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"ELECTRIC INSTALLATIONS FOR LIGHTING AND POWER ON THE MIDLAND RAILWAY "

by the late W. E. Langdon

In recent issues of "Histelec News" there has been several references to the Midland Railway and it's Derby Power Station, so Graham Warburton considered readers may be interested in some aspects of the work of W.E. Langdon, and his early achievements both in the field of electricity and telephones.

Electric Installations for Lighting and Power -The several installations which have been established on the Midland Railway are enumerated below. The approximate brake horse-power amounts in the aggregate to some 3,500 B.H.P.

Engines.-The form of engine employed in the several stations varies. With the earlier apparatus a simple horizontal engine has been employed, drivlng by belting either direct or through countershafting. In the later installations the dynamo shaft has been coupled direct to that of the engine, or both dynamo and engine have been mounted upon the same shaft. The steam engines are all compound, and run at 350 to 460 revolutions per minute according to their power capacity, which ranges from 75 to 300 B.H.P. In some instances gas motors have been provided. At Leicester the prime movers are all worked by gas, which is generated by a Dowson apparatus on the premises; and the intake valves of the engines are arranged so that either Dowson gas or the town (coal) gas may be used. The steam power at the Midland Central Goods Depot, Birmingham, has been supplemented by one gas engine; and that at Bradford by three gas engines. These have been introduced for economical reasons, either to save the cost of extending the steam plant, or to meet occasional demands. At Wellingborough the employment of a gas engine for the small power required, namely a few arc lights, is more economical than the establishment of steam plant including engine, boiler, chimney shaft, &c.

Electrical Apparatus. –The electrical plant varies. In all instances where the arc lights are run in series, dynamos are employed capable of affording a variable pressure of from 50 to 2,750 volts according to the demand. In other cases - especially where the lamps are situated in near proximity to the generating plant - low-tension machines are used, and the lamps are then run in parallel or series parallel. The high-tension machines employed are the Thomson-Houston, the Parker, and the Brush; while the low-tension machines include the Siemens, Parker, Brush, Edison-Hopkinson, Crompton, and others. The table shows that nearly all installations provide for incandescent as well as arc lighting. This tabulated statement also shows the cost of working for the half year ending 31st December 1897. These results are exclusive of interest on primary outlay, and of taxes, and make no provision for what is termed depreciation. The entire plant is maintained in the most perfect condition possible; each half year carries the cost of such renewals or improvements as are found necessary: so that depreciation, in its ordinary sense, arises only from the replacement of obsolete machinery, and improvements due to these new parts should, in order to warrant the change, secure more economical results, and thus pay for their introduction. The charges, are tabulated per unit, and the statement furnishes approximately the number of arc lamps and the number of incandescent lights embraced within each installation. The charges vary to some extent with the load generated, and with the number of hours the light is in operation. The cost indicated covers all charges incurred, inclusive of repairs and renewals, carbons for lamps, replacement of lamps, and the labour attending the same, together with the cost of supervision from head quarters.

Although high-potential generators have been used for series arc- lighting for some time, it is only recently that high-tension direct current machines have been adopted with a view to transforming to a lower potential at points somewhat distant from the initial generating stations. At the Hunslet Goods Depot, Leeds, a pair of 65-kilowatt generators have been recently brought into use for the purpose of providing current for lighting and power at the Wellington Street passenger station, a distance of about two miles by the railway. These generators work at 2,200 volts, and the mains are designed to involve a loss of only 5 per cent, when worked at their full normal capacity; the current is transformed down to 210 volts. At Kentish Town a central generating station of similar description is now approaching completion. This station is to supersede three local independent generating stations; and the concentration thus to be effected should result in a tangible saving in staff expenses. The stoking and engine driving, as well as the dynamo work, will be concentrated and reduced to a minimum. Here three 300 B.H.P. units of the Willans type, giving at each dynamo an output of 200 kilowatts, will form a nucleus which may be doubled in a few years, and perhaps be still further extended. Transforming centres are at present established at the St. Pancras goods and passenger stations, where the current will be distributed at a pressure of 210 volts. This plant has been designed to deal with both lighting and power. It will work pumps now being erected by the President of this Institution, Mr. S. W. Johnson, which are intended to lift and distribute some 45,000 gallons of water per hour to a height of 356 feet. It will work coal-wagon traversers, and a powerful fan erected by Mr. J. A. McDonald for improving the ventilation of the Midland portion of the Metropolitan Tunnel; and it will probably meet other demands for traversers for locomotive engines, and for driving tools in workshops; while the requirements for lighting will call for some 400 H.P. This generating station will thus have a fair day load as well as a night load, and is expected to effect its purpose in an economical manner. The Midland Railway hotels at St. Pancras, Bradford, Leeds, and Liverpool are also electrically lighted; but as the accounts are dealt with by the hotel department, they are not included in the statement in Table 1.

Derby Installation.-It is perhaps unnecessary to enter into further details of each of the installations referred to in the table; but as Derby was selected for this year's Summer Meeting of the Institution, a more complete description is given of the installation established there. The offices of the Midland Railway lighted from this installation consist of several independent blocks, extending over an area approximately 520 yards long and 340 yards broad. The blocks of buildings served are the mineral offices, goods offices, accountant's offices, the station proper, including parcels and booking offices and halls, the traffic department, waiting rooms, and the secretary's and general manager's offices. At the extreme north end of the station are two blocks of buildings devoted to the staff of the engineer of the line; and on the opposite side of the station are the general store-keeper's offices. These, with the Midland Railway Institute, complete the list of buildings that have to be thus provided for.

Number of Lamps.-The total number of lamps in operation consists of 2,175 of 16 candle power and 348 of 8- candle power. A few arc-lights are employed for special purposes, but the railway station platforms are not electrically lighted.

Generating Station.-The generating station is situated in Calvert Street, a point on the north-west border of the area served. This building was erected and the machinery installed during the latter portion of 1892. The system employed is the continuous current three-wire system. The current is delivered to the lamps at a potential of 110 volts. It was brought into operation in March 1893, and has now been running night and day for over five years, without a single failure. The only stoppages during that time have been on three occasions when some alteration has had to be made to the steam-piping, necessitating a shut-down for a few hours on a Sunday.

Boilers.-There are three locomotive-type tubular boilers, together having 2,808 square feet of heating surface, of which 265 square feet are in the fire-boxes; they work at 140 lbs. pressure, and each evaporates about 2,500 lbs. of water per hour. They are fed during times of moderate and heavy loads by means of an exhaust injector, and at other times by a donkey pump.

Engines and Dynamos.- In. the engine room are four steam dynamos; two give 500 amperes each at a maximum pressure of 125 volts, and two give 275 amperes each at the same maximum pressure. The engines are Willans central-valve, and the dynamos are by Messrs. Siemens Brothers. There are also two sets of compensators or regulators, each set controlling -automatically the potential difference on one of the two distinct groups of lighting. These compensators each consist of two series dynamos, coupled together and driven by a shunt motor, the current from the outside mains being sent through them in the usual way. They are wound in addition with a coil, which is connected in series with the middle wire of the three- wire system, but this coil is wound in the opposite directions upon each series machine. By this means any drop in the third wire, due to current in it, is compensated automatically by the volts being raised on one compensator, and dropped in equal amount on the other. There are three sets of feeders to each of the two groups of lighting, each group consisting of about 1,200 lamps of 16-candle power. These feeders are connected to the ring mains at different points. On the switchboard arrangements are made for working on the two wire system at light loads, thus saving one engine from running, and this is managed without stepping the lighting anywhere.

Output and Cost.-The following figures indicate the amount of electricity supplied:

Year	1893	1894	1895	1896	1897
Annual output of Units	93,268	137,348	151,867	175,054	203,519
Increase per cent	--------	--------	10	15	16
Cost per Unit, in pence	3.63	3.37	2.67	2.29	2.58

The max. output for 24 hours is 4,080 units; the maximum current observed in ordinary work 1,430 ampères; the maximum load of any complete day 1,695 units, and the minimum load for any one day 146 units.

In comparing the costs of working this station with those of other electric generating stations, it is necessary to bear in mind that the demands for the lighting required are exceptional, as compared with the usual demand on an electric generating station. By far the greater portion of the current is required for the service of offices in which the duties cease about 5.30 p.m. Consequently in the summer there is ordinarily no lighting required; and yet should a fog or thunder cloud pass over, the whole of the lighting would be called for, perhaps merely for half an hour; hence the boilers have to be kept constantly under steam. Even in winter the demand, although heavy for a time, covers but a short period. In the depth of winter the light is required for cleaning offices, and for a short time perhaps for the early duties, and again in the afternoon from about 4.0 to 5.30 p.m. All this tends to make the stand-by losses much higher than those of a generating station established purely for commercial purposes, where the demand for current would be not only much heavier, but also more continuous both morning and evening.

Application to Power.- So far the application of electricity in large quantities has been mainly devoted to lighting. Its value as an agent for transmission of power - for traction, haulage, pumping, and for working all kinds of machinery - is becoming, daily more recognized; and in erecting electric generating stations, especially on railways and in factories where both lighting and power are needed, it is desirable this should be borne in mind. The advantage to be derived from the employment of electricity over other methods of transmitting power lies in the fact that it can be applied just at the time, and for the time only, during which it is required, and at the speed needed. It can be conveyed to points distant from its source of origin with at least equal economy, and with greater convenience than other agencies of power; and it is practically unaffected by climatic changes. Where the demands are diverse, one source of power common to the whole may be applied with greater economy than is possible with two or more sources.

Cost of working Electric-Light Stations on the Midland Railway

Half Year ending 31st December 1897, and corresponding period of 1896.

Station	Half year ending 31st December	Number of Arc Lamps	Approximate Number of Incandescent Lamps	Total Units	Total Cost £
SOMERS TOWN	1897 1896	246 246	------- -------	213,358 208,767	2,560 2,391
WELLINGBOROUGH*	1897 1896	24 24	63 63	24,200 24,350	412 656
LEICESTER	1897 1896	141 137	320 288	154,711 147,302	1,493 1,945
DERBY	1897 1896	8 8	2,550 2,480	110,037 95,187	1,137 891
BIRMINGHAM (LAWLEY STREET)	1897 1896	139 137	52 52	136,430 132,536	1,363 1,290
BIRMINGHAM (CENTRAL)	1897 1896	72 70	297 283	90,669 95,833	1,060 859
NOTTINGHAM	1897 1896	131 95	266 202	126,014 92,115	1,273 949
SHEFFIELD	1897 1896	115 115	350 345	123,226 128,260	1,280 1,275
LEEDS (HUNSLET)	1897 1896	150 150	280 278	169,176 102,486	1,726 1,251
BRADFORD	1897 1896	194 194	784 784	163,508 155,002	1,573 1,827
LIVERPOOL (SANDON DOCK)*	1897 1896	115 115	111 110	36,161 39,290	759 729
Total for Total for	1897 1896	1,335 1,291	5,073 4,885	1,347,490 1,221,1287	14,636 14,063

- These stations are in operation but a few hours daily, and are excluded from the average

An instance of the advantage to be derived from the general use of electricity presents itself in recent applications to lighting and power at the Wellington Street station, Leeds. Power was required to work certain lifts in the hotel. To have erected a steam plant or even gas engines for the purpose would have entailed a considerable outlay, and have occupied much valuable space. The company possessed an electric lighting installation at their Hunslet Goods Depôt. By supplementing the machinery there with high tension generators, and transforming this high-tension current down to a lower potential at Wellington Street, the work required to be done, as well as the establishment of the electric light throughout the station and the hotel, was effected at much less cost than would otherwise have been the case. As previously mentioned, current is generated at 2,200 volts, and conveyed by concentric cables along the line of railway from Hunslet to Wellington Street, a distance of some two miles. At Wellington Street it is transformed down to a pressure of 210 volts, and employed for both are and incandescent lighting, and for working pumps for the service of the lifts. These lifts when completed will embrace one Ellington hydraulic balance passenger lift, one hydraulic suspended luggage lift, and five small hydraulic suspended service lifts. The passenger lift is capable of carrying six persons, and has a stroke of 46 feet; and the luggage lift can raise loads of 10 cwts. through 54½ feet. The pumping plant has been constructed by the Hydraulic Engineering Company, Chester, and includes some novel features. It consists of two sets of horizontal three-throw single-acting hydraulic pumps, each with a capacity of 23 gallons when running at 46 revolutions per minute, and forcing water into an accumulator with a ram of 10 inches diameter and 8 feet stroke, loaded to a pressure of 700 lbs. per square inch. One set of pumps meets the requirements of, the service; the other is held in reserve. Each set is driven by a Parker motor capable of giving an output of 23 B.H.P. at 650 revolutions per minute. This speed is brought down to about 46 revolutions at the pump crank-shaft by the interposition of double helical steel spur gearing. When the demand for pressure water temporarily ceases, it has been customary either to allow the motor to run continuously, and, by means of a diverting valve actuated by the accumulator, to return the water from the pumps to the suction tank, thus relieving the pumps of the load, or else to stop and start the motor as required. In this installation a device has been employed which enables the motor to run continuously, while the load on the pumps is varied according to the position of the accumulator………

OTHER RELEVANT ARTICLES – first from the LMS Magazine :-

THE FIRST RAILWAY TELEPHONE

"The fiftieth anniversary of the first telephone conversation ever held in this country occurred last march (1878), and in this connection it is interesting to note that the credit for the introduction of telephones on the railway belongs to the Midland Company. A neat frame in the Telegraph Superintendents Office at Derby contains the following letter from Mr. W.E. Langdon, Telegraph Superintendent, to Mr. W.L. Newcombe, Goods Manager. It bears the date April 4, 1878, and is of historic interest, because it refers to the first telephone used on the Midland Railway, and probably the first on any railway. The instrument must also have been one of the very first used in Great Britain.

"Dear Sir, - Should you feel interested in testing its capabilities, I beg to acquaint you that I have now telephone communication in operation between my office and the stores in Siddals Road.
If you would like to call at any time when passing, you will always find someone to attend upon you, and should I be in Derby myself, if you would give me intimation of intended visit, I should endeavour to be present myself. – I am, dear sir, yours faithfully, - W.E. Langdon.""

So who was W.E.Langdon and what was his background? – an extract form an IEE Obituary.

WILLIAM EDWARD LANGDON was born in 1832 at Alverstoke, Hant's, the son of Commander J.W. Langdon, R.N., Assistant Hydrographer at the Admiralty. After receiving his education at the Royal School, New Cross, he entered the service of the Electric and International Telegraphic Company at the age of 19, and while so engaged he acted as Assistant to Sir William H. Preece. Shortly afterwards he was appointed to the post of Junior Engineer. On the transfer of the telegraphs to the State in 1870 he took charge of the Telegraph Dept. of the London and South Western Railway Co. but he was subsequently recalled by the Post Office to take up the position of Assistant Divisional Engineer, a post which he held until 1878, when he was appointed Telegraph Superintendent of the Midland Railway Co. The entire block system on the Midland railway was completely reorganised under his supervision. The total mileage of wire on the Midland Railway increased during his term of service from 8,000 to 30,000, and the number of instruments from 7,000 to 26,000. When Mr Langdon retired in 1902 there were over 1,000 telegraph stations and 1,070 block signalling posts on the Midland Railway Company's system. There were also eleven generating stations for lighting and power purposes, all of which were established under his direction, the total annual output of these various stations being over 5,000,000 units.

During his connection with the Midland Railway Co., Mr Langdon erected for the Post Office the trunk telegraph line to Glasgow and the trunk telephone line to the North. At the end of 1902 he retired from the service of the Company, but was retained as Consulting Electrical Engineer. Mr Langdon read a number of papers before the Institution of Electrical Engineers, and was the author of a well-known work entitled "The Application of Electricity to Railway Working." He was a member of the Institution from the first year of its establishment as the Society of Telegraph Engineers, and in 1877 he acted for a short time as Secretary. He was elected a member of the Council in 1895, and held the office of President for the year 1901-2.
W.E.Landon died at his home, Palmeria Gardens, Westcliff-on-Sea on August 12th 1905, aged 73.

Acknowledgments:-
Mechanical Engineers Proceedings 1898.
Tony Overton.