MONTREAL JUNIOR ELECTRIC CLUB.

AT regular meetings of the above club held on the dates below mentioned, papers were read and discussed as follows:—

April 23rd.—Paper by S. W. Smith on "Direct Current Dynamo," part 1st.

April 30th.—Paper by R. H. Street and H. O. J. Overton on "Electric Light and Bell Circuits."

May 7th. Paper by Geo. Morris on "Steamboat Lighting by Electricity." (This paper was read before the Montreal Electric Club by R. W. Herring.)

May 14th. Paper by Wm. T. Sutton on "Storage Batteries," part 2nd.

ADVANTAGES OF DIRECT CONNECTED DIRECT CURRENT GENERATORS.*

BY W. N. STEWART.

MY remarks refer to electrical work over areas not exceeding three miles in any direction from the power house, in cities with 35,000 population, with streets lighted by arc lamps, and stores and residences with either arc or incandescent lamps, motive power being supplied as required, and the service extending over the 24 hours.

In a model, 500 H. P. plant, the essential machinery would be a 100 H. P. multipolar generator, directly connected to a compound engine running at 250 revolutions per minute; one 400 H. P. multipolar generator similarly connected and running at 170 revolutions; both engines being condensing when water is available. The generators to be built for 220 volts if used on a three wire system and 480 volts if used on a five wire system; the three wire for distances not over one mile, and five wire where they exceed one mile. Also 120 cells of storage battery, 30 amperes for 15 hours, for the three wire system, and 240 similar cells for the five wire system, these batteries to be used as an equalizer and regulator as well as to supply current. The usual switchboard and accessory apparatus would also be necessary. The wiring would consist of one circuit of mains and feeders to supply all customers with light or power, each consumer to have a meter connected to the outside wires. This plant could be operated by one engineer, one fireman, superintendent and the necessary lamp trimmers.

If the three wire system be used, a common grounded neutral wire could be used for both public and private lights, the arc lamps being connected in groups of two between the positive and neutral. If the five wire system obtains, they could be connected in groups of eight, each lamp having its automatic cut out. The necessary resistance should be in the line wire; iron wire being used in some cases, or copper wire not smaller than No. 8.

Apropos of the belief that resistance is waste of power, and therefore to be avoided. If the ordinary arc dynamo† give 78 per cent. efficiency and the constant potential machine 95 per cent., we have a difference of 17 per cent. in favor of the latter, and as the resistance for low tension arc lamps never exceeds 15 per cent. of the current, we have an advantage of 20 per cent. in favor of the system under consideration. Then we eliminate the friction of the belting which means a loss of 10 per cent., increased to 18 per cent. if a countershaft is used. Thus, in this case, 12 per cent. is gained, in the other 20 per cent.

The operation of such a station would commence by starting at 4 P. M. the small dynamo, the current from which would flow to the storage batteries. At dusk the large machine would be started, and the current would be divided between lights and the battery, until all the lights were burning, when the battery would act as a regulator. From 10 P. M. until 2 A. M. the current would be devoted principally to the charging of the batteries. This would mean an employe's working day of ten hours, the operation of the machines at full efficiency, and a battery working day of fourteen hours. Storage batteries are now extensively used in Europe and in some American stations with excellent results.

In our station we have one slow speed machine in operation at one time doing all the work, with an efficiency of 95 per cent., without loss in belting or shafting, and minimum repairs; ten hours daily run, current available day and night; low pressure wiring, hence no damage suits for personal injury; longer life and less blackening of incandescent lamps, the battery keeping the current uniform; less investment for real estate and buildings; less liability to breakdown; no burned out machine or armatures, less oil, fewer employes, no losses in transformers. The economy in such a station would be 40 per cent. over one run on the antiquated methods.

The high speed engine and belted dynamo are disappearing, and the direct connected slow speed combination is being adopted *because it pays to make the change*. The multipolar generator is almost perfection, its high initial efficiency is maintained for many years; it has an armature winding of solid copper bars; only about 20 per cent. of the current is used for the fields. Not less than $46,500 per annum economy is attained on the 17,500 incandescent lamp at the Chicago Auditorium, by the use of a direct connected plant, and equally favorable results are reported from other places. No reasons exist for managers retaining their obsolete apparatus and methods. In most places it would pay to sell the old dynamos and lamps, and adopt the direct connected combination and newer methods, which experience shows to be the most economical.

*Abstract of a paper read before the Northwestern Electrical Association, Milwaukee.

†Dynamos Electric Machinery: Prof. Sylvanus Thompson.

TELEPHONES.*

BY N. HOLLAND AND J. A. SHAW.

Before describing the construction of the telephone of to-day, we will consider what are the requirements of an instrument for transmitting speech and how they are met by inventors.

In transmitting speech electrically, the transmitter has to so control the current in the line that it will be able to reproduce at the distant end the three characteristics of a musical note, *pitch, loudness* and *quality*.

In the diaphragm at the distant end the pitch would correspond to the number of vibrations, or, as our alternating current friends would say, "the number of cycles passed through" in unit time. The loudness would depend upon the amount or amplitude of the fluctuations in each cycle; the quality depending on the form or nature of these fluctuations; and the necessary condition of a successful system of telephoning is the ability to reproduce these characteristics.

The first of these is very easy to reproduce, as of course, if we open and close the circuit sufficiently rapid we can get the period required.

It was on this principle that the much talked of Ries' instruments were made. His transmitter had a stretched skin diaphragm, with platinum points in the centre to make and break connections, and the receiver consisted of an electromagnet, which gave out sounds as it was magnetized and demagnetized. As the current was broken at every vibration caused by the sound in the transmitter, the sounds given out by the magnet were necessarily of the same pitch as those at the transmitter. Mr. Ries thought that the amplitude was also to some extent obtained by the varying length of contact in the transmitting instrument, but judging from the result of recent telephone investigation, it is highly probable that this was due, not to the duration, but to the varying degree of firmness of the contact.

The transmitters in commercial use to-day are constituted on two principles: 1st, By magnetic induction; and, By varying the resistance of the circuit. It was on the first of these principles that Graham Bell took out his now famous patent of 1877. When first brought out it was intended for both transmitting and receiving, but owing to the improvements in microphonic transmitters, it has now been used principally as a receiver. As it is this receiver (very little altered from the time it was put on the market) that is now used altogether, it would perhaps be excusable to give a short description of the way it is made, and how it performs its duties.

A laminated permanent magnet is used, as in this form it is less likely to lose its magnetism than if it were solid. On the end of this magnet is fixed a boxwood spool, having a soft iron core, wound with 1300 turns of 36 silk-covered wire, with a resistance of about 75 ohms. This magnet and spool is placed in a hard rubber shell, and has opposite to it, with its plane normal to the axis of the magnet, a thin ferrotype iron diaphragm about 2¾ inches in diameter, being held at the edges by the cover, cut in a convenient shape for the mouthpiece, which screws on, leaving it free to vibrate in the centre. Two receivers connected in series (no battery being required) constitutes the simplest form of telephone circuit.

The actions that take place in the instruments are as follows:—A person talking into the transmitting receiver throws its iron diaphragm into rapid vibrations. The diaphragm being close to the permanent magnet is magnetized by induction, and as it vibrates its magnetism is constantly changing, being strengthened as it approaches the magnet, and weakened as it recedes from it. This undulating magnetic field will in turn induce currents in alternate directions, in the coil of wire before mentioned. These currents traverse the whole length of the circuit; passing through the coil of the distant instrument. When the direction of the arriving current is such as to strengthen the power of the permanent magnet, it exerts a stronger attraction on the iron diaphragm, whereas, if it flows in the contrary direction, the permanent magnet is weakened, allowing the diaphragm to spring back. Thus any motions given to the diaphragm of the transmitting receiver are reproduced in the other. It follows from this, that words spoken at one end will be repeated at the other, though much enfeebled by the many transformations which take place.

There are numerous transmitters using the second principle of varying the resistance in the circuit, but nearly all of them are carbon in some form or other, and may be classed under three heads: Carbon Pencil, Granulated Carbon, and Platinum and Carbon. The Carbon Pencil is the most simple form of transmitter, though not much used on this side of the Atlantic. The Granulated Carbon is believed to be the best for long distance work. Perhaps the best form of this is the Hunning, which is much used for long distance transmission on this continent, notably between Detroit, New York, Chicago and Boston. The "Gower Bell" instruments are used between London and Paris; the latter end using the Carbon Pencil variety.

The third class, the "Platinum Carbon," gives the most perfect articulation, and it is under this head that the Blake transmitter comes—the transmitter which is in almost universal use on the continent. It is too well known to need description. Its action is due to the varying pressure between the platinum point and the carbon button, which, altering the resistance of the circuit, allows more or less current to flow. The diaphragm is to present enough surface for the sound waves to act on.

An induction coil is generally used with a microphone transmitter, the primary being in series with a cell of Leclanche Battery and the transmitter contacts, and the secondary being in circuit with the receiver and the line. The object of this is two-fold: 1st, The local circuit being short and of small resistance, the varying resistance at the carbon contacts is greater in proportion than if connected direct to line, and also as there are a great many more turns in the secondary than in the primary, the potential is increased. Having a good transmitter and receiver, it still becomes necessary to have some kind of signalling apparatus calling attention to the 'phone. For short distance, such as warehouse instruments, the ordinary battery and vibrating bell does very well, but as the distance becomes greater this would become impracticable, as it would require too much battery power; so that we now use a ringing set composed of a generator, having a permanent magnetic field and a Siemens armature of the H type. This armature is 2½ inches long and is wound with 2500 turns (500 ohms) of 36 silk-covered wire, wound equally on each side of the shaft. It has no commutator, so that the current is sent in alternations to the line. A polarized bell is used, the armature being kept polarized by the permanent magnet.

As both the ringing and the talking are done on the one line, a switching arrangement must be made so as to cut the different circuits to line; this is performed by means of the hook which holds the receiver. This hook also automatically disconnects the battery when not in use. We might also state that armature of the generator is short circuited, except when in the act of ringing up.

We will now call your attention to the way these circuits are "wired in" in the instrument itself. Referring to this diagram which is wired in shunt and is the way that the Bell Co. wire their instruments.

*Paper read before the Montreal Electric Club.