THE ZEROGRAPH.

It seems to be *de rigueur* that a fantastic name should be given to new instruments destined to be brought to the attention of the general public. The zerograph does not merely write cyphers, but is capable of transmitting the same number of letters and symbols as any other type-printing telegraph. However, a fancy name seems essential in this case, for to call the instrument the Kamm type printer, when one of its most important claims to attention is the absence of clockwork, would have been a comical error.

The general appearance of the instrument is shown in Fig. 1. Its overall dimensions are approximately 18in. by 20in. by 17in. high. The keys, 36 in all, are not arranged in alphabetical order, but those most often required, *i.e.*, those letters placed near the centre of a type-writer keyboard, are put at the extreme left, the figures and stops which are less frequently used being at the right-hand side. The reason for this will be explained presently. The most interesting part of the instrument is, as usual, the synchronising device, and its action will be gathered from the following description, and a reference to Fig. 2. The keys A, of which one is shown in the diagram, are connected to vertical pins B arranged in the arc of a circle at right angles to the plane of the paper. The centre of this circle is the axis of an arm D, termed by Mr. Kamm the synchronising arm. Normally this arm is held at a fixed starting position to the left of the arc of pins by a catch, and when the catch is released the arm is

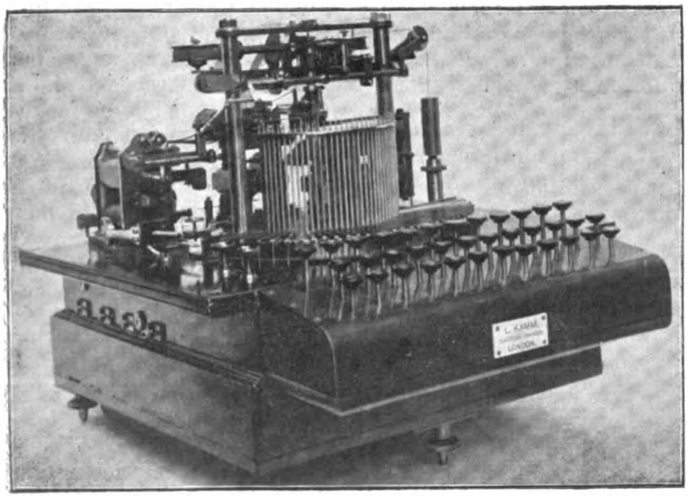

Fig. 1.—The Zerograph.

capable of swinging through the arc of a circle just above the pins already referred to until it is stopped by one of these rising. The impulse is given to the arm by a dropping weight connected to it by a cord passing over a pulley. The instruments at the two ends have exactly similar weights and synchronising arms, a screw adjustment being provided; by this means the space through which the impulse-giving weight drops can be varied, so that the speed of rotation at either end of the arm can be slightly altered if it is not in exact agreement with the other end. The weight acts on the spindle through a pawl so that it only acts during the forward swing of the synchronising arm. Two current impulses are sent to line, the first releasing the catch and starting the synchronising arm, and the second stopping the arm when the letter comes in a position for printing. The types are mounted on flat springs in the arc of a circle corresponding to that of the pins and fixed to the same spindle as the synchronising arm, and the printing is effected by a plunger pushed forward by the printing magnet, which presses the type against the paper tape. An ink ribbon is employed in the usual manner, this being continuous and passing over two ink pads on the circumference of two rollers.

The arm D carries two projections F and G moved by the magnet marked "synchronising magnet" in Fig. 2. The projection G is arranged to engage with any pin B as soon as this is raised by depressing the corresponding key A. The other projection F engages with a hook, C, attached to the armature of the "starting magnet," and this catch holds the synchronising arm in its initial position until the magnet is energised. On depressing any key A a contact at H is made as the key moves down, closing the circuit of the starting magnet and allowing the synchronising arm to start on its journey. The lever attached to the key also makes a contact between K and L, and the starting magnet closes a contact at J; it will be seen that these two contacts connect the line battery to line. The line current passes through the synchronising magnet at the other end, the armature M is attracted, F is released, and the synchronising arm at that end also starts. When the synchronising arm at the sending end reaches the pin B of the letter required it is stopped by the pin, and closes another local circuit energising the "second contact magnet" and the printing magnet. The former of these lifts its armature, making a contact at O, and sending another current impulse to line. This second current

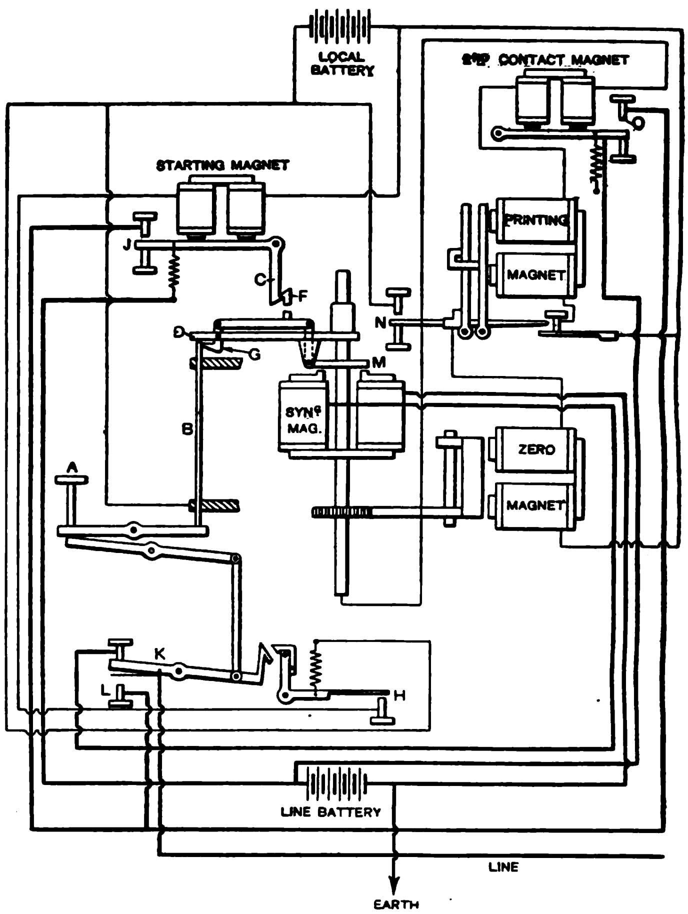

Fig. 2.—Diagram of Connections in the Zerograph.

again energises the synchronising magnet at the other end, the armature of which moves the projecting fang G, so as to stop the synchronising arm at the nearest spring-pin. This pin must correspond to that at the sending end of the line, if the two arms move with equal velocity. The same local circuit at each end is therefore closed, and the printing magnets press the type against the paper. At the same time the paper is fed by the usual mechanism, and the circuit of the "zero magnet" is closed at N, this magnet returning the synchronising arm to its initial position. We believe that an arrangement of condensers and resistances are connected across the contacts in the local circuits, to diminish sparking.

In point of speed the zerograph, although not competing with the Hughes type-printer, is, it is seen, far beyond instruments of the step-by-step type, of which latter the "telescriptor," described in our issue of November 5th, is a good example. The synchronising arm takes but half a second to swing to the limit of its travel and back, and as the letters most frequently used are placed to the left, at the first part of the range of the synchronising arm the average time per letter is but a very small fraction of a second; in fact, it is claimed that the instrument can transmit 25 words a minute. As evident from the description, however, everything depends on the accuracy with which the speed of the two synchronising arms agree, and although the spindles are mounted on jewels, and the instrument shows most careful and workmanlike finish, time only can decide whether in this important respect no trouble is likely to be experienced. We understand that experiments have been made on long artificial lines, but no actual trials on long telegraph lines. The synchronising magnet is very sensitive, and a 12 milliampere current suffices to work it, but we should expect that on long lines with considerable distributed capacity some method of curbing will be found necessary to ensure the first current impulse being completely wiped out before the second occurs. It is essential that each impulse should take the same time to reach the other end, but the time elapsing between successive impulses varies with each letter.

Mr. Kamm has also devised a "column printer," in which paper of a certain width is used instead of tape. To commence a new line a key is pressed which is not connected to any of the circle of pins, and the synchronising arm swings right to the end of its travel, closing a contact there which completes the local circuit of an extra electromagnet. This magnet moves the paper forward, and at the same time brings it back to the commencement of the line. This type of instrument is, however, not beyond the experimental stage, so that a detailed description of it would be out of place now.

ACCUMULATOR TRACTION ON RAILS AND ORDINARY ROADS.*

BY L. EPSTEIN.

While electric traction on the trolley system has proved, on the whole, an unqualified success, both from a technical and financial point of view, traction by means of accumulators could, until quite recently, only be pronounced a failure, and all that even its most ardent advocates can plead for is the substitution of the term "qualified success." However, at the present time signs are not wanting that promise at last success for accumulator traction. The progress made in the manufacture of secondary batteries, and the experience gained with regard to the best mode of using them, not only warrant that belief, but, what will no doubt prove more convincing, relatively good results have already been obtained. It will be remembered that ever since accumulators were produced on a commercial scale attempts were made from time to time to use them for traction purposes, but all these experiments up to a short time since—although frequently hailed with great enthusiasm—only led to disappointment, from a commercial point of view. An investigation of the causes which militated against success might prove useful, and will show that they may be divided into two classes—viz., inherent defects in the accumulators themselves, and mistakes in the mode of their application.

Dealing with the method of working, first, it will be seen, on analysing the expenses, that, apart from the cost of repairs and renewals, a heavy expenditure was incurred by the handling of the batteries; and, in view of the success of trolley traction, it is natural that the remedy should suggest itself to imitate, as far as possible, the latter system—that is to say, to employ accumulators in such a manner that they require a minimum of attendance and handling. It was, as we all know, the common practice to sub-divide the battery into a number of groups, each contained in a tray; and the connection between one tray and the next, as well as at the terminals, both on the cars and in the lifts for charging, was most imperfect. Sliding contacts were generally used, which were open to attack by the acid spray, necessitating almost incessant cleaning and repairs. Again, the pulling out and pushing in of these heavy trays was not always done with the requisite care, much to the detriment of the batteries, cars, and lifts. A further considerable source of waste consisted in the electrical leakage when charging, especially as many tiers of the cells were underground, and therefore out of sight, whilst they were not easily accessible, and were thoroughly saturated with acid spray.

These difficulties and losses can be obviated by adopting a system which will allow of the batteries being treated as a mechanically and electrically well-connected whole, either by being placed in the cars or preferably slung to the frame, or carried on a separate car—apart from the sub-division in groups for coupling in parallel or series during discharge. Where the conditions of working render it desirable, the motor, or motors, could also be fixed in the battery car, which would then assume the character of an electric locomotive; but in any case, whether carried in the car itself or slung to the frame, or carried on separate wheels, the battery should not be sub-divided and handled in the old way, but should always be treated as an indivisible unit. The obvious advantages gained by this method are the absence of lifts or similar contrivances, good connection between cell and cell, no corroding contacts, no loss of current through leakage, less wear and tear of the batteries and consequently easier management and reduced expenditure. The importance of obviating the exchanging of batteries has been fully recognised on the continent, and the methods of working in Hanover and Paris offer interesting illustrations of how this object has been attained.

In Hanover, as is well known, a combined system of trolley and accumulators is in use. The batteries are charged from the trolley *en route*, and an additional charge is given to them on their return to the car shed. This installation is on a sufficiently large scale to render the financial results of commercial value, and it is gratifying to see from the official report that the results for the year 1896 were pronounced to be in every respect satisfactory. The cost of maintenance is said to have been accurately ascertained, and found to average per car and month 40s., which, at an average mileage of 90 per car and day, corresponds with 0·177d. per car mile. The directors anticipate that this cost will be increased somewhat, but they are also confident that it will in no case exceed 60s. per car and month (which amounts to 0·266d. per car mile) even in those years when the quicker deterioration of the plates will occur. It must be understood that the cost of maintenance includes renewals of plates to keep the latter always in good condition, so that the additional depreciation is reduced to a rate not higher than that of the renewal of other parts of the machinery. Based on the actual experience gained, this rate has been fixed at 6 per cent., and with an accumulator car covering between 31,000 and 34,000 miles during the year on this mixed system, accumulator traction incurs an additional expenditure of 0·4d. per car mile, as compared with the trolley. Taking into account that in the absence of the accumulators the trolley system would have to be installed throughout the whole line at an outlay of £2,000 per mile of track, and further considering the maintenance of the overhead system and the saving in the wear and tear of the trolley, which is, of course, at rest while the accumulators are supplying the current, it is computed that even on the most unfavourable assumption the extra cost of the combined system compared with the overhead system alone does not in Hanover exceed 0·2d. per car mile. It may be of interest to mention here that the running expenses of the electrical system, including driver, amounted to 2·22d. per car mile.

This system, although so far satisfactory, is open to certain objections, the foremost being the dead-weight of the accumulators carried on the trolley wire section. It might be found more advantageous to place the batteries in a frame slung to the car, or in dummy cars, either of which could be picked up at the end of the trolley section, while the charging of the accumulators could still be effected in the same manner from the trolley wires, the only difference being that the charging would take place at fixed points instead of *en route*.

A different system is employed in Paris, where the Société des Moteurs have installed and are working a line about 12 miles long at the same cost, including depreciation, as horse

* Paper read before the Institution of Electrical Engineers, Nov. 11, 1897.

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CONTENTS OF THE CURRENT NUMBER.

NOTES.

Prof. E. B. Rosa, of America, commences in our issue this week a description of his electric curve tracer, an instrument which captivated Section A at the recent meeting of the British Association at Toronto. Of the numerous devices for graphically representing or recording alternating-current wave-forms and allied electromagnetic periodic functions, we do not think that any surpass Prof. Rosa's automatic tracer in regard to promptness combined with accuracy of record. Others there may be that are more accurate, but these do not make a permanent record, but only a transient luminous trace of the varying function; while others, again, which are designed to produce a permanent diagram, are objectionable on the score that they necessitate hand adjustments, requiring too much time, and thereby they prolong the operation of plotting a complete curve and increase the risk of its being inaccurate. In a later portion of his article Prof. Rosa will give a number of examples of curves plotted by his automatic tracer, and these will be found interesting, not only in relation to the process of drawing them, but also because they teach some useful lessons about the machinery by which the waves that are recorded were generated.

An interesting and suggestive Presidential Address was given on Wednesday by Mr. J. Sinclair Fairfax before the Society of Patent Agents, on "The Classification of Patents in Relation to a Preliminary Search for Novelty and Patent Law Reform." After reviewing and comparing the British and American systems of procedure in granting patents and in their classification, Mr. Fairfax showed that although, perhaps, the United States system of instituting an official search before granting a patent is theoretically the ideal one, practically it is rapidly becoming unreliable, as affording to an inventor a false criterion of the validity of his claim. In consequence of the vast accumulation of records with which the Office has to deal, unless the system is soon modified in some restrictive manner it is probable that it must ultimately break down under its own weight. Meanwhile, the sense of security hitherto felt in the possession of a United States patent must be shaken. It seems better, therefore, to content ourselves with our own system, with its advantages and admitted disadvantages, rather than to adopt a less practical one. Mr. Fairfax advocates the institution of an index museum of models, in which devices performing similar functions would be placed together, no matter to what use applied; and he further suggests that, "if, by a reform in law and procedure, the Patent Office were to assign an invention to one or more special classes, and the patentee allowed to restrict his invention to the same, or even to a special subdivision of a particular class, it would relieve him from much of the danger involving patents"; and, further, "if it should enact that a new manufacture is one that has not been worked or freely published during the last 25 years, it would probably lead to a revival of many industries"—which would, indeed, justify the granting of a monopoly, restricted as it would be to the special application of the revived invention.

It has been resurrected—that wonderful scheme of bygone years to generate electrical energy on the coalfields and distribute it instead of coal! The General Power Distributing Company, having negotiated with the British Thomson-Houston Company, has given notice of its intention to apply to Parliament for power "to find a market for the product of an almost untapped inland coalfield by the manufacture of electricity." The project is in reality being got up by a number of colliery proprietors and coal-owners. With "the north-west corner of the parish of Warsop" for centre, and at a radius of 25 miles, the Company proposes to describe a circle within which it will supply electric power generated in its central station. Particulars are not yet forthcoming in regard to the precise conditions of generation and

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