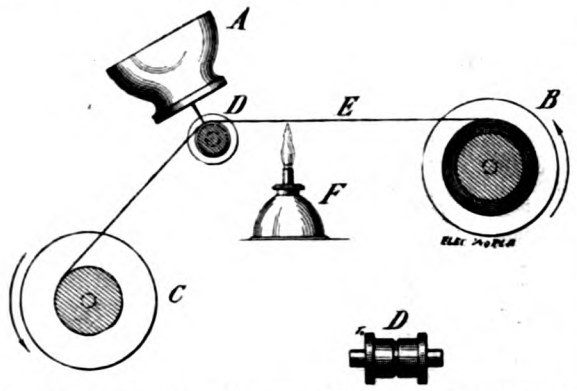
over or close to the joint are well supported, and after the insertion of the discs the two parts of the supporting cylinder are drawn together by the bolts shown, and the outside of the flanges is insulated by wooden rings. There are four sets of brushes, two positive and two negative, diametrically opposite brushes being coupled together.

The electro-magnetic inertia in a circuit conveying 250 h. p. is necessarily very large, and on this account it would be dangerous to break the whole current suddenly. It would therefore be inadmissible to insert a fuse or other form of cut-out into the circuit, as might be done with smaller machinery, in order to save the generator from the effects of an accidental short circuit or heavy leak on the line. Any type of cut-out interrupts the current



FIGS. 1 AND 2.—SOME POSSIBLE FORMS OF PHONOGRAPH.

suddenly, and must therefore not be used where the self-induction of the circuit is at all considerable. To overcome this difficulty, and yet protect his generator effectively, Mr. Brown in all his transmission plants employs an automatic arrangement by which the field of the generator is demagnetized as soon as the line current exceeds a certain value. This apparatus, which is shown in Fig. 2, is an automatic circuit closer, the contacts *C C* of which are coupled to the terminals of the exciting circuit of the field magnets of the generator. The main current, before it is sent into the line, is caused to flow through the exciting coil of an electro-magnet *M* with poles *P P*, below which is pivoted an armature *A*. With the normal strength of current, the excitation of the magnet *M* is insufficient to cause attraction of the armature; but if a certain strength of current be exceeded, the armature is lifted, and liberates a catch by which the weight *W* is ordinarily held up. The weight then swings round on its arm, and with the force of a hammer jams itself between the spring contacts *C C*, thus short circuiting the field coils on the generator, which has the effect of at once lowering the E. M. F. to the very small amount due to residual magnetism. In a transmission plant, where an overhead line is used, care must be taken to protect the machinery against lightning. Both generator and motor should be insulated from earth, and, in addition, some lightning protectors should be fitted. In the installation we are describing, lightning protectors are fitted at each end of the positive and negative line, but not at any intermediate point. The protector consists of a pair of metal plates with serrated edges facing each other, one plate being connected to the line and the other with an earth plate. That the electric transmission of energy has now become a most important branch of work in Switzerland and other countries where water power is abundant, will be seen from the following list of instal-

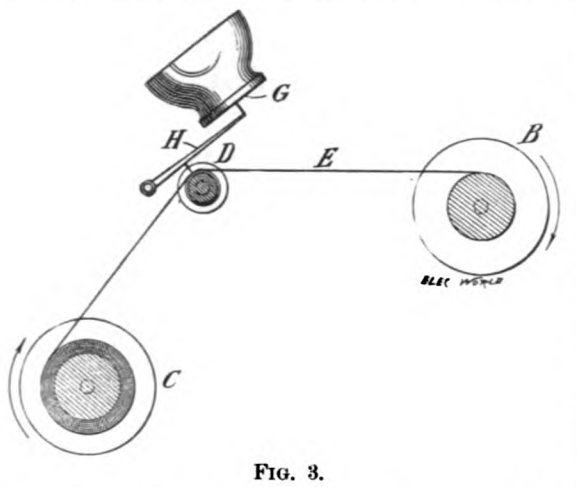


FIG. 3.

lations which have been erected, or are in course of erection, by the Oerlikon Maschinenfabrik:

Name of installation.	Horse-power.	Distance. Metres.
J. Müller-Haiber, Solothurn	50	8,000
Gaetano Rossi, Piovene, Italy	250	450
The Worsted Yarn Mill of Derendingen, Switzerland	280	1,300
J. Amman & Wepfer, Pordeone, Italy	60	1,000
Troller Bros. & Co., Lucerne	120	3,000
R. & M. Frei, Aarau	15	1,000
J. & M. Legler, Diesbach, Switzerland	120	600
Paper Mills, Steyrermühl-Aichberg, Austria	100	600
C. F. Bally, Schoenenwerd, Switzerland (combined with electric lighting)	12	500
Bay & Co., Steinbach-Berne	15	1,300
J. Rauch, Mühlau, near Innsbruck	50	600

Some Possible Forms of Phonograph.

BY OBERLIN SMITH.

There being nowadays throughout the scientific world great activity of thought regarding listening and talking machines, the readers of THE ELECTRICAL WORLD may be interested in a description of two or three possible methods of making a phonograph which the writer contrived some years ago, but which were laid aside and never brought to completion on account of a press of other work.

One of these methods is rudely shown in Figs. 1, 2 and 3, the construction and operation being as follows: *A* is a mouth piece and diaphragm, with spring and indenting needle, as in the Edison machine. *B* is a reel, carrying a thin ribbon *E* of iron, steel or other substance capable of being temporarily softened by heat. This ribbon is unwound from *B* and wound on to another reel *C*, which is revolved slowly by clock work or other means. *D* is a supporting roller (or stationary bar) with a flat groove the width of the ribbon *E*, and having a V-groove in the bottom of it for the needle to descend into, as seen in Fig. 2. *F* is a heating lamp, which, of course, must be protected from draughts, etc. All this is the recording apparatus or transmitter. The ribbon *E* being short at the point where, for the time being, it is hot, receives the indentations as easily as the tin-foil, or more so. It cools by the time it gets to reel *C*, and is then much harder and more durable than tin foil. The same apparatus can be used for the "talker," as in Edison's machine, but advantage may be taken of having the indented ribbon made of a hard substance by using a special talking diaphragm *G*, Fig. 3, which will augment the vibrations in amplitude by means of a lever *H*, the ribbon *E* being hard enough not to lose its form by the increased pressure due to the leverage, as tin-foil would do.

The probable advantages of this form of apparatus are: 1. The loudness of voice produced by the increased amplitude of vibration. 2. The simplicity and cheapness of the whole machine—requiring no accuracy in "registering" devices beyond having the groove in roller *D* to about fit the width of ribbon *E*. 3. The cheap material of which the ribbon may be made. 4. Durability of rib-

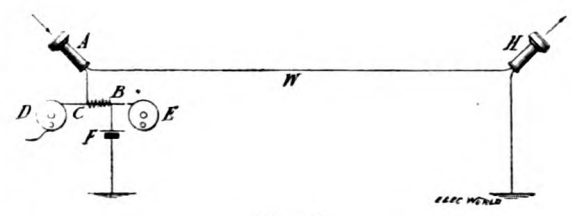


FIG. 6.

bon, even with oft-repeated use. 5. Convenience and freedom from injury in handling and transporting the ribbon-record when wound upon spools like thread. This ribbon would, if of iron or steel, probably be about $\frac{1}{50}$ inch wide and $\frac{1}{200}$ inch thick.

Its disadvantages, possibly fatal ones, would be the difficulty of evenly heating the metal ribbon and the probable rasping noise which would occur in the diaphragm when the sound was reproduced. A modified and somewhat simpler form of the above process might be employed by using an ordinary wire instead of the ribbon *E*, and allowing a chisel-shaped needle to indent it into a flattened and somewhat widened form, wherever it was struck.

The above two methods are, of course, wholly mechanical, as in the ordinary phonograph. The following proposed apparatus is, however, *purely electrical*, and is, as far as known to the writer, the only one fulfilling such conditions that has been suggested. Fig. 4 is the recording part of an electrical phonograph. Fig. 5 is the talking part of the same. Many of the pieces, as *D*, *E*, *B*, *C*, etc., can be the same ones as are used in Fig. 4. Fig. 6 shows the same ideas applied to a telephone line wire, so as to speak at a distance and at the same time record what is said, thus making a *recording telephone*. The sketches show only the essential parts, without the supporting framework, etc.

In Fig. 4 the voice or other sound is delivered into an ordinary telephone *A*. Preferably, this should be a carbon transmitter so as to have a battery *F* in the circuit, and thus use as strong a current as practicable. Possibly, however, a Bell telephone without a battery would answer the purpose. In either case the current, broken into waves of varying lengths and intensities corresponding with the vibrations of the diaphragm in the telephone, passes in its circuit through the helix *B*, converting into a permanent magnet any piece of hardened steel which may be at the time within the helix. Through this helix *B* passes a cord, string, thread, ribbon, chain or wire *C*, made wholly or partly of hardened steel, and kept in motion by being wound on to the reel *E* from off the reel *D*, *E* being revolved by hand, clock-work or other means. *J* is a tension spring or brake pressing against *D* to keep the cord *C* taut.

When in operation with the undulatory current from the telephone *A* passing through the helix, the cord *C* becomes, so to speak, a series of short magnets grouped into alternate swellings and attenuations of magnetism. The actual lengths of these groups depends upon the speed of their motion, but their *relative lengths* depend upon the *relative lengths* of the sound wave; and their *relative intensities* depend upon the *relative amplitudes* of these waves. The cord *C* therefore contains a perfect record of the sound, far more delicate than the indentations in the tin-foil of the mechanical phonograph. The probable construction of *C* would be a cotton, silk or other thread, among whose fibres would be spun (or otherwise mixed) *hard steel* dust, or short clippings of very fine steel wire, hardened. Each piece would, of course, become a complete magnet. Other forms of *C* might be a brass, lead or other wire or ribbon through which the steel dust was mixed in melting—being hardened afterwards in the case of brass or any metal with a high

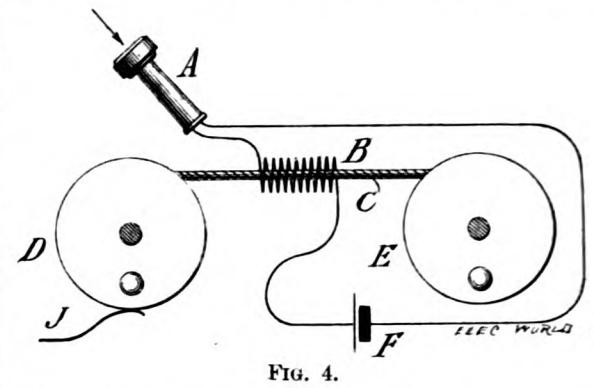


FIG. 4.

melting point. Another (but too expensive) form of *C* would be a chain with each link a magnet; or, if the magnets affected each other too much when in contact, each alternate link could be of non-magnetic material. This chain would not be as delicate as the dust magnets, because the effects of a given vibration might extend but part way along a link. Another imaginable form of *C* would be simply a hard steel wire, but it is scarcely possible that it would divide itself up properly into a number of short magnets. The magnetic influence would probably be distributed along the wire in a most totally depraved way, with nodal points just where they were not wanted. If it could be made to work it would obviously be the simplest thing yet suggested.

The cotton thread above mentioned would seem to be preferable to anything else on account of its cheapness, lightness and flexibility. The Lord's Prayer could be written upon a few feet of thread or string, while a young lady receiving a small spool of cotton from her lover would think herself abominably neglected if it was not "warranted 200 yards long."

In Fig. 6 the arrangement is precisely the same as in Fig. 4, except that the circuit is made through the telegraph wire *W* and the receiving telephone *H* in Boston or some other distant place. Of course the record might be made at the receiving instead of the transmitting end of the line, and thus our hypothetical young lady might, while listening to the impassioned pleadings of her chosen young man, be preparing the evidence for a future breach-of-promise suit.

To make the thread or cord *C* "talk back" it is, after having been rewound on to reel *D* again drawn through a helix *B*, Fig. 5, in whose circuit is the "talking" telephone *A*, probably a Bell receiver. Of course it is drawn through at approximately the same speed as before. In passing, the small permanent magnets in the cord *C* induce currents of electricity in their enveloping helix analogous to the currents in the field of a magneto-electric machine, or a dynamo with permanent magnets in its

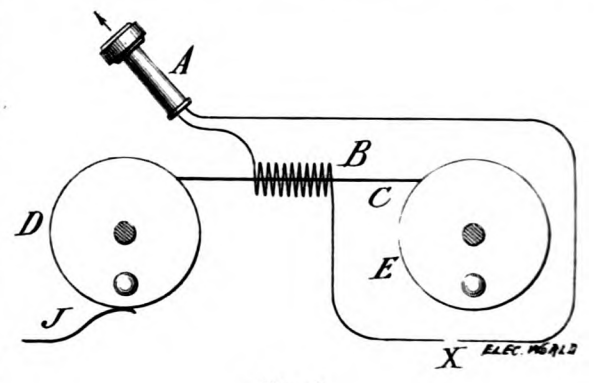


FIG. 5.

armature. A more exact analogy would, however, be the currents in the helix of a solenoid if its ordinary action were reversed, and its core made a permanent magnet. These waves of current will correspond in length and relative intensity with the original wave currents, and will therefore reproduce the vibrations of the original sound in the diaphragm of the telephone at any time in the future. If such induced currents are not strong enough to produce sufficiently loud sounds it may be possible to insert at *X*, Fig. 5, some intensifying apparatus, such as a battery, but which has not yet been thought out.

Like the two mechanical methods first mentioned, this electrical method has never been worked out to completion. The writer went far enough with it to build a temporary apparatus and to develop a successful machine for spinning metallic dust into a cotton cord, but was

obliged to lay aside the whole thing before arriving at any *acoustic* results. His experiments showed that it was difficult, with ordinary tools, to harden steel filings on account of excessive oxidation. Experiments with hardened steel wire, broken in a special machine into very short pieces, showed that they must not be too short —say not less than three or four times their diameter—or they could not be saturated with magnetism to any appreciable degree. Possibly this is because the poles (or points of maximum polarity) of a magnet lie at some distance from the ends of the bar, and consequently neutralize each other when the bar is too short. If this theory is correct it would prevent making magnets of steel dust, the grains of which are supposed to be about as broad as they are long.

To digress a little, it may be remarked that such a theory does not seem to agree with the fact of a magnetic polarity in approximately spherical or cubical bodies, like the earth, or a chunk of loadstone. Possibly, however, they would be much stronger magnets if elongated; and the tiny pieces of wire above referred to, may possess as much strength in proportion, though it be scarcely perceptible on account of their smallness.

The writer confesses to a good deal of ignorance upon the subject, but he was somewhat surprised to find an equal amount in several well known electricians whom he consulted; and also to find that none of the books he had at hand gave any definite data regarding the best proportions for permanent magnets or their actual strength (when saturated) in pulling power. Surely, there is in this department of electrical science a good sized (magnetic) field for a number of lines of force—mental ones—to work in, in the way of careful experimenting.

To return to our magnetized cord as a "phonogram," it is possible that an insuperable objection to it would be found in the great diameter and length which would be required to hold magnets of sufficient strength and quantity. This, however, can be determined by experiment only. Of course if this cord approached a clothes line rather than a piece of sewing silk, in its general proportions it would be utterly useless as a practical recording medium. Regarding the general convenience of a record in a cord or ribbon-like form compared with one indented upon a cylinder or a flat circular tablet, there are probably advantages on both sides One disadvantage of the cord is that if some small portion of the record near the middle has to be repeated there is a good deal of unwinding to do to get at it. The same objection, if it be one, applies to the first-mentioned methods, as well as the magnetic cord. In practice, however, it might prove that this unwinding was a small matter, if a rapidly-working automatic winder were used.

Another general principle which may perhaps be adopted for a phonograph is that of *variable conductivity*. Possibly a cord or ribbon may be made of a poor conductor (perhaps a flexible substance impregnated with carbon), and may then be made better and worse in certain spots by the action of the "transmitting" instrument, either by making spots of the cord denser or thinner, in some way, at the inward stroke of the diaphragm. This recording action would probably be entirely mechanical. The reproducing, on the contrary, would be wholly electrical, and would consist of passing a current through a conductor which was broken by a space filled by the cross-section of the moving record. This current would pass through a receiving telephone and would, obviously, be thrown into the proper undulations of strength by the varying conductivity of the cord, as it passed along by the motion of its reels.

The writer has not worked out the details of this latter scheme as completely as in the others mentioned—even upon paper. He has not the time, to say nothing of a properly equipped laboratory, to carry the ideas suggested to their logical conclusion of success or failure, and, therefore, makes them public, hoping that some of the numerous experimenters now working in this field may find in them a germ of good from which something useful may grow. Should this be the case, he will doubtless get due credit for his share in the matter; but if, on the other hand, these suggestions prove worthless, they will still have served a purpose, on the principle that a demonstration of what *can't* be done is often a pertinent hint as to what *can* be.

The Edison Patents in England.—A notice has been issued by the Edison and Swan United Electric Light Companies, of London, to the effect that the late decision invalidating Mr. Edison's patent has been appealed from, and that the appeal will probably be heard before Christmas.

Reporting Electrical Executions.—Elbridge T. Gerry says that the New York newspapers will have no accounts of the first execution of a criminal by electricity in this State. Though Mr. Gerry is an authority on this subject, the managing editors of New York ridicule his statement in question, as well as his threat that any editor who, contrary to the statutes, publishes such an account, will be imprisoned for a misdemeanor. The editors agree with Chester S. Lord, of the *Sun*, that considerable imprisonment would be necessary to break up their habit of printing the news. Julius Chambers, of the *Herald*, says that a paper which had sent to the Polar Sea for news wouldn't mind the trivial danger of imprisonment. Another editor said: "There would be a struggle for the distinction of such an imprisonment."

THE ELECTRIC LIGHT CONVENTION.

The pages immediately following this will be found to contain a very full and complete report of the Convention of the National Electric Light Association just closed in this city. We believe that the promptitude with which the report is issued, and the care taken in its preparation, will be generally appreciated, the more especially when it is borne in mind that during the session we have issued no fewer than four editions of our bulletin, now so familiar to all frequenters of these meetings. As to the paper itself, we may "point with pride" to its size, not less than to its contents. It is four pages larger than any previous issue. At the August Convention last year we printed a paper of 56 pages. For the convention in February at Pittsburgh we printed 64 pages. Our number this week contains no fewer than 68 pages. We may point out too, that while the paper is so large, it is not late; but on the contrary is actually issued eight days ahead of date, and one day after the close of the Convention. This special effort has necessitated a little departure, it will be observed, from our usual method of making up the paper.

The growth of the electric light and power industry was admirably brought out by President Duncan in his brief but pithy opening address. The figures have, we are glad to see, arrested general attention, and the direct outcome of the publicity thus given to these facts will be a development of new work.

Perhaps the leading question before the Convention was that of overhead and underground wires. Mayor Hewitt was not slow in winning the applause of the meeting with his address of welcome, in which he vindicated his line of policy as to the overhead wires, and it must be said that a better address in form and matter than the Mayor's has not been made before the body. At the same time, what we may call the progressive element had its inning in the papers presented by Dr. S. S. Wheeler and Mr. Chenoweth. The paper of Dr. Wheeler will be found worthy of study, based as it is upon an intelligent comprehension of the subject as a whole and a full knowledge of the work being done in this city. Supplementing all this is the excellent paper by Mr. Acheson on disruptive discharges in cables, and the various discussions. Any one who reads that part of the report will certainly be abreast of the latest information of the day on the underground wire problem.

We have no doubt that when Mr. Leonard reads of the cordial reception given to his unpretentious but valuable little paper detailing his experience in Minneapolis with petroleum fuel he will be somewhat surprised. Like some other members, he appears to be afraid of boring the Convention, but the fact is that such papers, with their facts and details on vital questions of management, are the best that can be brought before the Association, which does not meet to discuss scientific theories, but to arrive at all the facts that concern the practical operation of light and power plants.

While we do not consider the choice of the Hotel Brunswick as the meeting place to have been at all a happy one, it is the opinion of all that the coming to New York has been a good thing, and that the Convention has been one of the best, and thoroughly enjoyable. NewYork is the capital of the country in every sense of the word, and will remain so, and it is also a convenient point of rendezvous for all who are interested in electrical matters. Moreover, it was three years since the Association visited the city, and the time was fitting to make a new impression on the metropolitan consciousness. The reputation of our city for hospitality, also, has been well maintained, and not a delegate can go home without feeling that everything possible was done to render his sojourn here pleasant and profitable.

In speaking above of the impression made by the Convention on the metropolitan consciousness, we have reference more particularly to the manner in which the press has dealt with the proceedings. Having attended all the conventions, we make bold to say that never before have the reports as a whole been so full, so fair and so accurate. In fact, it is hard to pick out the best, where all have been so good. The evening papers have greatly gratified the officers and members by the excellence of their reports. On Thursday night, for example, the *Evening Post* published two full columns, the *Commercial Advertiser* had a column and a half, excellently done; and the *Mail and Express* supplemented a column of good report with another column of elegant and philosophic editorial. The New York *Graphic* made first-class portraits of the officers, and the *World* also came out with its neat thumbnail sketches of prominent speakers, while the *Sun*, *Herald*, *Tribune* *Times* and others gave the convention an unusually large amount of editorial notice and reportorial care. If we may venture to do it, we would heartily congratulate our brethren of the daily press on their good work. They have certainly done the Association good, and we think that hereafter the electrical questions that come up will receive better treatment at their hands than has sometimes been the case hitherto.

It is natural that the electric power question should occupy part of the time of the Association, and the hour devoted to Mr. Lufkin's able paper was well spent. It will be noticed that the paper is an able effort to determine the average running of motors in the different classes of employment, so as to have data from which to deduce the right schedule of charges. This is a highly important part of the motor question, and affects very closely the prosperity of the business. It will be seen also that Mr. Lufkin dwelt upon the interesting question of small motors versus large motors. There is evidently something to be said on both sides, and it is likely that the matter will long be one provocative of differences of opinion in motor circles.

The various presentations made during the Convention were, after all, but a small recognition of services rendered the Association. The Association, as it stands to-day, is largely Mr. Morrison's handiwork, and it is only appropriate that his zeal and the wise use made by him of his marked executive ability should be rewarded in substantial shape. The testimonial to the Westinghouse Electric Company was not less graceful and fitting. The company's liberal contribution to the funds of the Association enabled it to catch up in the publication of its proceedings, and to present a healthy balance sheet.

It was a good idea to secure a photograph of the delegates before leaving, with the Electric Club as a background. An interesting memento is thus obtained of a pleasant gathering and of the hospitality that found its centre at the Club House.

Allegheny City, Pa.—Specifications have been approved by the sub-committee on gas for 45 electric-light towers with 3 to 6 lights on each; 85 single pole lights and 1,500 incandescents for the city hall, engine houses, etc.

Brush Carbons.—The Brush Electric Company, Cleveland, O., report that their carbon business is larger than ever before. They have shipped within the last month or two, eight or ten solid car loads of carbons to different portions of the country.

Buffalo, N. Y.—The Brush Electric Light Company of Buffalo, N. Y., are increasing their electric light plant. They have recenty ordered from the parent company two 65-light 2,000 c. p. dynamos with lamps. This company is now burning, including the above dynamos, 1,300 arc lamps and a large number of incandescence.

The Graphophone in the West.—A company of Western men, with Hamilton S. Wicks, of Kansas City, at their head, has secured a contract with the syndicate controlling the Edison-Bell graphophone for all rights within the territory west of the Mississippi and east of the Rocky Mountains. Offices are to be established and the instruments introduced into the leading cities of that district by Oct. 1.

Electricity for Writers' Paralysis.—In one of the broad windows of the recording department of the office of James Bond, clerk of the superior court, is a small electric battery. It is used by the recorders for the relief of the cramp of the muscles of the hand which follows long continued and steady use of the pen. The relief is instantaneous, and the clerks who formerly were compelled at times to stop work for several days on account of swelling and contraction of the muscles of the hand now take a few gentle shocks of the electric current on the slightest approach of stiffness. They return to work at once, entirely relieved, and continue without inconvenience. Nearly every one of the score of clerks receives benefit from the electric current, and the battery is regarded as an indispensable fixture of the office.—*Baltimore Sun.*

Bell Telephone Output.—The instrument account shows gains in the output and a reduction in the instruments returned. For seven months there was an increase of 4,216 in instruments held by licenses. The income gains faster than the output of instruments. The latter is as stated below:

Month to Aug. 20.	1888.	1887.	Increase.
Gross output	3,694	3,533	161
Returned	1,760	3,353	*1,593
Net output	1,934	180	1,754
Since Dec. 20.	1887-8.	1886-7.	
Gross output	37,740	36,541	1,199
Returned	14,646	17,663	*3,017
Net output	23,094	18,878	4,216

*Decrease.