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The editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

THE ECONOMY OF ELECTRIC TRACTION.

It is not often in the development of a comparatively new invention or industry, that we have such a rare opportunity to test the new against the old as has been afforded by the substitution of electric for steam traction on the Manhattan Elevated Railroad system in this city. Here was the case of a long-established railroad that had been operated for several decades under the same management upon practically the same lines, that suddenly made a complete change in the character of its motive power, the other conditions, such as track, rolling stock, character of traffic, etc., remaining precisely the same. Hence the comparison is devoid of those complications arising from incidental and outlying influences, which are too often overlooked, but nevertheless exert a powerful modifying effect upon the ultimate result. It is, indeed, impossible to lay too much stress upon the significance of the results shown in the first months of the electrical operation of this railroad; and it is conceded by electrical engineers that in the present case the relative merits, in point of convenience to the public and economy for the company, have been proved to absolute and final demonstration.

Now, let us consider the official statement of the earnings and expenses of the system for a period of three months in two successive years, namely, the quarter ending June, 1902, and the same quarter in 1903, it being borne in mind that during the first quarter the Manhattan Elevated Railroads were operated entirely by steam, and in the second quarter entirely by electricity. During the quarter ending June, 1902, the gross earnings under steam operation amounted to $2,857,250. In the same quarter in 1903, the gross earnings under electrical operation were $3,271,787, an increase of $414,537. The expenses for the quarter in 1902 were $1,401,106, and for the same quarter in 1903 they fell to $1,302,089, a decrease of $99,017. The net earnings, therefore, showed for the quarter an increase due to the introduction of electrical traction of $513,534. These are most surprising and gratifying results, better probably than even the most sanguine advocates of electric traction would have predicted; and they are particularly gratifying when we remember that both the company and the public have reaped the benefit; for while the company's earnings have been largely increased, the public are being carried at greater speeds, with less crowding, and on a more frequent service than they ever knew or dreamed of in the days of the steam locomotive. The great increase in the capacity of the road is to be attributed primarily to the greater tractive power which can be applied to trains under electric than under steam traction, particularly on a structure like the Manhattan Elevated, which has a very limited carrying capacity, and will not admit of wheel loads above a certain limit. The old steam engines, built to carry the maximum amount of load on their axles that the structure would permit, exerted a maximum drawbar pull of 7,000 pounds, and the longest trains that could be hauled at the slower speeds that prevailed under the old system, consisted of five cars. With motors carried on the axles of the cars, however, the power was raised to the equivalent of a 20,000-pound drawbar pull, or the equivalent of about three of the steam locomotives. This resulted in an acceleration of the speed of from 20 to 30 per cent. At the same time, the old vacuum brake was replaced by the Westinghouse air brake. Moreover, it became possible to run six-car instead of five-car trains, and thus it will be seen that with an increase of twenty-five per cent in train speed and twenty per cent in the size of the trains, the capacity of the road was vastly augmented. The immediate effect has been an increase in the capacity and number of the trains, a marked decrease in the crowding of the trains, and an all-around improvement in the service. As showing the distance covered by the trains, it may be mentioned that, although there is a total of only 110 miles of track, the train service has reached under electric traction an average of 165,000 car-miles per day. Now just what this means can be best understood by a comparison with one of the trunk lines, say, for instance, the New York Central between New York and Albany. Taking as a basis the Empire State Express, which is a four-car train, we find, by a little calculation, that in order to maintain a service of these trains that would make in a single day a car mileage of 165,000 miles, it would be necessary to start an Empire State Express at intervals of ten minutes, both from Albany and New York, throughout the whole twenty-four hours. Summing up the results of the change from steam to electricity, we find that it has reduced the operating expenses at the rate of about $400,000 per annum, and increased the earnings at the rate of over $2,000,000 per annum. To have done this with the added convenience to the public of higher speed and more frequent and more comfortable service, as a feat upon which the electrical engineers are to be most warmly congratulated.

Public attention will now turn naturally to that other great work of electrifying steam railroads, namely, the change of the New York Central lines, involving the whole of the suburban traffic for from twenty-five to forty miles out of New York. While it is too much to expect that on these roads, with their heavier trains and less frequent service, equally remarkable economies will be effected, we have not the slightest doubt that the advantages both to the operating companies and to the traveling public will be so great, as to bring the date of the complete electrical operation of all-steam railroads, long-haul and short-haul alike, within measurable distance.

THE STORAGE RESERVOIR AS A PREVENTIVE OF FLOODS.

Although the suggestion to use storage dams as a preventive of excessive floods has been carried to somewhat extravagant lengths of late, there is no question that there are many rivers in the United States subjected to disastrous overflow which might be kept within their bounds by this very practicable method of control. As a case in point we might mention the turbulent Passaic River, which has played such havoc upon that twice-stricken town of Passaic, N. J. Here is a case where the loss of several lives and several million dollars has twice occurred within a few months, because of the inability of the river to carry off the surplus waters of a heavy rainfall. The magnitude of the recent precipitation, when in the course of two days there was a fall of 10½ inches of water, proves that in a case like this the only possible method of control would be the temporary storage of the excess waters during the rainstorm, and their subsequent gradual release into the ordinary river channel. In commenting on the possibilities of such control, our contemporary, the Passaic Daily News, quotes from the report of C. C. Vermeule, of the New Jersey State Geological Survey. The report, which was called for by the State after the disastrous flood of last year, proposes to create storage reservoirs converting certain flats in the Passaic Valley into artificial lakes. This remedy would be a sanitary measure; would serve the purpose of draining these flats; would render heavy freshets harmless; and would have the great advantage of maintaining the normal flow of the river at four times its ordinary amount. At the same time the provision of these reservoirs would mitigate the sewage evil, keeping the river well flushed, while incidentally it would afford at Little Falls and Passaic an extra provision of over 10,000 continuous hydraulic horse power. Consequently, not only would the city be safeguarded against the recurrence of these most disastrous floods, but the very works by which this security was obtained would prove a valuable asset to the city as a source of light and power. On the face of it, the report calls for the most serious consideration on the part of the authorities, and if the proposal is carried through, its operation will be watched with close interest in other communities that are subjected to similar disastrous overflows.

THE FIRST TURBINE ATLANTIC LINER.

The steam turbine having proved highly successful in its adaptation to steam yachts and the smaller types of passenger steamships engaged in the Clyde and the English Channel traffic, it has been decided to construct an Atlantic liner equipped with this engine in place of the ordinary reciprocating engines. The Allan Steamship Line have been closely following the developments of the turbine-propelled vessels at present in operation, their behavior under all conditions of weather, their speed, economy, and steadiness in travel, and proportion of coal consumption in relation to the speed developed. They have now decided to build a ship equipped with the turbine for traffic between the Clyde and Canada. This liner when completed will be the largest and heaviest, as well as the fastest vessel in the Allan fleet.

The contract for the construction of the vessel has been placed with the shipbuilding firm of Workman & Clark, of Belfast, Ireland, and the turbines will be built by the Parsons Company, of Newcastle-on-Tyne. The vessel will be 500 feet in length over all, with a gross tonnage of 12,000 tons; a horse power of 10,000 indicated, and a contract speed of 17 knots.

It may be urged that the speed is very low in comparison with that of some of the vessels driven by reciprocating engines plying between New York and Europe; but it is a noteworthy increase in speed of vessels plying between Canada and Great Britain. As a matter of fact, this latest ship will be two knots faster than any other Allan liner running to the Dominion ports, while it marks an increase in tonnage of about 1,400 tons upon the last-constructed vessel, the "Tunisian," of the Allan fleet. It is anticipated, however, that when the vessel is in commission, the contract speed will be exceeded. There is no doubt that had the British or the Canadian government seen the way to grant a subsidy to the Allan line in regard to this vessel, a greater speed would have been arranged; but it is conceded that 17 knots is the fastest speed which the promoters can hope to maintain at a profit in a vessel engaged in this class of traffic. At all events, it will satisfactorily meet all the requirements of the St. Lawrence trade.

To the Allan line will consequently pertain the honor of having introduced the turbine in a transatlantic liner, and the results of the experiment will be followed with keen interest by the various shipping companies engaged in ocean traffic. It also partially realizes the ambition of Parsons, the inventor of the turbine, who from the first has maintained that his invention was the most satisfactory system of propulsion for deep sea trade.

THE TELEPHONE AND THE RAILWAY.

Some interesting tests have recently been made on a number of American railway lines with the telegraphone, which should not be confused with the Poulsen telegraphone recently described in these columns. Trials have been made on the Rome, Watertown & Ogdensburg division of the New York Central system, the Buffalo, Rochester & Pittsburg, as well as the Atchison, Topeka & Santa Fé.

One object of the telegraphone is, in case a train is halted between stations, to enable the trainmen to communicate at once by telephone with the dispatcher at either end of the line, without interrupting the telegraphic business on the wire so utilized. One of its functions also is to establish communication at will between a station where there is no telegraph operator or a siding with the dispatching officers of the division. In order to accomplish these results, a telegraph wire, which may be the wire used by the dispatcher or any commercial wire, is equipped especially for the purpose. In equipping a train, a special telephone is installed in one of the cars. This telephone is provided with a reel, an insulated wire, and a portable extension rod to which connection from the train telephone is made. The extension rod is provided with a file-surfaced clamp, which is placed on the telegraph wire, thus establishing electric communication between the train instrument and the wire, without cutting into the line.

If a train, equipped with the telephone appliances, is halted between two stations, and it is desired to get into immediate communication with the dispatcher, by means of a special magnet, a direct pulsating signal is made, which gives the telephone call to all of the Morse instruments on the line on the side of the temporary connection with which it is desired to communicate, neglecting the Morse instruments on the other side of the temporary connection. This call is a signal for the dispatcher to go to the telephone installed in his office. Having done so, he is in direct communication with the halted train by telephone. While communication with the train is maintained, as has been said, the business of the Morse circuit on the same wire is not interrupted, nor is the telephone communication interrupted by the operation of the Morse circuit instruments. If it is desired to communicate with the dispatcher at the other end of the division, a plug is placed in another "jack" in the train instrument, and the initial signals affect only the relays on that side of the temporary connection. Wherever instruments are placed in stations, and when it is desired to communicate with the dispatcher from a station, the operator at the station calls the dispatcher to the telephone, by signal over the wire. When a track instrument is placed at a siding, all that is necessary to summon the dispatcher to the telephone is to give the emergency ring on the telephone.

The method of equipping a wire for telephone purposes is simple, but interesting. In stations where Morse instruments are "cut in" to the circuit, these instruments are bridged with dead non-inductive resistance. The relays of the Morse instruments are wound for 100 or 150 ohms inductive resistance. The high resistance of the shunt is, on the contrary, a non-conductive. It is so constructed as to eliminate the factor of impedance when the high-frequency telephone current is superposed on the line. Thus the high shunt resistance prevents the passage of the Morse current, but in accordance with the well-known law, it will offer a free path for the talking waves. The shunt resistance being non-inductive, does not impede or interrrupt the high-frequency telephonic current. The initial call is made by means of a direct, slowly-pulsating signal by a special magnet with two segments on its armature, one only of which is alive, thus giving direct, pulsating waves. If by means of the plug and jacks in the train instruments, this direct, pulsating current is given one polarity, the pulsating current will affect the Morse relays in the circuit to its polarity. On the side of the temporary connection, where the line is in direct polarity with the superposed pulsating current from the special magneto generator, the latter will strengthen the battery on the part of the line, and will not annunciate the emergency signal on that part of the line. On the other side of the temporary connection, over which it is desired to communicate, however, the pulsating magneto current is in opposition to the force of the line battery on that part of the circuit which is a reverse polarity. As a result, all relays on that part of the line which are in reverse polarity are caused to give the brief pulsating call. If it be desired to give the signal on the opposite side of the temporary connection, the plug is inserted in the other jack, reversing the polarity of the magnet. It will be understood that the magnet circuit is normally open, except when the brief emergency signal is being given. A condenser connected into the secondary of the telephone prevents the Morse current from grounding, while at the same time permitting the passage of the talking waves of the telephone current.

One of the most interesting trials of the telegraphone recently occurred on the line of the Rome, Watertown & Ogdensburg Railroad, under the supervision of Mr. John Dennis, of Rochester, N. Y., the inventor. A locomotive and tool car were dispatched from Rochester toward Oswego under the orders of the dispatcher at Oswego. The trip was made over a busy single-track railway, but it was understood that a stop could be made between stations at discretion. A heavy rain was falling, electrical conditions thus lending themselves to the breakdown test which had been determined upon. Between Windsor Beach and Sea Breeze stations, the wrecking outfit came to a halt on the main line. One of the crew attached the wire from the reel of the train instrument to an extension pole, with a clamp on its extremity, and hooked it over a commercial wire which was crowded with messages. A call was made through the relays on the line on the side toward Oswego, and within thirty seconds from the time the special had halted, communication was established with the train dispatcher at Oswego, seventy miles distant, and the train was placed under his orders. After calling Trainmaster Halleran, in his office at Oswego, to the telephone, and exchanging condolences on the weather, by simply changing the jack in the caboose instrument the agent at the Rochester office was called in turn in a similar manner. The Rochester operator jacked the telegraphone in with the Rochester Telephone Company's exchange, at Rochester, and a conversation was held from the wrecking outfit, otherwise isolated between stations, with the superintendent of that company. Then Mr. Dennis's home telephone was called, and he talked with his family. The Oswego dispatcher, who had been constantly in touch with the isolated train, was called, and orders for the movement of the special were taken by the trainmen. One of the men removed the pole, the wire was reeled in, and the special started on its return trip.

THE BRITISH QUEST FOR AN EIGHTEENPENNY SAFETY LAMP.

In no way discouraged by their previous failures to find a table-lamp which may reasonably be regarded as "safe," and which can be retailed at a fair profit at 1s. 6d., the promoters of the Grocers' Exhibition have again this year invited inventors and manufacturers to send in designs embodying the conditions laid down, and, as a further stimulus to competition, have increased the monetary value of the prize from £50 to £120. This sum itself is well worth having, but Mr. A. J. Giles, the secretary to the committee which has the matter in hand, stoutly maintains that, when put to practical use, the successful design would probably be worth twenty times the amount of the prize to the inventor. In the conditions laid down the committee stipulated that the design, to be successful, must be satisfactory from a mechanical, a scientific, and a commercial point of view—that is to say, (*a*) the lamp must be made of thoroughly sound and durable materials, and be of reliable workmanship; (*b*) it must be adapted to burn any brand of petroleum; and (*c*) it must be possible for oilmen or grocers who possess no special acquaintance with lamp-construction to handle and sell it at a profit. Whether all, or indeed any, of these conditions are to be found in the designs sent in this year will not be known until the judges have made their report (which may not be for some weeks yet), but so far as a superficial examination of the selected patterns and a demonstration of their capabilities, carried out in the presence of members of the trade press on September 24, enable one to form an opinion, it seems quite within the range of possibility that a solution of the problem has been found.

For obvious reasons, continues the Ironmonger, from which paper these remarks are republished, no detailed inspection of the internal construction of the competitive designs was permitted at the demonstration, nor will the names of the judges be divulged, for the present at all events. We were, however, assured by the secretary that the committee are being advised by gentlemen who are experts in lamp-construction, and upon whose decision the competitors and the public alike may place implicit confidence.

The preliminary tests on September 24 were open to the public, and were carried out in a roped-off portion of the Minor Hall at Islington, the lamps (of which some eighty-four had been sent in, as against fifty-three last year) being arranged on trestles placed against the wall. As a precaution against fire, a heap of wet sand in charge of some workmen was provided, and one of the firemen attached to the place was also in attendance. About half a dozen of the more promising lamps having been lighted and turned up fully, the attendants proceeded to tip them upside down, the operation almost invariably bringing the various extinguishing devices into play and promptly putting out the light. In several instances, however, the oil followed the example of the flame, and also "went out" of the container in rather an unpleasant and disconcerting fashion. Indeed, one fantastically devised light-giver, formed with an inner oil-container swinging upon the outer shell, gimbal fashion, completely emptied itself of oil upon being inverted. Among the little knot of privileged spectators who were admitted inside the ropes were Mr. Alfred Spencer, of the L. C. C. Public Control Department, and Dr. Paul Dvorkovitch, of the Petroleum Institute, both of whom, although for different reasons, are deeply interested in the subject of safety-lamp construction.

The bulk of the lamps on view were of British make, but there were a few designs from Germany, Austria, and France, and one or two from British colonies. The patterns adhered in the main to the familiar table-lamp style, viz., square or circular base, with vase-shaped container, and the orthodox basket, gallery, cone, and winder. Several radical, and even daring departures from the conventional outline were, however, to be seen. One of these monstrosities was shaped something like a "duck" or "torch" lamp, the only point which redeemed its unspeakable ugliness being the impossibility of the flame ever heating the container or of raising the temperature of the oil to flashing-point. Another freak was so arranged that, when it stood on a table by itself, an extinguishing-cap was "on," and only by holding the base firmly down by both hands could the wick be lighted and kept alight. Such a lamp might be suitable as a punishment device for convict prisons, but it would hardly be the sort of thing to introduce into happy British homes. Another funny pattern embodied a container with a water-jacket, the idea being to keep the oil cool while the lamp was alight and to "douse the glim" in the event of the structure being upset. With this device the inventor had considerately sent two small enameled mugs—one, as he was good enough to explain, being for pouring in the oil and the other for pouring in the water. Most of the lamps were fitted with flat-wick burners, but a few had a round wick and flame-spreader.

Metal predominated in the construction, some of the cast-iron bases being very poor specimens of the founders' art, while the attempts at decoration were equally unsatisfactory. Many of the bases, moreover, were too small for security, a point which lamp-designers frequently overlook. Glass containers were but sparingly adopted, and, so far as one could see, even the few on show were not sufficiently stout to render them reasonably safe against breakage if overturned or dropped onto the ground.

All the designs appeared to be provided with chimneys, and nothing of a freak character had been attempted in this direction, the committee having been emphatic on the point that the lamp galleries and burners should follow the accepted shapes, so as to put no difficulties in the way of the purchasers of the approved pattern obtaining refills of wick and new glasses.

After the conclusion of the testing the judges and committee adjourned to the restaurant in the hall for lunch.

Replying to the toast of his health, Mr. A. J. Giles, who is the organizer of the lamp competition, mentioned that his committee, undeterred by previous failures, were determined to persevere in the attempt to find a lamp answering their requirements. The fact that from 300 to 500 fires were caused in the metropolis each year, in addition to much loss of life, from the use of insecure lamps, was, he contended, ample justification for the efforts they were making. The committee had been greatly encouraged by the expert assistance and advice which had been placed at their disposal, and they were confident that ere long success would be achieved.

NEW GERMAN RED PHOSPHORUS MATCH.

By a law of May 10, 1903, Germany forbade the use of white phosphorus in the making of matches. A new material, made of non-poisonous red phosphorus and potassium chlorate, has been bought by the government and is to be substituted in its works for the deleterious and oftentimes more dangerous white phosphorus. A commission of experts appointed by the government to consider the matter of allowing or forbidding the use of white phosphorus and of buying the right to manufacture the new material defends itself against the claim that the new material, which lights at a point about 100 deg. (160 to 180 deg. Cel.) Réaumur, is of little more value than the white phosphorus match-making material, which lights at 50 to 80 deg. Cel. In spite of its high igniting point, the new material may be lighted by scratching on almost any material—sandpaper, bricks, boards, soles of shoes, rough clothing, etc. Great gain attaches to the fact that it does not ignite easily, hence removing or minimizing the danger from fire. How important this is appears when one is reminded of fires caused by the ignition of white phosphorus matches by the sun's rays. In regard to danger to employes, the commission says explosions are practically impossible with the new material.

Then, again, the fact that the new material contains only 15 per cent of lead, while all others contain from 18 to 45 per cent, is in its favor. Matches made of the new material in 1898, when the government first bought the rights thereto, were found to be as good in 1903 as they were when made. The prices of production are interesting. The new kind cost 6.3 marks ($1.50) per 100,000 for the cheapest, and the dearest, 8.10 marks ($1.93). The prices of the others run between 60.50 and 68.20 marks ($14.40 and $16.23).

THE CURRENT SUPPLEMENT.

The rapid increase in the number of agricultural colleges throughout the country is partly responsible for the remarkable improvement which has been noted in the farming methods of those States which are fortunate enough to possess such institutions. Day Allen Willey, in the current SUPPLEMENT, No. 1451, discusses the Agricultural College of the Ohio State University, a typical institution of its kind, and shows just how the instruction fits the student for scientific farming. Mr. Charles J. Sullivan shows how it is possible to produce a battery of sufficient power to perform the many practical experiments requiring a voltage of at least fifty. His outfit requires the care of only five gravity cells. Prof. Robert H. Thurston presents an instructive paper entitled "Functions of Technical Science in Education for Business and the Professions." Of interest to automobilists are the articles on the Ossant muffler and the Lohner-Porsche electric automobile. Mr. Albert Ladd Colby in a valuable article presents a *resumé* of the properties and applications of nickel steel. The usual Selected Formulæ, Trade Notes and Recipes and Consular Notes are also published.

ALUMINIUM IN FLOWERING PLANTS.

Hitherto aluminium has not been found in phanerogamic plants, or at most only in minute traces, although cryptogams appear to use it as a food material. Mr. H. G. Smith, of Sydney, however, has recently found it in one tree belonging to the Proteaceæ, viz., *Orites excelsa*, R.Br., in even greater abundance than it is found in any of the cryptogams. In a paper read before the meeting of the Royal Society of New South Wales, Mr. Smith showed that this tree uses aluminium almost to the exclusion of other mineral elements, and that the aluminium is deposited in cavities and natural fissures as a basic succinate.

SUN SPOTS PHOTOGRAPHED.

Two photographs of spots on the sun have been taken at the Naval Observatory. The photographs show a group of spots, the largest observable for many years, capable of being seen with the naked eye protected by smoked glass.