THE EDISON ELECTRIC LIGHT.

The following is an abstract from an article describing Edison's electric light, which appeared in a late issue of the *Engineer:*

We publish herewith accurate copies of the three principal drawings of Edison's electric light apparatus lodged with the French specification, and we have no doubt that they are in all respects identical with those which accompany all the applications which Mr. Edison has made in other countries for a patent. He has used in all no fewer than forty-eight figures to render the nature of his inventions clear; but the great majority of them represent comparatively insignificant modifications of the ideas illustrated by our engravings, and consequently we have not thought it necessary to reproduce them.

The invention is divided into two parts—the first refers to the means of producing electricity, the second to the lamp.

The electro-magnetic machine is thus described in the specification:

"It has long been known that if two electro-magnets, or an electro-magnet and a permanent magnet, be drawn apart or caused to pass by each other, electric currents will be set up in the helix of the electro-magnet. It has also been known that vibrating bodies, such as a tuning-fork or a reed, can be kept in vibration by the exercise of but little power. I avail of these two known forces, and combine them in such a manner as to obtain a powerful electric current by the expenditure of a small mechanical force. In Fig. 1 of the drawing a tuning fork, *a*2, is represented as firmly attached to a stand, *b*2. This fork is preferably of two prongs, but only one might be employed upon the principle of a musical reed. The vibrating bar or fork may be two meters long, more or less, and heavy in proportion. It has its regular rate of vibration like a tuning fork, and the mechanism that keeps it in vibration is to move in harmony. A crank and revolving shaft, or other suitable mechanism, may be employed, but I prefer a small air, gas, or water engine, applied to each end of the fork. The cylinder *a*1 contains a piston and a rod, *b*1, that is connected to the end of the bar, and steam, gas, water, or other fluid under pressure acts within the cylinder, being admitted first to one side of the piston and then the other by a suitable valve; the valve and directing rod, *c*2, are shown for this purpose. The bar of fork, *a*2, may be a permanent magnet or an electro-magnet, or else it is provided with permanent or electro-magnets. I have shown an electro-magnet, *c*1, upon each prong of the fork—there may be two or more on each—and opposed to these are the cores of the electro-magnets *d*. Hence as the fork is vibrated a current is set up in the helix of each electro-magnet, *d*, in one direction as the cores approach each other, and in the opposite direction as they recede. This alternate current is available for electric lights, but if it is desired to convert the current into one of continuity in the same direction a commutator is employed, operated by the vibrations of the fork to change the circuit connections each vibration, and thereby make the pulsations continuous on the line of one polarity. A portion of the current thus generated may pass through the helixes of the electro-magnets, *c*1, to intensify the same to the maximum power, and the remainder of the current is employed for any desired electrical operation wherever available. I, however, use the same, especially with my electric lights, but I remark that electricity for such lights may be developed by any suitable apparatus. I have represented commutator springs or levers, *c*3, *c*4, operated by rods that slide through the levers, *c*3, *c*4, and by friction move them. When the prongs, *a*2, *a*2, are moving from each other the contact of levers, *c*3, *c*4, will be with the screws, 40, 41, and the current will be from line 1, through *c*1 to *c*, thence to *c*3 to 41, 43, and to circuit of electro-magnets, *d d*, and from *d d* by 42 to 40, *c*4, and line as indicated by the arrows. When the prongs, *a*2, *a*2, are vibrating towards each other the circuit will be through *c*1, *c*, *c*3, 42, in the reverse direction through the circuit and magnets, *d d*, back to 43, and by *c*4 to line."

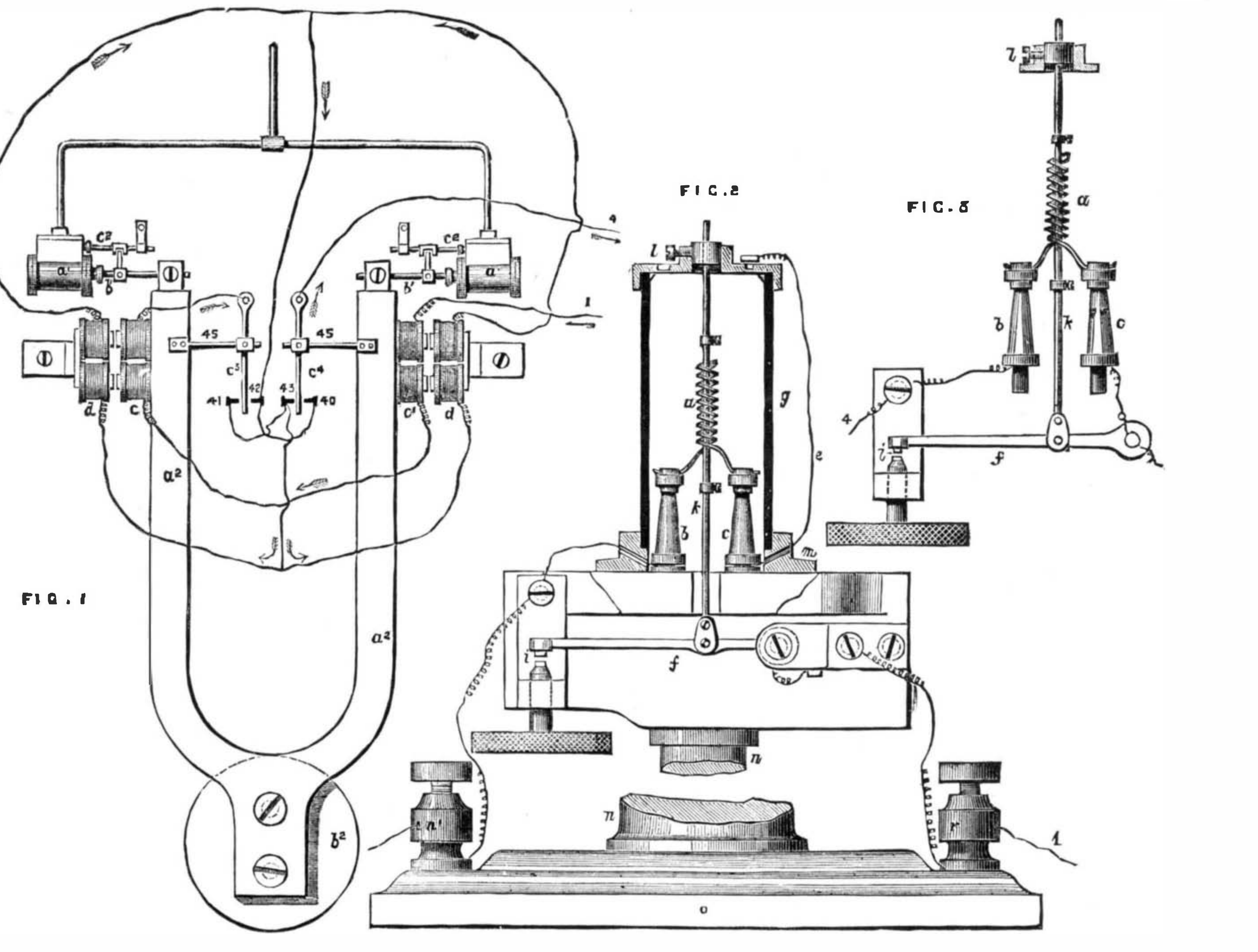
Fig. 2 shows the Edison lamp, which is thus described by the inventor:

"Platinum and other materials that can only be fused at a very high temperature have been employed in electric lights; but there is risk of such light-giving substance melting under the electric energy. This portion of my invention relates to the regulation of the electric current, so as to prevent the same becoming so intense as to injure the incandescent material. The current regulation is primarily effected by the heat itself, and is automatic. In Fig. 2 I have shown the light producing body as a spiral, *a*, connected to the posts, *b c*, and within the glass cylinder, *g*. This cylinder has a cap, *l*, and stands upon a base, *m*, and for convenience a column, *n*, and stand, *o*, of any suitable character, may be employed. Most of the other figures are in the form of diagrams to more clearly represent the electrical connections. I remark that it is preferable to have the light within a case or globe, and that various materials may be employed, such as alum water, between concentric cylinders, to lessen radiation, retain the heat, and lessen the electric energy required; or colored or opalescent glass, or solutions that reduce the refrangibility of the light, such as sulphate of quinine, may be employed to moderate the light, and the light may either be in the atmosphere or in a vacuum. The materials that I have found especially adapted to use as light-giving substances are set forth hereafter. The electric circuit, Fig. 2, passes by line 1 to the post, *r*, and by a wire to the lever, *f*, thence by the wire or rod, *k*, cap *l*, wire, *e*, to the post, *c*, through the double spiral, *a*, to the post, *b*, and by a metallic connection or wire to the post, *n*1, and line 4, and so on through the electric circuit, and the light be developed in *a*. The rod, *k*, will expand in proportion to the heat of the coil, or in proportion to the heat developed by the passage of the current through the fine wire, *k*, and, if the heat becomes dangerously high, injury to the apparatus is prevented by the expansion of rod, *k*, moving the lever, *f*, to close the circuit at *i* and short circuit or shunt a portion of the current from the coil, *a*, and reducing its temperature; this operation is automatic, and forms the principal feature of my invention, because it effectually preserves the apparatus from injury. The current need not pass through the wire or rod, *k*, as the expansion thereof by the radiated heat from the coil, *a*, will operate the lever, *f*, as indicated by Fig. 3, but the movement is not so prompt. It is to be understood that in all cases the action of the short current through the light-giving substance and the circuit-closing devices play up and down at the contact point, maintaining uniformity of brilliancy of light."

Most of the details of this invention, taken separately, are not new. The use of an incandescent substance was first patented in this country, not by King in 1845, as is generally believed, but by De Moleyns in 1841. The materials named by Mr. Edison, such as platinum, iridium, osmium, etc., have all been used or proposed to be used long since. In this direction, therefore, there is nothing about Mr. Edison's invention to encourage hope or excite fear. There remains, however, the device for protecting the incandescent material from overheating, and this is very pretty and ingenious, and will probably work very well in competent hands; but it is a delicate bit of mechanism, which must not only be adjusted to begin with, but kept in adjustment with minute accuracy, or the wire coils will be destroyed or the light will go out. Mr. Edison will no doubt attain much success at Menlo Park, where everything will be under his own control; but for the ordinary purposes of lighting our houses an electric lamp has probably yet to be invented.

With all its defects for domestic purposes, still Mr. Edison's lamp might perhaps be used to much advantage for street lighting, and in factories or theaters; in fact, in any situation where it could be looked after by a skilled attendant.

We reproduce the following portion of Mr. Edison's spe-



EDISON'S NEW ELECTRIC LIGHT APPARATUS.

cification, omitting the figures and the references to them, as we fancy the passage will be intelligible without them: "In lighting by electricity it is often important to use a secondary battery in connection with the main current. Electric light coils may be put in a secondary circuit containing cells, with plates in a conducting liquid; and a lever is vibrated by an electro-magnet or by clock-work. When the lever is in contact the current from line 1 passes through the electro-magnet and cells, but when the contact ceases the line is closed, but a local circuit is made through the coils and secondary battery; the discharge of the secondary battery gives the light, and the movement is so rapid that the light appears continuous. A single secondary battery may be introduced with one or more lights, the expansion of the light-giving material short circuiting the current through the secondary battery. Instead of a rheostat in the shunt circuit I sometimes employ a button of carbon. In this case the spring lever bearing upon the carbon button lessens the resistance by the increase of pressure, as the platina strip expands, and as it contracts and lessens the pressure on the carbon button the resistance of that carbon button increases, and a greater portion of the current is sent through the platina strip. This regulation is very accurate."

Mr. Edison's claims are as follows: "(1) The combination with an electric light of a thermal circuit regulator, to lessen the electric action in the light when the maximum intensity has been attained, substantially as set forth; (2) The combination with the electric light of a circuit closing lever, operated by heat from the electric current or from the light, and a shunt or short circuit to divert the current or a portion thereof from the light, substantially as set forth; (3) The combination with the electric light and a resistance of a circuit closer operated by heat, and serving to place more or less resistance in the circuit of the electric light, substantially as set forth; (4) The combination with an electric light of a diaphragm operated by the expansion of a gas or fluid in proportion to the temperature of the light to regulate the electric current, substantially as set forth; (5) The combination with a vibrating body similar to a tuning fork of mechanism for maintaining the vibration, and magnets, cores, and helixes, whereby a secondary current is set up, so as to convert mechanical motion into electric force, or the reverse, substantially as set forth; (6) The combination with electric lights, substantially such as described, of means for regulating the electric current to the same, in proportion to the heat evolved in the light, so as to prevent injury to the apparatus, substantially as set forth."

In all this it will be seen that we have not one word concerning any new or extraordinary contrivances for dividing the electric light. Mr. Edison has many other patents in progress, but that with which we have just dealt is, no doubt, *the* patent; that which has attracted more attention, and the publication of the contents of which has been looked for with more avidity than perhaps any other ever applied for in England. How far it justified the hopes and fears which have been fostered concerning it, we have placed our readers in a position to judge for themselves. It may not be improper to say before concluding, that Mr. Edison's complete specification has not yet been filed in this country, and cannot be seen at the Great Seal Patent Office, or anywhere else save Paris.

RIGHI'S TELEPHONE.

Professor Augusto Righi, Professor of Physics at Bologna, began his experiments with the following described instrument in December, 1877, and on the 14th of March, 1878, exhibited the apparatus in working order before the Academy of Sciences of Bologna.

The receiving telephone of Professor Righi differs but little from the old Bell telephone; the Righi instrument has a larger and stronger magnet, and the iron disk is secured in the middle of a sheet of parchment paper placed at the mouth of a wide funnel. This arrangement results in the delivery of very clear and strong sounds. But results that are quite satisfactory may be obtained with an ordinary Bell telephone by substituting for the membrane a thin sheet or veneer of wood.

Professor Righi's transmitter is entirely different. It contains a conducting powder, which is more or less pressed upon by the vibrating body, and as the conductivity of the powder varies with the pressure, the intensity of the electric current which passes will be relatively varied with the vibrations, and the receiver, if placed in the circuit, will reproduce the sounds. It is interesting to study the advantages which the use of pulverized conductors present.

If the current from a pile passes through a galvanometer and through a powder contained in a tube of glass, it is easy to demonstrate that the intensity of the current depends on the condition of the powder. The deviation of the needle will be in proportion to the pressure applied to the powder. Whatever the character of the powder, if it is not fine, the variations of intensity are small and irregular; if, on the contrary, it is very fine, the intensity of the current increases with the pressure regularly and without any interruption. Different effects will be produced, according to the character of the powdered material which is employed. Thus, if silver be reduced to an impalpable powder, after having been compressed, it retains in part the new disposition of its particles, for it will be found that the compressing piston no longer touches the powder when it returns to the position it was in before the current was closed.

On the contrary, with very fine graphite, when the pressure is diminished, the current shows anew the same intensities which it had before in the same positions of the pressing piston when it was being moved to give pressure. The effects which other powders produce resemble more or less those of silver and graphite.

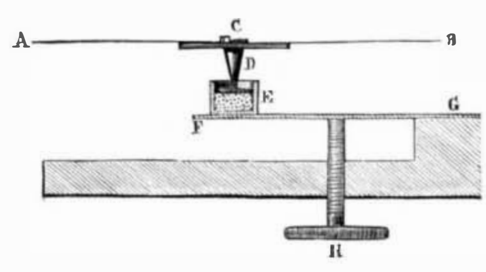
The author does not know in virtue of what force the powder tends to assume its primitive condition when the pressure is diminished. It might be called the elasticity of readjustment.

The possibility of transmitting very acute sounds with certain powders shows that this elasticity is sufficiently active to permit the powder rapidly to acquire the same condition which it had before being compressed. It may be also that this elasticity of readjustment, which is perfect in some powders, is due to the elasticity of the atmosphere of gas which adheres to the particles of the powder.

We know that there are solid bodies which operate in a manner analogous to these powders, and that they have been employed in the construction of transmitting telephones; such are the retort carbons, iron, and graphite. In these bodies the variations of conductivity obtained by pressure are less than with powders, but in all cases they are produced by extremely small movements of the vibrating body. Very strong sounds cause a complete and periodical separation of the metal which compresses the carbon, thereby producing loud rumblings in the receiver, which prevents the understanding of the transmitted words. In order that the circuit may not be opened by the vibrations, it is necessary to increase the pressure upon the carbon or diminish the mobility of the vibrating body which produces the pressure; but in that case we experience considerable loss in the intensity of the sounds; hence the necessity of frequent adjustment by means of the screw. On the other hand, it is found that the strong disagreeable rumblings are produced by the loosening of the particles of the carbon during the vibrations.

With this class of telephones, and also with those of Bell, it is necessary to place the receiver close to the ear in order to understand the transmitted words.

With the pulverized conductor these inconveniences are avoided. It is much more flexible than the carbon, and we are able to use in connection with it a body which easily vibrates, and in which the vibrations will have much amplitude without opening the circuit; and as the variations of the resistance of the powder are very great, the sounds which the receiver reproduces are very intense.



THE RIGHI TELEPHONE.

In this transmitter, a membrane of parchment paper is vibrated by the sound waves, but a metallic sheet or a membrane of wood may be used. In the center of the membrane, A B, is fixed a piece of metal, C D, the lower end of which has the form of a flat piston, and rests upon the powder contained in the thimble, E. The spring, F G, carries the thimble, E, and the elastic force of the spring is regulated by a screw, H. When the pressure upon the powder is once adjusted, which is easily done, the apparatus will work for a long time without readjustment. If in an electric circuit we place a galvanometer and a transmitter such as we have described, and if with the finger we press upon C, in the direction C D, it will be observed that the needle remains almost stationary. In fact the spring, F G, yields, while the pressure upon the powder is scarcely changed. This proves that the jarring, shaking, or bending of the wood of the apparatus does not involve the necessity of adjustment by means of the screw, H.*

Every kind of pulverized conductor will answer more or less well in a transmitter; but that which has given the author the best results is a mixture of carbon or plumbago and silver, very finely pulverized. The results obtained depend very much on the quality of the graphite. In order to communicate between two points it is desirable to place at each of them a transmitter and a receiver, also a battery.

A battery composed of from one to four Bunsen couples is sufficient, or an equivalent number of couples of Leclanche or other system.

The three instruments are arranged in one circuit between the line and the earth.

It is better to throw the transmitter out of the circuit when receiving, as it will be a useless resistance in the circuit. In every case the one who listens is able at all times to interrupt the one who speaks by sending sounds or words.

The intensity of the sounds delivered by the receiver depends upon the intensity of the current and the total resistance of the circuit. Over a distance of two or three kilometers, and with four small Bunsen pairs, the voice of a person who speaks at one of the ends of the line will be understood at the other end at a distance of six to nine feet from the receiver. Singing and the sounds of musical instruments will be heard perfectly at a distance of twenty-five or thirty-five feet, and sometimes even further. If at the hearing station two or more receivers are used, they may be so arranged that a large number of persons may simultaneously hear what is being said.*

In order to transmit speech or other sounds, it is not necessary to produce them close to the transmitter; words spoken at a distance of several feet from the instrument are heard perfectly at the other end of the line. Effects especially notable have been obtained over lines of considerable length;† but the resistances are very easily overcome by employing the induction coil. For this purpose it is necessary to have: 1, a transmitter; 2, a receiver; 3, an induction coil; 4, a battery. The large wire of the coil, the receiver, and the transmitter (when sending), form a closed circuit with the battery. The fine wire of the coil communicates at each station with the line wire at one end and with the ground at the other end. Thus arranged, the variations of intensity which the transmitter produces at one of the stations, gives rise to induced currents in the fine wire of the induction coil, which are propagated along the line to the fine wire of the coil at the next station; at which place, by secondary induction, variations of intensity in the local current will be determined, and the receiver will be correspondently affected. It is in this manner that the latter instrument reproduces the sounds. The voice of a person speaking is heard at a distance of some six feet from the receiver even when the line has interposed resistances amounting to hundreds of kilometers; the louder sounds of the instrument are heard at a still greater distance. But it must not be forgotten that there is a difference in the effects, as between an artificial resistance and that of a regular line, particularly in view of the imperfect insulation of the latter.

The clearness and intensity of the sounds obtained with the telephone we have described, permit the hope of its useful applications both for civil and military purposes.

* Many of these instruments, sent by railway from Paris to Bologna, operated very well on their arrival, without the necessity of touching the regulating screw.

* On the evening of April 27, 1878, with two receivers, which had been placed in one of the saloons of the Society of Arts of Milan, more than 500 persons were enabled to hear the sounds and voices produced at a distant station. In the same manner, on the evening of August 27, 1878, during the lecture of Professor Cornu, in the grand amphitheater of the Conservatory of Arts and Artisans of Paris, all present were able to hear the singing and the sounds produced in a saloon situated at a great distance, which were reproduced by means of two receivers suspended in the amphitheater.

† On the evening of April 7, 1878, an experiment was made on a telegraph line between Bologna and Ferrara, which is 154 miles long. The numerous auditors assembled at each end of the line were enabled to hear perfectly the sounds, the words, the songs, which were emitted from the opposite station. In the experiments made in Bologna, Ferrara, Milan, Pavia, and lastly in Paris before the Physical Society, the Academy of Sciences, at the Exhibition, etc., the resistances of the lines were much less.

THE MEXICAN INDUSTRIAL EXHIBITION.

It has been announced officially at the City of Mexico that the proposed Industrial Exhibition of the products of Mexico and the United States will open on Jan. 15, next year (1880). The construction of the building has been begun already. The Department of Public Works is acting with energy in the matter. Full information will be promptly furnished to American manufacturers and the press. President Diaz is resolved that nothing shall be left undone to make the exhibition successful and advantageous to the industries of Mexico and the United States.

The Western merchants, who lately started on a commercial mission to Mexico with so much enthusiasm, returned less confident of a speedy development of trade with that country. Trade revolutions are not brought about simply by willing them. New markets have to be won by patient effort, not less in educating new customers than in learning how to supply wants already existing. Exhibitions like the one proposed may help wonderfully in both directions; and it is to be hoped that the efforts of President Diaz will not go unseconded here.

THE AGRICULTURAL EXHIBITION IN LONDON.

The Royal Agricultural Society of England will hold a great agricultural show in London, June 30 to July 7 next. Special efforts are making to insure a successful exhibition. Several classes are open to American competition. Entries must be made on printed forms, to be obtained of the secretary of the society, Mr. H. M. Jenkins, No. 12 Hanover Square, London, W., England. No entry fee is required for American exhibitors. In view of the importance of England as a market for American farm produce, the advantage of being well represented at the coming exhibition need not be enlarged upon. In most cases the entries must be made by producers and owners, so that farmers cannot rely on dealers and exporters to make a display for them.

Improvement in the Iron Trade.

The iron trade shows a decided upward tendency; prices are advancing, and the demand is better than for several years. A Philadelphia paper reports that all the Pennsylvania rail mills are full of work, while structural iron is in such demand that many of the larger mills are engaging other mills to fill their orders. Most of the producers of steel rails in that State already have their production sold for months ahead. One mill lately had to decline an order for nearly 20,000 tons at favorable prices owing to inability to fill it. The demand for sheet iron and bar iron is also strong. It is further reported, on the authority of one of the largest machine tool establishments in Philadelphia, that the demand for heavy machinery is greater than for several years past.