slightly eccentric in order that they may operate as cranks of short radius. The axle, P', is provided with a lever handle, P², for causing it to oscillate and to thus bring about an oscillation, in one direction or the other, of the frame that carries the axle of the disks, L'—that is to say, these latter are put in contact, at will, with the friction wheels, L, or isolated therefrom, according as it is desired to set the hammer in operation or stop it.

By modifying the pressure between the parts, L and L', the speed of the hammer may be either checked or carried to its maximum. It should be stated that this system of frictional driving gear has been found to work just as well when applied to the electric machine as to all those high-speed apparatus in which it is not prudent to attempt a sudden change from a state of rest to a maximum of velocity, and *vice versa*.

It results, also, from the arrangement that we have just pointed out, that it is by bringing the parts, L and L', in contact that the belt acquires sufficient tension to carry along the pulleys, M², while it slackens naturally when the mechanism is thrown out of gear.

The maneuver by which the entire machine is moved along the platform, A, to regulate the distance of the tool from the surface to be operated upon, and also to change its position in measure as the cutting deepens, is likewise performed by hand. The mechanism by means of which this operation is effected may be seen in Figs. 2, 5, and 6. It consists of a horizontal shaft, Q, carrying an endless screw, *e*, that engages with a wheel, *f*. This latter is fixed upon a vertical shaft, *g*, to whose lower part is forged a straight pinion, R, which gears with a rack, R', affixed to the side of the platform. It is by acting upon the winch, Q', then, that the machine is moved so as to bring the tool to its point of attack. Every time the position is changed the machine is fixed firmly in place by means of a binding screw provided with a handle, *h* (Fig. 6).

ARRANGEMENT OF THE TOOL CARRIER AND ITS MOTOR.

The tool carrier, properly so called, consists of a tube, S, sliding by slight friction in a hollow cylinder which is cast in a piece with the plate, S², upon which are fixed all the parts composing the machine. This plate and the cylinder, S¹ (as shown in the transverse section in Fig. 7), are mounted like a carriage upon the platform, A. The tool, X, is a steel bar having a cylindrical base, *i*, by means of which it is keyed to the socket, *i'* (Figs. 11 and 12). This latter belongs to a piece, X', which is united by a similar keying to the movable tube, S. It is in the interior of this latter that move the two pistons, T and T', that are affixed to the rod, *j*, to which is attached the rod, N', of the driving gear. These two pistons, which have an ordinary backward and forward motion, operate on each side of a fixed cut-off, *k*. There result from this arrangement two chambers, *l* and *m*, in whose interior the air is alternately compressed and expanded between the fixed partition and the surfaces of the pistons. So, then, when by virtue of the motion communicated by the connecting rod, the two pistons move from left to right, the air, through the inertia of the tube and its equipments, becomes compressed in the chamber, *l*, until such compression is sufficient to overcome the said inertia and to give an outward thrust to the tool. In the contrary motion it is evident that compression will occur in the chamber, *m*, and bring about a return of the tool.

Seeing that it would be impossible to keep these air chambers absolutely closed, and consequently at the same degree of mean tension, they are arranged so as to be in constant communication with the external air through two apertures, *l'* and *m'*, which are sufficiently large to allow a re-entrance of the air during the period of expansion, and which do not interfere with compression, since they are closed by the corresponding piston as soon as compression begins.

We show by the aid of a geometrical diagram, in Fig 10, the relation between the rotary motion of the driving shaft and that of the tool carrier, whose axis is nearly tangential to the circle described by the head of the connecting rod, so that the whole resolution of the motion is carried over to the inactive return period.

It is estimated that the forward thrust of the hammer is effected while the crank is describing only one-twelfth of a revolution. Now, this shaft being very well able to make 240 revolutions per minute, it results that the contact of the tool with the rock cannot last more than one forty-eighth of a second. The striking of the bar is effected, then, with sufficient velocity to permit the machine to be moved at the same time with all the facility desirable.

This utilization of compressed air, which establishes the sole interdependence of the tube and pistons, is also accompanied by an independence between the travel of the tool and that of the hammer which is highly advantageous; for, according as the rock is more or less penetrable, the tool reaches or does not reach its maximum travel, and it is the air chambers that undergo the sole consequences of it.

In conclusion, we may state that it is possible with this machine to make cuttings as much as two meters in depth in slaty rocks.

THE FIRST TELEPHONE, AS DESCRIBED BY THE INVENTOR.

The following is a copy of an autograph description of Reis' telephone, which has been presented to the library of the Society of Telegraph Engineers and Electricians, London, by Mr. William Ladd, member:

[COPY.]

INSTITUT GARNIER,
FRIEDRICHSDORF.

DEAR SIR: I am very sorry not to have been in Frankfort when you were there at Mr. Albert's, by whom I have been informed that you have purchased one of my newly-invented instruments (telephons), though I will do all in my power to give you the most ample explanations on the subject. I am sure that personal communication would have been preferable, specially as I was told that you will show the apparatus at your next scientifical meeting, and thus introduce the apparatus in your country.

Tunes and sounds of any kind are only brought to our conception by the condensations and rarefactions of air or any other medium in which we may find ourselves. By every condensation the tympanum of our ear is pressed in ward, by every rarefaction it is pressed outward, and thus the tympanum performs oscillations like a pendulum. The smaller or greater number of the oscillations made in a second gives us, by help of the small bones in our ear and the auditory nerve, the idea of a higher or lower tune.

It was no hard labor, either to imagine that any other membrane beside that of our ear could be brought to make similar oscillations, if spanned in a proper manner and if taken in good proportions, or to make use of these oscillations for the interruption of a galvanic current. *However, these were the principles which guided me in my invention;* they were sufficient to induce me to try the reproduction of tunes at any distance. It would be long to relate all the fruitless attempts I made until I found out the proportions of the instrument and the necessary tension of the membrane. The apparatus you have bought is now what may be found most simple, *and works without failing when arranged carefully* in the following manner:

The apparatus consists of two separate parts, one for the singing station, A, and the other for the hearing station, B.

The apparatus, A, is a square box of wood, the cover of which shows the membrane, *b*, on the outside, under glass. In the middle of the latter is fixed a small platina plate, to which a flattened copper wire is soldered, on purpose to conduct the galvanic current. Within the circle you will further remark two screws; one of them is terminated by a little pit in which you put a little drop of quicksilver, the other is pointed. The angle, which you will find lying on the membrane, is to be placed according to the letters, with the little hole, *a*, on the point, *a*, the little platina foot, *b*, into the quicksilver screw, the other platina foot will then come on the platina plate in the middle of the membrane.

The galvanic current coming from the battery (which I compose generally of three or four good elements) is introduced at the conducting screw near *b*, wherefrom it proceeds to the quicksilver, the movable angle, the platina plate, and the complementary telegraph to the conducting screw, *s*. From here it goes through the conductor to the other station, B, and from there returns to the battery.

The apparatus, B, a sonorous box, on the cover of which is fixed the wire spiral with the steel axis, which will be magnetic when the current goes through the spiral A second little box is fixed on the first one, and laid down on the steel axis to increase the intensity of the reproduced sounds. On the small side of the lower box you will find the corresponding part of the complementary telegraph.

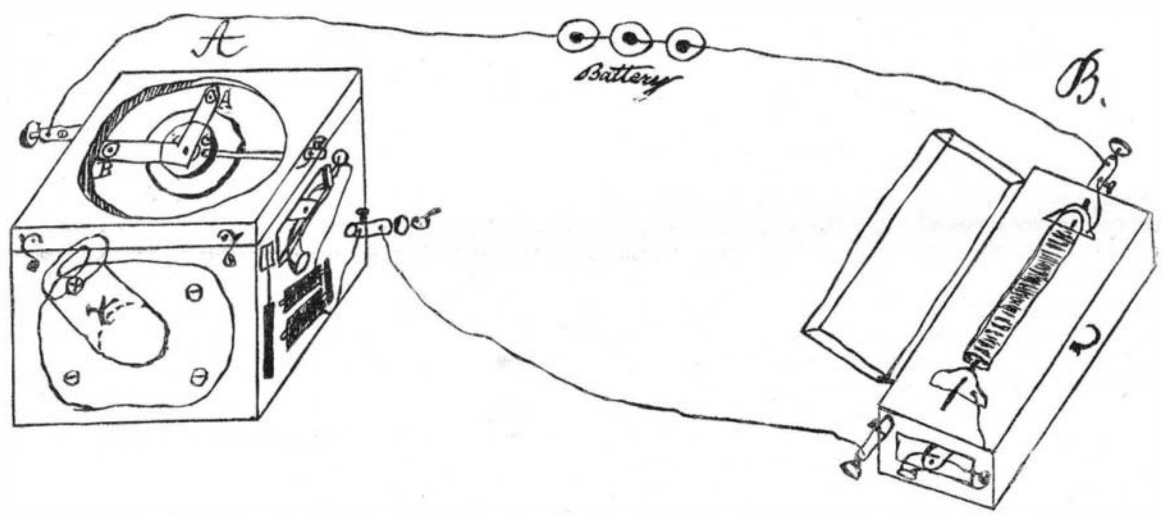
If a person sing at the station, A, in the tube, *x*, the vibrations of air will pass into the box and move the membrane above, thereby the platina foot, *c*, of the movable angle wil be lifted up, and thus will open the stream at every condensation of air in the box. The stream will be re-established at every rarefaction. In this manner the steel axis at station B will be magnetic once for every full vibration, and, as magnetism never enters or leaves a metal without disturbing the equilibrium of the atoms, the steel axis at station B must repeat the vibrations at station A, and then REPRODUCE THE SOUNDS WHICH CAUSED THEM. ANY SOUND will be reproduced, if strong enough to set the membrane in motion.

The little telegraph which you find on the side of the apparatus is very useful and agreeable for to give signals between both of the correspondents. At every opening of the stream, and next following shutting, the station A will hear a little clap, produced by the attraction of the steel spring. Another little clap will be heard at station B, in the wire spiral. By multiplying the claps and producing them in different measures, you will be able, as well as I am, to get understood by your correspondent.

I am to end, sir, and I hope that what I said will be sufficient to have a first try; afterward you will get on quite alone.

I am, Sir,
Your most obedient servant,
PH. REIS.

FRIEDRICHSDORF, 13, 7, '63.
To MR. WILLIAM LADD.



SKETCH OF THE FIRST TELEPHONE, AS MADE BY THE INVENTOR.

An Electrical Street Car.

The Electrical Power Storage Company, London, has recently built a street passenger car worked by electricity. This car was constructed at the company's works at Millwall, and is of the usual dimensions for carrying forty-six inside and outside passengers. It weighs with its accumulator and machinery, but without any passengers, 4½ tons. Under the inside seats of this tramcar is placed the accumulator, consisting of fifty Faure-Sellon-Volckmar cells, each measuring 13 inches by 11 inches by 7 inches, and each weighing about 80 pounds. This accumulator, when fully charged, is capable of working the tramcar with its maximum load for seven hours, which means half a day of tramway service.

From the accumulators the current is communicated by insulated wire to a Siemens dynamo placed under the car, and which acts as a motor, the motion being transmitted to the axle of the wheels through a driving belt.

To start the car the current is switched on from the accumulator to the dynamo, the armature of which being set in motion, the power is communicated to the driving wheels. The car can be driven from either end, and the power required can be exactly apportioned to the work to be done by using a greater or lesser number of cells. On a level road, for instance, with a light load, only a comparatively small number of cells will be necessary, but with a heavy load or on a rising gradient greater power will be required, and additional cells must be switched in.

The action of the motor, and consequently the direction of the car, can be readily reversed by reversing the current, and the car can also be as readily stopped by shutting off the current entirely, and applying the hand brake with which the car is fitted. At night the car is lighted by means of four Swan incandescent lamps, two of which are placed under the roof and one at each end of the car. All the lamps derive their current from the accumulator. The car is also fitted with electric bells, worked from the same source. With regard to the all important question of expense, it is stated that the actual daily cost of horsing a tramcar, as given by some of the metropolitan companies, is £1 6s, while that of electrical power is put at 6s. 3d. The question of first cost, it is said, need not here be taken into consideration, inasmuch as it is almost identical in each case. Electricity, however, would appear to have the advantages of requiring less space and a smaller working staff, while the machinery would be exempt from those epidemics which may at any time incapacitate the stud of a tramway company.

THE *Railway Age* publishes a summary of railway construction in the United States for the year 1882. The account covers only the main track, and shows the construction in States and Territories. On 342 lines the aggregate is 11,343 miles, or about 2,000 miles more than in 1881, which exceeded any previous year by 2,000 miles. The construction is divided as follows: Five New England States, 53½ miles; four Middle States, 1,315¼ miles; five Middle Western States, 2,077½ miles; eleven Southern States, 1,490½ miles; four in Missouri River belt, 2,063½ miles; five in Kansas belt, 2,157¼ miles; five in Colorado belt, 1,165 miles; six in Pacific belt, 1,020 miles.