storekeeper is very apt to become sufficiently interested to want to get the thing started, and from the fact that he is willing to do it, he is ready to sell anything. Now as to residences and new buildings. In the average town of 50,000 there will be found about six architects, in the town of 25,000 perhaps one or two. To each of these men your canvasser must do is to set himself to get acquainted with these architects, not alone in his own city, but also in the neighboring towns and villages, so that a feeling of friendship may spring up between them. Let him join their clubs, take them out to dinner, &c. After this "entente cordiale" has been established, and an easy glibness and a gravity to act from the start what is taking place in the line of creating new street lighting, every householder will be called upon to contribute his light the installation of isolated plants. Get the architects on your side. Of course, the building permits must be followed up closely. Let no guilty man escape. — Every new building must be wired, and I am sure to do this is to see the builder the day his permit is issued (before, if possible), and to follow him right up until the business is done. The same with permits for alterations. When the owner is serious, and there is any doubt as to whether wiring or not is the psychological moment to approach him about installing an electric illumination on the premises. These are new business permit points that can not be neglected.

A first-stirrion proposition that the new residence is the unavoidable one. If you can get there and see your man among the developers in a city of 50,000—which, if wired, would yield a fair and certain revenue. How to get him wired is the problem. Your consumer advertising hold him by writing to the householders to a realisation of all the many advantages and conveniences of an electric service. Then it is to convince him that the coal and iron canvasser in his day time, get the "lady of the house" on his side, and then make an appointment for evening after supper, when the householders is likely to let him in the ear of the canvasser must meet with (already predisposed in his favour) husband and together. May and June are especially good months to canvass residences in, because almosts who are out of town in July and August can arrange to have the wiring done in their absence, saving them some inconvenience.

But there are householders who would like to have an electric illumination, but they are not feeling that they can afford to put it out of the question of wiring in a lump sum. If these respectable citizens let the company help them out by financing the deal, the money to be repaid in monthly installments, the canvasser has cost $240 to $250, and that is more than the householder wants to pay at one time. What does this canvasser do? He furnishes his living room, kitchen, cellar, back parlour, parlor and lower halls, which can be delivery in $100, including fixtures.

The organisation for getting new business outlined in the foregoing has the advantage of being elastic. As soon as the canvasser has signed up a customer the tendency is to quit him and pass by on the other side of the street. This must be avoided. The customer ought to be frequently visited by the man who took his contract, cementing an acquaintance, ascertaining and attending to his wants, and what is the utmost importance in more ways than one, retaining his good will. If the customer has a complaint, it is better to relieve him of it than to let it rankle in his chest, and the complaint may be of something readily remedied. Besides, the customer may desire to add to his installation to the storekeeper is very apt to become sufficiently familiar with problems to handle this end of the business, the canvasser knows better than anyone else to whom the money has been given the cost of wiring in a lump sum. If these be reputable citizens let him agree to install the motors at night, on Sundays and holidays. The man has gone, and he does the business. He is now running not to remove himself from that ideal base of operations, which is nearly uniform for at least 12 hours per day. This man's example is to be followed. There is one matter that your general agent and canvassers must not lose sight of. In the natural desire for new business, do not overlook or neglect old business.

As soon as the canvasser has signed up a customer the tendency is to quit him and pass by on the other side of the street. This must be avoided. The canvasser ought to be frequently visited by the man who took his contract, cementing an acquaintance, ascertaining and attending to his wants, and what is the utmost importance in more ways than one, retaining his good will. If the canvasser has a complaint, it is better to relieve him of it than to let it rankle in his chest, and the complaint may be of something readily remedied. Besides, the customer may desire to add to his installation. The canvasser has a chance to follow up this new line of business to the last, because it is at once, being primarily day load, of the utmost importance to the central station, and, at the same time, ordinarily the most difficult to secure.

First of all, let me say that while it is possible to secure lighting business on a low price, it is not possible to make a profit on it, because of superiority and also because average installations are of such size that isolated generating plants are impracticable, to get any large slice of new power business, your price has got to be right, for even if you can go into a factory and demonstrate how out cutting and saving leads to don't let it rankle in his chest, and the complaint may be of something readily remedied. Besides, the customer may desire to add to his installation. The canvasser has a chance to follow up this new line of business to the last, because it is at once, being primarily day load, of the utmost importance to the central station, and, at the same time, ordinarily the most difficult to secure. In the natural desire for new business, do not overlook or neglect old business.

As soon as the canvasser has signed up a customer the tendency is to quit him and pass by on the other side of the street. This must be avoided. The canvasser ought to be frequently visited by the man who took his contract, cementing an acquaintance, ascertaining and attending to his wants, and what is the utmost importance in more ways than one, retaining his good will. If the canvasser has a complaint, it is better to relieve him of it than to let it rankle in his chest, and the complaint may be of something readily remedied. Besides, the customer may desire to add to his installation. The canvasser has a chance to follow up this new line of business to the last, because it is at once, being primarily day load, of the utmost importance to the central station, and, at the same time, ordinarily the most difficult to secure. In the natural desire for new business, do not overlook or neglect old business.

As soon as the canvasser has signed up a customer the tendency is to quit him and pass by on the other side of the street. This must be avoided. The canvasser ought to be frequently visited by the man who took his contract, cementing an acquaintance, ascertaining and attending to his wants, and what is the utmost importance in more ways than one, retaining his good will. If the canvasser has a complaint, it is better to relieve him of it than to let it rankle in his chest, and the complaint may be of something readily remedied. Besides, the customer may desire to add to his installation. The canvasser has a chance to follow up this new line of business to the last, because it is at once, being primarily day load, of the utmost importance to the central station, and, at the same time, ordinarily the most difficult to secure. In the natural desire for new business, do not overlook or neglect old business.

As soon as the canvasser has signed up a customer the tendency is to quit him and pass by on the other side of the street. This must be avoided. The canvasser ought to be frequently visited by the man who took his contract, cementing an acquaintance, ascertaining and attending to his wants, and what is the utmost importance in more ways than one, retaining his good will. If the canvasser has a complaint, it is better to relieve him of it than to let it rankle in his chest, and the complaint may be of something readily remedied. Besides, the customer may desire to add to his installation. The canvasser has a chance to follow up this new line of business to the last, because it is at once, being primarily day load, of the utmost importance to the central station, and, at the same time, ordinarily the most difficult to secure. In the natural desire for new business, do not overlook or neglect old business.

As soon as the canvasser has signed up a customer the tendency is to quit him and pass by on the other side of the street. This must be avoided. The canvasser ought to be frequently visited by the man who took his contract, cementing an acquaintance, ascertaining and attending to his wants, and what is the utmost importance in more ways than one, retaining his good will. If the canvasser has a complaint, it is better to relieve him of it than to let it rankle in his chest, and the complaint may be of something readily remedied. Besides, the customer may desire to add to his installation. The canvasser has a chance to follow up this new line of business to the last, because it is at once, being primarily day load, of the utmost importance to the central station, and, at the same time, ordinarily the most difficult to secure. In the natural desire for new business, do not overlook or neglect old business.

As soon as the canvasser has signed up a customer the tendency is to quit him and pass by on the other side of the street. This must be avoided. The canvasser ought to be frequently visited by the man who took his contract, cementing an acquaintance, ascertaining and attending to his wants, and what is the utmost importance in more ways than one, retaining his good will. If the canvasser has a complaint, it is better to relieve him of it than to let it rankle in his chest, and the complaint may be of something readily remedied. Besides, the customer may desire to add to his installation. The canvasser has a chance to follow up this new line of business to the last, because it is at once, being primarily day load, of the utmost importance to the central station, and, at the same time, ordinarily the most difficult to secure. In the natural desire for new business, do not overlook or neglect old business.

As soon as the canvasser has signed up a customer the tendency is to quit him and pass by on the other side of the street. This must be avoided. The canvasser ought to be frequently visited by the man who took his contract, cementing an acquaintance, ascertaining and attending to his wants, and what is the utmost importance in more ways than one, retaining his good will. If the canvasser has a complaint, it is better to relieve him of it than to let it rankle in his chest, and the complaint may be of something readily remedied. Besides, the customer may desire to add to his installation. The canvasser has a chance to follow up this new line of business to the last, because it is at once, being primarily day load, of the utmost importance to the central station, and, at the same time, ordinarily the most difficult to secure. In the natural desire for new business, do not overlook or neglect old business.

As soon as the canvasser has signed up a customer the tendency is to quit him and pass by on the other side of the street. This must be avoided. The canvasser ought to be frequently visited by the man who took his contract, cementing an acquaintance, ascertaining and attending to his wants, and what is the utmost importance in more ways than one, retaining his good will. If the canvasser has a complaint, it is better to relieve him of it than to let it rankle in his chest, and the complaint may be of something readily remedied. Besides, the customer may desire to add to his installation. The canvasser has a chance to follow up this new line of business to the last, because it is at once, being primarily day load, of the utmost importance to the central station, and, at the same time, ordinarily the most difficult to secure. In the natural desire for new business, do not overlook or neglect old business.
ENCLOSED MAGAZINE FUSE BOX.

The insertion of a new fuse on a main lead is often the occasion of considerable delay and loss of temper. An experienced workman, when called upon to replace a fuse, and, above all, the correct size of fuse wire, has to be summoned before the fault can be rectified. To overcome these objections, Mr. E. G. Annuss and Mr. W. Runn (68, Hoveveis Road, Blackheath, N.) have designed a magazine fuse box, for the purpose of immediately introducing a fuse into a circuit by simply turning a handle.

The apparatus, an external and internal view of which we reproduce herewith, consists, briefly, of a porcelain drum or fuse-carrier, mounted on a wrought-iron spindle, so as to revolve between suitable metallic contacts. The porcelain drum is provided around its periphery with a series of longitudinal channels, separated from one another by walls of porcelain; in each of these channels a fuse wire is contained. The drum, contacts, and connections to external mains are all housed in a neat cast-iron case. On the front of the case is provided an inspection shutter, by which the fuse in circuit is readily inspected; means are also provided by a small hole for seeing the number of fuses remaining in the box. The handle, which has a spring action, has only to be turned through about 45°, and by the action of a strong spring will fly back to the normal position, switching in a new fuse with a smart, snap-like action, and thereby preventing any burning of the contacts. Only one fuse can be in circuit at a time. The handle can only be turned in one direction, through a fixed range, thereby making the apparatus extremely simple and "fool-proof."

The magazine fuse can be made in several sizes and types for various voltages and currents, and as a minimum contains seven fuses. It is further proposed to construct magazine fuses for voltages above 600 volts, and for this purpose the ordinary fuse wire will be replaced by a dust fuse, which is of similar design to the well-known Mordey enclosed fuse. By this arrangement a high-tension circuit-breaker of limited capacity is obtained; that is to say, until all the fuses in the box have been used up it is then only necessary to withdraw the drum and re-fuse it (which should be done by some authorised person), and start the case again.

The situations where such a magazine fuse box could be usefully applied are very numerous. Already its value has been indicated in connection with supply companies' mains to large buildings. If, of course, the consumer blew several fuses in succession, it would not be wise to advise the supply company of a fault, but often a main fuse "goes" through some momentary overload or through some passing carelessness. Its sphere of usefulness, however, is mainly found in power circuits. One fuse blows, and with no loss of time, mess or trouble, another is jumped into its place, while melting of the fuse wire can in no way earth the circuit or make the magazine inoperative.

POWER TRANSMISSION LINES.

By T. L. KOLKIN.

Several articles on the theory of transmitting electrical energy have recently appeared in some of the periodicals. It is, of course, of importance for the designer to be familiar with this theory, but it is of just as great importance to know how to use it to best advantage, and that is what the writer in the following article will endeavour to demonstrate.

In laying out a transmission line the following points have to be taken into consideration:—

1. Mechanical strength—not only of the poles and insulators, but also of the wires. A certain wire may be found to be of sufficient strength to take a certain drop, but if it does not possess a sufficient mechanical strength, the use of such a wire would lead to bad results.

2. Current density. Before deciding upon a certain size of conductor, it is necessary to make sure that the heating current does not exceed a certain limit per unit of the sectional area, especially where cables are used. A current density of 1,800-1,860 amperes per sq. in. is, as a rule, the maximum allowed for overhead wires.

3. Voltage Drop and Regulation. This is a point which should receive careful investigation, especially where large motors doing intermittent service are installed, and where the torque limits the output of the motors. It must be remembered that in the case of a three-phase system a 10 per cent. drop below the full voltage on the motor means about 19 per cent. less torque; or, in other words, the customer receives only about 81 per cent. of the torque he has "installed."

4. The energy is to be used for power or for lighting; in case the energy is to be used for driving motors it is necessary to know the size of the motors. For instance, a 25-H.P. motor, two or three-phase, can be wound for 1,800 volts, a 40-H.P. motor can be wound for 2,000 volts, and a 50-H.P. motor can be wound for 3,000 volts. Motors wound for a higher voltage than 3,000 volts very seldom come into consideration; for instance, where motor-generators of considerable size are to be installed. In case the drive is such that high tension motors can be used, it should be investigated whether the energy can be transmitted at such a voltage that step-down transformers are required only for the smaller motors, or whether it would be of advantage to transmit at a higher voltage and use step-down transformers for all motors.

5. Restrictions or Difficulties in obtaining wayleaves, &c., may limit the voltage, and have, of course, to be taken into consideration.

6. Situation of Plant. It is, undoubtedly, more difficult to repair a high tension motor than a low tension motor. High tension motors should, therefore, not be used where very good skilled labour is not obtainable. Climatic conditions have further to be considered, as to whether the climate is dry or moist, &c.

7. Possibility of Shunting Down the line in case of emergency. In many cases it will be found that a certain percentage of the total load has always to be available, and that a shunting-down of the transmission line even for a few hours would cause great inconvenience and loss. In such cases it is necessary to put down two or more independent circuits. The maximum power to be transmitted with one circuit shut down, or mechanical reasons, may necessitate putting down a larger line than is actually required in ordinary conditions. I think the importance of this item is, as a rule, under-estimated.

8. Cost of energy or coal.

9. Cost of the transmission line.

10. Working time and working conditions of the various motors, or better still, a 24-hours load curve. By means of 8, 9 and 10 the "most economical" size of conductors can be determined (by the application of Kelvin's law).

If items 1 to 7, however, have received proper consideration
there is, in many cases, not much room left for a strict application of this law.

It will easily be understood from the above that a general rule as to what voltage should be used cannot be given. As a guide, I find that under ordinary circumstances—

\[
\text{Voltage} = 150-200 \sqrt{\text{Kw.}} \times \sqrt{\text{distance in miles}}
\]
gives fairly good results. For instance, for transmitting 1,600 Kw. over a distance of 36 miles this would give—

\[
\text{Voltage} = 150-200 \sqrt{1,600 \times 36} = 20,000-25,500 \text{v.}
\]

**EFFECT OF THE WIND PRESSURE.**

In the following we will investigate from what size of wires we can expect a good result as far as mechanical strength is concerned, and, at the same time, draw a comparison between copper and aluminium. The strain on the suspended wire is due to—

1. Weight of the wire.
2. Wind pressure.
3. Weight of snow and ice on the wire.

The strain per unit of cross-sectional area due to the weight of the wire is evidently independent of the size of the wire. With the strain due to the wind-pressure this is, however, not the case. As regards snow and ice, this acts practically in the same way as the weight of the wire. In this country it is hardly necessary to take snow and ice into consideration—at any rate, not simultaneously with maximum wind pressure.

For determining the wind pressure, I will use the usual formula for cylindrical surfaces, which is—

\[
\text{Pressure} = \frac{3}{2} \times \frac{125 \times d \times l}{d \times l} \text{kg. per m.}^2,
\]

where \(d\) is the diameter and \(l\) the length of the cylinder (wire) in metres. Assuming—

- \(s\) = section of wire in \(\text{mm.}^2\),
- \(p\) = weight of wire in kg. per m.,
- \(p_1\) = wind pressure on wire in kg. per m.,
- \(p_2\) = resultant of \(p\) and \(p_1\) = \(\sqrt{p^2 + p_1^2}\) in kg. per m.

We have then—

![Fig. 1](image)

**TABLE I.—COPPER.**

<table>
<thead>
<tr>
<th>(s)</th>
<th>(p)</th>
<th>(p_1)</th>
<th>(p_2)</th>
<th>(c = \frac{p_1}{p})</th>
<th>(d) in mm.</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>987</td>
<td>307</td>
<td>31</td>
<td>36</td>
<td>27</td>
</tr>
<tr>
<td>20</td>
<td>274</td>
<td>423</td>
<td>48</td>
<td>27</td>
<td>51</td>
</tr>
<tr>
<td>40</td>
<td>344</td>
<td>608</td>
<td>696</td>
<td>20</td>
<td>72</td>
</tr>
<tr>
<td>80</td>
<td>696</td>
<td>108</td>
<td>154</td>
<td>100</td>
<td></td>
</tr>
</tbody>
</table>

**TABLE II.—ALUMINIUM.**

<table>
<thead>
<tr>
<th>(s)</th>
<th>(p)</th>
<th>(p_1)</th>
<th>(p_2)</th>
<th>(c = \frac{p_1}{p})</th>
<th>(d) in mm.</th>
</tr>
</thead>
<tbody>
<tr>
<td>20</td>
<td>954</td>
<td>423</td>
<td>43</td>
<td>8</td>
<td>54</td>
</tr>
<tr>
<td>40</td>
<td>108</td>
<td>307</td>
<td>36</td>
<td>56</td>
<td>72</td>
</tr>
<tr>
<td>80</td>
<td>316</td>
<td>233</td>
<td>243</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>160</td>
<td>432</td>
<td>126</td>
<td>133</td>
<td>143</td>
<td></td>
</tr>
</tbody>
</table>

Fig. 1 shows the relationship between \(s\) and \(c\). In the case of copper we find that for a wire of 10 mm.\(^2\) section, the resulting strain is 3.6 times the strain due to the weight of the wire. It will be noticed that \(c\) is rapidly decreasing for wires up to, say, 30-40 mm.\(^2\) section, while from this point the decrease is less marked. This shows that we can expect better results as regards mechanical strength from large wires than from small ones, and that wires of less than 30-40 mm.\(^2\) section should not be used—say, wire No. 3 S.W.G.—except, of course, for short distributors.

![Fig. 2](image)

In the case of aluminium, we find that the limit is about at 60-70 mm.\(^2\) section, or No. 00 S.W.G.

**Influence of the Temperature.** —We will now consider what influence the fluctuation of the temperature has on the strain to which the transmission line is subject. Referring to fig. 2, we will call—

- \(I\) = temperature in C.\(^\circ\),
- \(\alpha\) = coefficient of temperature,
- \(\sigma\) = strain per unit of section,
- \(s\) = section of wire,
- \(p\) = weight of wire per unit of length,
- \(\Sigma\) = modulus of elasticity,
- \(b_0\) = length of wire at \(I = 0\) and \(\sigma = 0\),
- \(b\) = length of wire at a certain \(I\) and \(\sigma\),
- \(\lambda\) = modulus of elongation.

And we find—

\[
I = (b_0 + b \lambda) (1 + \alpha I),
\]

and

\[
\sigma = \frac{\lambda}{\Sigma} = \frac{\lambda}{\Sigma} (1 + \alpha I + \sigma) = \frac{b_0}{b} (1 + \alpha I + \sigma).
\]

Owing to the sag being very small as compared with \(l\), we can in this case use the well-known formula—

\[
l = \sqrt{\frac{8 \times h^2}{3 \times w}},
\]

where \(h\) is the sag, and \(w\) = the length of the span.

We further know that the sag—

\[
h = \frac{\mu \sigma}{\alpha},
\]

and from (2) and (3) we find—

\[
l = \sqrt{\frac{8 \times p^2 \mu^2}{24 \sigma^2 \rho^2}},
\]

Thus

\[
l = l_0 (1 + \alpha I + \sigma) = \sqrt{\frac{8 \times p^2 \mu^2}{24 \sigma^2 \rho^2}}
\]

and

\[
l = \frac{1}{\alpha} \left(\frac{w - l_0}{l_0} - \sigma + \sigma^2 + \sigma^3 + \sigma^4 \right),
\]

\(w\) is practically \(= 1\), so that

\[
l = \frac{w - l_0}{l_0} = \frac{\alpha}{\Sigma} + \frac{\alpha^2 \mu^2}{24 \sigma^2 \rho^2 l_0}.
\]
For the Campbell Gas Engine Co., Halifax, to the specification of 1,000 H.P., the company have on order seven motors, totalling 4,000 H.P., while for the Urban Electric Supply Co., at Hawick, they have recently delivered motors totalling 3,000 H.P. We understand that the Phoenix Dynamo Co., Philadelphia, have on order totalling 5,000 H.P. They report that the sale of their electric drilling machine is proceeding satisfactorily, and that they have recently placed upon the market a horizontal grinding machine. They are also now proceeding to introduce a new starting switch, this "Dix-Sandford" patent, which embraces several novel features.

**P.D.M.** Contracts.—Among work recently executed and started up by the Phoenix Dynamo Manufacturing Co. is a 600-H.P. set for the Gloucester Corporation, the dynamo for which was recently received, is a through construction of the steam turbine type. This is coupled to an engine by Messrs. W. Sisson & Co., running at 360 r.p.m. For the Johannesburg municipality, to the specification of Messrs. Morsley & Dawbarn, and to the order of Messrs. D. Stewart & Co., they have recently completed four motors which are rather abnormal as regards the conditions under which they have to run; they are for driving blowers in connection with gas plant, and were required to give an output of 54 a.m. at any speed between 175 and 200 r.p.m. when running on a 600-volt circuit, the said speed regulation being obtained entirely by means of field regulation. These, in common with all the large machines recently made by them, are of their "Phoenix Poli" type, and the above four machines went through an exhaustive series of tests by the consulting engineers, in which we are informed the specified conditions were most satisfactorily obtained, the machines having an abnormal overload capacity at any speed. For the West Riding County Council, to the order of S. Dixon & Sons, they have recently completed two 80-k.W. sets with Williams & Robinson's engines; for the Barns-Rufeurn Electric Company electricity department they have recently completed and installed a balancer booster set; for the Great Western Railway works at Swindon they are now delivering three 160-k.W. slow speed sets, running at 200 r.p.m. for direct-coupling to gas engines. Among contracts recently taken may be mentioned a 200-k.W. set with Messrs. Williams & Robinson's engines; for the Newcastle upon Tyne Electricity Works; a contract for auxiliary machinery for the Birmingham Corporation consisting of two 100-k.W. balancer sets; one 200-k.W. motor-generator; four 50-k.W. balance booster sets and one reducer. A group of boosters, each set to consist of two 42-k.W. machines with motor for driving same, the total horse-power of the Birmingham order is approximately 1,100. For the Farnley Iron Co., Leeds, they have on order a special dynamo for direct-coupling to a Premier gas engine, the output being 140 k.W., at 105 r.p.m. For the South African Technical College, Cape Town, they have received orders for the complete equipment of their electrical laboratories, there being some 4,000 k.W. of motive-power. Of a similar one for the South African company, supplying some 350-k.W. three-phase motors and motor-generators.

**Prices Advance.**—The Electrical Power Storage Co., Ltd., announce that owing to the continued increase in the price of all raw materials, they are compelled to increase their prices by a further increase in prices, to take effect as from 10th inst. All prices in their 1906 list are increased as follows:—Renewal sections, page 30, 15 per cent.; all other prices 10 per cent.

**Book Notices.**—Gas Works Directory and Statistics, 1906-7. London: Hazell, Watson & Viney, Ltd. 10s. 6d. net.—We have received a copy of this directory for the current year. It gives in convenient form particulars of all the various gas supply undertakings in the kingdom, the information being of the same character as that to which we are accustomed in electric lighting works' statistics. The officials of the different companies and works are stated, and the price of gas (a thing the electrical precision motor generally likes to know before he applies his motor) is given in every case. Wherever an electricity works is operating the fact is indicated. An alphabetical index to officials is given at the commencement of the directory, and at the end there is a list of foreign and colonial gas works having offices in London. The information given in the book is corrected up to the 31st March 1906, with over 40 illustrations. The new matter embraces centrifugal pumps, the laws of falling bodies and projectiles, energy stored in fly-wheels, tension of scales and wires, loading of beams, &c.

**New test questions have been added, and recent examination papers.** A wonderful variety of subjects is dealt with in the book, illustrative examples drawn from actual practice forming a prominent feature of its contents. The author has a natural gift for lucid exposition, a quality admirably valuable in written explanations for students, and this is well seconded by the numerous and clear illustrations. Most of the latter are line drawings or wood-cuts, and therefore, with few exceptions, they print up well. The punctuation might be improved in some of the newer parts, where, for some reason, commas are unduly plentiful. The author does not attempt to impose the academic "poundal upon his readers," though, as in duty bound, he defines it in a foot-note; curiously enough, he twice defines the engine efficiency, as the ratio of output of heat units of mass, on consecutive pages (pp. 289 and 290). The use of the word "power" to denote force is severely condemned, but the letter P is frequently employed to represent a force; the difficulty which this introduces is ingeniously circumvented by describing the force as a "pull." These, though apparently minor points of importance, not mentioning the student to true conceptions of the quantities concerned, but also as indications of the author's exerted in eliminating the pitfalls which so frequently have marred the pages of text-books on mechanics. The work is one which should not only instruct, but also engage the interest of the student, an essential factor in all stages of his education, and pre-eminently so in the early stages.

**Engineering Standards Committee's Reports.**—Quite a number of these Reports have recently been issued, several having a more or less direct bearing on electrical engineering. The British Standard Specification for Steel Conduits for Electrical Wiring, it admits close-joint, brazed, welded and solid-drawn tubes of mild steel, stove-enamelled or galvanised inside and out. Two classes are recognised,—A, plain light-gauge unscrewed conduit, and B, heavy-gauge screwed conduit, with Whitworth pipe threads, as defined in a previous Report (No. 21). Both classes are to be of the dimensions given in a table, and are to be made in lengths of 10, 12 or 14 ft. The dimensions of the sockets and couplers are also specified, as well as the radii of bends. Limit gauges are recommended for gauging the inside diameter of every length of conduit, while the thickness of each should be determined by weighing a quantity measuring not less than 100 ft. in length; screwed (not limit) gauges made according to the Report above mentioned are to be used for judging the fit of threads. Seven gauges are required for each standard size of conduit, socket and coupler; the dimensions, however, are included in one small table. The diameters range from 3 in. to 2 in., and the thicknesses (Class A) from 0.049 to 0.064 in. (Class B) from 0.064 to 0.074 in.

Report No. 25 deals with Errors in Workmanship, based on measurements carried out by the Standards Division of the Physical Laboratory, at the works of a number of leading manufacturers. For the pinion and pinion gearings, the examination was confined to plain cylindrical work, in connection with locomotives, gun mountings, gas engines, dynamos, high-speed engines and machine tools. "Clearance" is defined as the difference expressed in inches, prescribed in order to tolerate unavoidable imperfections of workmanship." "Allowable wear" is "a difference in dimensions, prescribed in order to allow of various qualities of fit." "Cleanance" is "a difference in dimensions or shape prescribed in order that two surfaces or parts of surfaces, after being in contact for a certain number of hours, or for such other periods, as may be determined by experiment, shall be capable of being separated without the application of force, and without, or with but a slight, apparent loss of justness, and of being again fitted together as before, their fit being thereby improved."
and clearance being left to the discretion of manufacturers. The analysis of the data obtained is very complete, many tables and diagrams being given. It appears from those that in practice the average total error of 2°5 mils, which is the average departure from the exact dimension, is nearly three times the average total error on shafts averaging 0°85 mil, an average departure from perfection of less than half a mil; according to the analysis, this is more due to friction of attachment, and the total error was 1°2 mils, but even here the error was but little more than half a mil. The tendency observable, as might be anticipated, is the tendency to set the correctly sized and vice versa in the case of holes, to ensure the parts coming together. Turning to classified tables, it is very pleasing to note that next to small tools, which have a total average error of only 0°5 mil, high-speed engine and dynamo shafts are at the head of the list with a total average error of 1°4 mil. Gas-engine run to 2 mils, large machine tools to 2°1, and locomotives to 3°7 mils. In the case of holes, high-speed engines and dynamo actually reach the sumit, for while the total average error in the case of small tools is 1°9 mil, it is entirely +; engines and dynamos have the same total average error, but it is nearly equally distributed on either side of the true size (+ 0°6, — 0°4), and is therefore practically half as great. No fewer than 34 per cent. of the holes measured in this report were greater than the true size, and 66 per cent. less. As regards uniformity in dimensions along the specimens, ground shafts show a marked superiority over undressed, and extremely well dressed in comparison with the variation of 1°6 mils in engines and dynamos. The limits of tolerance recommended by the Committee are practically the same as those suggested by one of its members—Mr. B. Boles—Messrs. Mesers, St. W. G. A., Whithworth and Co., Ltd.—and approximately follow the law

\[ \text{limit} = \left( \frac{a + b}{2} \right) \]

where \( n \) is the diameter in inches and the limit is expressed in mils; but above 5 in. the slope is reduced, to allow the limitations of the precision instruments representing 0°003 in. at 15 in. to hold good, the total tolerance as that diameter 0°003 in. Much valuable information regarding current usage in connection with various classes of work is given in the Report, which should prove a valuable work of reference.

Report No. 27 gives the conclusions of the Committee as to the tolerances allowed in various classes of work. An extensive report is also based on the foregoing.

Three general classes of workmanship are defined, and an extensive description of the work. The Committee recommends, for running fits, that the shaft shall be the element more nearly approaching the true dimension, and allowance be made on the hole. Taking a 5-in. shaft, as an example, in the first class, the tolerance is 2 mils; the limits of diameter prescribed are 5°000 and 4°998 in. The allowance is 1°5 mil, and its limits of diameter of the hole are 5°002 and 5°004 in. In second-class work the tolerances and allowance each become 4 mils, and in third-class work they are 6 mils on the shaft, 8 mils allowance and 8 mils on the hole. The range in first-class work is from 3°5 and 3°3 mil on a diameter of 4°5 to 3°5 and 3°3 mils on a diameter of 12 in. Tables give the data for sizes advancing by 1 in., and a diagram is added embodying the whole of the standards.

Deals with Structural Steel for Bridges and Buildings, and covers plates, bars, rods, &c., specifying the composition, strength and ductility of the materials, with dimensions of thickness and length.

Report No. 24 relates to materials used in the construction of Buildings, and covers plates, bars, rods, &c., specifying the composition, strength and ductility of the materials, with dimensions of thickness and length. The limits of diameter of the hole are 5°002 and 5°004 in. In second-class work the tolerances and allowance each become 4 mils, and in third-class work they are 6 mils on the shaft, 8 mils allowance and 8 mils on the hole. The range in first-class work is from 3°5 and 3°3 mil on a diameter of 4°5 to 3°5 and 3°3 mils on a diameter of 12 in. Tables give the data for sizes advancing by 1 in., and a diagram is added embodying the whole of the standards.

Deals with Structural Steel for Bridges and Buildings, and covers plates, bars, rods, &c., specifying the composition, strength and ductility of the materials, with dimensions of thickness and length. The limits of diameter of the hole are 5°002 and 5°004 in. In second-class work the tolerances and allowance each become 4 mils, and in third-class work they are 6 mils on the shaft, 8 mils allowance and 8 mils on the hole. The range in first-class work is from 3°5 and 3°3 mil on a diameter of 4°5 to 3°5 and 3°3 mils on a diameter of 12 in. Tables give the data for sizes advancing by 1 in., and a diagram is added embodying the whole of the standards.

Deals with Structural Steel for Bridges and Buildings, and covers plates, bars, rods, &c., specifying the composition, strength and ductility of the materials, with dimensions of thickness and length. The limits of diameter of the hole are 5°002 and 5°004 in. In second-class work the tolerances and allowance each become 4 mils, and in third-class work they are 6 mils on the shaft, 8 mils allowance and 8 mils on the hole. The range in first-class work is from 3°5 and 3°3 mil on a diameter of 4°5 to 3°5 and 3°3 mils on a diameter of 12 in. Tables give the data for sizes advancing by 1 in., and a diagram is added embodying the whole of the standards.

The excellent work which has been and is being done by the Engineering Standards Committee, and the energy which it has been in course of preparation for over four years. It applies very directly to locomotive construction, but a large part of it is more concerned with machinery in general. The limits of the tolerances recommended are 3°1 and 3 mils on a diameter of 5 in. The tolerance is 5 mils, and its limits of diameter of the hole are 5°052 and 5°054 in. In second-class work the tolerances and allowance each become 4 mils, and in third-class work they are 6 mils on the shaft, 8 mils allowance and 8 mils on the hole. The range in first-class work is from 3°5 and 3°3 mil on a diameter of 4°5 to 3°5 and 3°3 mils on a diameter of 12 in. Tables give the data for sizes advancing by 1 in., and a diagram is added embodying the whole of the standards.

Deals with Structural Steel for Bridges and Buildings, and covers plates, bars, rods, &c., specifying the composition, strength and ductility of the materials, with dimensions of thickness and length. The limits of diameter of the hole are 5°002 and 5°004 in. In second-class work the tolerances and allowance each become 4 mils, and in third-class work they are 6 mils on the shaft, 8 mils allowance and 8 mils on the hole. The range in first-class work is from 3°5 and 3°3 mil on a diameter of 4°5 to 3°5 and 3°3 mils on a diameter of 12 in. Tables give the data for sizes advancing by 1 in., and a diagram is added embodying the whole of the standards.

Deals with Structural Steel for Bridges and Buildings, and covers plates, bars, rods, &c., specifying the composition, strength and ductility of the materials, with dimensions of thickness and length. The limits of diameter of the hole are 5°002 and 5°004 in. In second-class work the tolerances and allowance each become 4 mils, and in third-class work they are 6 mils on the shaft, 8 mils allowance and 8 mils on the hole. The range in first-class work is from 3°5 and 3°3 mil on a diameter of 4°5 to 3°5 and 3°3 mils on a diameter of 12 in. Tables give the data for sizes advancing by 1 in., and a diagram is added embodying the whole of the standards.

Deals with Structural Steel for Bridges and Buildings, and covers plates, bars, rods, &c., specifying the composition, strength and ductility of the materials, with dimensions of thickness and length. The limits of diameter of the hole are 5°002 and 5°004 in. In second-class work the tolerances and allowance each become 4 mils, and in third-class work they are 6 mils on the shaft, 8 mils allowance and 8 mils on the hole. The range in first-class work is from 3°5 and 3°3 mil on a diameter of 4°5 to 3°5 and 3°3 mils on a diameter of 12 in. Tables give the data for sizes advancing by 1 in., and a diagram is added embodying the whole of the standards.

Deals with Structural Steel for Bridges and Buildings, and covers plates, bars, rods, &c., specifying the composition, strength and ductility of the materials, with dimensions of thickness and length. The limits of diameter of the hole are 5°002 and 5°004 in. In second-class work the tolerances and allowance each become 4 mils, and in third-class work they are 6 mils on the shaft, 8 mils allowance and 8 mils on the hole. The range in first-class work is from 3°5 and 3°3 mil on a diameter of 4°5 to 3°5 and 3°3 mils on a diameter of 12 in. Tables give the data for sizes advancing by 1 in., and a diagram is added embodying the whole of the standards.

Deals with Structural Steel for Bridges and Buildings, and covers plates, bars, rods, &c., specifying the composition, strength and ductility of the materials, with dimensions of thickness and length. The limits of diameter of the hole are 5°002 and 5°004 in. In second-class work the tolerances and allowance each become 4 mils, and in third-class work they are 6 mils on the shaft, 8 mils allowance and 8 mils on the hole. The range in first-class work is from 3°5 and 3°3 mil on a diameter of 4°5 to 3°5 and 3°3 mils on a diameter of 12 in. Tables give the data for sizes advancing by 1 in., and a diagram is added embodying the whole of the standards.
tion of the better known types of Siemens-Schuckert electricity meters. These are listed in Price List 8a, a copy of which was circulated at the meeting. A new advance is effected by a reduction in the gross discount of 2½ per cent. on the Siemens-Schuckert patent meters. These are listed in Price List 5a, a copy of which was distributed. The table of contents shows examples of tools and machinery driven by请选择正确答案。... Read more
Chatham.—In regard to the new power station for the Admiralty, now nearing completion, it is of interest to note that for external lighting about 300 arc lamps will be erected, and for internal lighting purposes some 70,000 incandescent lamps, totalling about 70,000 incandescent lamps. Not only will the dockyard be supplied, but also the Naval Barracks, the Marine Barracks, the Guns- Wharf, and the naval part of the Royal Naval Hospital. It is also proposed to provide a supply of energy to the powder magazines at Upnor and elsewhere, and this will necessitate a cable being laid under the river. Electric motors have been provided over the yard for operating cranes, &c.

Boscombe.—Sixteen homes have been destroyed by a fire, which has also clapsed since the works of the Kent Electric Power Co., Ltd., at Chatham, were destroyed by fire; the company is now engaged on a new generation station on the banks of the Medway, near Strood. Five thousand n.p. of plant is installed in three sets of steam turbo-alternators, giving three-phase energy at 11,000 volts. Sub-stations are erected in various parts of the district to transform the energy down to 400 volts for power, and 230 volts for lighting. The trunk cables between the generating station and the transformers are laid in earthenware conduits (already laid between Frimley and Luton, Chatham). It is intended to provide duplicate mains so as to minimise inconvenience should a fault occur at any time.

Chipping Norton.—A public electric lighting scheme has recently been inaugurated, energy being supplied by a 50-n.p. gas plant. Eight frame arc lamps have been erected, and existing gas standards are, we understand, being adapted for electrical incandescent lamps.

Continental Notes.—Germay.—The municipality of Allstein (East Prussia) has decided on the establishment of an electric lighting scheme for the town. The municipal E.L. undertaking at Malhouse (Alsace) is about to be extended at an estimated cost of £89,000.

Iraty (Friuli) has decided to establish an electric lighting undertaking. The municipal E.L. undertaking at Mulhouse (Alsace) is about to be extended at an estimated cost of £89,000.

Cotton Mills.—We learn that Messrs. W. Moores and Sons, cotton goods manufacturers, of Dunkhill, Bolton, are about to adopt electricity in their mills, and they are about to build a new shed to hold 200 looms, bringing their total up to 2,000 looms.

Darlington.—The T.C. has applied to the L.G.B. for a loan of £4,250 for main, stations, meters, switchboard extensions, and mechanical stokers.

Dudley.—The annual accounts of the Corporation's electrical undertaking were issued last week. It shows that the revenue from the sale of energy for public, trade, and private supply, together with that for lamps, &c., amounted to £11,068, compared with £10,597 for the previous 12 months. Of the total receipts, the sum of £4,153 has been absorbed in the repayment of loans and interest thereon, £622 by bank charges, leaving a net profit of £623 on the operation of the scheme, which was formerly charged to another department. The gross profit was £571 less than last year. The total capital expenditure in connection with the undertaking up to March 31st last was £83,450.

Farah.—The U.D.C. has decided to supply energy to two places outside the compulsory area, on a guarantee of an annual consumption of the sum of £40 being given. An altercator and a belt-driven exciter are to be added to the plant.

Huntingdon.—The T.C. has given its assent to an application for a prov. order for E.L. by the Electrical Works Development Co., reverting to the Council the right of safeguarding its interests as regards the area of supply, site of works, maximum charges, street lighting, and terms of purchase.

Ivybridge.—After a long discussion, the U.D.C. has passed a resolution approving of electric lighting for the town.

London.—Lambeth.—The report of Mr. G. Pearson, the auditor appointed by the B. of T., to examine the accounts of the South London Electric Supply Corporation for the year ended December 31st, 1906, was circulated by the B.C. on Wednesday. The report was as follows:—"I have audited the above accounts for the year 1905, and found them correct. I have to report that the overdrawn balances of £3,320 and £2,257, which were charged to the accounts for 1905, of £2,575 to capital for directors' fees has not yet been corrected. The total revenue, £15,186, contains unsatisfactory results as follows:—(1) Expenses of flotation of company, £3,058; (2) battery of accumulators, £1,231. The provision for depreciation is still inadequate. I have made no provision beyond an amount of £3,000, which was formerly charged to another department, explains the slight increase in costs per unit.

Fareham.—The U.D.C. has decided to supply energy to two places outside the compulsory area, on a guarantee of an annual consumption to the sum of £40 being given. An altercator and a belt-driven exciter are to be added to the plant.

Swinton and Pendlebury.—The U.D.C. on September 4th sealed the agreement with the Lancashire Electric Power Co. for a supply of energy in bulk. The U.D.C. will now be asked to sanction the loan applied for.
TRAMWAY AND RAILWAY NOTES.

Accrington.—The lease of the Accrington tramways expires in April. The system is then, we understand, to be electrified by the Corporation. A sub-committee appointed to consider a scheme for the electrification of the Accrington tramways has recommended that the Corporation should purchase and operate the system direct by its own staff rather than lease it. The estimates are: Construction of new and alteration of existing tramways, £25,600; cost of electrical equipment, £24,000.

Blackpool.—On the 6th inst. a man was knocked down by an electric tramcar; his leg got under the life-guard, and he was dragged a few yards, before a man got between the front bogie wheels and the brake blocks. The car was raised by means of jacks, but death ensued. At the inquest a verdict of "Accidental death" was returned.

Continental Notes.—Germany.—The scheme promoted by the Continental Company for Electrical Enterprises, which aims at the construction of a suspended electric railway between Grunewalden, Alexander Platz and Birkedorf, on the same system used at Barcem, has not made any progress from the point of view of the investigation of the plan by the regulating authorities in Berlin. On the other hand, the company's Berlin bureau has utilized the summer for the purpose of making five models on a large scale of the various kinds of constructional supports intended for the railway, and these will be shown to the authorities in order to demonstrate the limit extent to which light weight would be withdrawn from the streets by the building of the railway. As will, perhaps, be remembered, the Municipal Highways Committee adhered to the opinion that the company should construct an experimental line in one of the streets which would later on be used by the electric railway. The Committee has now agreed to the company's proposal to construct the trial section at a spot which would permit of comparison with the elevated electric railway, and shall be an example of all the methods of supporting the suspended structure. It is hoped by the company to overcome all the objection to electric tramways on aesthetic grounds by reason of having secured the services of four well-known Berlin artists designing the architectural features of the constructional ironwork and of the railway stations.

Dewsbury.—The T.C. on September 6th decided to apply to the B. of T. for a loan of £9,500 for the electrical equipment of that part of the Dewsbury, Batley and Birstall tramways within the borough. The amount also includes costs in connection with the purchase. The B. of T. has also agreed to approve of the lease of the tramways to the B.E.T. Co., and an agreement with the National Electric Construction Co. for the construction and leasing of the tramways from Dewsbury to Ossett has been arranged.

Gateshead.—The T.C. has consented to the application of the local tramway company for a further extension of time for completing the tramway to the borough boundary at Wrekenton.

Halifax.—The Mayor last week received a requisition, signed by 500 residents, asking the T.C. to reconsider the attitude of the Tramways Committee of the Salford Corporation in refusing the recent application of the motormen to be placed in the same position as their fellows in Manchester, and granting the conductors a 1d. per hour advance in wages.

Wemys and District.—The cars on the Wemys and District Tramways system have been in operation since August 25th, but the formal inauguration took place on Saturday last, when Lady Eva Wemyss entertained a large and representative company to luncheon at Wemyss Castle. Since the opening, the traffic has exceeded expectations, and it is realised that, for increased wages or to take back en bloc the men who had refused the recenttramway strike, the Corporation is prepared to inspect the line, and lay a definite scheme before it for acceptance.

Salford.—A correspondent writing on Tuesday said that arrangements had been made for a meeting to be held at midnight on the 15th inst. by the trammen and men of half the district. The attitude of the Tramways Committee of the Salford Corporation in refusing to make the recent application of the motormen to be placed in the same position as their fellows in Manchester, and granting the conductors a 1d. per hour advance in wages.

Woking-Bagshot.—In October the construction of a light railway to connect Woking and Bagshot stations of the London and South-Western Railway is to be commenced. Electricity, conducted by the overhead system, is to be the motive power, and the line at Woking is to be electrified. The line is nearly eight miles long, and starts at Durie Street, Leven, joining the Kirkcaldy Railway's system at Gallowtou. For something like three-fourths of the distance the line is constructed on land secured for the purposes of the companies.

TELEGRAPH and TELEPHONE NOTES.

Derelict Wires.—Our esteemed contemporary, the Globe, referring to the London Corporation's account of the overhead wires in the City, says: Since 1879, when the Corporation undertook the work of supervision, 224 miles of derelict wires have been removed; all owners of overhead wires are required to have the work done for them, and, if they fail to do so, the operators can identify them by having a perforated nine ribbon of approved pattern attached. During 1905 the number of private lines in the city increased by 131, the number of combinations being at 18. Both have considerably added to their number of spans during the last 12 months, and those of the London, Chelsea and Sheerwater Company have passed the 300 public telephones, as compared with 69,000 spans last year and 360,000 spans in 1899. There has been a net increase of nearly 250 miles of National Telegraph lines during the year.

Grimsby.—The Highways Committee of the Corporation has considered and rejected an application of the National Telephone Co. for leave to lay telegraph and telephone cables underground along the roadway, as implied by the Mayor's remarks, appears to be that, because the present service is unsatisfactory, the company shall not be allowed to improve it. Such is the wisdom of Bumble.
Glasgow.—On Tuesday last the Post Office acquired possession of the Corporation Telephone Service, for which, with loose tools and stores, £280,005 was paid. What the total cost will be by the time the service has been made efficient remains to be seen; it is admitted that much of the plant is obsolete. The employees have been taken into the service of the Post Office, but the status of their cases remains open for consideration. The Postmaster-General foresees an early revision of the rates charged—evidently intending to raise them to a remunerative level.

Holland.—The Journal Télégraphique publishes in extenso a Royal Decree providing for a 10 cents per word and a minimum charge of 1 franc for sending telegrams from telegraph stations on the coast in wireless communication with ships at sea or one another. The Minister of Public Works may, however, authorise the collection of an additional fee of 5 cents per word for wireless stations on ships. Rates are payable by the senders of messages to ships at sea and by the receiver in the case of messages from ship to shore. If, however, the captain or commanders of ships guarantee the payment, the sender may prepay messages. The station at Rotterdam is in the chief one, and all work must be sent through it. It is open day and night. Records are to be kept on a prescribed form of all particular works, messages sent, received and transmitted. When the logs leave British territorial waters a preliminary signal is to be sent to the station for the purpose of ensuring proper working. When the ships enter British territorial waters a signal is to be given to cease transmission. Signals or messages from ships in distress are to be given priority over all other works, and transmission of other work must be suspended until these signals are answered.

New Cables.—The Correspondencia de España, in a recent issue, reports that the arrangement for the cable between the Eastern and Western Telegraph Companies has been completed, and that the two cables will be laid through the Straits of Gibraltar and the Mediterranean. The company will lay a cable between the United States and Europe in the spring of next year.

Telegraphic Interruptions and Repairs.—

- Trinidad.—The island is one of the most important in the British Empire, and the work of the Trinidad Telegraph Company is of great importance to the island.
- London.—The work of the London Telegraph Company is of great importance to the United Kingdom, and the work of the company is of great importance to the country.
- Norwich.—The work of the Norwich Telegraph Company is of great importance to the city.
- Southport.—The work of the Southport Telegraph Company is of great importance to the town.

Wireless Torpedoes.—Senior Leonardo Torres Quevedo, the inventor of the "Telekino," an electrical apparatus for directing torpedoes, states that he has solved the problem of directing torpedoes which come into action as soon as the Hertzian current ceases and causes the boat to stop. The correspondents further states that he has seen it directing the movements of tricycles, carriages and boats, which obey the wishes of the inventor with minute precision. The inventor believes he has solved the problem of directing torpedoes from poes and submarines from land. This is pleasant reading for our Navy—but we lack the inventor's confidence in his apparatus.

Fire.—On Wednesday a serious fire took place in Holborn, destroying a large number of overheard lines and cables. More than 300 subscribers were cut off. The National Telephone Co. took vigorous steps to repair the damage with the utmost dispatch.

**CONTRACTS OPEN and CLOSED.**

**OPEN.**

Blackrock (Co. Dublin).—September 22nd. The Main Electric Board wants tenders for electric power installation. See "Official Notices" September 7th.

Dublin.—September 19th. The City Technical Education Committee wants tenders for the electric lighting of the Technical Schools, Lower Kevin Street. Specification, with general conditions and form of tender, may be obtained at the office of the City Electrical Engineer, Fleet Street, Dublin, 10s. 6d. for each specification.

Edinburgh.—September 26th. The School Board invites estimates for the electric lighting of the Old Grammar School Place. Specifications, &c., may be obtained at the office of Mr. Currie, Architect, 3 Queen Street.


Limerick.—October 2nd. Gas plant, gas engine and dynamo, switchboard extensions and cables for the Corporation Electric Department. See "Official Notices" 30th October.

Mersey Railway.—The directors invite tenders for the supply of all oil, grease, ironsmongery, waste, castings, asbestos and india-rubber goods, chemicals, bricks blocks, firebricks, switches and switchsboard cables, and other general stores for 12 months. Forms of tender may be had on application to the secretary.

Methyr Tydfil.—September 20th. Stores for the Hill's Plymouth Co., Ltd., for 12 months, including india-rubber, asbestos and other electrical appliances, &c.


**CLOSED.**

Brandón.—The U.D.C. has accepted the tender of Mr. W. Flower, of Newcastle, for the supply of poles, cables and lamps, for electric lighting at Stoberton and Waterhouses.

Halifax.—The T.C. has accepted the tender of the British Insulated and Helsby Cables, Ltd., for the supply of cable for two three-wire feeds, at £1,505.

London.—The managers of the West London District Schools have accepted the tender of Messrs. Johnson & Phillips, Ltd., for two steam dynamos, switchboard and cables.

Battersea.—The T.C. has accepted the following tender in connection with the extensions of plant at the central station and with the New Eliza lighting scheme:—T. W. Glover & Co., Ltd., cable, £4,169.

Harwich.—The Electricity Committee, in a report circulated on Monday, stated that it had received during the vacation the following tenders for the electric lighting of the Town Hall:

- Bremer, Hattersley, & Co., for £11,975.
- Drake & Gorham, Ltd., for £11,975.
- Smith & Co., for £11,975.
- Johnson Bros., for £11,975.
- J. H. Dooling (electrical), for £11,975.
Manchester.—Messrs. A. Reproil & Co., Ltd., have been instructed by the Committee to supply motor starters during 1906.7.

Yeath.—The R.D.C. has placed an order with Messrs. Johnson & Phillips, Ltd., for the supply and laying of extension distributor cables and wires and erecting all street lanterns.

South Shields.—The Tramways Committee recommended the acceptance of the Biagh West House Co.'s tender, at 23,595, for the supply of 10 additional cars.

Stalybridge.—The Joint Tramways and Electricity Board has accepted the tender of Messrs. W. T. Glover & Co., Ltd., for the supply of cable.

Messrs. Brown Poles & Co., Ltd., have received an order, through Messrs. Williams & Robinson, for one 2,000-kw. 6,000-volt a-c cycle turbo-generator for the Stalybridge, Hyde, Mosley and Dukinfield tramways.

Sydney (Australia).—The Municipality of Sydney (Australia) has decided to install two 2,000-kw. steam turbine sets, and the order for the turbines and the necessary condensing plant has been placed in the hands of Messrs. Williams & Robinson, Ltd., of Rugby, who are manufacturing the plant to the order of Messrs. Dick, Kerr & Co., the main contractors. The turbines are being arranged for driving the Dick, Kerr turbine type of alternator.

Torquay.—The T.C. has accepted the tender of Mr. Timar, of Torquay, for the supply of electrical fittings for the Free Library, at £105 10s.

FORTCOMING EVENTS.

Saturday, September 14th.—Engineering and Machinery Exhibition opens at Olympia, London, W.

September 16th, 20th and 21st.—Municipal Tramways Association. Fifth Annual Conference at Leeds. (See "Notes" to-day.)

MANUFACTURERS SELLING DIRECT TO CONSUMERS.

This following letter from the Electrical Co. came to hand too late for inclusion in our "Correspondence" columns. We print with it a letter on the same subject from the Northern Electrical Co.

Our attention has been drawn to the correspondence under the above heading which has appeared in your paper, and particularly in your issue of August 31st and 31st last, in which it is stated that the Electrical Co. have supplied a large drapery establishment in Denton with Nernst lamps, whilst not calling on the electrical firm of the district.

We have investigated the matter, and beg to give the statement a distinct and emphatic denial. The drapery establishment, whose name we have obtained from your correspondent, is not, and never has been, a customer of our firm. We have accordingly placed the matter in our solicitors' hands, with a view of obtaining a withdrawal and apology from your correspondent.

We would ask you to insert this letter by way of correction in your next issue, so as to dissociate our firm from the practices referred to, to which they have never been a party, and would also be glad if you would state the full name of the correspondent who wrote on this subject, signing himself "Transgressor."

The Electrical Co., Ltd.

London, W.C., September 12th, 1906.

In your issue of August 31st we made certain complaints about the Electrical Co. dealing direct with consumers. We find that the people actually transacting the business are the "A.E.G." and the Electrical Co. are not the same people we beg to offer the latter our sincere apologies.

The Northern Electrical Co.

Denton, September 8th, 1906.

NOTES.

Popular Science.—One of our valued lay contemporaries—the Morning Post this time—has broken out in a fresh place. It informs us that "Very slight currents are employed in telephony. The electromotive force sufficient to light one foot high would operate a telephone for 15,000 years. Consequently great care must be taken to prevent leakage of those minutes and delicate currents, and to this end thick wires are used. The line between London and Glasgow contains eight hundred pounds of copper per circuit for every mile, it being insisted that the subscriber talking between the two cities has the exclusive use of more than 130 tons of copper. Lucky man! We fear he does not fully appreciate his good fortune. We should like to see a few lamps of that energetic electric-motive force. Though we never saw an ounce a foot high, we have seen a pound 30 ft. in circumference—formerly used for illuminating stray donkeys—and we think it is a pity it has fallen into disuse. Our informant goes on:—"The electrical transmission of power, so far as the upper limits are concerned, still awaits better means of insulation. It is not feasible to transmit voltages of higher than 50,000 or 60,000. That is quite high enough for the purpose of transmission when the distances are not very far; but it imposes a limit to the distances at which water power can be used." Clearly he has forgotten that if thick wires are used, leakage will be prevented! In another, but less eminent, paper we read that certain persons find their legs give way when they enter electric transeuns, and they attribute this failing to the "static electricity at large." Several people dare not use the cars for this reason. We never heard it called static electricity before—perhaps it is X-rays.

Voltax—A New Insulator.—Our esteemed contemporay the Génie Civil, quoting from an American paper, describes a new insulating material known as "Voltax," a heavy hydrocarbon, which has a higher melting point than the similar substances generally used. The process is worked by the Electric Cable Co., of Bridgeport, U.S.A., who insulate wires with cotton tape impregnated with the material (of which the exact composition is secret); the tape is wound on in layers to a thickness depending upon the pressure to be resisted after which, says the Génie Civil, the wires are cabled, and the cable thus formed is finally covered with one or more layers of jute to prevent external damage. Wires insulated in this way with a single tape, tested at the Electric Testing Laboratories, New York, broke down with a pressure of 2,500 volts alternating, but some stood pressures up to 70,000 volts. With two windings, the breakdown pressure was 4,000 to 10,000 volts, and a wire covered with six windings, after steeping in salt water for 72 hours, withstand the test until 25,000 volts was reached. The wires were then traversed by heavy currents, up to 200 amperes (the gauge of the wire is not stated); at this current the insulating material began to melt. Again tested after this, the wire covered stood up to 3,000 volts, and those with four up to 10,000 volts. Lamination of the insulator "75 mm." (this is obviously a misprint for 75 mm.) in thickness were pierced at 20,000 to 25,000 volts; those of "105 mm." (evidently 105) at 30,000 volts. Their resistance was too high to be measured accurately. The substance can be used for filling wooden conduits in which bare wires are laid on porcelain insulators.

Railway Motor-Coaches in Germany.—The Prussian Minister for Railways has requested the Combustion Motor Co. to submit a report on the subject of a petition presented by the Wesusbanden Chamber of Commerce, asking for the introduction of motor-coaches and motor-trains on the Prussian railways. It appears from investigations made by the Chamber, that electric accumulator coaches and one steam motor-train are now being used for branch lines of the railways in the Palatinate, although the battery vehicles were supposed to have been abandoned long ago. The Chamber, however, finds that they are still in service, and that they fulfil the object of intervening in the long intervals existing between the running of the trains, and of transporting school children, notwithstanding that they possess both technical and economic defects. In Baden several electric battery coaches are also in operation, although, in some cases, the increase in the traffic has necessitated the substitution of ordinary steam trains. The demand for motor-coaches in Bavaria has also become large, and trials are now being made in Upper Bavaria; motor-coaches are likewise being worked in Switzerland on the section Baar-Zug-Scham-Rothkreuz. The Wesusbanden Chamber of Commerce, in drawing attention to those instances, suggests that similar experiments should be made on the Prussian railways, and the question is at present under the consideration of the railway officials.

Cheap Electric Wiring.—At the Royal Cornwall Polytechnic Exhibition, at Falmouth, on 6th inst., Mr. C. E. Algar, of Newport, read a paper on artificial lighting. He pointed out that the cost of the installation was much less than that of the oil or gas lighting, and later remarked that a serious problem facing electrical engineers was the large cost of the system of cables and wires. He compared them from the electrical point of view, as compared to the similar installation of gas lighting. The solution had been found on the Continent with what is known as the "A.E.G." wires were made at probably one-third of the cost. Instead of wires of an expensive make enclosed in casing of wood or steel, wires were being often used of a very much cheaper make and were carried on the face of the walls mounted on tiny insulators, which were not found objectionable in appearance.
What is a Prime Mover?—A Glasgow firm sent out an electrical letter to Ceylon, describing it as a "prime mover." Under the Customs tariff in Ceylon, steam, gas, and oil engines are admitted free of duty as "prime movers." But the Customs authorities declined to recognize the motor as such, on the ground that it simply used current supplied by cable from the powerset. The complainant paid the duty under protest, and asked what the difference was between a gas engine using gas conveyed to it through pipes, and an "electrically working" engine on very similar lines. The Customs authorities replied that steam, oil, and gas engines generated power, but that an electric motor was only on a par with a water wheel. The Glasgow Chamber of Commerce is to take up the question. We cannot agree that an electric motor comes under this head, but, on the other hand, a water wheel certainly does.

Educational Notes.—NORTHAMPTON INSTITUTE.—In view of the increasing work of the Institute and the insufficiency of the accommodation, notwithstanding the large size of the building, the Governing Body has, for the coming session, taken the rooms in the British Horticultural Institute in Northampton Square. The work of the Technical Optics Department will be conducted in this building. Some of the rooms thus vacated by the removal of this department have been equipped during the vacation for an intermediate electrical engineering laboratory. Another of the rooms made vacant is to be devoted to an extension of the technical electrical testing laboratory. An extension of the instrument works has also been added from the proceeds, having been carried out. In the two last cases the want of accommodation has led to the refusal to enrol late-comers in the past, but no such refusal should in future be necessary during the coming session. The classes of the day courses commence on Monday, October 1st, and the evening course on Monday, September 24th. Enrolments for the latter have already commenced. The head of the Electrical Engineering and Applied Physics Department is Dr. H. J. Massey, a past president of the Institute, who is also the principal of the Institute. The associate head of the department is Dr. C. V. Drysdale, and Mr. H. M. Hobart is lecturer in electrical engineering design.

Incidental.—Enoch Archer, a workman employed by the Darlington Corporation, was, on Thursday last week, repairing an overhead tramway wire, when he received an electric shock which caused him to fall from the ladder, 15 ft. to the ground. He struck his head on a pillar, and was then unconscious. He was not wearing rubber gloves as he should have done at the time, and that is one of the reasons why his conduct was not considered proper. But he at once set about repairing the damage without the proper appliances, and without giving notice to the officials. Witness stated that, after the accident, and found that Archer had been attempting to repair a switch. The voltage at the time of the accident was 506, which would not be fatal, but would give a serious shock on a wet day.

The jury returned a verdict of "Accidental death."

H. M. Hobart is lecturer in electrical engineering design.

Wages at Portsmouth Dockyard.—The Times says that the Admiralty has granted increased pay, varying from 6d. to 2s. a week, to men employed in the dockyard for the re-employment of electricians, draughtsmen, and electricians employed in the dockyard for the re-employment of electricians, draughtsmen, and electricians. The Admiralty was appointed, its Parliamentary head would be one who had commercial experience and possessed the thorough confidence of the country in favour of trade's being put upon a higher and more constructive, engineering, and electrical departments of Portsmouth Dockyard, to date from April 2nd, 1906.

Hayes v. Electrical Bleaching Co.—At the Chancery Court, (London) proposed a resolution regretting that it had not been possible during the present session to give effect to the express desire of the Chambers of Commerce, that a Ministry of Commerce should be established with a status equal to that accorded to other departments of the State, and urging upon the Government the great importance of early action being taken with this object. According to the Times report, he said they wanted a Ministry of Commerce which was identified with all the commercial projects of the country, and they had a right to ask that an advisory committee should be set up to advise the Cabinet in the leading past six years of the country, so that Government action should not be taken until those questions had been adequately discussed. Our position was being violently attacked by our great commercial opponents, America and Germany, and we had to put our house in order and see that our men were equipped with weapons at least as good as those on the other side. It was hoped that when this Ministry of Commerce was established the President of the Board would be one who had had commercial experience and possessed the thorough confidence of the commercial men of the country. Mr. E. Parks, M.P., in seconding the resolution, said that there was a great feeling in the country in favour of trade's being put upon a higher and more constructive basis, and that the Government had recognised the thorough and energetic manner in which Mr. Lloyd-Goodge had tackled questions of trade, but he urged the importance of making the President of the Board a principal minister of State. The motion was passed.

Amendment of Patent.—Mr. W. P. Thompson is appealing against a decision of the Board Patent Office, 18,814 of 1905 for "Electric Incandescent Lamp with filament of Metallic Tungsten." See our "Official Notices" to-day.

Water-Power in Sweden.—At the recent technical congress, held at Norrkoping, Lieut. Sven Lubeck, submitted a paper dealing with the water-power of Sweden and the neighboring countries. The following were the results given in Sweden at 10,000,000 h.p., that of Norway at 28,000,000 h.p., and that of Finland at 4,000,000 h.p. It would, however, only be possible to compute the power of these three northern countries on account of the fact that many of the lakes, rapids, and falls are inaccessible, and known only from maps and maps of the country. According to Lieut. Lubeck, Sweden is able to use her water-power to a greater extent than Norway—namely, up to 10,000,000 h.p. and Finland only 300,000 h.p. The Swedish water-power could be exploited specially for the purposes of mining, the smelting of metallic ores, and the working of chemical factories and paper mills. By means of the utilization of water-power the demand for coal in Sweden would be reduced, and the country's commercial balance would change. Indeed, it is calculated that the imports of coal would decline by £2,000,000 per annum simultaneously with an increase of nearly £7,000,000 in the exports. The production of saltpetre electro-lytically would reduce the imports of artificial saltpetre. The Swedish Government, which owns 12 per cent. of the water-power of the country, has purchased the Trolhättan Falls, and provided £279,000 for the acquisition of other sources of water-power.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, to contribute to the "Personal Column," to keep readers of the Electric Review posted as to their movements.
of the electrical men in the city employment. The chief assistant engineer, who began in 1896 with a salary of £150, had had his salary increased on various occasions since then, and he now £375, which the chairman stated should be raised to £400. The superintendent of mains was appointed five years ago at £250, and he has had his salary increased to £300 a year. It is proposed to give him £350. The first assistant to the superintendent of mains, who has £150, is recommended for an additional £20; and the second assistant, with £130, is recommended to have the salary of £200 a year paid to the resident engineer’s clerical assistance is proposed to add £20.

Mr. A. Zoller, shift engineer to the Fulham electricity undertaking, has resigned. Upon the occasion of his leaving to take up an appointment at the Fulham electricity works, Mr. E. H. Hatfield, senior shift engineer at Croydon, was on 2nd inst. made the recipient of a silver cigarette-case and match-box from the members of the staff.

A Committee recommends the South Shields T.C. to increase the salary of the borough electrical engineer from £450 to £500, rising by annual increments of £50 to £700.

The Nelson T.C. last week adopted recommendations of the Electricity Committee appointing Mr. Dacre Helme, of Nelson, as engineer and tramway manager (£160); Mr. G. F. Helme succeeds Mr. Helme as chief assistant, and Mr. William Hasty becomes main superintendent in the place of Mr. Naylor.

The marriage of Mr. C. G. Shuttleworth, sub-station superintendent atகெக்சிளைன், to Eliza E. daughter of Mr. J. W. Kercher, locomotive department G.C. Railway, was solemnised at Grimsby on the 4th inst.

With reference to the notice which appeared in last issue regarding Todmorden, Mr. Holland asks us to contradict this statement, as no appointments have yet been made to his knowledge.

Mr. C. G. Collinson has resigned the post of switchboard attendant at the Electricity Works, Longbottom, in order to take up a position in charge of the electric light and power plant at the General Post Office, Leicester, from 3rd inst.

Mr. P. W. Sothmann, late consulting engineer of the city of New York, has been appointed chief engineer of the Electrical Power Commission of Ontario, and enters upon his new duties on September 1st. Mr. Sothmann is a native of Denmark, and graduated at the Institute of Technology at Charlottenburg, Germany, in 1891. Although only 38 years of age, Mr. Sothmann has had a wide experience. He has been contracted and managing engineer for various water-power and steam development works in the United States and South Africa for the Western and Haiso Co., and for seven years was manager and engineer for the large distributing company of Strassburg, Germany. Since 1905 Mr. Sothmann has been in New York. His appointment as Sothmann’s duties as chief engineer of the Hydro-Electric Power Commission will be to supervise the estimating, constructing and managing on behalf of such municipalities as may apply to the Commission for power under the recently passed Act.

So much is heard of the irregularity of gas engines, that the points which determine such irregularity ought to be fully comprehended in order that correct conclusions may be arrived at.

Tasting the ordinary or Otto cycle, more properly styled the Beau de Rochess cycle, the common variety of single-acting gas engine at its best only possesses one working stroke in four. The crank must pass through 720° of arc for each propulsion stroke, and the fly-wheel must have a sufficient store of energy to enable it to maintain the desired speed between one working stroke and the next. It is assumed that the normal speed is 200 r.p.m., and that the limit of speed is two revolutions on either side of the normal. Then the engine will run at 202 r.p.m., and in the course of three strokes will slow to 198 r.p.m. It will decelerate at the rate of 1° per stroke, so that the retardation will be regular and imperceptible. Since, however, the working stroke is required to put the speed up by 4 r.p.m., it follows that during this one stroke the acceleration will be 4 r.p.m in one stroke, or three times more severe than the rate of loss of speed during the idle strokes.

When an engine is made double-acting, it may be made of one-half the cylinder area for equal power. Indeed, it may have less than half the area if friction be duly allowed for. Consequently the working strokes will be doubled in a given time, and the impulses will be halved in intensity. Since there will be a working stroke for each revolution, the rate of acceleration during the working stroke will be the same as the deceleration during the idle stroke.

Regularity is again doubled when the engine is arranged both double-acting and with an explosion every stroke, as when the engine is worked on the Clerk cycle, with separate charging cylinders or pumps. With such an engine the regular turning effect only falls short of that of the steam engine if its indicator card shows it to be so, and it can hardly be said that gas engine cards with poor gas show anything of this.

If, however, the Clerk cycle be not employed, then it becomes necessary to employ two cylinders to attain the same result as is attained by one cylinder of a steam engine; or, failing this, the fly-wheel energy must be increased in intensity and trebled in regularity of the ratio of acceleration to deceleration. There will still remain the fault of a greater irregularity for partially loaded engines—a fault only to be got over by employing high and and carefully graduated charges, which, if less efficient economically, have the advantage in greater regularity of turning effort.

Regularity is again doubled when the engine is arranged both double-acting and with an explosion every stroke, as when the engine is worked on the Clerk cycle, with separate charging cylinders or pumps. With such an engine the regular turning effect only falls short of that of the steam engine if its indicator card shows it to be so, and it can hardly be said that gas engine cards with poor gas show anything of this.

If, however, the Clerk cycle be not employed, then it becomes necessary to employ two cylinders to attain the same result as is attained by one cylinder of a steam engine; or, failing this, the fly-wheel energy must be increased in intensity and mass action in order to compensate for the difference.

The bad character which was earned by the early gas engines was very largely due to the use of too powerful a gas. Most of the illuminating gas supplies possess a calorific capacity of about 650 B.T.U. per cb. ft. In addition, they were almost wholly hydrogen or of fairly light hydro-carbon, and were, therefore, very rapid burners. They burned explosively, and were not adaptable for large engines, because such gas is very liable to pre-ignition, and this fault rapidly grows to be a danger with the increase of size of the cylinder in which it is exploded. A modern power gas has a calorific capacity of about 550 B.T.U. per cb. ft. Blast furnace gas, which is the prototype of the modern power gas, has, indeed, often less than 100 B.T.U. per cb. ft. Capacity. By "power gas" is to be understood a gas, the combustible part of which is chiefly carbonic oxide. This...
gas is slow to burn, and a small percentage of hydrogen is allowed to quicken its combustion. Its combustion may be so dilatory that maximum pressure is only attained after the piston has travelled well away from the dead point. Engines worked by such gas show no shocks, but work with the same quiet as steam engines, and do not require more than the above described desiderata to be of equal turning and cyclic regularity.

If, therefore, the steam engine can be made to run alternators in parallel, it should be equally possible to do the same with a modern gas engine. The bad character given to the gas engine by highly calorific gas has, in fact, been allowed too long to influence men's minds. What physical or mechanical objection was there to the development of gas engines on some system that did not rest on a heavier scale— and reduced the year's surplus to £1,608.

The prices charged are:—Private lighting, 7d. and 2d., maximum per unit; power, 14d. to 6d. per unit. The chief engineer is Mr. Arthur Ellis.

The result of the last completed year's working shows the department to be moving on favourably in 1906.

Municipal Electricity Supply Accounts.

Cardiff Municipal Electricity Supply.

The result of the last completed year's working shows the department to be moving on steadily. The output increased some 16 per cent., and with a load factor of 73½ per cent., the working costs more than maintained their favourable position in 1905. On the year a gross profit of £14,740 was earned, as compared with £12,517 in the previous year; the financial charges, however, were on a heavier scale— and reduced the year's surplus to £1,608.

The recent adoption of alternative tariffs is expected to affect next year's income, although this can hardly fail to help the undertaking eventually.

£12,517 was paid to the tramways department for some 2,000,000 units (c.o.); this amount was allocated as to £3,564 to the distribution side and the balance to loan charges.

The prices charged are:—Private lighting, 7d. and 6d. maximum demand system, or 6d. flat rate; power, 6d. and 1d. maximum demand system, or 1d. per unit. The chief engineer is Mr. Arthur Ellis.
Bristol and Depreciation.—The question of the financial position of the bristol electrical undertaking having arisen, the Electrical Committee consulted Prof. Lawrence R. Dicksee, of Birmingham University and of Messrs. Sellars, Dicksee & Co., chartered accountants, London, and Sir William Henry Reece, in regard to the matter. Prof. Dicksee's report deals largely with the question of depreciation, based on the life of the various assets as estimated by Sir William Henry Reece. He states that the Committee's questions resolve themselves into the following:—

(a) Can the revenue account be relieved of annual contributions to sinking fund in respect of assets displaced, provided a depreciation fund equivalent to the outstanding debt thereon has been provided out of revenue at the time of such displacement? (b) Is ample provision being made for depreciation?

He gathers that it is not the Committee's policy to provide both for the repayment of loans and for the renewal of wasting assets when such becomes necessary; they are desirous, however, of making any necessary financial provision.

He point out that if the Statutory Sinking Fund equals the true depreciation charge, no further charge is necessary; where, however, the sinking fund is insufficient for that purpose a further provision is necessary, and, on the other hand, a "long-lived" asset which has expired must be renewed by re-borrowing, but the excess on long-lived assets would not be available to meet the deficits on "short-lived" ones. In order to arrive at the true financial position Prof. Dicksee calculates, for the "long-lived" assets, the proper charge against revenue to accumulate at 3 per cent. compound interest equal to a sum equal to the original expenditure (less the residual value), which he makes £5,363 6s. per annum. The sinking fund in respect of such items works out at £19,921 4s. 4d. per annum, or an excess of £5,557 7s. 8d. against which must be set the compensating error due to the "short-lived" assets.

In respect of the latter the proper charge is calculated at £4,389 9s. 5d. per annum, a sum which exceeds the sinking fund payments by £4,655 6d.

The report continues as follows:—

"It is important to bear in mind that, while the deficit referred to in the preceding paragraph can be properly set against the surplus mentioned ... ; but for the purpose of ascertaining the true net profits of the undertaking (thus showing that on the present system of accounting the true net profits are, upon the whole, decidedly in excess of those stated in the published accounts), no such adjustment would be made, in view of the system of adjustment Prof. Dicksee calculates, for the "long-lived" assets, the proper charge against revenue to accumulate at 3 per cent. compound interest to a sum equal to the original expenditure (less the residual value), which he makes £5,363 6s. per annum. The sinking fund in respect of such items works out at £19,921 4s. 4d. per annum, or an excess of £5,557 7s. 8d. against which must be set the compensating error due to the "short-lived" assets.

In respect of the latter the proper charge is calculated at £4,389 9s. 5d. per annum, a sum which exceeds the sinking fund payments by £4,655 6d."

CITY NOTES

The United Electric Car Co., Ltd., Preston.

The report of the directors, to be submitted to the eighth ordinary general meeting, to be held at the office of the company, 2, Lytton Road, Preston, on Thursday, September 20th, at 12 noon, says that, during the year ending June 30th, 1906, the works have been efficiently maintained as regards buildings and machineries, and the net profit of which has been charged against revenue. After paying depletion interest amounting to £3,360, and charging £1,450 for depreciation, the profit for the year is £13,535, which is added £1,463 brought from last year, making a total of £15,014; after deducting preference dividend for the period ending December 31st, 1906, £3,000; there remains an available balance of £12,014. The directors recommend that this amount be dealt with as follows: Preference dividend for the half-year ending June 30th, 1906, £3,000; write off portion of preliminary expenses in connection with the purchase of Hadley and Manchester works, and the issue of preference shares, £2,415; dividend on the ordinary shares of 5 per cent., less income-tax, for the year ending June 30th, 1906, £7,500; carry forward to next year, £2,560; total £14,929.

Electrical Shares on the Berlin Exchange.—The new issues of electrical shares in Germany during the past two or three years have brought an accession to those which were already quoted on the Berlin Stock Exchange. In the year 1903 there were 16 securities in the list, and these have now been increased to 25.

The United Electric Car Co., Ltd.—A further issue of 10,000 6 per cent. cumulative preference shares of £10 each, fully paid.

The Canadian General Electric Co., Ltd.—The usual quarterly dividend of 8 per cent. has been declared.

The Mexican Electric Tramways, Ltd.—The traffic returns for the month of August amounted to $104,700; deducting expenses the net revenue was $73,100.
Compared with the corresponding period of 1905, the railway traffic has increased. One week only, compared with the same period last year, the receipts for the week ending May 31, 1906, were as follows:

<table>
<thead>
<tr>
<th>Locality</th>
<th>Receipts for No. of Total to date</th>
<th>Hon. Price.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Per mile.</td>
</tr>
<tr>
<td>Aberdeen</td>
<td>5,240</td>
<td>14</td>
</tr>
<tr>
<td>Barry</td>
<td>8,207</td>
<td>10</td>
</tr>
<tr>
<td>Birkenhead</td>
<td>1,056</td>
<td>14</td>
</tr>
<tr>
<td>Blackpool</td>
<td>1,090</td>
<td>14</td>
</tr>
<tr>
<td>Bournemouth</td>
<td>4,356</td>
<td>14</td>
</tr>
<tr>
<td>Cardiff</td>
<td>8,546</td>
<td>14</td>
</tr>
<tr>
<td>Exeter</td>
<td>5,803</td>
<td>14</td>
</tr>
<tr>
<td>Ipswich</td>
<td>5,799</td>
<td>14</td>
</tr>
<tr>
<td>Liverpool</td>
<td>10,395</td>
<td>14</td>
</tr>
<tr>
<td>London</td>
<td>5,266</td>
<td>14</td>
</tr>
<tr>
<td>Manchester</td>
<td>8,657</td>
<td>14</td>
</tr>
<tr>
<td>Oxford</td>
<td>5,286</td>
<td>14</td>
</tr>
<tr>
<td>Plymouth</td>
<td>5,256</td>
<td>14</td>
</tr>
<tr>
<td>Reading</td>
<td>4,896</td>
<td>14</td>
</tr>
<tr>
<td>Slough</td>
<td>2,633</td>
<td>14</td>
</tr>
<tr>
<td>Stockport</td>
<td>5,789</td>
<td>14</td>
</tr>
<tr>
<td>Sunderland</td>
<td>5,379</td>
<td>14</td>
</tr>
<tr>
<td>Swansea</td>
<td>4,896</td>
<td>14</td>
</tr>
<tr>
<td>Warrington</td>
<td>3,829</td>
<td>14</td>
</tr>
<tr>
<td>Weymouth</td>
<td>3,249</td>
<td>14</td>
</tr>
<tr>
<td>York</td>
<td>5,249</td>
<td>14</td>
</tr>
</tbody>
</table>

The traffic returns for the week ending May 31, 1906, were as follows:

<table>
<thead>
<tr>
<th>Traffic Returns</th>
<th>Fortnight</th>
<th>Total to date</th>
<th>Hon. Price.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aberdeen</td>
<td>Sep. 5</td>
<td>4,200</td>
<td>14</td>
</tr>
<tr>
<td>Barry</td>
<td>Aug. 5</td>
<td>3,540</td>
<td>14</td>
</tr>
<tr>
<td>Birkenhead</td>
<td>Aug. 5</td>
<td>1,056</td>
<td>14</td>
</tr>
<tr>
<td>Blackpool</td>
<td>Aug. 5</td>
<td>1,090</td>
<td>14</td>
</tr>
<tr>
<td>Bournemouth</td>
<td>Aug. 5</td>
<td>4,356</td>
<td>14</td>
</tr>
<tr>
<td>Cardiff</td>
<td>Aug. 5</td>
<td>8,546</td>
<td>14</td>
</tr>
<tr>
<td>Exeter</td>
<td>Aug. 5</td>
<td>5,803</td>
<td>14</td>
</tr>
<tr>
<td>Ipswich</td>
<td>Aug. 5</td>
<td>5,799</td>
<td>14</td>
</tr>
<tr>
<td>Liverpool</td>
<td>Aug. 5</td>
<td>10,395</td>
<td>14</td>
</tr>
<tr>
<td>London</td>
<td>Aug. 5</td>
<td>5,266</td>
<td>14</td>
</tr>
<tr>
<td>Manchester</td>
<td>Aug. 5</td>
<td>8,657</td>
<td>14</td>
</tr>
<tr>
<td>Oxford</td>
<td>Aug. 5</td>
<td>5,286</td>
<td>14</td>
</tr>
<tr>
<td>Plymouth</td>
<td>Aug. 5</td>
<td>5,256</td>
<td>14</td>
</tr>
<tr>
<td>Reading</td>
<td>Aug. 5</td>
<td>4,896</td>
<td>14</td>
</tr>
<tr>
<td>Slough</td>
<td>Aug. 5</td>
<td>2,633</td>
<td>14</td>
</tr>
<tr>
<td>Stockport</td>
<td>Aug. 5</td>
<td>5,789</td>
<td>14</td>
</tr>
<tr>
<td>Sunderland</td>
<td>Aug. 5</td>
<td>5,379</td>
<td>14</td>
</tr>
<tr>
<td>Swansea</td>
<td>Aug. 5</td>
<td>4,896</td>
<td>14</td>
</tr>
<tr>
<td>Warrington</td>
<td>Aug. 5</td>
<td>3,829</td>
<td>14</td>
</tr>
<tr>
<td>Weymouth</td>
<td>Aug. 5</td>
<td>3,249</td>
<td>14</td>
</tr>
<tr>
<td>York</td>
<td>Aug. 5</td>
<td>5,249</td>
<td>14</td>
</tr>
</tbody>
</table>

ELECTRIC TRAMWAY AND RAILWAY

TRAFFIC RETURNS.

The weekly traffic returns for the week ending May 31, 1906, were as follows:

<table>
<thead>
<tr>
<th>Traffic Returns</th>
<th>Fortnight</th>
<th>Total to date</th>
<th>Hon. Price.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aberdeen</td>
<td>Sep. 5</td>
<td>4,200</td>
<td>14</td>
</tr>
<tr>
<td>Barry</td>
<td>Aug. 5</td>
<td>3,540</td>
<td>14</td>
</tr>
<tr>
<td>Birkenhead</td>
<td>Aug. 5</td>
<td>1,056</td>
<td>14</td>
</tr>
<tr>
<td>Blackpool</td>
<td>Aug. 5</td>
<td>1,090</td>
<td>14</td>
</tr>
<tr>
<td>Bournemouth</td>
<td>Aug. 5</td>
<td>4,356</td>
<td>14</td>
</tr>
<tr>
<td>Cardiff</td>
<td>Aug. 5</td>
<td>8,546</td>
<td>14</td>
</tr>
<tr>
<td>Exeter</td>
<td>Aug. 5</td>
<td>5,803</td>
<td>14</td>
</tr>
<tr>
<td>Ipswich</td>
<td>Aug. 5</td>
<td>5,799</td>
<td>14</td>
</tr>
<tr>
<td>Liverpool</td>
<td>Aug. 5</td>
<td>10,395</td>
<td>14</td>
</tr>
<tr>
<td>London</td>
<td>Aug. 5</td>
<td>5,266</td>
<td>14</td>
</tr>
<tr>
<td>Manchester</td>
<td>Aug. 5</td>
<td>8,657</td>
<td>14</td>
</tr>
<tr>
<td>Oxford</td>
<td>Aug. 5</td>
<td>5,286</td>
<td>14</td>
</tr>
<tr>
<td>Plymouth</td>
<td>Aug. 5</td>
<td>5,256</td>
<td>14</td>
</tr>
<tr>
<td>Reading</td>
<td>Aug. 5</td>
<td>4,896</td>
<td>14</td>
</tr>
<tr>
<td>Slough</td>
<td>Aug. 5</td>
<td>2,633</td>
<td>14</td>
</tr>
<tr>
<td>Stockport</td>
<td>Aug. 5</td>
<td>5,789</td>
<td>14</td>
</tr>
<tr>
<td>Sunderland</td>
<td>Aug. 5</td>
<td>5,379</td>
<td>14</td>
</tr>
<tr>
<td>Swansea</td>
<td>Aug. 5</td>
<td>4,896</td>
<td>14</td>
</tr>
<tr>
<td>Warrington</td>
<td>Aug. 5</td>
<td>3,829</td>
<td>14</td>
</tr>
<tr>
<td>Weymouth</td>
<td>Aug. 5</td>
<td>3,249</td>
<td>14</td>
</tr>
<tr>
<td>York</td>
<td>Aug. 5</td>
<td>5,249</td>
<td>14</td>
</tr>
</tbody>
</table>

ELECTRICITY SUPPLY CANVASSERS SHOULD NOTE THIS.—At a meeting of the Liverpool Health Committee on Thursday last, reference was made to the report of Dr. Brislee, of the University, on the unnecessarily and seriously dangerous 4 volts supplied to some of the city districts, and a deputation was appointed to wait upon the Lighting Committee, who should be approached to ask for the introduction of 4 volts. The latter, incorporated two years ago, has not yet finished all its construction work, but is coming to its conclusion, and with the coming of autumn and winter there should be better traffics for the Twopenny Tube. City and South London Ordinary has fallen to 44, but there are anxious buyers of the 1901 Preference stock at 115. Baker Street and Waterloo Debentures remain at 119. New Light railway, with electricity for its motive power, is to be constructed between Woking and Bagshot. At the former place the line will join the London and South-Western goods sidings, and the cost is placed at £100,000. The electrical railway issues have not altered much. As regards the steam lines, there is a four week Parliament when it meets may introduce fresh labour legislation; at the expense of the capitalist, to give workmen shorter hours and more money.

The Electrical Review.

THE ELECTRICAL REVIEW. [Vol. 59. No. 1,503, Supremum 14, 1906.]

STOCKS AND SHARES.

Money once more rules the financial roost. Whatever may happen on Thursday, the present outlook certainly justifies the apprehension of a rise in the Bank Rate, and Consols are therefore weak and depressed, of which a rise, unheat, this rises upon Home Railway stocks, and the prices of which are, as a whole, proportionately weak with Consols. Electrical railway issues have not altered much. As regards the steam lines, there is a four week Parliament when it meets may introduce fresh labour legislation, at the expense of the capitalist, to give workmen shorter hours and more money. Notwithstanding the agitation against the revised fares on the District Railway, the stock remains steady at 13½, and Metropolitan is 64. The Wimbledon cloumer is somewhat ineffective as far, because of the fact that competition has scarcely made itself felt, the South-Western service being of little use to the hundreds who use the District. But the Central London can hardly fail to benefit by the change; passengers from Ealing and neighbourhood will see to that. The season of the motor-camnibus does not seem to be coming in as yet, the opening of autumn and winter there should be better traffics for the Twopenny Tube. City and South London Ordinary has fallen to 44, but there are anxious buyers of the 1901 Preference stock at 115. Baker Street and Waterloo Debentures remain at 119. A new light railway, with electricity for its motive power, is to be constructed between Woking and Bagshot. At the former place the line will join the London and South-Western goods sidings, and the cost is placed at £100,000. Most of the changes in the Telegraph list in the upward direction: the only complaint is that there are not more of them.

Anglo-Americans happen to be easier, due to the sales of some few operators taking profits prior to the settlement. The price may be very different on Friday from what it is now. The "B" Stock is 7 lower at 114. Direct United States Cable shares have recovered the 5 lost a week ago, and are 15½, and "China" shares are a point better at 145. West African Telegraphs rose to 10 upon the revival of interest and prices in the "Jungle" mining market. Several Debentures are rather harder. The Cuban rebellion has, so far, failed to produce any effect upon Cuba Telegraph shares, but it is otherwise with the London and South-Western goods sidings, and the cost is placed at £100,000. The electrical railway issues have not altered much. As regards the steam lines, there is a four week Parliament when it meets may introduce fresh labour legislation; at the expense of the capitalist, to give workmen shorter hours and more money.
**SHARE LIST OF ELECTRICAL COMPANIES.**

**TELEGRAPH AND TELEPHONE COMPANIES.**

<table>
<thead>
<tr>
<th>Stock or Bond</th>
<th>Dividends for the last four years</th>
<th>Closing Quotations Sept. 28th.</th>
<th>Closing Quotations Sept. 30th.</th>
<th>Businees done during week ended</th>
<th>Rise or Fall</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Amazon Telegraph Co.'s shares, Nos. 1 to 25,000.</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>19,000</td>
<td>$46  -  $50</td>
<td>1,000</td>
<td>1,000</td>
<td>950</td>
<td></td>
</tr>
<tr>
<td>100,000</td>
<td>$46  -  $50</td>
<td>1,000</td>
<td>1,000</td>
<td>975</td>
<td></td>
</tr>
<tr>
<td><strong>Anglo-American Telegraph Co.'s shares, Nos. 1 to 1,000.</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>25,000</td>
<td>$46  -  $50</td>
<td>1,000</td>
<td>1,000</td>
<td>950</td>
<td></td>
</tr>
<tr>
<td>150,000</td>
<td>$46  -  $50</td>
<td>1,000</td>
<td>1,000</td>
<td>975</td>
<td></td>
</tr>
<tr>
<td><strong>Brazilian Telegraph Co.'s shares, Nos. 1 to 50,000.</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>75,000</td>
<td>$46  -  $50</td>
<td>1,000</td>
<td>1,000</td>
<td>950</td>
<td></td>
</tr>
<tr>
<td>400,000</td>
<td>$46  -  $50</td>
<td>1,000</td>
<td>1,000</td>
<td>975</td>
<td></td>
</tr>
<tr>
<td><strong>British and Portuguese Tel. Co.'s shares, Nos. 1 to 50,000.</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>50,000</td>
<td>$46  -  $50</td>
<td>500</td>
<td>500</td>
<td>475</td>
<td></td>
</tr>
<tr>
<td>250,000</td>
<td>$46  -  $50</td>
<td>500</td>
<td>500</td>
<td>475</td>
<td></td>
</tr>
<tr>
<td><strong>British Oriental Telegraph Co.'s shares, Nos. 1 to 100,000.</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>35,000</td>
<td>$46  -  $50</td>
<td>1,000</td>
<td>1,000</td>
<td>950</td>
<td></td>
</tr>
<tr>
<td>200,000</td>
<td>$46  -  $50</td>
<td>1,000</td>
<td>1,000</td>
<td>975</td>
<td></td>
</tr>
<tr>
<td><strong>British Portuguese and South-American Telegraph Co.'s shares, Nos. 1 to 50,000.</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>25,000</td>
<td>$46  -  $50</td>
<td>1,000</td>
<td>1,000</td>
<td>950</td>
<td></td>
</tr>
<tr>
<td>125,000</td>
<td>$46  -  $50</td>
<td>1,000</td>
<td>1,000</td>
<td>975</td>
<td></td>
</tr>
<tr>
<td><strong>British South American Telegraph Co.'s shares, Nos. 1 to 100,000.</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>25,000</td>
<td>$46  -  $50</td>
<td>1,000</td>
<td>1,000</td>
<td>950</td>
<td></td>
</tr>
<tr>
<td>150,000</td>
<td>$46  -  $50</td>
<td>1,000</td>
<td>1,000</td>
<td>975</td>
<td></td>
</tr>
<tr>
<td><strong>British South American and Oriental Telegraph Co.'s shares, Nos. 1 to 25,000.</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10,000</td>
<td>$46  -  $50</td>
<td>500</td>
<td>500</td>
<td>475</td>
<td></td>
</tr>
<tr>
<td>50,000</td>
<td>$46  -  $50</td>
<td>500</td>
<td>500</td>
<td>475</td>
<td></td>
</tr>
<tr>
<td><strong>British Transatlantic Line Co.'s shares, Nos. 1 to 200,000.</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>50,000</td>
<td>$46  -  $50</td>
<td>1,000</td>
<td>1,000</td>
<td>950</td>
<td></td>
</tr>
<tr>
<td>250,000</td>
<td>$46  -  $50</td>
<td>1,000</td>
<td>1,000</td>
<td>975</td>
<td></td>
</tr>
<tr>
<td><strong>Cable &amp; Wireless Co.'s shares, Nos. 1 to 10,000.</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2,000</td>
<td>$46  -  $50</td>
<td>100</td>
<td>100</td>
<td>95</td>
<td></td>
</tr>
<tr>
<td>10,000</td>
<td>$46  -  $50</td>
<td>100</td>
<td>100</td>
<td>95</td>
<td></td>
</tr>
</tbody>
</table>

Including shares.

**ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.**

<table>
<thead>
<tr>
<th>Stock or Bond</th>
<th>Dividends for the last four years</th>
<th>Closing Quotations Sept. 28th.</th>
<th>Closing Quotations Sept. 30th.</th>
<th>Businees done during week ended</th>
<th>Rise or Fall</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Anglo-Italian Railway, &amp;c., shares, Nos. 1 to 100,000.</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>25,000</td>
<td>$46  -  $50</td>
<td>1,000</td>
<td>1,000</td>
<td>950</td>
<td></td>
</tr>
<tr>
<td>150,000</td>
<td>$46  -  $50</td>
<td>1,000</td>
<td>1,000</td>
<td>975</td>
<td></td>
</tr>
<tr>
<td><strong>Anglo-Italian Railway Co.'s shares, Nos. 1 to 100,000.</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>25,000</td>
<td>$46  -  $50</td>
<td>1,000</td>
<td>1,000</td>
<td>950</td>
<td></td>
</tr>
<tr>
<td>150,000</td>
<td>$46  -  $50</td>
<td>1,000</td>
<td>1,000</td>
<td>975</td>
<td></td>
</tr>
<tr>
<td><strong>Anglo-Brazilian Railway Co.'s shares, Nos. 1 to 200,000.</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>50,000</td>
<td>$46  -  $50</td>
<td>1,000</td>
<td>1,000</td>
<td>950</td>
<td></td>
</tr>
<tr>
<td>250,000</td>
<td>$46  -  $50</td>
<td>1,000</td>
<td>1,000</td>
<td>975</td>
<td></td>
</tr>
<tr>
<td><strong>Anglo-Chilean Railway Co.'s shares, Nos. 1 to 200,000.</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>50,000</td>
<td>$46  -  $50</td>
<td>1,000</td>
<td>1,000</td>
<td>950</td>
<td></td>
</tr>
<tr>
<td>250,000</td>
<td>$46  -  $50</td>
<td>1,000</td>
<td>1,000</td>
<td>975</td>
<td></td>
</tr>
<tr>
<td><strong>Anglo-Caribbean Railway Co.'s shares, Nos. 1 to 200,000.</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>50,000</td>
<td>$46  -  $50</td>
<td>1,000</td>
<td>1,000</td>
<td>950</td>
<td></td>
</tr>
<tr>
<td>250,000</td>
<td>$46  -  $50</td>
<td>1,000</td>
<td>1,000</td>
<td>975</td>
<td></td>
</tr>
<tr>
<td><strong>Anglo-Chinese Railway Co.'s shares, Nos. 1 to 200,000.</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>50,000</td>
<td>$46  -  $50</td>
<td>1,000</td>
<td>1,000</td>
<td>950</td>
<td></td>
</tr>
<tr>
<td>250,000</td>
<td>$46  -  $50</td>
<td>1,000</td>
<td>1,000</td>
<td>975</td>
<td></td>
</tr>
</tbody>
</table>

(Continued on next page.)
<table>
<thead>
<tr>
<th>Name</th>
<th>Stock or Shares</th>
<th>Dividends for the last four years</th>
<th>Closing Quotations</th>
<th>Closing Quotations</th>
<th>Business done</th>
<th>Share or Price</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Sept. 4th.</td>
<td>Sept. 11th.</td>
<td>Sept. 11th.</td>
<td>September</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>1902</td>
<td>1905</td>
<td>1906</td>
<td>1906</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Interim Dividends</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**ELECTRICAL SUPPLY COMPANIES.**

<table>
<thead>
<tr>
<th>Name</th>
<th>Stock or Shares</th>
<th>Dividends for the last four years</th>
<th>Closing Quotations</th>
<th>Closing Quotations</th>
<th>Business done</th>
<th>Share or Price</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Sept. 4th.</td>
<td>Sept. 11th.</td>
<td>Sept. 11th.</td>
<td>September</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>1902</td>
<td>1905</td>
<td>1906</td>
<td>1906</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Interim Dividends</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Shares not officially quoted—Mackay Companies, ord., 96—76. Pref. 75—76. Interim dividends.**

(Bank rate of discount 3½ per cent. June 21st, 1906.)
EARTH IN COLLIERIES.

In a paper read before the recent annual meeting of the Institution of Mining Engineers, Mr. Sydney F. Walker deals with this very important question, with reference to the special rules as to the use of electricity in collieries, and shows to some extent the futility of attempting to comply with the rules in connection with earthing.

Practically, the paper hinges upon a series of experiments carried out by Mr. C. G. Wood, T.R.S.E., at the Armstrong College, Newcastle-upon-Tyne, to obtain the specific electrical resistance of coal and the rocks lying above and below each seam of coal, and it may be interesting to give the results as shown in the following table—

**Specific Resistances of Minerals Found in Mines.**

<table>
<thead>
<tr>
<th>Name of mine</th>
<th>Description of mineral</th>
<th>Specific resistance per cubic centimetre.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coleshill Pit</td>
<td>Roof: black shale</td>
<td>446,000</td>
</tr>
<tr>
<td>Coleshill Pit</td>
<td>Steam coal</td>
<td>36,000,000</td>
</tr>
<tr>
<td>Coleshill Pit</td>
<td>Steam coal</td>
<td>20,300</td>
</tr>
<tr>
<td>Coleshill Pit</td>
<td>Grey sandstone</td>
<td>423,000</td>
</tr>
<tr>
<td>Coleshill Pit</td>
<td>Coal</td>
<td>33,000,000</td>
</tr>
<tr>
<td>Coleshill Pit</td>
<td>Coal</td>
<td>13,000</td>
</tr>
<tr>
<td>Coleshill Pit</td>
<td>Coal</td>
<td>337,000</td>
</tr>
<tr>
<td>Coleshill Pit</td>
<td>Coal</td>
<td>80,000,000</td>
</tr>
<tr>
<td>Coleshill Pit</td>
<td>Coal</td>
<td>233,000,000</td>
</tr>
<tr>
<td>Coleshill Pit</td>
<td>Coal</td>
<td>3,500,000,000</td>
</tr>
<tr>
<td>Coleshill Pit</td>
<td>Coal</td>
<td>150,000</td>
</tr>
<tr>
<td>Coleshill Pit</td>
<td>Coal</td>
<td>1,000,000</td>
</tr>
</tbody>
</table>

In addition to the above, it was also ascertained that a block of cement concrete flooring had, a specific resistance of 731,000 ohms per cubic centimetre; and it may also be interesting to note that the Barton carboniferous limestone is the limestone recently adopted by the North-Eastern Railway Co. to lay between the rails and sleepers on the electrical portion of their system.

It is thus at once seen that in the case of a dry mine a “good earth” is practically impossible, and even in the case of a wet mine in which all the districts worked are more or less wet or moist, there will still be a considerable amount of resistance between an earth plate near the generator on the surface and the frame of a machine earthed, say, to the rails a certain distance “inbye.” Hence at some point between these extremes the earth would probably be at a low enough potential to enable a workman to receive a serious shock if the insulation of one cable has broken down, the path through the insulation being alive a totally different set of conditions is produced, the full scope of which is difficult to forecast. There would be differences of pressure between the different parts of the cable, and although these may not be great at first, when things are comparatively new, the constant changes, the constant deteriorations that are going on may produce the very difference of pressure which is the object of the Departmental Committee to avoid.

The real trouble lies in the latter part of the extract, and no one without actual practical experience in mining operations can credit the rapidity and extent to which this does occur. It would appear therefore—and it has already been pointed out in our columns—that the very best system of installing earth cables altogether, using only high class, low-density, well insulated cables, either rubber or bitumen, whichever will best withstand the conditions of the mine. Cheap bitumen cable is sometimes recommended for use by electrical contractors who have absolutely no idea whether it is suitable or not. The cable eventually gives trouble, which the manager has to bear, the contractor evading all responsibility, with the result that the system of electrical transmission is not recommended it being regarded as dangerous and unreliable. For the same reason it is questionable as to whether it is wise to take underground any current above 500 volts pressure, though, in the case of underground systems, 80,000 volts and over are being applied directly to motors underground. When new and in good order, there is no doubt high pressure may be perfectly satisfactory, but how long will it remain so? Further, it must not be forgotten that raising the pressure increases the “earthling” difficulty. Adopting such a pressure may save a few pounds in first cost, but where efficiency, safety, and insurance against breakdown are the principal factors, the question becomes one not lightly disposed of. It may be that such a voltage is used in Germany, but there conditions are vastly different, capital expenditure is not considered, the collieries are worked in a leisurely manner, and a breakdown is not looked upon so seriously as in this country.

In America it is a common plan to use the conductor carrying the earth return wire, which is far in advance of the concentric uninsulated return as suggested by Mr. Walker; but for three-phase current the best system is to adopt a well-insulated three-core cable with the neutral point “inbye.”

With regard to apparatus for recording leakage or indicating when an earth is on the system, there does not appear to be any difficulty with continuous current installations, but, practically speaking, the instrument may be of little value, and with long three-phase cables are absolutely useless, owing to the capacity of the cables.

Probably the best and most satisfactory means of indicating earth fault is to use a lamp or lamps connected between each main and earth through a fuse on each circuit, which may be frequently tested during working hours by the attendant, and as soon as an earth is indicated, no matter whether “slight” or “full,” it should be at once reported and attended to and removed at the earliest possible moment. It matters little whether the leakage current is \( \frac{1}{2} \) of \( \frac{1}{2} \) or \( \frac{1}{4} \) of the maximum supply current; in a mine the insulation should be maintained as perfect as it is possible to do, by means of a high pressure supply, and if the insulation of one of the cables is broken down, the pressure increases the “earthling” difficulty. Adopting such a pressure may save a few pounds in first cost, but where efficiency, safety, and insurance against breakdown are the principal factors, the question becomes one not lightly disposed of. It may be that such a voltage is used in Germany, but there conditions are vastly different, capital expenditure is not considered, the collieries are worked in a leisurely manner, and a breakdown is not looked upon so seriously as in this country.

In America it is a common plan to use the conductor carrying the earth return wire, which is far in advance of the concentric uninsulated return as suggested by Mr. Walker; but for three-phase current the best system is to adopt a well-insulated three-core cable with the neutral point “inbye.”

With regard to apparatus for recording leakage or indicating when an earth is on the system, there does not appear to be any difficulty with continuous current installations, but, practically speaking, the instrument may be of little value, and with long three-phase cables are absolutely useless, owing to the capacity of the cables.

Probably the best and most satisfactory means of indicating earth fault is to use a lamp or lamps connected between each main and earth through a fuse on each circuit, which may be frequently tested during working hours by the attendant, and as soon as an earth is indicated, no matter whether "slight" or "full," it should be at once reported and attended to and removed at the earliest possible moment. It matters little whether the leakage current is \( \frac{1}{2} \) of \( \frac{1}{2} \) or \( \frac{1}{4} \) of the maximum supply current; in a mine the insulation should be maintained as perfect as it is possible to be installed, by only using the best material, good machines, well-designed switchgear and decent switchboards, and a reasonable pressure.—T. C. F.

Manchester and Liverpool Electric Express Railway.

—According to a notice in last Friday's London Gazette landowners and others whose property would be interfered with or rendered less valuable by the commencement, construction or abandonment of the above railway, and any others who claim to be entitled to any part of the funds out of the above railway, are requested to prove their claims before Mr. Justice Swinfin Eady in London.
A CHAT ABOUT STEAM TURBINES.

By E. Austin

Much has been written about steam turbines, so much, in fact, that it might appear unwarranted on the part of the author to revert to this subject. On the other hand, it is one that many engineers are always glad to hear about, hence its revival is, perhaps, not quite so uncalled for as at first sight it appears.

It is not the object of this article to discuss the turbine's merits or demerits, or its relative efficiency as compared with other prime movers, neither is it the object to consider turbines of different makes. The following will be confined to those constructed on the Parsons principle, the constructional details of which most readers are fairly familiar with. We will assume that a turbine has been installed in a reciprocating station; that is to say, a station in which the plant has hitherto consisted of reciprocating engines, where the engineers are fully acquainted with all points in connection with their old plant, but are lacking in turbine experience. It is not surprising that in such a station a few errors of judgment sometimes occur. Of course, there are merits or demerits, or its relative efficiency as compared with connection with their old plant, but are lacking in turbine experience. It is not surprising that in such a station a few errors of judgment sometimes occur. Of course, there is the contractor's engineer who is always very ready to give advice, but since the station engineer is inexperienced in this class of work, he often omits to ask the most pertinent questions, and only finds this out when the contractor's man has left the job. Then, again, there is the instruction sheet; this is a valuable help, but unfortunately the instructions are often too general. And, finally, the writer's opinion, they might well take the form of a book, which should be compiled by someone who has actually had to deal with the running and upkeep of this type of plant. It should be understood, however, that the writer has no fault to find with instruction sheets served out by any particular firm, other than that they are, as a rule, rather incomplete.

The first question that a man will ask when called upon to start up a steam turbine is, Does it require warming up? To this I would reply (in spite of the differences of opinion that appear to exist on this point) in the case of turbines working with clearances common in the Parsons type, decidedly yes; moreover, they should be thoroughly warmed up. It is not sufficient for steam merely to appear at the neck glands, neither does it follow that the turbine is thoroughly warmed through when the exhaust pipe is felt to be hot. For a turbine to be ready for starting, steam should first circulate in every part, and it will be found that the last part to become heated is that where the balance pistons are situated. It should be remembered that steam can only reach the dummy pistons by way of the balance-gland or ports; it is evident that these are not filled until after the main cylinder, and it may well be found that while the exhaust end is perfectly hot, the steam end where the balance pistons are situated is quite cold. Many argue that turbines do not require warming through, but it is the writer's opinion that a large number of the breakdowns due to blade stripping can be traced to starting before the turbine is thoroughly hot. It should not be concluded, however, that a turbine takes longer to warm up than a reciprocating engine, for the reverse is the case, and with a little practice it is surprising how quickly large sets may be warmed up and set in motion, but it cannot be emphasised too strongly that with some parts hot and others cold, the blade clearances may be considerably reduced, and the chances of the moving blades catching is very great.

While the warming process is going on, the oil should be pumped up into the bearings by means of the hand pump, which is always provided where a gear main oil pump is fitted, as this type is somewhat slower in starting to work than a reciprocating pump, and it is also desirable that they should be flooded. In order to make sure that the hand pump is ready for starting, a steam should first circulate in the oil-gauge glass while the handle is being worked, and the turbine should not be set in motion until the oil is seen to fill several inches. When running up, the principal thing to look for is the speed; if a gauge is kept on the oil-pressure gauge while the handle is being worked, and the speed may then be gradually brought up until the emergency valve closes, thus shutting the turbine down. This done, say, once a week will not only keep the gear free from rust, but also tends to prevent oil-sealing defects. Emergency governors fitted to the Parsons turbines are of two kinds, viz., those actuated by means of the ordinary centrifugal flyball and those of the inertia type. As regards reliability and general satisfactory condition, I
think most engineers will agree that the former is the more satisfactory, for once the correct compression is given to the controlling spring there is very little fear of the valve closing except when the speed reaches the limit. If any trouble is experienced the exhaust steam valve will be found to be the cause, the valve closing late rather than early; this is generally due to one of the levers or rods working a little stiffly, or to some kind of obstruction caused, for instance, by lack of freedom in the packing of the neck glands. A rapid inspection of the gear will generally reveal the trouble.

With the inertia governor, on the other hand, the cause of erratic conduct is not always so apparent, and engineers have been known to lose their temper when adjusting governors of this type. Their action is dependent on the inertia of a moving weight, which travels along a short spindle, and at a certain speed engages with a lever connected to the runaway valve, causing it to close. The adjustment is made by altering the length of a small spiral spring behind the weight, the compression being varied by means of a nut which is, of course, locked.

It is surprising what a number of trials must be made sometimes, and if a satisfactory tension is arrived at. Once, of course, the governor is set at the maker's works, there should be no need to interfere with it, but vibration often makes a considerable difference, and when the conditions of working are different from those at the works, the governor may be out of order. Slipping or working too slowly, according to the speed beneath the piston, is often an indication that the vibration is sufficient to cause the governor to act much too soon. I have known governors on new machines to shut off exactly at the 10 per cent. when running without the governor or control, and this has, of course, been caused by the adjustment of the relay governor being incorrect. The relay is a small round plunger which is given a reciprocating motion by a lever driven from a cam. When the plunger is on the up stroke the steam is allowed to escape from beneath the piston, and the speed rises; when it is on the down stroke the exhaust is closed, hence the steam forces the piston down, thus closing the main valve. When the governor has been set by the maker at his works, the number of puffs, of course, will generally be felt. The importance of being careful will be fully realised when it is remembered that the turbine is thrown out of action until a new plunger is obtained. If, after carrying out the above instructions, the speed is still unsatisfactory, or otherwise unsatisfactory conduct continues, it will be found that the speed is too low. The plunger should be carefully removed, and clamped in the vice by means of its iron head-piece, and then polished up with a piece of fine emery cloth. When this has been done it should be assembled to the rocking lever until it is felt to work perfectly freely. Should it still be found to bind, it should again be cleaned with emery cloth, applied mostly at the places where the binding is felt, and careful attention should be exercised in removing this plunger, as it is made from a special metal having a very small expansion coefficient, which is extremely brittle; and if not warned, nine out of ten will shatter to pieces.

Returning to the question of governing, it is well known that a 3 per cent. variation in speed from no load to full load, or vice versa, should not be exceeded when the governor is in order. Slipping or working too slowly, according to the speed beneath the piston, is often an indication that the vibration is sufficient to cause the governor to act much too soon. I have known governors on new machines to shut off exactly at the 10 per cent. when running without the governor or control, and this has, of course, been caused by the adjustment of the relay governor being incorrect. The relay is a small round plunger which is given a reciprocating motion by a lever driven from a cam. When the plunger is on the up stroke the steam is allowed to escape from beneath the piston, and the speed rises; when it is on the down stroke the exhaust is closed, hence the steam forces the piston down, thus closing the main valve. When the governor has been set by the maker at his works, the number of puffs, of course, will generally be felt. The importance of being careful will be fully realised when it is remembered that the turbine is thrown out of action until a new plunger is obtained. If, after carrying out the above instructions, the speed is still unsatisfactory, or otherwise unsatisfactory conduct continues, it will be found that the speed is too low. The plunger should be carefully removed, and clamped in the vice by means of its iron head-piece, and then polished up with a piece of fine emery cloth. When this has been done it should be assembled to the rocking lever until it is felt to work perfectly freely. Should it still be found to bind, it should again be cleaned with emery cloth, applied mostly at the places where the binding is felt, and careful attention should be exercised in removing this plunger, as it is made from a special metal having a very small expansion coefficient, which is extremely brittle; and if not warned, nine out of ten will shatter to pieces.

Returning to the question of governing, it is well known that a 3 per cent. variation in speed from no load to full load, or vice versa, should not be exceeded when the governor is in order. Slipping or working too slowly, according to the speed beneath the piston, is often an indication that the vibration is sufficient to cause the governor to act much too soon. I have known governors on new machines to shut off exactly at the 10 per cent. when running without the governor or control, and this has, of course, been caused by the adjustment of the relay governor being incorrect. The relay is a small round plunger which is given a reciprocating motion by a lever driven from a cam. When the plunger is on the up stroke the steam is allowed to escape from beneath the piston, and the speed rises; when it is on the down stroke the exhaust is closed, hence the steam forces the piston down, thus closing the main valve. When the governor has been set by the maker at his works, the number of puffs, of course, will generally be felt. The importance of being careful will be fully realised when it is remembered that the turbine is thrown out of action until a new plunger is obtained. If, after carrying out the above instructions, the speed is still unsatisfactory, or otherwise unsatisfactory conduct continues, it will be found that the speed is too low. The plunger should be carefully removed, and clamped in the vice by means of its iron head-piece, and then polished up with a piece of fine emery cloth. When this has been done it should be assembled to the rocking lever until it is felt to work perfectly freely. Should it still be found to bind, it should again be cleaned with emery cloth, applied mostly at the places where the binding is felt, and careful attention should be exercised in removing this plunger, as it is made from a special metal having a very small expansion coefficient, which is extremely brittle; and if not warned, nine out of ten will shatter to pieces.

Returning to the question of governing, it is well known that a 3 per cent. variation in speed from no load to full load, or vice versa, should not be exceeded when the governor is in order. Slipping or working too slowly, according to the speed beneath the piston, is often an indication that the vibration is sufficient to cause the governor to act much too soon. I have known governors on new machines to shut off exactly at the 10 per cent. when running without the governor or control, and this has, of course, been caused by the adjustment of the relay governor being incorrect. The relay is a small round plunger which is given a reciprocating motion by a lever driven from a cam. When the plunger is on the up stroke the steam is allowed to escape from beneath the piston, and the speed rises; when it is on the down stroke the exhaust is closed, hence the steam forces the piston down, thus closing the main valve. When the governor has been set by the maker at his works, the number of puffs, of course, will generally be felt. The importance of being careful will be fully realised when it is remembered that the turbine is thrown out of action until a new plunger is obtained. If, after carrying out the above instructions, the speed is still unsatisfactory, or otherwise unsatisfactory conduct continues, it will be found that the speed is too low. The plunger should be carefully removed, and clamped in the vice by means of its iron head-piece, and then polished up with a piece of fine emery cloth. When this has been done it should be assembled to the rocking lever until it is felt to work perfectly freely. Should it still be found to bind, it should again be cleaned with emery cloth, applied mostly at the places where the binding is felt, and careful attention should be exercised in removing this plunger, as it is made from a special metal having a very small expansion coefficient, which is extremely brittle; and if not warned, nine out of ten will shatter to pieces.

Returning to the question of governing, it is well known that a 3 per cent. variation in speed from no load to full load, or vice versa, should not be exceeded when the governor is in order. Slipping or working too slowly, according to the speed beneath the piston, is often an indication that the vibration is sufficient to cause the governor to act much too soon. I have known governors on new machines to shut off exactly at the 10 per cent. when running without the governor or control, and this has, of course, been caused by the adjustment of the relay governor being incorrect. The relay is a small round plunger which is given a reciprocating motion by a lever driven from a cam. When the plunger is on the up stroke the steam is allowed to escape from beneath the piston, and the speed rises; when it is on the down stroke the exhaust is closed, hence the steam forces the piston down, thus closing the main valve. When the governor has been set by the maker at his works, the number of puffs, of course, will generally be felt. The importance of being careful will be fully realised when it is remembered that the turbine is thrown out of action until a new plunger is obtained. If, after carrying out the above instructions, the speed is still unsatisfactory, or otherwise unsatisfactory conduct continues, it will be found that the speed is too low. The plunger should be carefully removed, and clamped in the vice by means of its iron head-piece, and then polished up with a piece of fine emery cloth. When this has been done it should be assembled to the rocking lever until it is felt to work perfectly freely. Should it still be found to bind, it should again be cleaned with emery cloth, applied mostly at the places where the binding is felt, and careful attention should be exercised in removing this plunger, as it is made from a special metal having a very small expansion coefficient, which is extremely brittle; and if not warned, nine out of ten will shatter to pieces.
The object of this little booklet, as explained in the preface, is to meet the want felt by power users, attendants and others for literature dealing with the equipment and care of electrical machinery, in language that can be understood by the layman. There is no doubt that much trouble has been caused through the utter lack of knowledge of unsophisticated attendants. As the average technical book is beyond their power of comprehension, the Vulcan Boiler Company has prepared a little plain book, which is to be placed in the hands of every person responsible for running them.

To be concluded.)

REVIEW.


The什么意思 of this little booklet, as explained in the preface, is to meet the want felt by power users, attendants and others for literature dealing with the equipment and care of electrical machinery, in language that can be understood by the layman. There is no doubt that much trouble has been caused through the utter lack of knowledge of unsophisticated attendants. As the average technical book is beyond their power of comprehension, the Vulcan Boiler and General Insurance Co. have attempted to fill the gap. The compilation of a satisfactory book of this nature is no easy matter. It is not difficult for a technical man to write a popular book on electrical matters is easy, because it is to be hoped that in future editions of this booklet more attention will be paid to this point, and that the author will not place his own views (which, to quote his own words, "may not be accepted as strictly accurate by electrical experts") side by side with a trigonometrical treatment of alternating-current theory.

The Book shows traces of careless preparation; for example, on page 6 a watt is defined as "the unit of electrical work," and "is the work done in one second by a current of 1 ampere flowing with a pressure of 1 volt." In the following paragraph we read, "Power, it is important to note, is not work," so that the unsophisticated reader's views on the relations between power and work can more easily be imagined than described. Errors of this nature are quite inexcusable.

On page 11 the statement is made that "a wire moved upwards near the North Pole would produce a current in the same direction as a wire moved downwards near the South Pole." Now, if two isolated pieces of wire are meant, there will be no current produced whatever, and the E.M.F.'s that are induced will act in opposite directions. On the following page it is mentioned that if the wires are suitably interconnected, the E.M.F.'s will assist each other in the closed circuit; but, nevertheless, the statement, as it stands, is ambiguous and misleading.

Starting switches are now universally admitted to be a most important feature in a motor installation, but we protest against the statement on page 49 that "a poorly made motor will run satisfactorily when controlled by a good type of starter."

With the exception of the minimum and maximum release, a starter is not concerned with the operation of a motor when it has run up to speed. On page 50 we read that the starting switch is not designed to stop the motor. As most starters are arranged to cut the motor circuit out when an enemy is not working at all, we cannot understand what is the meaning of this remark.

Altogether we may say that the intentions of the author, but that his execution is bad; and we hope that in future editions the book will be completely remodelled and rewritten.


An advanced student of physics, the Cours de Physique has a secure place on his bookshelves. In many ways it is to be recommended. There is, for instance, a total absence of those long-winded algebraical proofs, which, in spite of cheap books in the calculus, still mar many a physics treatise. What is still more important, there are copious references to the original papers, so that students interested may pursue their studies ad libitum. The present volume is no exception, and the above remarks apply to it generally.

The first chapter deals with radiation from black bodies, and the pressure of radiation. Here the verification of Maxwell's prediction is discussed, Larmor's calculation and Leduc's experiments being given. The experiments of Nichols, and Hull, and Poynting are also referred to.

Chapters II and III deal with emission from gases, limits of spectrum, Schumann's rays, N-rays, and dispersion. Whatever may be thought about the N-rays of Blondlot in this country, it seems beyond doubt that many of Blondlot's results have been confirmed by physicists in the front rank in France. The writer has attempted to repeat Lebed's experiments, using a Nertz lamp as a source of N-rays, but without the slightest trace of success.

Chapter IV deals with Hertz waves and wireless telegraphy. With reference to the wireless telegraphy period, it is stated that the wave emitted by an earthed antenna is a hemispherical Hertz wave, etc. This, of course, is orthodox theory; Dr. Erskine Murray has recently given an
entirely different explanation, and, in fact, regards "Hertz radiation" as dead loss. Others, again, hold that the earth does most of the signalling. The recent experiments render an explanation of Marconi on selective signalling (Phil. Trans., Royal Society, March 22nd, 1905) as useless. The remaining chapters dealing with Electrolysis, Radio-activity, Ionisation, study of sparking and Paschen's Laws, are very clearly written.

Chapter VI, on alternating currents, and XVII, on electric instruments, seem to the reviewer altogether out of place in this treatise. In all other respects, we can heartily recommend this interesting volume to the notice of students.


In no one of the electrical industries can it be said that there are not radical changes and advances of progress, as in the art of telephony. This applies not only to methods of switching and schemes of distribution, but to type of plant used in the distribution, and to scientific investigation of the underlying principles of practical telephony.

A book on the latest phases of practical work by anyone so closely connected with the practical side of telephony as the author, therefore, to be welcomed. Although this is a third edition of a work first published in 1895, it is practically a new book, and can be treated as such, as it has been completely re-written and re-arranged to embrace the latest aspects of the art.

The amount of matter condensed within the work is surprisingly large as compared with the size of the book. Both theory and practice are covered in manner worthy of commendation, the illustrations being profuse and well prepared.

The history of the telephone is also briefly related in a terse and interesting manner. A specially interesting chapter is devoted to the history and development, told in brief, of the common battery system of telephony, imported into this country from America, and now making great headway against the old systems.

Most of the instruments and switching used either in magneto systems or common battery systems are fully described and illustrated. In addition to full descriptions of methods and appliances used for connections between subscribers in local areas, space is found for a brief but sufficient reference to the systems commonly used in long distance work.

The author is careful to impress on the reader that, though it has been thought that the mutual capacity was about one-tenth of that of a single wire to earth, the recent measurements have contradicted this view.

The author's statement that more accurate measurements can be obtained by this plan than by using the scrumhullmeter is questionable. The latter is, at least, definite in its measurements, and the former is indefinite, at any rate where iron-cored coils are to be measured. The whole subject of practical methods of inductance measurements is one that will bear careful investigation and overhaul.


In "Electricity Meters" Mr. C. H. W. Gerhardi has given us a valuable addition to the literature on this important subject.

He commences by giving a clear explanation of the units of work and energy, and his classification of meter types is good, the main divisions being—(1) Meters suitable for alternating currents only; (2) meters suitable for continuous currents only; (3) meters suitable for either alternating or continuous currents; (4) prepayment meters and double-tariff and maximum demand indicators. Each of these divisions is arranged alphabetically.

The descriptions and illustrations are good, and the author has criticised most of them in a manner which shows thorough acquaintance with the subject. In a large number of cases the drop in pressure due to the resistance of the series winding and the current in the shunt winding is given.

The choice of meters is discussed fully, and the author mentions a number of points which require consideration, but he lays too much stress on his statement that "a really good meter should have a 'curve' which is a straight line starting from the lowest load." A meter which has a curve starting from a low load and similar to those obtained with most induction-type meters can be just as good as one with a straight line error curve.

The author does not consider the shunt losses to be of serious importance. It certainly is difficult to estimate quite accurately what this loss costs, but that there are appreciable losses in any other amount there can be no doubt, particularly in the case of one of the meters described, which had a shunt loss of 20 watts at 200 volts pressure in the 50-amperes size.

Under certain circumstances, however, there can be no doubt that the very great reductions in the shunt losses which have been made recently are not so advantageous as appears on first consideration. The author goes on to describe a very complete testing room, giving a number of diagrams and illustrations. It certainly is an important part of a central station, and more attention should be given to it than is usual. For station engineers designing a test room, this chapter should be most useful.

Dealing with instruments, the author recommends the use of Kelvin balances and electrostatic voltmeters. In advising these latter, he has not been forgotten that for direct current it is necessary to use the two reed switching a reversing switch. Whilst this is quite true, it is only of importance on low pressures, as the difference in the reading is only about 0·5 volt, which on a 200-volt circuit is quite negligible.

The frequency indicator designed by Mr. A. Campbell is described, but the later ones consisting of vibrating pendulums are not mentioned. The measurement of time is dealt with, and the author lays special stress on the testing of stop-watches.

The testing of meters is dealt with carefully, and the real meaning of a percentage error is explained.
The last chapter deals with the keeping of meter books. In conclusion, this book can be thoroughly recommended to every one interested in electricity meters.

**ELECTRIC PUMPING AT COLLIERIES.**

In a paper read before the Manchester Geological and Mining Society, Mr. Gerald H. I. Hooghwinkel generally discusses and describes some electrically-driven mine pumps. Probably as many objections might be made to electrically-driven mine pumps as can be made to steam. As the author says:—"The disadvantages of steam as a direct motive power are obvious, if one only considers underground pumps and shaft sinking pumps with long and leaky shaft ranges, obstructing the shaft to such an extent that shaft or pipe repairs become exceedingly difficult without stopping the pumps;" but it must be noted that it would be a very wise security to have as many electrically-driven mine pumps without stopping the pumps. "These disadvantages, together with the high cost of steam installation and heavy repairs, have given the first impulse for the use of electricity in the underground workings of collieries." With regard, however, to the question of heavy repairs, this objection is exaggerated, as a well-designed heavy duty steam pump will run for years without costing a penny for repairs, and there are now working at some collieries steam pumps, both on the surface and underground, that are doing their work both economically and efficiently, consuming but 20° cent. of power per horsepower-hour, without requiring "heavy repairs. In fact, there is no reason why this should not be so, as a pumping load is probably the easiest to deal with—being steady and constant—to obtain the highest efficiency. The trouble, however, is in conveying steam down the pit shaft to an underground pump, and where the water is bad, in obtaining efficient condensation, as with bad water the valves, pipes, &c., often become thickly incrusted, necessitating frequent cleaning and repairs in the steam pumping engine—except in cases of emergency—must be considered.

These objections may be met by placing the pump on the surface, where the steam transmission may be very short, and if the water is bad, expensive, and a source of an independent power, water for an independent source may be obtained; but placing the pump on the surface means heavy floor space, heavy water installation, and heavy foundation work, &c., and a frequent source of trouble is the breaking of one of the "spars"—which are usually long pitch-pine rods connecting the pump to the large bell cranks or " quadrants",—serious damage being sometimes done to the engine. As before stated, however, with a well-designed pump, and efficient supervision, the steam pump does its work, and it is a matter of saving perhaps thousands of dollars, to use moderately high speed motors resulted in the design of high speed motors for pumping purposes. As gearing was thought to be objectionable by most mining engineers, these high speed motors were built up of large number of three-throw or " eccentrics." The main advantage of these pumps, from a commercial point of view, is the economy of cost of installation, and the absence of valve troubles. The author then describes the Sulzer and Rateau type of pumps, and states that "the commercial construction of the Sulzer Type is equal to 4 lb. of chlorine from bleaching powder—the 15°12 lb. of chlorine cost 97°94 cents, whereas 51°54 cents for material plus 27°84 cents for energy—a total of 79°38 cents per horsepower-hour. The Sulzer Type is equal to 4 lb. of chlorine from bleaching powder—the 15°12 lb. of chlorine cost 82°60 cents, whereas 51°54 cents for material plus 27°84 cents for energy—a total of 79°38 cents per horsepower-hour. The Sulzer Type is equal to 4 lb. of chlorine from bleaching powder—the 15°12 lb. of chlorine cost 82°60 cents, whereas 51°54 cents for material plus 27°84 cents for energy—a total of 79°38 cents per horsepower-hour.

**ELECTROLYTIC MANUFACTURE OF SODIUM HYPOCHLORITE.**

A PAPER on the "Application of Electrolytic Chlorine to Textile Bleaching" was read a short time ago by Mr. H. S. Buckworth before the New England section of the Society of Chemical Industry, and published in the Journal. The paper is taken up with a description of the Hans-Oettel apparatus for electrolyzing trichloro-acetic acid, a method of anode in use at the works of the Oettel Chlorine & Sulphur Co. for nearly three years. The plant consists of a cell made of "asphalt composition," placed within an insulated water-tight tank. The cell contains a plate of carbon at each end, &c., in that, standing vertically, and connected with the source of current. Transversely the cell is divided into a number of compartments by means of partitions charged with the source of the chlorine. The main electrodes reach to the bottom of the cell, and the water flows through various passages underneath, and support a second non-conducting plate above them. These cells are entirely submerged in liquid when the outer vessel is fully charged, and are each provided with an aperture at the base and at the top for the circulation of the electrolyte. As the electrodes are covered with liquor, the chlorine evolved during the passage of the current has to pass through this liquor; it is, therefore, absorbed, and no colour of chlorine is produced in the room where the apparatus is at work. The liberation of hydrogen in each cell causes the liquid to be carried upwards until it has a head above the liquid in the outer vessel, and thus there is a constant circulation between tank and cells through the two holes in each of the latter. The separate cells also serve to collect dirt and other foreign matters which the circulating current of electrolyte leaves in the machine. As to efficiency, the author says:—"A practical average value for the highest, rising to 95 per cent. Others show from 90 to 92 per cent of efficiency. Centrifugal pumps have a lower efficiency, about 70 per cent for Sulzer-type pumps and 90 per cent for Rateau-type pumps.

On the whole, the paper is too general to be of much value, and would have been much better had the author given sectional drawings and entered into a little more detail in his descriptions of the constructions. The mining engineer must be delighted in—some particulars of actual costs.

**SECONDARY CURRENTS.**

A recent article in the "Engineering News" on the "Method of using Electric Current for Telephonic Communication" is worth the attention of all who are connected with the electrifying of the telegraph industry. The following is a summary of the article:

It will be seen that the present methods provided for secondary currents are doubtless not the most convenient that could be devised for their transmission, and that in a number of cases they might be replaced by a more efficient system or transmission, the present systems being doubtless not suitable for the transmission of secondary currents.

In 1906, 10,000 miles of electric railway and similar lines were in use in the United States, and the total amount of electric power consumed at the railway stations was estimated to be 

<table>
<thead>
<tr>
<th>Year</th>
<th>Number of Railways</th>
<th>Total Length of Railway</th>
<th>Total Amount of Electric Power Consumed</th>
<th>Total Amount of Electric Power Consumed in Railways</th>
<th>Total Amount of Electric Power Consumed in Railways</th>
<th>Total Amount of Electric Power Consumed in Railways</th>
</tr>
</thead>
<tbody>
<tr>
<td>1905</td>
<td>10,000</td>
<td>30,000 km</td>
<td>800,000 kWh</td>
<td>720,000 kWh</td>
<td>720,000 kWh</td>
<td>720,000 kWh</td>
</tr>
</tbody>
</table>

In the case of the English system of railway telegraphy, it will be seen that the first expense is the cost of the railway and the second expense is the cost of the telegraph system. The total cost of the railway and telegraph system is estimated at 

<table>
<thead>
<tr>
<th>Year</th>
<th>Number of Railways</th>
<th>Total Length of Railway</th>
<th>Total Amount of Electric Power Consumed</th>
<th>Total Amount of Electric Power Consumed in Railways</th>
<th>Total Amount of Electric Power Consumed in Railways</th>
<th>Total Amount of Electric Power Consumed in Railways</th>
</tr>
</thead>
<tbody>
<tr>
<td>1905</td>
<td>10,000</td>
<td>30,000 km</td>
<td>800,000 kWh</td>
<td>720,000 kWh</td>
<td>720,000 kWh</td>
<td>720,000 kWh</td>
</tr>
</tbody>
</table>

It will be seen that the present methods provided for secondary currents are doubtless not the most convenient that could be devised for their transmission, and that in a number of cases they might be replaced by a more efficient system or transmission, the present systems being doubtless not suitable for the transmission of secondary currents.

Some of the more important methods of secondary current transmission are the following:

1. The use of electric traction motors at the railway stations for the transmission of secondary currents.
2. The use of electric traction motors at the railway stations for the transmission of secondary currents.
3. The use of electric traction motors at the railway stations for the transmission of secondary currents.
4. The use of electric traction motors at the railway stations for the transmission of secondary currents.
5. The use of electric traction motors at the railway stations for the transmission of secondary currents.

In conclusion, the author's article is worth the attention of all who are connected with the electrifying of the telegraph industry, and leaves open the question of the most efficient system for the transmission of secondary currents.

**THE ELECTRICAL REVIEW.**
The following figures will show the vastness of the “Bell” telephone system (American Telephone and Telegraph Co.), which covers 3,687,854 miles of wire, has 46,655 officials and wage-earners, and deals with 3,074,500,000 conversations out of a total of 5,070,554,553.

Tables are given and comparing figures for each State, under the heads of commercial, mutual, rural, independent, &c., and altogether the amount of traffic handled. Publishing the various records published must have been enormous, and great difficulty must have been experienced in attempting to abstract them all.

It appears that American telephone and telephone companies have no leaning towards preferred stock, for out of the total of stock outstanding, $10,777,583 (2402,196,361), or 16.1 per cent., is preferred.

103 of the commercial systems reported a deficit amounting to $2,157,958 ($4,199,399). Real estate is now being largely purchased by the telephone companies, on which they build their own offices, whereas formerly it was leased. Assets under this head amounted to $217,766,538 ($4,643,307), whereas for rent of offices and real estate the annual payment was $9,498,214 ($2,498,945), while $1,349,894 ($269,779) was received on this account.

The report further states that the general reservation of depreci- ation and reserve appears to be inadequate. Examinations of every use of the necessity for frequent and entire reconstruction of lines and exchanges on account of the growth of the telegraphic system in the changes in the methods of operation. An instance is quoted of a company in Baltimore whose entire original plant, after being in service but five years, was replaced at an amount of $23,015,525 ($431,000) was spent in its replacement.

The report further states that the general reservation of depreci- ation and reserve appears to be inadequate. Examinations of every use of the necessity for frequent and entire reconstruction of lines and exchanges on account of the growth of the telegraphic system in the changes in the methods of operation. An instance is quoted of a company in Baltimore whose entire original plant, after being in service but five years, was replaced at an amount of $23,015,525 ($431,000) was spent in its replacement.

The report further states that the general reservation of depreci- ation and reserve appears to be inadequate. Examinations of every use of the necessity for frequent and entire reconstruction of lines and exchanges on account of the growth of the telegraphic system in the changes in the methods of operation. An instance is quoted of a company in Baltimore whose entire original plant, after being in service but five years, was replaced at an amount of $23,015,525 ($431,000) was spent in its replacement.

The report further states that the general reservation of depreci- ation and reserve appears to be inadequate. Examinations of every use of the necessity for frequent and entire reconstruction of lines and exchanges on account of the growth of the telegraphic system in the changes in the methods of operation. An instance is quoted of a company in Baltimore whose entire original plant, after being in service but five years, was replaced at an amount of $23,015,525 ($431,000) was spent in its replacement.

The report further states that the general reservation of depreci- ation and reserve appears to be inadequate. Examinations of every use of the necessity for frequent and entire reconstruction of lines and exchanges on account of the growth of the telegraphic system in the changes in the methods of operation. An instance is quoted of a company in Baltimore whose entire original plant, after being in service but five years, was replaced at an amount of $23,015,525 ($431,000) was spent in its replacement.
Employés.—While women have found a limited employment in themselves by quoting the latter. There were in 1902 25 systems with 1,318,350 miles of wire (exclusive of 16,677 nautical miles of telephones, against 3,400,000 in the United States. The United and this is followed by Chapter XI, dealing with the history and reduc+ the amount of traffic; for it subscribers are charged by the operators employed.

When counting traffic, usually each operator is provided with a wooden peg about the size of the ordinary plug, and is instructed to use it to mark each call that is made during her watch. The pegs are usually made of yellow pine, and range from 3 ft. to 10 ft. in length.

The invention of the so-called paper cable has completely revolutionized the telegraph. Telegraph lines are now laid in metallic tubes, which can be compressed into a small space. The manufacture of these tubes and the conductors of the insulators can be compacted in a small space. The manufacture of these tubes and the conductors of the insulators can be compacted in a small space. The ma-

ners and illustrations are given showing them as a whole and in parts.

Clear-cut poles are largely used in the States of the North Atlantic and North Central divisions, and in the South Atlantic and South Central divisions, jupiter, cypress, cedar and sometimes southern pine are employed, although the pine and cypress not so regularly to make the maintenance of each pole an expensive item. In States of the Western division the various kinds of pine and fir are preferred from the North Pacific coast. Cross-arms remain in the operating training school a period of two weeks. An additional sum is paid when the applicant has graduated and while in at least two of the larger cities the companies have for

room, made for the comfort of operators, and in the East several are provided, and also some comfort. The operators have been trained for the purpose of operating exchanges, and six pages are devoted to this, with various illustrations.

Telegraphs.—As the last statistics compiled in 1880 "did not 'dry as dust." We think the compilers of this report are to ve controversy as to the charge which should be made by the Electricity Committee to the Tramway Committee for electricity supplied to the丰胸

To the last report we refer for the number of messages transmitted. With a flat rate service there is upon the number of instruments installed, and not upon the volume of traffic, while in the case of employment in the exchanges, and new operators are encountered in ascertainment the number of messages, owing to the difficulty which a company, owning both a land and ocean business, has in separating the messages, it has been stated that the competition of the telegraph has kept down the use of the telegraph.

The rates of pay are generally lower, and for every long distance they are overwhelmingly in favor of the telegraph, if the message be taken as the unit; but if the number of words exchanged be taken into account, as well as the time required for getting into communication, the telegraph is at a disadvantage, in case of the smaller messages, for the brief message will suffice, and the written telegraph serves as a record, but where a swift interchange is required, the telephone serves to have them more quickly established its superiority. The public employs the telegraph at the rate of only a little more than one word per capita, whereas the number of telephone messages is already 65 per capita. Seven of the 25 telegraph systems reported an expenditure of $9,776,705 (2,385,335) for the year. Of the total length of the lines 2,657,800 miles were operated under the American figure, and the remainder leased. Of the owned wires, 131,650 miles, or 78.5 per cent. was operated; 37,255 miles, or 21.5 per cent. was under ground, and 679 miles, or 1 per cent. was in subsurface cable. Owing to the complicated nature of the Press business, it has been impossible to arrive at any figures, and the British figures of 14,588,456 words per week are known to be far below the American.

The District Messenger service of about 50 companies operating in 1,400 of the most important cities has been acquired by the American New York and in large exchanges, and 1,200 messengers. It is also stated that the Postal Telegraph Cable Company has organised a number of district messenger services, and that these are maintained. Each of these services was collected in regard to them. It has been stated by one of the largest companies that 50 cents per cent. of messages transmitted referred to some kind. The report demonstrates the great usefulness of the signal corps, which has been on duty at all times. It has been reported that operators' work in telephone exchanges attracts a superior class of women. It has been demonstrated beyond all doubt that the work of operating is better handled by women than by men or boys, and that trained and well-trained women operators perform the work in a more satisfactory service. That has resulted in gathering into the exchanges throughout the country young women above the average intelligence.

From an early day the telephone companies in the United States have been alive to the importance of securing and retaining a good grade of labor, and in this they have been successful. Of the operators, 37,253 were women, and only 3,552 were men, the former being paid $100 per month, and the latter $150. About half the women are given a record of the number of calls each operator has answered. If lines are supplied with a message box, this is unnecessary, as an hourly inspection of each meter is all that is required. Several pages of this exhaustive report deal with the instruments in use, and illustrations are given showing them as a whole and in parts.

On the other hand, telegraphy has provided for a large number of young girls employment at a lower rate of pay, comparing in this respect, it seems to render. Of the operators, 37,253 were women, and only 3,552 were men, the former being paid $100 per month, and the latter $150. About half the women are given a record of the number of calls each operator has answered. If lines are supplied with a message box, this is unnecessary, as an hourly inspection of each meter is all that is required. Several pages of this exhaustive report deal with the instruments in use, and illustrations are given showing them as a whole and in parts.

From an early day the telephone companies in the United States have been alive to the importance of securing and retaining a good grade of labor, and in this they have been successful. Of the operators, 37,253 were women, and only 3,552 were men, the former being paid $100 per month, and the latter $150. About half the women are given a record of the number of calls each operator has answered. If lines are supplied with a message box, this is unnecessary, as an hourly inspection of each meter is all that is required. Several pages of this exhaustive report deal with the instruments in use, and illustrations are given showing them as a whole and in parts.

From an early day the telephone companies in the United States have been alive to the importance of securing and retaining a good grade of labor, and in this they have been successful. Of the operators, 37,253 were women, and only 3,552 were men, the former being paid $100 per month, and the latter $150. About half the women are given a record of the number of calls each operator has answered. If lines are supplied with a message box, this is unnecessary, as an hourly inspection of each meter is all that is required. Several pages of this exhaustive report deal with the instruments in use, and illustrations are given showing them as a whole and in parts.

From an early day the telephone companies in the United States have been alive to the importance of securing and retaining a good grade of labor, and in this they have been successful. Of the operators, 37,253 were women, and only 3,552 were men, the former being paid $100 per month, and the latter $150. About half the women are given a record of the number of calls each operator has answered. If lines are supplied with a message box, this is unnecessary, as an hourly inspection of each meter is all that is required. Several pages of this exhaustive report deal with the instruments in use, and illustrations are given showing them as a whole and in parts.

From an early day the telephone companies in the United States have been alive to the importance of securing and retaining a good grade of labor, and in this they have been successful. Of the operators, 37,253 were women, and only 3,552 were men, the former being paid $100 per month, and the latter $150. About half the women are given a record of the number of calls each operator has answered. If lines are supplied with a message box, this is unnecessary, as an hourly inspection of each meter is all that is required. Several pages of this exhaustive report deal with the instruments in use, and illustrations are given showing them as a whole and in parts.

From an early day the telephone companies in the United States have been alive to the importance of securing and retaining a good grade of labor, and in this they have been successful. Of the operators, 37,253 were women, and only 3,552 were men, the former being paid $100 per month, and the latter $150. About half the women are given a record of the number of calls each operator has answered. If lines are supplied with a message box, this is unnecessary, as an hourly inspection of each meter is all that is required. Several pages of this exhaustive report deal with the instruments in use, and illustrations are given showing them as a whole and in parts.

From an early day the telephone companies in the United States have been alive to the importance of securing and retaining a good grade of labor, and in this they have been successful. Of the operators, 37,253 were women, and only 3,552 were men, the former being paid $100 per month, and the latter $150. About half the women are given a record of the number of calls each operator has answered. If lines are supplied with a message box, this is unnecessary, as an hourly inspection of each meter is all that is required. Several pages of this exhaustive report deal with the instruments in use, and illustrations are given showing them as a whole and in parts.

From an early day the telephone companies in the United States have been alive to the importance of securing and retaining a good grade of labor, and in this they have been successful. Of the operators, 37,253 were women, and only 3,552 were men, the former being paid $100 per month, and the latter $150. About half the women are given a record of the number of calls each operator has answered. If lines are supplied with a message box, this is unnecessary, as an hourly inspection of each meter is all that is required. Several pages of this exhaustive report deal with the instruments in use, and illustrations are given showing them as a whole and in parts.

From an early day the telephone companies in the United States have been alive to the importance of securing and retaining a good grade of labor, and in this they have been successful. Of the operators, 37,253 were women, and only 3,552 were men, the former being paid $100 per month, and the latter $150. About half the women are given a record of the number of calls each operator has answered. If lines are supplied with a message box, this is unnecessary, as an hourly inspection of each meter is all that is required. Several pages of this exhaustive report deal with the instruments in use, and illustrations are given showing them as a whole and in parts.

From an early day the telephone companies in the United States have been alive to the importance of securing and retaining a good grade of labor, and in this they have been successful. Of the operators, 37,253 were women, and only 3,552 were men, the former being paid $100 per month, and the latter $150. About half the women are given a record of the number of calls each operator has answered. If lines are supplied with a message box, this is unnecessary, as an hourly inspection of each meter is all that is required. Several pages of this exhaustive report deal with the instruments in use, and illustrations are given showing them as a whole and in parts.
THE FUTURE REGIME OF ELECTRICITY IN PARIS.

Paris finds herself to-day in a most awkward situation with regard to the supply and distribution of electrical energy. The position may be stated as follows:—At present the city is supplied with electricity by six independent companies, called the six Sectors, who received various concessions from the municipal authorities for the carrying on of this work. These concessions are about to expire, some in 1907 and some in the beginning of 1908, so that the Council must decide very quickly what action it shall take to ensure a uniform and economical supply. The trouble is that while, on the expiration of the concessions, the distributing network will revert to the town, neither the power stations, sub-stations, nor any of the feeder cables will go with it. Thus Paris may find herself, in a few months, in the unenviable position of owning a large network, but no generating or feeding plant.

What is to be done? That is the question of the hour in Paris.

There are two main schemes in existence, namely, the scheme of M. Schneider-Milde and that of a society called "The Parisian Society for the Distribution of Electricity," the latter being simply an association formed from members of the Sectors. Both relative values of the two schemes may be best judged by a comparison given in a communication by the Prefect of the S-line to the Municipal Council. This official states that both schemes are of a transitional nature, designed to bridge over a period of time between the expiration of the concessions to the Sectors and a date when the town will be able to take up the whole supply and distribution for itself. The project of the Sectors (let us call this No. 1) provides for the supply and distribution of energy for five years' transitional period, are based on the instalment of a five years' transitional period, are based on the instalment of the concession to the Sectors, and a date when the town will enter into possession of the old and new networks: the project Schneider-Milde (No. 2) supplies energy until the end of 1938, at which time the town will enter into possession of the whole outfit, network, power stations, substations, &c.

There is an equivalence of financial value, as nearly as can be calculated, between the two schemes; but in the opinion of the Prefect No. 1 would be less satisfying to the public, because the project Schneider-Milde supplies energy until the end of 1938, at which time the town will enter into possession of the whole outfit, network, power stations, substations, &c.

IN PARIS.

A scheme that has been proposed, and has attracted a great deal of attention locally, was definitely decided on the 21st of March that the Corporation should both construct and work a scheme of its own.

The provisional order under which the tramways have been constructed was obtained in 1898, but it was not until the early part of last year that a definite decision was arrived at a certain amount of work of construction was commenced in June, 1905. Some delay was caused by the fact that up to the end of February, 1905, the town was served by horse cars, which prevented the old lines from being interfered with until the expiry of the lease. So soon as the lease had expired, however, the work of pulling up the old lines and preparing a way for the electric tramways was commenced and carried forward expeditiously. Meanwhile the new routes had been in course of construction, so that generally good headway had been made; altogether some 6 miles will eventually be open for traffic.

The tramway is, in the main, double track, and is constructed on the overhead trolley principle. Except in the way of what may be called street improvements, the work of construction has not been attended by any exceptional difficulty; the steepest gradient in the whole system is 1 in 16, and this only occurs for a short distance.

The total cost, inclusive of street improvements and land, may be approximately put down at £140,000. The constructional work was carried out by Messrs. Underwood & Brother (permanent way work and bonding), and Messrs. Dick, Kerr & Co., Ltd. (overhead equipment). Mr. J. H. Cawthra, the borough electrical engineer, was responsible for the whole of the electrical equipment.

The rails are of British Standard Section Nos. 2 and 3c. These are used on straight track work weigh 30 lb. per yd., and on curves 101 lb. per yd. The rails are laid to the 4 ft. 8½ in. gauge, each joint being anchored by means of rolled steel joints, each 24 in. x 8 in. x 7 in.; in addition to these there are holding-down bolts with cast-steel disks 7 in. dia., pitched every 6 ft., the whole being embedded in concrete. The points, crossings, and other special work are of manganese steel, and have been supplied by Messrs. Hadfield. In the electrical equipment of the track, 12½ in. protected bonds of the Forest City Electrical Co.'s manufacture have been used, two at each joint, with cross bonds of 0000 B. and 8 gauge inserted every 160 ft. approximately, and intertrack bonds of the same size, placed every 240 ft. approximately, bridging bonds being used at all points and crossings.

The overhead construction is chiefly on the side bracket principle; two grades of poles are used, except at one or two curves where an extra heavy pole is used to take the severe tension. Grooved trolley wire of hard drawn copper No. 000 B. and S. gauge, inserted every 160 ft. approximately, and intertrack bonds of the same size, placed every 240 ft. approximately, bridging bonds being used at all points and crossings.

The overhand construction is chiefly on the side bracket principle; two grades of poles are used, except at one or two curves where an extra heavy pole is used to take the severe tension. Grooved trolley wire of hard drawn copper No. 000 B. and S. gauge, inserted every 160 ft. approximately, and intertrack bonds of the same size, placed every 240 ft. approximately, bridging bonds being used at all points and crossings.

The car depot is capable of housing 40 cars, and is built on the most approved principle. It consists of a main brick building, with workshop, paint shop and offices adjoining. There are eight tracks in the main building, and the running is almost the entire length. Kineen steel revolving shutters, with patent trolley-wire attachments, are provided at the entrances. The depot was built by Messrs. Arnold, of Doncaster. The cars are of the double-deck type, and were constructed by Messrs. Hurst, Nelson & Co., Ltd., with the exception of the control room, the sitting-rooms, and the car-body of the fabricators for the equipments. The cars are 29 ft. in extreme length, and 7 ft. wide, with open staircases and garden-type seats both inside and out. The trucks are of the Beyer type, the wheel base being 6 ft. 6 in.; the wheels, steel tired, are 30 in. dia. Each truck is fitted with two 30-H.p. motors and both hand and electric

and half into low pressure direct current in a second power house situated in the heart of Paris.

The principal objections to this scheme are as follows:—
1. Considerable lapse of time before realisation of the project.
2. Important loss of energy on the line.
3. Unaccustomed length of transmission line.
4. Want of reliability of supply.

In stating these objections we have set aside altogether those of a technical nature. Such a transmission does not present long time necessary to carry out the project, the estimates varying from 4 to 10 years.

Meanwhile, the Municipal Council came to no conclusion. The Sectors whose concessions are expiring are making valiant efforts to effect a compromise. Many of their arguments are good, but several are quite unacceptable.

THE SOUTH SHIELDS ELECTRIC TRAMWAYS.

The South Shields Electric Tramways is a scheme that has been proposed, and has attracted a great deal of attention locally, was definitely decided on the 21st of March that the Corporation should both construct and work a scheme of its own.

The principal objections to this scheme are as follows:—
1. Considerable lapse of time before realisation of the project.
2. Important loss of energy on the line.
3. Unaccustomed length of transmission line.
4. Want of reliability of supply.

In stating these objections we have set aside altogether those of a technical nature. Such a transmission does not present long time necessary to carry out the project, the estimates varying from 4 to 10 years.

Meanwhile, the Municipal Council came to no conclusion. The Sectors whose concessions are expiring are making valiant efforts to effect a compromise. Many of their arguments are good, but several are quite unacceptable.

The difficulty regarding the want of reliability of service is more serious, and this drawback is but little affected by the fact that the project provides two distinct lines following different paths for the going and coming of the current—for they are in series. The most important objection is the long time necessary to carry out the project, the estimates varying from 4 to 10 years.

Meanwhile, the Municipal Council came to no conclusion. The Sectors whose concessions are expiring are making valiant efforts to effect a compromise. Many of their arguments are good, but several are quite unacceptable.

The difficulty regarding the want of reliability of service is more serious, and this drawback is but little affected by the fact that the project provides two distinct lines following different paths for the going and coming of the current—for they are in series. The most important objection is the long time necessary to carry out the project, the estimates varying from 4 to 10 years.

Meanwhile, the Municipal Council came to no conclusion. The Sectors whose concessions are expiring are making valiant efforts to effect a compromise. Many of their arguments are good, but several are quite unacceptable.
brakes are provided. The cars have each sealing accommodation for 50 persons.

Energy for the system is drawn from the Corporation Electricity Works by three 550-Kw. direct-current traction generators, to provide for the new demand to be made upon them. In the boiler house one marine boiler has been added to the five already in position. This boiler is 14 ft. 6 in. external diameter, by 10 ft. 6 in. long, and has a heating surface of about 2,000 sq. ft.; the working steam pressure is 165 lb. per sq. in. The generating plant consists of two 550-Kw. d-c. traction generators, made by Messrs. Dick, Kerr & Co., Ltd., direct-couple to triple-expansion marine engines, and running at 150 r.p.m. The engines each have an output of 1,500 amperes at 550 volts, and are compounded to give a rise of 50 volts before they reach the brushes. They are designed for an overload of 25 per cent. for a period of two hours or more, and 40 per cent. for short periods. The engines were made by Messrs. J. and H. McNaughton, Ltd., and the generators by Messrs. Dick, Kerr & Co., Ltd. The condensers are of 194 in., 304 in., and 48 in. diameter, with a 9 ft. stroke. Each engine is fitted with a 6-y. wheel 11 ft. 6 in. diameter, and weighing 18 tons. Surface condensers are provided, each given a cooling surface of 1,600 sq. ft. The air pumps are of the Edwards type, 28 in. diameter, with 10 in. stroke.

Two Worthington circulating pumps have been installed; these are equipped with deal flaps, admissions, and are additional to three sets of the same size originally installed.

Water is pumped from the Tyne, the works being situated close on the other side, an 18-in. diameter main being laid to copy with the extra quantity of circulating water required. This pipe, which runs from the pump room, is split into two branches after reaching the works, those branches being of rubber pipe 18 in. internal diameter x 10 ply thickness, and each terminates in a copper plate of 3/4 in. thickness, fixed to three storage tanks placed on the roof, and can also be pumped directly to the condensers if required.

The main injection and discharge pipes are in duplicate and are respectively 10 in. and 12 in. diameter cast-iron.

The steam piping is of lump-rolled steel and copper, the main steam ring being 9 in. diameter. Cast-steel toes have been used where branches have been taken off to the engines. All the extensions to the works have been carried out by Messrs. J. Abbot & Co., Ltd., Gateshead. The traction switchboard is the production of the British Thomson-Houston Company, and is of enamelled slate, mounted on an iron framework. There are three generator panels, one being a spare one at present, and four feeder cables, two with four 500-lb. coiled lengths on each. The usual Board of Trade panel in the centre. At the end of the board two distribution cables are fixed to a swinging bracket for the bus-bar voltage. At present five feeder cables are laid, two of these being 39 in. section, and the others 15 sq. in.; these are drained at the generator for safety. The new receivers are also laid, each 4' sq. in. section, laid in earthenware troughing, filled with bitumen. All the feeder cables are lead covered and jacketed over-all.

A complete telephone installation has been provided in connection with the feeder cables, enabling a ready means of communication with the power station.

PUBLISHED SPECIFICATIONS

Copies of any of these Specifications may be obtained of Messrs. W. P. Thomrom & Co., 82, High Holborn, W.C., and at Liverpool, to whom all inquiries should be addressed.

NEW PATENTS APPLIED FOR.


19,139. "Improvements in and relating to electric switches." F. E. N. Bray, 8,457. April 9th.

19,239. "Improvements in the cooling of electrical machines." Allgemeine Elektricitats Aktien-Gesellschaft. (Date applied for under Patents Act, 1901, August 28th, 1905, being date of application in Germany.) August 28th.


19,306. "Improvement in devices for securing electrical continuity in conduit tubes and the like." F. H. Tempest. (Date applied for under Patents Act, 1901, September 1st, 1905, being date of application in United States.) September 2nd.


19,345. "Improvements in and relating to electric arc lamps." J. A. Roscoe. August 30th.


19,389. "Improvements in alternating current commutator machines." Siemens Schuckertwerke G.m.b.H. (Date applied for under Patents Act, 1901, August 29th, 1905, being date of application in Germany.) August 30th.


19,421. "Improvements in chinsmas and lights, for gas, electric, and oil lamps and the like." J. H. Holmes. August 31st.

19,424. "Improvements in systems of electric distribution in which vapour electric devices are employed." P. H. Thomas. (Date applied for under Patents Act, 1901, September 1st, 1905, being date of application in United States.) September 2nd.


19,440. "Improvements in and relating to electric arc lamps." Bellow and Meston. August 31st.

19,443. "Improvements in and relating to electric lighting systems." Bellus and Hass. August 31st.

19,450. "Improvements in and relating to electric transformers." The British Thomson-Houston Co., Ltd. (General Electric Co., United States.) August 31st.

19,461. "Improvements in and relating to electric switches." W. N. Smith, G. W. Brink, & H. E. Clap. August 30th.

19,465. "Improvements in telephonic apparatus with automatic control." Siemens Schuckertwerke G.m.b.H. (Date applied for under International Convention, May 18th, 1905.) September 2nd.

19,468. "Improvements in and relating to electric machinery." Siemens Schuckertwerke G.m.b.H. (Date applied for under International Convention, May 18th, 1905.) September 2nd.

19,476. "Improvements in current-transformers and apparatus for transforming electrical energy into chemical energy." L. M. Macnamara. August 31st.


19,497. "Improvements in and relating to electric motors." F. H. Tempest. (Date applied for under Patents Act, 1901, September 1st, 1905, being date of application in United States.) September 2nd.


19,520. "Improvement in systems of electric distribution in which vapour electrical devices are employed." P. H. Thomas. (Date applied for under Patents Act, 1901, September 1st, 1905, being date of application in United States.) September 2nd.