

The Recent Developments
of the
Telephone.

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The Telephone

Recent developments of -

Electricity has been and is being put to innumerable uses, and one of its most important uses is in the transmission of sound. The mystery of its action is rather difficult to explain, but the mechanism by which it is produced is by no means obscure. Ever since 1831, when Wheatstone found that vibrations set up in one place could be transmitted, through a medium, to another station, the "Telephone" has made a steady growth, although at times the growth was noticable by outbreaks, until at present we are nearing perfection.

The mechanism of the phone will be readily understood if we run through a very simple one, which will be described later. It is well understood by the scientific world that all sound is due to vibrations in surrounding mediums. The object to be accomplished in the "Telephone" was to construct a machine by which vibrations could be set up here and reproduced accurately at another place regardless of the distance. Men scratched their heads and pondered over this primary problem for

many years, til Wheatstone partially solved it by taking two guitars, connecting the sounding boards with a light pine stick, and then setting up vibrations in one found that the same sounds were reproduced by the second. On this basis of experiment others worked until today we have the vibrating phone.

"If a wire, from a galvanic battery, through which a current of electricity is passing, be wound around a piece of steel or soft iron, it will be noticed first that the bar of soft iron is magnetized, and kept in that condition as long as the current continues to pass round it, and its ends will then attract and hold bits of iron, but will drop them when the battery is taken away. And, secondly, that the bar of steel will become magnetic and attract as before; but unlike the soft iron bar, it will retain its magnetism, and attract the iron even after the battery is removed. A steel bar in this condition is termed "permanent magnet." Since, however, electricity made the magnet, we can, in turn, make the magnet a source of electricity. Suppose the magnetized steel bar has attracted and is holding on to a piece of iron. We can now take the battery away and join the ends of the wire, then, if the piece of iron be pulled off and stuck on again, a current of electricity will run through the wire every

time it is done. Electricity produced in this way is called "magneto-electricity," and the current in the wire is said to be an induced electric current. If now the original wire be extended to a distance, and coiled around another magnetized bar, the currents induced in it by making and breaking the contact of the piece of soft iron with the first magnet, will simultaneously affect the magnetism in the distant magnet also. Though the magnets be a mile or a hundred miles apart, the disturbance in one is immediately and equally manifested in the other. These induced currents may be sent through the wire without actually touching the soft iron to the steel bar.

If this piece of iron is brought very near to one end of the magnet without a contact, and then withdrawn, an electric wave is produced in the wire which is felt in the distant magnet, just as if the contact was actually made and broken. And so if we play the piece of soft iron backward and forward before the magnet, no matter how rapidly or slightly, each motion is felt as an electric pulse in the magnet at the other end.

We have now the fundamental principles of the "Telephone." And from these, there have been

improvements made in all directions

It is well known that Bell patented the first telephone instrument, whether he received by so doing, what was rightfully due him or not, yet he had the rights of construction and sale in his power and no one could intrude upon those rights.

This man it is known, secured great amounts of money from the patent, which the general public considered no more than stealing. At this time the race was at a high rate of progress, and the matter of time was a very important factor. Dravling was too slow a method by which to transact business, so telegraphing was used. This also became too slow, and the business world called for the phone. Bell's was the one in the market and the only one. And understand, these phones could not be bought outright, but were merely rented. The rent was simply outrageous, exorbitant prices were collected from all users. But now the patent has expired, and innumerable companies have sprung up all over the country, whose sole business it is to manufacture "Telephones" and telephone supplies.

Of course all the phones are necessarily made alike, that is, in so far as their fundamental

principles are concerned. They are all due to the microphone contact, that is, a broken contact made by carbon, and this contact with the amount of current are the only variable constants. The only difference between the receiver and transmitter is that the transmitter has a large induction coil, while the receiver has not, and perhaps it will be well to say that the contact in the transmitter is much more sensitive than that in the receiver.

We hear so much to day about the long distance and short distance phones. As a matter of fact the only difference in these is the number of batteries used on the phone. A short distance phone will work on a long distance line as well as on the short line or visa versa, if we will remember that the amount of current must vary directly as the distance.

In our "Polyphone" systems there are three circuits used i.e. The Ground, Metallic, and Lap circuits. Each of these circuits is found beneficial in some cases. For instance, if we wished to put up a cheap line we would resort to the Ground circuit.

If one free from induction, the Metallic circuit, etc.; but all the time we must keep in mind the resistance of the different materials used. Could the resistance be overlooked, it would be possible for me to have an instrument, with batteries, here on the banks of the river, and dip the ends of the wire in the water, then say another party at Topeka would do the same, we could have a very cheap and efficient line, for water is as good a conductor as we have. But on account of the high resistance of the water in this condition, could not be done without the aid of a strong current, and even then it would be doubtful because of the distribution of the electric current over the surface and into the ground. It would more than likely all be lost before it reached such a distance. Thus we see the ground circuit, in construction, is cheap, but it would not be advantageous to connect two points too far distant, e.g. when the cost of the current exceeds that of the cost of a double wire the whole distance. In constructing a ground circuit line, we run a line wire from one phone to the other, attaching it at either end to one of the two binding posts on the instrument. From the other

post a wire is run to the ground, where it is buried deeply enough to have a moist contact with the earth at all times. This contact may be facilitated by placing the wire in a metal pipe and sinking the pipe into the earth, then keep the pipe filled with water. Now if a current be started at one end, it will flow this way:- through the batteries, over the wire which connects the two phones, down through the batteries of the second instrument, then down the wire and return through the earth.

The Metallic circuit on the other hand differs from the Ground circuit in that the two posts at the instruments, which in the Ground circuit were grounded, are connected with a wire, making between the two phones two lines of wire, and when a current is started at one end it passes as before, except that it returns over the second wire: thus we have as the name implies, a complete metallic circuit. A system constructed upon this plan is rather expensive, the wires are numerous, as there are two to every; but the current would not ordinarily be very strong. The great advantage in a system of this kind is the fact of its being entirely free from induction. The reason for this is that every

phone has an outgoing and an ingoing wire, which is free from all the others, and the current is confined to the two: thus confining the current to such an extent that the leakage is practically nothing, hence freeing the line from the induction which is so bothersome at times. One point, which might be, in some instances looked at as disadvantageous, in the Metallic circuit is the necessity of all the wires terminating in the central office.

The Tap Circuit is where several returns are all over the same wire. I can best represent it by calling to mind the way in which a river system is formed. Take the Mississippi, it begins with a single stream, and as it proceeds down the basin, other similar streams empty into or tap into it, til at its mouth it empties through a number of small channels; but to make this a more nearly perfect example, it should empty through as many channels as it receives on its course down. The Tap circuit is used where several wires run along the same line, as in city "Polyphone" systems. The way they bring a number of different instruments into central by means of this system is something on this plan, starting say with a line at the outskirts of town,

a direct line wire is stretched which connects central and the instrument, the direct or line wire is generally of galvanized iron. Then there is stretched a heavier wire, or one of greater conductivity and also insulated, to central. This completes this phone. We go on in towards central till we reach the next instrument that is to be wired. A line wire is again run; but in this case the return wire is strung differently; instead of making a separate line, which would be the second to central, the wire is taken from the machine, carried to the nearest pole and attached or tapped onto this first return wire; thus the two currents are returned over the same wire, making a complete and independent circuit for each instrument. We go a little further and connect up another, tapping its return on to this original wire, and so on until there may be forty or fifty returns all on one wire. When this return wire is arranged in central, there are as many ends attached to it as there were wires tapped on to it while coming in. These are paired off with their proper line wires and connected to the switch board. We can now see that the Tap circuit is no more than the Metallic circuit modified; for we have in the former system

all the returns coming in over one wire, while in the latter they would come in over separate returns. By the Tap circuit system, which is most widely used, they do away with the expense of wiring two lines for every phone, and to the bundlesome mass of wires which would, in the Metallic circuit system, appear on the poles.

The Central office switch board to one of the Tap circuit systems, though complicated in the minute mechanism, is nevertheless easily understood if we look at the general principles.

The board is usually rectangular, with the drops in parallel rows across it. These drops are so hinged and balanced that they are overbalanced and dropped, due to the action of a magnet behind them, when a current is passed.

The drops are all numbered according to the wires from the phones attached to them, and a corresponding plug hole below on another section of the board.

All of the return wires come onto the board at one place, and the line wires as well. In tracing one wire through the board, we find it goes down through the plug, then up through the drop, and out. When the drop falls it is the signal to push in the plug,

which when placed breaks the connection or rather cuts out the drop by springing down what is called the "spring jack". This cuts out the drop and lets the current pass through the central phone. If now we wish to connect two outside phones, we pick up a parallel plug and place it in the plug hole of the number wanted, this forms a loop at central connecting the two machines. This is the same as connecting the ends of two wires by a third and short piece. When the parties are through using the line, a similar signal is received, at central, to that one when the first phone rang up, and the drop fell. Only the drop falls corresponding to the pair of plugs used. This necessitates a lively person at central at all times.

While as yet the "Telephone" is only in the prime of its life, it has extended over all of the large cities and most of the small ones. And we do know that perfection is not far distant and that in a few years its wires will form a network over the whole United States as has already been done in the case of telegraph wires and that a person can talk business or

pleasure from Boston or New York, to one
in San Francisco, as is now being done
between Boston or New York and Chicago.

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