POULSEN TELEGRAPHONE.

BY SPECIAL PARIS CORRESPONDENT OF THE SCIENTIFIC AMERICAN.

One of the most interesting devices exhibited at the Paris Exposition is the telegraphone invented by the Danish engineer, Valdemar Poulsen. The principle of the apparatus will be understood from the diagram, Fig. 1, in which *E* is an electro-magnet of small dimensions, placed in a telephone circuit including the battery, *B*, microphone transmitter, *M*, and receiver, *T*. The poles of the electro-magnet are very near together, with just sufficient space to allow the steel wire, *a b*, to pass; the wire may be drawn forward so as to bring its successive portions between the poles. The wire used is steel piano-wire of about $\frac{1}{50}$ inch diameter, and it advances at the rate of seven or eight feet per second. The arrangement resembles that of an ordinary phonograph in which the wire, *a b*, replaces the wax cylinder, and the magnetic flux between the poles, the stylus. The sound is recorded in the following manner: when the microphone is spoken into or otherwise receives a series of impulses, the electric impulses set up in the circuit cause variations of current in the coils surrounding the electro-magnet, and in consequence the magnetic flux between the poles undergoes a series of variations corresponding to the original sound waves. These magnetic pulsations act in turn upon the steel wire as it passes along in front of the poles, and magnetize it transversely; each part of the steel wire thus preserves its part of the magnetization, which depends upon the strength of the flux at that instant. The magnetic trace upon the wire thus corresponds exactly to the original sound waves. It remains only to reproduce the record; this is done by connecting the receiver to the terminals of the electro-magnet and passing the wire again between the magnet poles, in the same direction as before and at about the same speed. As its magnetization varies from point to point its movement between the poles causes a variation in the magnetic flux and sets up a series of pulsating currents in the circuit, corresponding in form of wave with the preceding, and thus a sound may be heard in the telephone receiver which corresponds to the original.

M. Poulsen had constructed several different types of the telegraphone before reaching the form now shown at the Exposition. With this instrument, the sound as heard in the receiver is very distinct and is entirely free from the disagreeable scratching noises generally heard in the phonograph. The illustration and diagrams, Figs. 2a, 2b, and 3, show the general appearance of the instrument and the disposition of the various parts. A drum about 15 inches long and 5 inches in diameter revolves between two supports fixed to a metal base; at one end of the cylinder is a pulley which receives a cord passing below to the motor. In this case an electric motor is used, connected with the main lighting circuit. The drum is of brass and has a spiral groove in its surface in which is wound a continuous layer of steel piano wire about $\frac{1}{50}$ inch in diameter; the wire makes about 380 turns. The carriage containing the electro-magnet slides upon a rod which extends across between the brackets. The electro-magnet, shown in section in the diagram, has its cores formed of soft iron wire about $\frac{1}{16}$ inch in diameter, surrounded by electro-magnets about $\frac{3}{8}$ inch long, wound with fine wire. The poles are brought near together and the ends are sharpened and slightly curved on the inner surfaces so as to partly embrace the wire. The coils are surrounded by insulating material, which consolidates the whole. The magnet, *M*, is held above the wire upon a support, *S*, and into it is fitted a contact-piece, *C*, carrying a flexible cord for the current. To guide the magnet along the wire by the points alone might injure these, as they are somewhat delicate, and accordingly a guiding arrangement has been provided which consists of a steel knife edge, *K*, fixed to an arm in the rear; the arm is fixed to a brass sleeve, *B*, which slides upon the main rod. In this way, the carriage, which rests also upon the sleeve, is guided by the knife-edge. The arrangement devised by Poulsen to bring back the carriage to the starting point is simple and ingenious. As the cylinder turns the carriage is thus guided to the end of its course; at this point is fixed an inclined plate, *S*, carried on an arm, seen also to the left of the illustration. The projecting piece, *T*, of the lever, *H*, strikes the plate and the magnet carriage is tilted back in the direction of the arrow; the lever then engages with a catch, *E*. It will be seen that if the carriage is now moved to the right, the rear arm, *A*, will be lifted by the weight of the carriage around *R* as a center. This causes the button, *R*, to engage with a wire, *P*, which is wound spirally around the rod, *O*, and as this rod is revolved by a pulley the carriage is brought back to its starting point. The chain, shown at *L*, serves to hold the magnet off the wire when not in use.

In order to reproduce conversations with the utmost distinctness, the wire-wound drum must be rather rapidly rotated. Experience has shown that a velocity of 1·64 feet (0·5 m.) per second gives the best results. A conversation of one minute in duration could, therefore, be recorded on 98·4 feet (30 m.) of wire, which is approximately the capacity of the instrument illustrated in Fig. 3. But, for the ordinary requirements of life, this time is far too short. Longer conversations are recorded and reproduced by means of the apparatus shown in Fig. 4, in which a very thin, flat steel ribbon, resembling a telegraph tape, takes the place of the wire. The ribbon, *A*, passes from one roll over a standard mounted in the middle of the apparatus to a second receiving roll. Upon the standard the electro-magnet—not shown in the illustration—is mounted, the two poles of which are arranged transversely to the ribbon. The principle is the same as that of the instrument previously described. Although the layers of the ribbon are tightly rolled in a coil, the magnetism of one layer exerts no influence whatever upon the magnetism of the adjacent layers.

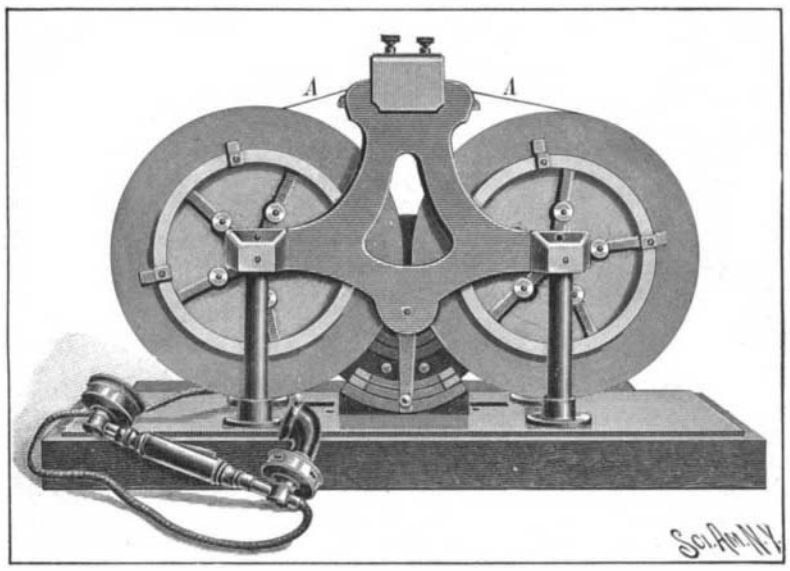

Fig. 4.—POULSEN'S RIBBON TELEGRAPHONE.

A conversation once magnetically recorded can be repeated indefinitely. Experiments which have been made show that a conversation can be reproduced from one to two thousand times without any perceptible diminution in clearness.

To efface the record, it is necessary only to pass a current from a few cells of battery in the circuit of the electro-magnet, when the magnetization of the wire is equalized and it is ready to receive another record. Poulsen recently presented an account of the telegraphone to the Académie des Sciences, in which he explained its principles. He also noted an interesting experiment which has been made by his assistant, M. Pederson, who has charge of the instrument at the Exposition; this is the registering and reproducing of two separate conversations on the same wire. Two electro-magnets are used, whose windings are combined so that each is insensible to the record produced by the other. The first electro-magnet has its windings connected in series, and the second in opposition; under these conditions the records produced by the two magnets may be superposed and separated at will. The superposition of the two magnetic curves has the effect of a resultant in each point of the steel wire, but as one of these components is always neutralized by one or the other of the receiving magnets, it is seen that by using one or the other set of magnets, the first or second series of components may be received, that is to say, the first or second conversation.

The telegraphone is already in practical operation in several telephone stations in Denmark, and by its use telephone messages may be received and kept indefinitely. A subscriber may thus receive messages which have been sent in his absence.

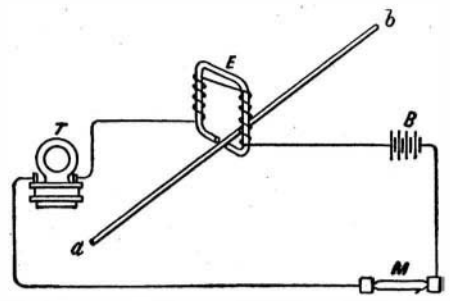

Fig. 1.—DIAGRAM SHOWING PRINCIPLE OF POULSEN'S INVENTION.

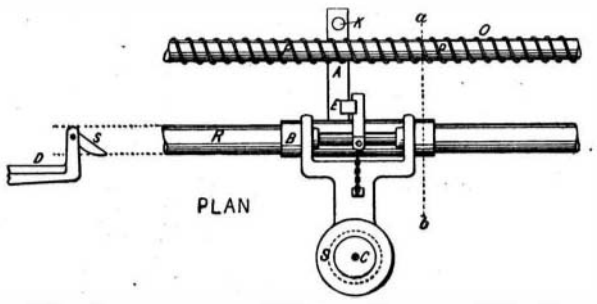

Fig. 2a.—TOP-PLAN VIEW OF THE WIRE-WOUND DRUM AND RECORDING MAGNET.

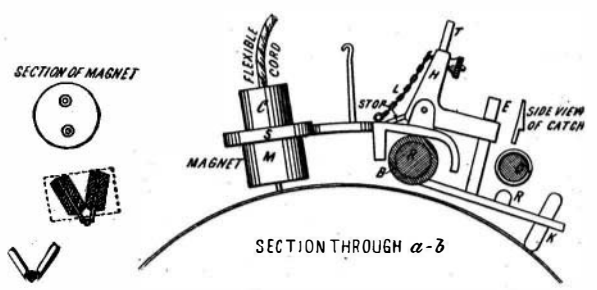

Fig. 2b.—SECTION OF WIRE-WOUND APPARATUS.

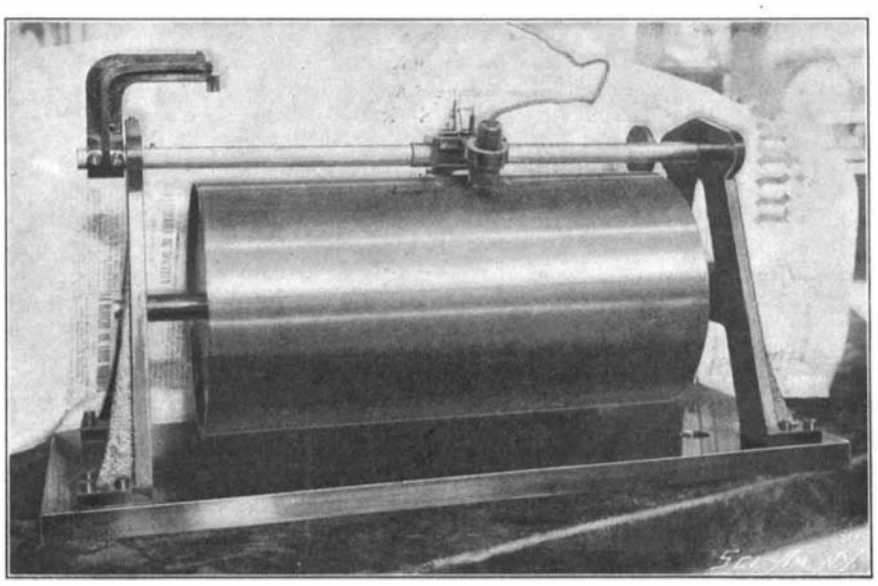

Fig 3.—POULSEN'S WIRE TELEGRAPHONE.

The Majert Accumulator.

A new type of accumulator, designed by Dr. Majert, of Berlin, is coming into use in France, and is now being made by a firm near Paris. In this battery, the negative plates are of the Faure type with lead grid upon which the oxide is pasted; a second form has a grid formed with horizontal projections, which are bent up after the active matter is applied, thus holding it in place. The construction of the positive plate is the main characteristic of the system; it is of the Planté type, being of solid lead upon which a layer of peroxide of lead has been formed; this form is considered as more solid and will permit of discharging at a greater rate, while at the same time a great capacity is obtained; however, to realize these advantages, a great surface must be obtained within small dimensions. The usual method of doing this is to make a plate with a great number of grooves, but this is somewhat difficult in practice. With the plate made by the Majert process, for a battery of one to three hours' discharge, the grooves are about $\frac{3}{8}$ inch deep and $\frac{1}{50}$ inch wide, separated by $\frac{1}{50}$ inch. A plate of this kind cannot be obtained by moulding, and the method of forcing it through a die by hydraulic pressure involves too great an outlay for dies and power. In the Majert process a traveling cutter is used, of special form, which cuts the required groove in the plate; an arrangement is used to take out the shaving perpendicularly at each cut. The plate is placed on a perfectly plane table, and to keep the lead flat a roller passes over it in advance of the cutter. The plate is thus cut on both sides; the tool can make ninety courses in one minute. The arrangement is automatic, and one workman can attend to two plates. To cut a plate having 100 square inches surface requires about ten minutes, making fifty to sixty plates per day.

PROF. HAECKEL, of Jena University, and David J. Walters, a law student, are about to start to find the pithecanthropus. Mr. Walters intends to pursue his investigations in Java and will arrive in that isle before the great evolutionist. The pithecanthropus if found will be of great value, as it will tend to supply the missing link in the evidences of evolution.