COWPER'S WRITING TELEGRAPH.

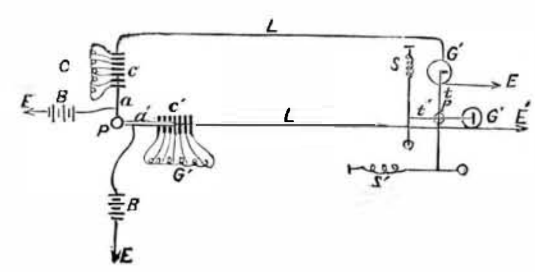
The most recent of the brilliant series of telegraphic marvels which has from time to time, and especially of late, engaged the attention of the world, is the "telegraphic pen" of Mr. E. A. Cowper, the well known engineer of Great George street, Westminster. This ingenious apparatus, which constitutes the first real telegraph, was publicly shown by its inventor at the meeting of the Society of Telegraph Engineers on Wednesday, February 26.

There had been no lack of copying telegraphs hitherto. We have Bakewell's, Casselli's, Meyer's, and D'Arlincourt's, so recently tried at our General Post Office by Mr. Preece. All of these instruments telegraph an almost perfect copy of the writing or sketch submitted to them by means of synchronous mechanism. But the process is necessarily complex and slow; whereas by the new device a person may take the writing pencil in his hand, and himself transmit his message in the act of writing it.

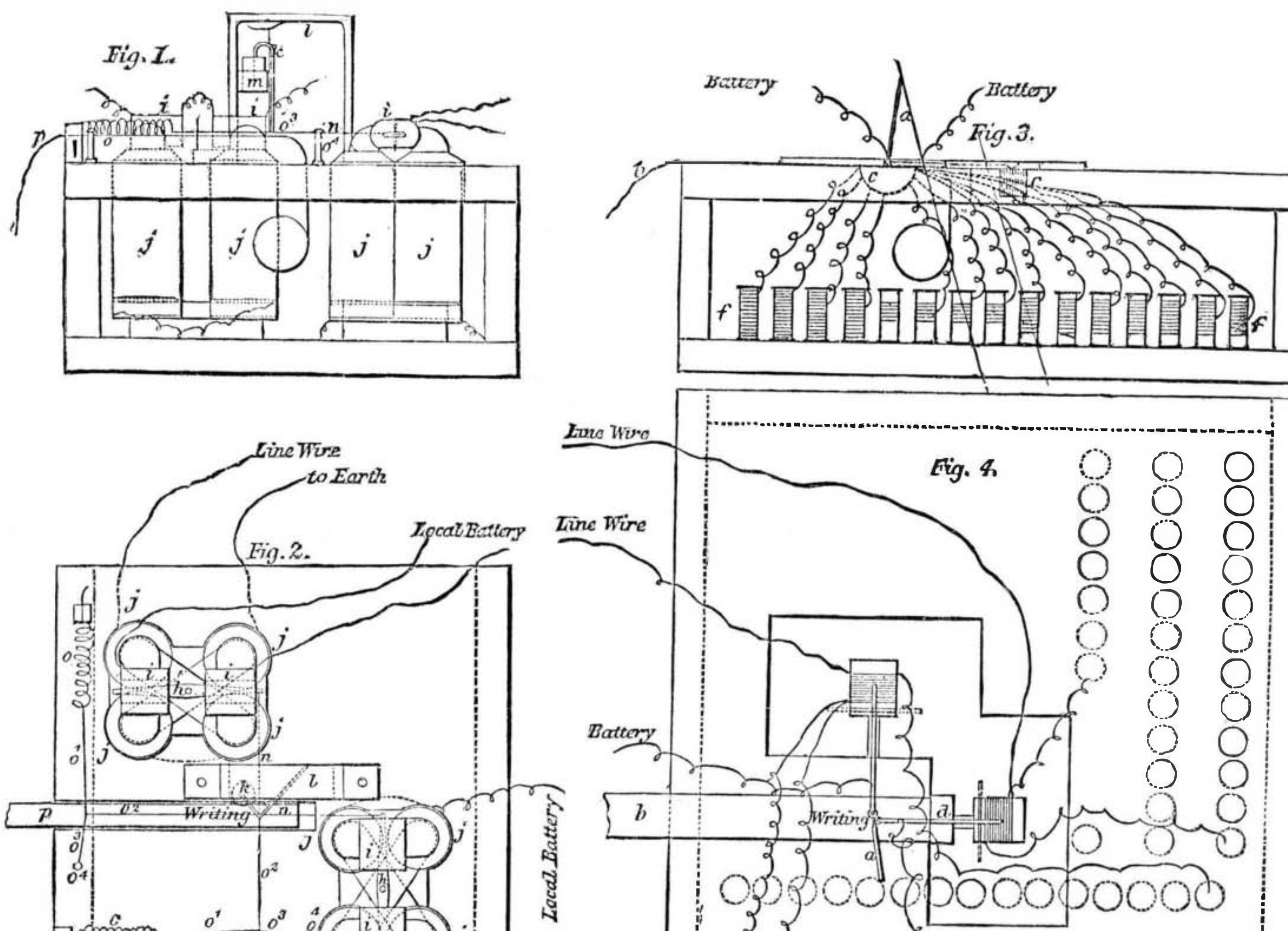
The principle which guided Mr. Cowper to a solution of the problem which he has successfully overcome, is the well known mathematical fact that the position of any point in a curve can be determined by its distance from two rectangular co-ordinates. It follows, then, that every position of the point of a pencil, stylus, or pen, as it forms a letter, can be determined by its distance from two fixed lines, say the adjacent edges of the paper. Moreover it is obvious that if these distances could be transmitted by telegraph and recombined so as to give a resultant motion to a duplicate pen, a duplicate copy of the original writing would be produced. But inasmuch as the writing stylus moves continuously over the paper, the process of transmission would require to be a continuous one; that is to say, the current traversing the telegraph line, and conveying the distances in question (or what comes to the same thing, the up and down, and direct sidelong ranges of the stylus) would require to vary continuously in accordance with the range to be transmitted.

Mr. Cowper effects this by employing two separate telegraphic circuits, each with its own wire, battery, sending, and receiving apparatus. One of these circuits is made to transmit the up and down component writing of the pencil's motion, while the other simultaneously transmits its sidelong component. At the receiving station these two components are then recomposed by a pantograph arrangement of taut cords, or levers, and the resultant motion is communicated to the duplicate penat that place. The plan adopted by Mr. Cowper to transmit each continuously varying component is to cause the resistance of the circuit to vary very closely with the component in question. Fig. 5 shows how the apparatus is theoretically arranged for this purpose. P is the writing style, which is held in the writer's hand in the ordinary way, while he shapes the letters one by one on paper pulled uniformly underneath by means of clockwork. To P are attached, at right angles, two arms, *a a*, one for each circuit: but as it is only necessary to consider one of the circuits, say that sending up and down motions, we will confine our attention for the present to the arm, *a*. One pole of the sending battery, B, is connected to the arm, *a*, the other pole being connected to earth. Now the arm, *a*, is fitted with a sliding contact at its free extremity, and as the pencil, P, is moved in writing, *a* slides lengthwise across the edges of a series of thin metal contact plates, C, insulated from each other by paraffined paper. Between each pair of these plates there is a resistance coil, C, and the last of these is connected through the last plate to the line, L. It will be seen that as *a* slides outward across the plates the current from the battery has to pass through fewer coils, since *a* short-circuits a number of coils proportional to its motion. But the fewer of these coils in circuit the stronger will be the current in the line; so that the extent of the motion of the arm, *a*, in the direction of its length, that is to say, the direct component of the motion of the pencil along the line of the arm, *a*, is attended by a corresponding change in the current traversing the line. If the pencil makes a long up and down stroke there will be a strong current in the line, if a short one there will be a weak current, and so on. A precisely similar arrangement is used to transmit the sidelong motion of the pencil along the line, L.

Fig. 5.



The current from the line, L, flows at the receiving station through a powerful galvanometer, G, to earth. The galvanometer has a stout needle, one tip of which is connected to a duplicate pen, P, by a thread, *t*, which is kept taut by a second thread stretched by a spring, *s'*. The current from the line, L', flows through a similar galvanometer, G', to earth. The needle of G' is also connected to the pen, P, by a taut thread, *t'*, stretched by means of the spring, *s*. Now, since the needle of each of these galvanometers deflects in proportion to the strength of the current flowing through its coil, the points of these two needles keep moving with the varying currents. But since these currents vary the motions of the sending pen, the receiving pen controlled by the united movements of the needles will trace out a close copy of the original writing. We give on another page a facsimile of a sentence written by Mr. Cowper's telegraph.



THE COWPER WRITING TELEGRAPH.

The receiving pen is a fine glass siphon, drawing off aniline ink from a small glass holder. There are thirty-two coils, C, in each circuit, with a corresponding number of contact plates, *c*, so as to get accuracy of working. A few Daniell's cells are sufficient to operate the apparatus, and writing has been already sent successfully over a line 40 miles in length. The writing may be received either of the same size or larger or smaller than the original, as the case may be. At present the writing must not be too hurried, that is, unless the characters are bold and well formed; but further improvement will, of course, quicken the working of the apparatus.

The engravings, Figs. 1 to 4, illustrate the actual apparatus. Fig. 4 is a plan of the sending instrument, with the writing pencil, *a*, the traveling paper, *b*, the light connecting rods or arms, *d* (which correspond to *a* in the theoretical diagram above), the series of metal contact plates over which these arms slide, the resistance coils connected to these plates, and the battery and line wires. It will be seen that each arm, *d*, is connected to its particular battery, and each set of contact plates to its particular line. Fig. 3 is an elevation of the sending instrument, in which *a* is the pencil as before, *c c* the contact plates over which the arms, *d d*, slide, *f f* the coils, and *b* the traveling slip of paper.

Fig. 2 is a plan of the receiving instrument, in which *h h* are the light pivoted needles surrounded by coils of fine insulated copper wires, *i i*, and controlled in their zero position by the electro-magnets, *j j j j*, placed underneath, the whole forming a pair of galvanoscopes or current detecters, one for each line. It will be understood that the varying currents from the lines are allowed to flow through the coils, *i i*, so as to deflect the needles, and that the deflections of the needles follow, so to speak, the variations of the currents. The electro-magnets are magnetized by a local battery; permanent magnets might, however, take their place with a gain in simplicity.

Now the writing pen, *k*, is connected to the nearest tip of the needle, *h*, of each galvanoscope by threads, *n n*, which are kept taut by the fibers, o_1 o_2 o_3, the springs, *o*, and the pins, o_4. In this way the motions of the needles are recombined in the motion of the duplicate pen upon the paper, *p*.

Fig. 1 is an elevation of the receiving instrument, in which *i i* are the coils as before, *j j j j* the controlling electro-magnets, *k* is the writing siphon dipping with its short leg into the ink well, *m*, and *l* is the bridge from which the writing siphon is suspended by means of a thread and spring. The long leg of the siphon reaches down to the surface of the paper, *p*, which is pulled along beneath it in contact with the film of ink filling the point of the tube. When the siphon is at rest its point marks a zero line along the middle of the paper, but when the receiver is working, the siphon point forms each letter of the message upon the paper as it passes.—*Engineering.*

ALUMINUM.

The splendid exhibit of the French aluminum manufacturers at the late Exhibition has again called attention to that metal, which is so admirably adapted to many purposes on account of its great lightness and its stability under the influence of the atmosphere. While aluminum industry has heretofore been thought to be confined to France solely, we are now told by Mr. C. Bambery, in the Annual Report of the Society of Berlin Instrument Makers, that for some years past aluminum has been extensively manufactured in Berlin.

Three firms especially(Stückradt, Häcke, and Schultze) are engaged in this branch of industry.

The articles manufactured principally are nautical instruments, as sextants, compasses, etc. The German navy is supplied throughout with aluminum instruments. As a proof of the superiority of German aluminum, it may here be mentioned that the normal sets of weights and balances used by the International Commission for the regulation of weights and measures, which lately was in session at Paris, were obtained from Stückradt, in Berlin, and not from any of the firms at Paris, the reputed seat of aluminum industry.

Aluminum is, in Berlin, generally used pure, and cast pieces only are composed of aluminum containing about 5 per cent of silver.

Nevertheless the use of aluminum will remain limited, even in case the cost of manufacturing it could be materially reduced, until some method shall have been discovered by which aluminum may be soldered.

This difficulty has, in spite of all efforts, not yet been overcome, and for some purposes, to which the metal would otherwise be well adapted, it remains so far unavailable. Here then is a chance for some ingenious mind.