ATCA
P.O. Box 1252
McPherson, KS 67460

Chartered
1971

AN INTERNATIONAL ORGANIZATION ASSOCIATED WITH THE MUSEUM OF INDEPENDENT TELEPHONY OF ABILENE, KANSAS

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VOLUME 39, NUMBER 1 **NEWSLETTER** **JANUARY 2009**

Maitland Telephone & Insulator Show

Saturday, January 17, 2009

Maitland Civic Center 8AM - 4PM Set-up 7am
641 S Maitland Ave., Maitland, FL
Registration $5 Tables $20 additional tables $15
Send to Paul Mikula, 650 Chapman Ct., Oviedo, FL 32765
contact: 407-365-4686 email: wecoman@bellsouth.net
Motels: Days Inn North(formely Comfort Inn) 8245 S, US Hwy 17/92 Casselbery FL 32730
Tel: 407-339-3333
Motel 6, 5300 Adanson Rd. Orlando, FL 32810
Tel 407-647-1444

ATCA Website Password

What can you find by going to atcaonline.com? The ***Members Only*** section has a color version of our newsletter with extra pages that are not found on the printed version. In addition, a current membership directory which includes known email addresses can be downloaded as a microsoft excel file. When entering the ***Members Only*** section, you will be asked for either a login or user name depending on which internet system you are using and then a password. The login/username is atca in lower case.

The **January password will be chuck**

2009 VIRGINIA REGIONAL TELEPHONE SHOW — SATURDAY, FEBRUARY 28, 2009

LOCATION — HOLIDAY INN - PATRIOT, 3032 RICHMOND ROAD, WILLIAMSBURG VA 23185
SHOW HOURS WILL BE FROM 8 AM TO 1 PM on Saturday.

Rooms at the Holiday Inn - Patriot: $59 per night plus taxes. This rate is good for additional nights before or after the show. Rooms have either two double beds or a king size bed. Rooms are equipped with refrigerators and microwave ovens. No continental breakfast, but restaurant will be open. Please call the Holiday Inn direct (not the national reservation center) at 1-800-446-6001 to reserve your room with a valid credit card. Ask for rooms in the Virginia Regional Telephone Show block to receive this rate. The show room is at ground level and will accommodate about 50 tables.

Registration: $10.00 for ATCA members. Spouses, children and non ATCA member guests — no charge. Tables: $10.00 for the first and $5.00 for each additional. On Friday evening (5-7 pm) there will be a meet and greet gathering in the Back 9 Bar and Grill at the Holiday Inn - Patriot. Pizza provided by the host. Cash bar.

Contact: Russ Cowell
WECoguy@cox.net.

757-258-5308 or
105 Woodmere Drive
Williamsburg, VA 23185

Spring Telephone Show hosted by John Huckeby....May 15th and 16th....Springfield, OH...OVER 10,000 buyers will walk past your tables. **This is a unique opportunity**. We will have our own building at the Springfield Antique Show and Flea Market for their extravaganza. Three antique malls nearby with over 1000 dealers. Nearly 1500 dealers set up at the show itself. We will have our own security. Details will be in the February newsletter.

Address change?? Send it to: ATCA, P O Box 1252, McPherson, KS 67460

Send all ads to: ATCA, PO Box 910, New Castle, IN 47362 **Email ads to j.huckeby@comcast.net**

Antique Telephone Collectors Association Since 1971

Board Chairman
Mike Davis
mvtel@verizon.net
Levittown, NY
516-735-9765

Board Members
Roy Basci
Brooklyn, NY
call380@msn.com
718-331-3102

Art Bopp
atca3844@optonline.net
Levittown, NY
516-579-7920

Barry Huckeby
Saginaw, MI
barryhuckeby@speednetllc.com
765-749-9479

Bill Provencher
Barre, VT
802-476-7189

Jeremy Walters
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jeremy.walters@sbcglobal.net

President
John Infurna
Phoenix, AZ
infurnaj@juno.com
623-849-4907

Vice-President
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215-739-5229

Secretary-Treasurer
Cindy Goldsmith
McPherson, KS
office@atcaonline.com

Listserv Manager
Chuck Eby
webmaster@atcaonline.com

Editor
John Huckeby
765-686-0189
j.huckeby@comcast.net
editor@atcaonline.com

Board Message

We are pleased to announce that the ATCA has been granted 501(C)3 non-profit status by the IRS. This will have a significant impact on the organization's ability to raise funds through tax deductible contributions made on or after January 28, 2008. The status will have far reaching benefits such as the reduction of expenses and the ability to attract corporate and other sponsors for ATCA sanctioned shows and other activities.

If you made any donations to the ATCA since the effective date or know of a prospective sponsor, please contact an ATCA board member for more information.

ATCA continues to encourage members to host more regional shows. We can provide technical and financial assistance as well as insurance for sanctioned events. Please contact an ATCA board member if you are interested.

ATCA August 14, 15 Telephone Show

The contract is not signed yet but I am announcing this show in anticipation of everything falling in place so you can schedule your vacation days.

It looks like the August show will be held next to the largest shopping mall in the US, according to the Valley Forge Radisson Hotel in King of Prussia, near Philadelphia, PA.

The show will be hosted by Roy Basci, Art Bopp, and Mike Davis.

The Radisson has a fanatastic set up room. The show will begin on Friday evening with a reception and cash bar. Following the reception, the show room will be opened for set up and trading. The show will close on Friday night at a time to yet be determined by the hosts. The show will open on Saturday morning at 8 AM. We will have the show room until 5 that evening.

Details of the show will be published in the February newsletter.

Ray Kotke Telephone Show

Mason, Michigan - Saturday, April 4th, 2009
8:00AM to 2:00PM

Cobblestone Events Center
Mason Antique's District
205 Mason Street, Mason, Michigan 48854

Social reception Friday, April 3rd, 6pm - 10pm
Complimentary refreshments & pizza
Registration /Admission - $10.00
Tables - $10.00

Contact Ray Kotke - e-mail:
kleenax@gmail. com
Telephone: 517-230-6730
Eastern Time

Work will begin soon on the new membership list. If you have not sent in your renewal, please send your check for $35 to Cindy at ATCA, PO Box 1252, McPherson, KS 67460.

If you are not sure if you have paid your dues, check the label on this mailing. If there is an /08 after your ATCA number, then you have not sent in your dues. The dues for a spouse is still $10. A student membership (under 16) is still $10. All international dues are still only $35.

ATCA SHOW 2010... Farmstead Inn Shipshewana,IN... Aug. 6 & 7

Technical Corner

By ***Mike Zyla***, Philadelphia, PA, December 20, 2008, mzyla@mmzdesign.com

Long-Lines Transmission
Analog to Digital Transition

Introduction

This is the first in a series of articles addressing technical subjects of interest to club members. I'll pick the first subject, but I encourage readers to contact me about topics you'd like to read in future issues. I'd also welcome feedback (too deep, too narrow, too broad, …) and letters to be included in this column to express member's opinions. Contact me if you find an error or mistake.

A little about me. I spent a good part of my career at AT&T Bell Labs and was fortunate enough to have worked in these major Areas: Components, Switching, Transmission, Station and Military. I didn't work in Research. I do love all things phones.

In this article, I'd like to discuss some of the major obstacles that faced telephone transmission line engineers from the beginnings of telephony all the way to the point where digital transmission replaced analog transmission. I will use the word "transmission" very broadly. Most people would define transmission as inter-switch connection. But that would, for example, leave out pair-gain systems that technically could fall under subscriber loop. And when VOIP is considered, the entire transmission field becomes cloudy. When I write about transmission, I'll cover the subscriber loop as well as inter-switch connection, and I'll be mindful of the fact that eventually, everything telephone will be digital except for the transducer at the ear piece and mouth piece of the handset.

It's my goal to bring the reader to the point where the state of the art of analog transmission, as good as it may have been, was not up to the challenge. There were many sound reasons why digital replaced analog. Early on, digital was more expensive than analog, yet it was destined to replace analog. We'll eventually get to that point in time, and cover the factors and tradeoffs as R&D money was allocated to digital and de-allocated from analog.

There's an interesting aspect when comparing a digital and an analog transmission service that I call *duality*. The first thing that comes to my mind with digital transmission is the ability to have a limitless number of repeaters without degradation of the signal. After all, with analog repeaters, you're always going to amplify the previous repeater's signal **and noise**, and the noise is additive as the number of repeaters is increased. Traditional "analog" noise degradation of signal does not play a significant role in digital transmission.

This is precisely the number on factor that was overwhelmingly in favor of digital transmission, due in most part, to gains in semiconductor large scale integration technology. But duality plays a role here.

Yes, you can allow a digital pulse train to attenuate over a long line transmission circuit to an almost negligible, but detectable, amount, and fully recover that pulse train as if it were the source itself. But upon further investigation of the overall system (analog to digital conversion, digital transmission over a circuit of significant length, and finally, digital to analog conversion), you might end up with a signal that is much worse than had you deployed the transmission system using all analog technology.

We are getting way ahead of ourselves at this point, but I will get to the discussion of the duality of analog versus digital transmission technology further into this article. Here's some hints: No accumulation of multiple repeater noise (biggest customer complaint to Long-Lines Department), but the effects of analog to digital and digital to analog conversion, such as quantization error, slew, eye distortion, random jitter and deterministic jitter, play a major role in being able to faithfully reproduce the original near end signal at the far end. Any error in the conversion from analog to digital **will** be reproduced (faithfully but unfortunately) and repeated all the way to the far end. This is the aspect of duality. The engineer is faced with trading off additive accumulation of noise from multiple analog repeaters with quantization and jitter effects from the D to A and A to D conversion process. We will cover all of this as we move through this article. I'll show jitter and eye diagrams, and talk at length about how bit errors and recognized and corrected in near real time. Hopefully, I've peaked your interest. As we move through this article, particular attention will be paid to the state of the art of the last of breed analog transmission technology, and compare this to the first of breed digitaltransmission technology, addressing the trade-offs and benefits engineers sought in transitioning to digital transmission technology. This article represents my perspective on the subject, and it's my intention is to educate and promote further discussion. It is not a treatise on the subject; readers can Google for more information or consult the many books available on the topic, especially, the series of books once published by AT&T, entitled, "A History of Engineering and Science in the Bell System".

One last comment before we move to the subject as hand: Early long line transmission obstacles are rather simple when viewed from today's knowledge base. I want to cover these early obstacles and I feel a need to cover some basic electricity topics. The first transmission engineers had to face basic resistance of wire as a problem to be solved. Early wire was made from iron, not copper, and iron has a much higher resistance than copper. This resistance caused loss of the undulating current (from the carbon transmitter) and attenuation of voice signal. There are the concepts of maximum power transfer, balance and termination, and attaining satisfactory performance of the earliest transmission systems meant dealing with these concepts. Later on in this article, I would like to address near and far end echo, cross talk, distortion, signal to noise ratio and other factors that determine the quality of analog transmission systems.

Basic Electricity

The science of transmission, or the process of sending power from one place to another **without loosing any of the power in the process**, is as old as the discovery, design and development of

power producing devices. If you take two telephones and connect them with a wire, and expect one phone to communicate with the other, you must generate power, then send that power across the line (the transmission line), and then use that power at the other end of the line. This is as true for phones and as it is true for electric companies. Phones (let's leave digital phones and VOIP technology out for a while) produce and send power and so do electric company power plants. You can also send power wirelessly over the air (could be a future article).

There are many, obstacles to sending power across a transmission line **efficiently**. In practice, when you input a signal into the near end of a transmission line, the output power at the far end of the transmission line may not be the same. The power output will not be greater than the power input. The power output will most probably be less than the input power because there are forces within the transmission line that causes attenuation and distortion of the signal. Transmission loss or attenuation of the telephone voice signal was a significant obstacle to long lines engineers. Other obstacles to sending power across a transmission line, and there are many depending on application, include cost of manufacturing and installation, meeting required bandwidth, maintaining balance, reducing reflection, maximizing power transmission, maintaining characteristic impedance, reducing distortion, and more. They are all related, as you would expect. Each of these obstacles could be covered in depth in a separate, future article. But in order to address even the fundamentals of transmission lines, and how telephone engineers dealt with the obstacles, it is necessary to get some basic facts about electricity out of the way.

A little bit about power in and of itself. Electric power is the *rate* at which electrical energy is transferred and used in an electric circuit. A transmission line is an electrical circuit. The part of a power source (a generator, a phone, …) that couples this source to the transmission line is an electrical circuit. And the device at the end of the transmission line, the load (a light bulb, a phone, …) is also an electrical circuit. Power is not something that exists by itself in nature, it is the mathematical product of voltage and current; it measures the rate at which work is done. For phones, work is done when the receiver converts the electrical power delivered to it, to acoustical power, enabling us to hear the work-product which is acoustical sound. Power is something that you calculate; power is voltage times current.

Ok, so what is voltage? I've always thought of voltage as something I can get my hands around. It is a force. A force can be a tow truck pushing a disabled car off the road, or a loco*motive* pulling a consist of train cars. Sure, these motive forces can be rated with power, like horsepower, and the work done can be seen as it is movement from one place to another. Voltage is an ***electro***motive force. We say "electro", because work can be done with electricity, without seeing something being moved.

Voltage is the potential difference between two points in a circuit. When we heat our house with a resistance heater, work is done with electricity. In this case, the two wires of the heater are the two points in a circuit, and the voltage applied across the heater's terminals causes power to generate heat. You can't see it, but the work is nevertheless done. And you can be sure work is done at the other end of the transmission line – the power plant, which feeds a city (thus, electro-city or electricity).

When we use a phone, work is done at the transmitter (talking), and work is done at the receiver (listening) Work is also done on the transmission line, albeit unwanted work, which is the **loss** of some of the power as it is sent from transmitter to receiver. Before transmitters of the "undulating current type" existed (carbon granule transmitters), work (power) in a telephone set sending out voice power was very much like a power plant generator. A G Bell's earliest transmitters were *electro*-dynamic. Electro is likened to electricity and dynamic is liked to movement (like coils in a dynamo at a power plant). Some engineers refer to electro-dynamic transducers (transferring from one domain to another, in this case from acoustical power to electric power) and electro-magnetis. They were, in fact, voice powered generators. They generated a small amount of power (work) in much the same way that a power plant generator works: by passing a coil through a magnetic field, or causing the magnetic field to change, as voice is sent into the transmitter. Bell's electro-dynamic transmitters produced a voltage (remember, electromotive force, potential difference), and this voltage was applied to the transmission line, where it was then sent to the receiver. At the receiver, the voltage is applied to the resistance of the receiver, which caused a current flow (amperage), which produced an acoustical output (sound).

Let's briefly touch on current (amperage) and resistance (ohms). Voltage by itself won't cause work to be done. The voltage has to be **applied** to something. If you just have a potential difference (for example, the voltage measured across the terminals of Bell's early transmitters) and don't have a load (telephone receiver connected to the transmitter) then no real work is done for the intended purpose – hearing sound from the receiver. There has to be some resistance presented to the voltage source, (to the potential difference). With no connection, there is no resistance for the voltage to "see". When a tow truck pushes a car, there are frictional and gravitational *resistances* to movement (losses) which require *power* to overcome the losses. Similarly, if you apply the voltage (from Bell's early transmitter) to a receiver, which is the load, electro-acoustical work will be done only if there is some resistance (inside the receiver) to the voltage.

Resistance is the force which **opposes** the free flow of electricity. The measurement of resistance is the ohm (fundamental DC circuits). Remember, voltage, resistance and power is just electrical **terms**. If you think about these terms as a potential to do work (V), work being done (P), and work being caused by an opposition to the flow of electricity (R), you'll do fine. By the way, resistance is something I feel I can also get my hands around. I would rather have a bunch of gold wire, which has less resistance to the flow of electrons, say per 100 feet as compared to a bunch of wire made from iron or copper (again, per 100 feet).

Current (another term) is defined as the flow or movement (there it is, that word movement once again) of electrical charge. Current is measured in amperes or amps for short. The symbol for amps

is (I). The electric **charge** (like when you charge your rechargeable battery) may be from the voltage's potential difference. I won't get into the physics of all this, but consider the potential difference as a difference of the amount of electrons between those two points in a circuit we talked about earlier where there is an electro-potential difference (voltage). Let's say the first point in the circuit has an excess of electrons and the other point doesn't, or vice-versa. If you connect the two points with a wire, the potential difference or charge will cause the flow if electrons to eventually balance or cancel out the potential difference of electrons. Potential difference, battery are charged, no potential difference, batteries not charged. All things considered otherwise equal, the lower the resistance (gold wire rather than copper wire), with a constant potential difference (voltage), the more is the rate of flow of electrons. You have more amps with the lower resistance gold wire than you do with the copper wire (less amps).

The four terms we talked about, Voltage (V), Current (I), Resistance (R) and Power (P) are related by a set of equations.

$$V=IR$$

Let's say we have a source of 10 volts. Then V=10. If you have a load of one ohm of resistance, R=1, then for the equation to balance, I, amps, has to be 10. 10 = 10 X 1. On the other hand, if the voltage is the same, 10 volts, and the resistance is 10 ohms, then the amps have to be 1. 10 = 1 X 10. There's all kind of games to play here. Change the voltage and keep the resistance the same, and you vary the amps.

There's an equation for Power (P) as well.

$$P=EI$$

The more volts (V) you have, or the more amps (I), or the more of both, the more power. If you vary I with a constant E, then P changes accordingly, and so forth

Telephone engineers had a source of power, the phone speaking, which has a voltage output, and they had a load, the phone listening, which has its resistance, and they had the transmission line between these phones. And you guessed it; the transmission line had loss because it has resistance. Early transmission lines were made of iron, which has much more resistance than copper or gold wire, per unit length. Gold wire was way, too expensive. Copper wire that would allow it to be supported on telephone polls by itself wasn't affordable during the early days of telephony. Let's say you have 100 feet of transmission line between the phones. That 100 feet of transmission line has a certain amount of resistance. And yes, the receiver and transmitter also has some resistance (so they can produce or use the voltage and current – power – to do the work of converting acoustical power to electrical power and then back to acoustical power).

Let's say you send 10 volts of telephone sound across a transmission line with NO resistance. Then the load at the other end, the receiver, will get all of the sound energy because the transmission line presents NO resistance or **loss** to the potential difference (the ten volts) of the source. The amps that flow over the transmission line are strictly a function of the transmitter and receiver internal resistances. Now let's say we have a transmission line with 600 ohms of resistance, and a receiver with 600 ohms of internal resistance. (We will disregard the resistance of the source, the transmitter, for simplicity). If we go through the equations, you will see that one half of the power of the transmitter is dissipated in the transmission line (600 ohms) and the other half of the power is dissipated in the receiver (600 ohms). Not a good situation.

You've lost half of your signal. Do this for a very long line and you might have no perceivable sound at the end of the long line. The rule here, all else being equal, is **the longer the transmission line, the more resistance, and thus, more loss**! In the early days of telephony, that is, before amplification, overcoming transmission line loss was a big problem.

Now if you work through the equations solving for minimum transmission loss, or maximum power transmission, you would discover that you can lower the **power** that is **lost** in the **transmission line** (as compared to the power delivered to the receiver) if you have a higher voltage and lower current, rather than a low voltage and high current on the transmission line. Remember you can have many different combinations of V and I given the same R and still have the same P. I'm not going to go through the math, but it's true. That's why long line electric company transmission systems are high voltage. It's all there in the two equations set forth in this article. Contact me if you want help in this.

Telephone company engineers also knew that higher voltage and lower current lessened the loss effects of the telephone transmission line. One of the functions of early induction coils inside a telephone set or subset was to take the power from the transmitter and step up the voltage, which, if all else considered is the same, reduce loss over the transmission line. Let's say for simplicity, a phone without an induction coil has a current which we'll call x_1 amps, and a voltage we'll call y_1 volts. This power inside the phone or subset is available for the transmission line (or subscriber loop in this case) and would be P = V X I, or for our specific example:

$$P_1 = y \text{ volts X } x \text{ amps}$$

Where P_1 is the available power for the transmission line. If we send this power across a transmission line, the power at the far end would be

$$P_{far\text{-}end} = P_{near\text{-}end} - P_{line\text{-}loss}.$$

Now let's use an induction coil (a perfect one for this example), and apply the available power from the transmitter to the primary of the induction coil. Since this induction coil is perfect, we will design the turns ratio of the induction coil such that the output voltage is 10 times more volts as compared to its input voltage. Now we install the coil in the phone or subset and connect the output of the induction coil to the transmission line (subscriber loop).

Since the induction coil is perfect, there are no losses in the coil. Thus, input power equals output power. For this example **with** an induction coil, output voltage is ten times input voltage (by our design), or: $10y$ volts. Now let's solve for output current:

$$P_1 = 10y \text{ volts X } 0.1x \text{ amps}$$

You can see that the equation remains satisfied, even though we increased the voltage. Let's recap. Power, P_1 is the same as without an induction coil. Voltage is ten times more than if there were no induction

coil, and current is 1/10th as much compared to no induction coil. Now we send this new signal across the transmission line. The transmission line has not changed since we added the induction coil, and its resistance is therefore the same. All else being equal, the effect of transmission line resistance on voice signal, in other words, signal attenuation, is less. If anyone would like to see the math for this, contact me and I'll send you the equations. In effect, it's like we flipped the relative value of current for the relative value of voltage, making voltage higher than we could get from the transmitter.

Induction coils also allowed for power steering. By use of multiple windings, you could send more of the outgoing signal across the transmission line and less to the local receiver. This concept, sometimes involving issues of side tone and anti side tone is a possible topic for another article, where we analyze turns ratio, magnetic field, current flow direction, back EMF and other interesting aspects of induction coils.

One main reason the Bell System had a hard time extending its long lines from coast to coast is the loss of power in the transmission line. Flipping current for voltage was an early blessing, but it still didn't allow coast to coast call capability. We will have to wait for a mechanical repeater or vacuum tube amplifiers.

What about the magneto? Why such a bulky item in each and every early phone? If you compare the power needed to produce sufficient sound in the telephone receiver to the power needed to ring the bell in the telephone set, you soon find the ringer needs a lot more power than the receiver to operate. This is why early telephone sets used a magneto to call attention to the switchboard operator, or to call other extensions on the line or private line. The magneto, a power generator, was capable of generating a very high voltage when compared to the voltages occurring during conversation. And the currents were higher as well. This combination of very high voltage and a good amount of currents allowed the requesting telephone set to ring the bells at the called telephone set or switchboard, which required a good deal more power than conversation. Again, higher voltages have a better chance of overcoming transmission line loss.

Let's go back before the use of carbon transmitters. As we said earlier, transmitters were electro-dynamic. Voice goes in and a small voltage and current comes out. I know of at least one telephone manufacturer that produced the magneto-transmitter. This transmitter used very strong magnets in the transmitter to possibly produce more voltage and more current – more power, but it was still very limited. Using stronger magnets in the magneto-transmitter allowed engineers a little bit more flexibility (experimenting with broader ranges of internal resistances and using different types of diaphragms or coils), but all of the energy, the voice power, still came from the person speaking and not from the magnets.

So how do you overcome transmission line loss when amplifiers (vacuum tube or solid state) didn't exist? Let's think back to the induction coil, which allowed the telephone set to convert or flip its internal voltage and current such that the output of the telephone set had a higher voltage and lower current than there would be without the induction coil. Given this understanding, the task is now how to increase the current **inside** the telephone set and pass that increased current to the induction coil.

The carbon microphone or transmitter, in simple terms, generates a large electric power output from its acoustical power input. Bell's first electro-dynamic transmitter generated a very small current. The carbon transmitter is NOT an amplifier (if we look at it as only a electric circuit), but it is an active device in that it controls an external, larger power source. The external power source is a current much larger than the current from an electro-dynamic transmitter. Bells voice powered electro-dynamic transmitters were called passive because they simply converted acoustical power to electrical power. Telephone engineers needed more current on the telephone side of the induction coil so that they could get much more voltage on the line side of the induction coil. The carbon transmitter is a current modulator or undulating current device. It takes an otherwise constant current, and modulates or changes the current in response to its acoustical power input. Now, with this much stronger current from the carbon transmitter, engineers fed this stronger current into the induction coil primary side and produced reasonably high voltages at its secondary side that could be sent across transmission lines measured in hundreds of miles rather than hundreds of feet.

At this point, we are at miles rather than feet. But we still have severe losses approaching 1000 miles of transmission loss. What else is there to overcome transmission line loss? We've already used undulating carbon granule transmitters, specially designed induction coils at the near and far ends of the line. And for sure we've done all the calculations necessary to provide transmission line conductors of the proper size (gauge) and kind (copper). Before amplification, there were two developments to counter transmission line losses: Loading and Mechanical Repeaters (kind of like an amplifier, but not really). Some older telephone engineers (not me!) might say conductor transposition allowed for longer effective transmission lines. We will talk about these three concepts very briefly, but they do deserve to be treated as separate articles.

Early Mechanical Amplifier

Around the turn of the century, perhaps 1904, the Shreeve Repeater was developed. This repeater was a mechanical amplifier based on a very efficient receiver either *acoustically* coupled or mechanically coupled to an acoustically efficient carbon transmitter. Let's try that again: electrical power input, conversion to mechanical or acoustical power, coupling of this mechanical or acoustical power to a carbon transmitter. This is a conversion to a coupling to a conversion device. It must be said that conversion is inefficient. Many of our audio sound systems require hundreds of electrical watts to produce a few acoustical watts. Nevertheless, these devices were deployed commercially with mixed success. They failed to meet expectations because they were not a real amplifier.

Why? Given a constant current, which was undulated or modulated by a carbon granule transmitter, there exists two components to the signal sent across the transmission line: The constant current in its static state (no conversation), and the modulated component impressed upon the constant current by the undulating current carbon granule transmitter (the conversation).

These components can be

analyzed separately. The constant, quiet current is the DC component of the signal, and the voice sound is the AC (alternating current) component. Mr. Shreeve proposed that transmission line length can be increased by refreshing or increasing the DC component of the signal. Therefore, at regular intervals, the Shreeve Repeater separated the AC component from the DC+AC signal, reinvigorated (his words) the AC signal by coupling it to a new carbon transmitter with fresh battery, and then sending the signal along to the next repeater. I'm not saying that the Shreeve Repeaters didn't work. But it had problems with feedback or "whistle", didn't satisfy basic transmission line matching theory in terms of maximum power transfer, and the concepts of refreshing the DC and reinvigorating the AC component while not really amplifying the AC component was hard to characterize mathematically. Shreeve Repeaters also did not work on loaded lines.

Loading

Did I say loaded lines? Loading is a way to reduce attenuation of a telephone transmission line at the expense of bandwidth. In order to fully understand the effects of loading, it would be necessary to discuss transmission line theory in terms of its complex AC characterization. This is beyond the scope of this article, but if there is interest, this could be covered in a future issue.

But let's try to get some very fundamental concepts on loading on the table. We've already discussed resistance, which is an opposition to the flow of an electric current. There is resistance in all conductors of electricity at normal temperatures. On circuit boards, we may see resistors, which are devices manufactured to provide engineers with almost any resistance as a standard component. We all can buy 1000 ohm resistors, as can we buy 10,000 ohm or 10 or 1,000 ohm resistors. But what about capacitors and inductors? These devices present an opposition to current flow just like resistors, but they act as a function of the AC frequency of a signal. A resistor presents a constant resistance regardless of signal frequency.

Because capacitors and inductors have varying resistance with frequency, we can't really use the term resistance, since it already applies to a resistor with constant resistance over frequency. We use the term reactance to describe a capacitor's and an inductor's "AC Resistance". Capacitors and inductors can store an electrical charge for a brief period of time. A simple capacitor can be described as two parts of a conductor separated by an insulating material. A simple inductor can be described as a coil of wire wrapped around a core of metal or even air. At high frequencies or very long lengths of wire, even a straight wire can be treated as an inductor. An electro magnet is a coil of wire. If we apply a current through this coil of wire, a magnetic field is created. Electric cranes used in scrap yards use inductive coils and, when energized, use the resultant magnetic field to puck up pieces of scrap metal. When the electric field is cut off, the magnetic field collapses and reduces in strength and the scrap metal is dropped.

It is interesting to note, again, that the magnetic field collapses when the current is cut off. The collapsing field actually induces an (opposite direction) current to flow. DC current flowing one way into an inductor generates an expanding magnetic field, and a collapsing magnetic field induces a current to flow in the other direction. A good example of this phenomenon is a spark coil in older automobiles. The collapsing magnetic field is large enough to cause a spark. It's also interesting to know that there is a time constant or time lag for the inductor's electro-magnetic field to expand and collapse. This is in contrast to a resistor where there is NO time factor. Increase voltage across a resistor and the current through the resistor almost instantaneously increases in lock step with the voltage. No lag or time constant with a resistor.

Capacitors behave similarly to inductors. When you charge a capacitor, an electrostatic field is generated between the two conductors separated by an insulator. Remove the voltage from the capacitor, and the electrostatic field collapses causing the voltage to remain across the capacitor's two terminals for a time (even though the voltage source to the capacitor was removed or cut off). The ability for inductors and capacitors to return the charge back into the charging circuit is sometimes called Counter-EMF or counter electro-motive-force. If you return to the beginning of this article, I'm sure you will see the terms electro, motive and force used to describe some of the basic properties of DC circuits.

It is the combined phenomena of stored charge, charge decay, and time lag that cause inductors and capacitors to behave as a function of AC signal frequency. A capacitor's reactance or opposition to electric flow decreases with signal frequency. It is inversely proportional to frequency. Raise the frequency and the reactance goes down towards zero ohms, like an almost dead short. That's because, at DC signal, i.e. no alternating current, just constant current, the charge on the capacitor is equal to the voltage applied to the capacitor, and so it looks like no resistance i.e. very high resistance, almost infinite resistance. But as you start alternating the source signal applied to the capacitor, the electrostatic field has to expand, then collapse, and then expand again to follow the AC waveform. Because of the time lag, all of this takes **work** (another term we used earlier in DC circuits) which can be thought of in terms of instantaneous power, voltage and current. Increase the signal frequency while keeping voltage constant and even more work has to be done to pull and push that electrostatic field. More work, more current to do the job, thus, lower resistance if the voltage is held constant.

An inductor's reactance increases with frequency. It is proportional to frequency as opposed to the capacitor's reactance being inversely proportional to frequency. Take the salvage yard crane. Apply a DC current to the coil, the magnetic field expands, and stays expanded until the DC current is removed. With constant DC applied, the coil is like a piece of wire with a certain amount of resistance, but with a constantly energized inductive magnetic field. The field stays on because the current flow is constant. Now chance the current flow to alternating current (AC). As the frequency increases, that magnetic field keeps trying to maintain current flow. Increase the frequency considerably and the energy in the magnetic field dominates and there is little opposition to current flow. The reactance or inductive resistance increases with frequency.

I know this is a lot to take in, and I took a lot short cuts to make points that could be argued on strict technical grounds, but you'll see now how all this effects

telephone transmission loss.

A telephone transmission line is a long length of wire. At DC current flow, the transmission line certainly has resistance. Now consider a capacitor. I said earlier that a capacitor is a conductor separated by a non conductor. The non conductor can be almost any man-made insulating material, and it could even be air. Well, take a long, open wire metallic circuit, a two conductor transmission line. Isn't it a pair of conductors separated by a non conducting material like air? Yes it is. A long transmission line now has resistance and capacitance. But wait, there's more. Didn't we say that an inductor is a coil of wire wrapped around metal or air? Yes we did. A transmission line is a coil of wire, albeit more straight than coiled, but it is a long wire and therefore the telephone transmission line also has inductance, as well and capacitance and resistance. And remember, capacitive and inductive reactance act to oppose electric flow just like resistance, only reactance is a function of frequency while resistance is not. Native transmission lines usually are effected more by its characteristic capacitance rather than its characteristic inductance.

If you think long enough about capacitance and inductance, you might find that they are kind of opposites. Capacitive reactance is inversely proportional to frequency while inductive reactance is proportional to frequency. Think about it long enough and you might conclude there's a single frequency where a certain inductor's reactance and a certain capacitor's reactance is the same. Take these two devices and hook them up in parallel and feed them a signal at that special, "tuned" frequency. Since capacitors and inductors are duals of each other (one tries to maintain current when a source of current is cut off, while the other tries to maintain voltage when a voltage source is cut off), something special happens at this special frequency. Here's the answer: The reactive effect of this parallel circuit which is tuned to that one special frequency behaves as if they are not there. In other words, has an extremely high, if not infinite resistance. At frequencies below this tuned frequency, inductive reactance opposes the flow of AC current. At frequencies above the special, tuned frequency, capacitive reactance takes effect, trying to oppose the flow of AC current.

Now back to the open wire, telephone long line transmission lines. Let's assume that a long line telephone transmission line has more of an effect from capacitive reactance than from inductive reactance. As signal frequency increases, there is lower and lower reactance. Multi-conductor transmission lines in tightly formed cables have even greater capacitance between conductors. Thus, long line telephone transmission lines are affected by capacitive reactance that gets worse with frequency, and by resistance which is constant with frequency. But didn't we just say that if you tune an inductor and capacitor to behave as duals then the reactive effect disappears? Yes we did, and that's exactly what loading coils do. They attempt to tune out the negative effect of capacitive reactance by creating a tuned circuit, or resonating frequency, such that the reactance is zeroed out of the equation, leaving only the resistive component to deal with. This explanation of loading is overly simplistic, as years of work, more than a decade, went into the mathematics, research, development, testing, specifying. It is a complex subject because you're dealing with AC reactance and DC resistance, and applying the technology to a range of frequency rather than a single frequency.

In practice, there is only one frequency where reactance is cancelled out. But there are techniques to spread the positive effect of tuning the capacitive effect of the transmission line with inductance from loading coils over the range of frequencies characteristic of voice conversation (70-3200 Hz.). The topic of loading coils can be addressed in a future article. Loading coils were very effective in increasing transmission line lengths, but they still did not allow coast to coast long line transmission line capability. To accomplish this, technology had to wait for amplifiers.

Next issue, we will get back to conductor transposition and wire twisting to reduce crosstalk and inductive noise pickup, and then talk about amplifiers, echo, return loss, ringing and other subjects that apply to transmission lines. And don't forget, we want to get to the point where we can evaluate the state of the art of analog transmission and compare it to digital transmission.

MIKE DAVIS #2022
30 Ring Lane
Levittown, NY 11756
(516) 735-9765
Email mvtel@verizon.net
www.geocities.com/mikesvintagetelephone

WANTED:

☐ Gray, "BELL" shaped coin collector. ☐ Early coin relays for 3 slot payphones with the flat magnet between the 2 coils or just the magnet. ☐ Early payphones and parts.

FOR SALE:

☐ WE 410 2 line 302 type phone with the line select switch in the lower right corner. The phone is in very good condition with #5 dial and cloth cords $100. ☐ WE 302 type phone with the factory installed on off switch in the lower right corner. The phone is in very good condition with #5 dial and cloth cords $100. ☐ WE "FIRST" 302 with small buttons and vents under the handle. The phone is very clean, the paint has some aging I'd rate it at about 70%. It has a #5 dial and cloth cords $100. ☐ WE original factory painted "IVORY" 462 BC4 (ALSO STAMPED 455 IN RED)(6 clear buttons, 4 lines, 1 hold, 1 local) The phone is very clean with some wear of the paint mostly on the handset. Has a nice early 5J (white housing and open center finger wheel) dial and matching cloth handset cord. The 2 plunger buttons are factory clear as well. Dial and line cards are original. No line cord. $125. ☐ WE original factory painted "GOLD" 462 (ALSO STAMPED 455 IN RED)(6 clear buttons, 4 lines, 1 hold, 1 local) the phone is very clean with some wear of the paint mostly on the handset. Has nice early 5J dial (white housing and open center finger wheel) and matching cloth handset cord. The 2 plunger buttons are factory clear as well. Dial and line cards are original. Cut line cord. $125. ☐ WE original mouthpieces with the small star in the center $25 each. ☐ WE original mounting brackets for 211 space savers $15 each. ☐ Good condition (may need a little or no cleaning) WE black 500s with metal finger wheels. These are from the 1950s or 1960s, $15 each or all 18 for $200. Complete les card holder, add a card holder for $2.50 each. ☐ WE nice non dial sticks, no receivers transmitters or cords. Otherwise complete with back cups, base covers, hooks etc $60 each.

GENESIS OF PACIFIC TELEPHONE & TELEGRAPH CO.

February 17, 1878 to December 31, 1906

Compiled by Steve Hilsz

The earliest telephones on the Pacific Coast were those of the Gold & Stock Telegraph Company, a Western Union subsidiary. In San Francisco, an exchange was opened at 222 Sansome Street with George S. Ladd President. By 1878, exchanges were located at 965 Mission Street, California & Fillmore Streets, 211 Kearny Street, Twentieth & Mission Streets, Powell & Union Streets, 833 Sutter Street, Hayes & Laguna Streets, and in the southeastern portion of the city known as Butchertown.

The Gold & Stock company used telephone sets manufactured under agreements with Thomas Edison, Elisha Gray, and Amos Dolbeer. These telephone sets were superior to those manufactured by Bell because they utilized a Primary Circuit with carbon transmitter, and an Induction Coil. The coil's Secondary Circuit served to step up the voltage of the local battery and made the telephone sets suitable for Long Distance work. Western Union manufactured these instruments at their Western Electric shops, and the company used the umbrella name American Speaking Telephone Company.

Gardiner Hubbard was A. G. Bell's Father-In-Law. Hubbard's brother Samuel opened an exchange at 140 Sansome Street. At first, Samuel used old Bell Telephone (New York) stationery for some of his first invoices; later they were imprinted "The Bell Telephone Company." The address on this stationery was "Corner Halleck & Sansome Streets, over Wells, Fargo & Co's Express, San Francisco."

By April 12, 1880, Samuel Hubbard had sold the exchange to the National bell Telephone Company. Shortly thereafter, the Bell Patent suit was settled and Western Union sold its exchanges to Bell. In San Francisco, the entity formed by the fusion of the various exchanges became known as Pacific Bell Telephone Company. Pacific Bell was granted an exclusive license from National Bell to operate in California. Other areas under this license included Oregon, Nevada, Arizona, Washington State, and part of Utah. George S. Ladd became President of Pacific Bell Telephone Company.

There arose the need to connect the various exchanges in different cities and to this end in 1883 was formed the Sunset Telephone-Telegraph Company. This entity was licensed to operate in all the states listed above, but not in San Francisco. John Sabin was Superintendent of Sunset Telephone-Telegraph and we also find his signature on Pacific Bell Telephone letterheads. This entity lasted until 1889, when the Sunset Telephone and Telegraph Company was formed.

The new company was incorporated by George S. Ladd, John I. Sabin, Monroe Greenwood, William Oliver, Percy Morgan, Louis Glass, and David Gage, in April, 1889. Pacific Bell Telephone Company became the majority stockholder.

On September 19, 1889, the first Pacific Telephone and Telegraph Company was incorporated and absorbed the majority stock in Sunset Telephone & Telegraph, and all assets of the old Pacific Bell Telephone Company. This entity survived until 1900. Note the absence of the word "The" in the title of Pacific Telephone & Telegraph Company. This distinguishes the first incarnation from the later organization.

On May 11, 1900, the Pacific States Telephone & Telegraph Company was incorporated in Oregon. On August 1, 1900, the Pacific States company acquired Pacific Telephone & Telegraph Company, Oregon Telephone & Telegraph Company, and Inland Telephone & Telegraph (Washington State). This arrangement lasted until late1906.

On December 31, 1906, The Pacific Telephone & Telegraph Company was incorporated. The corporate title now included the word "The" before "Pacific." The arrangement was such that the new corporation acquired all of the San Francisco exchanges and leased operating territory in southern Oregon and western Washington from Pacific States Telephone & Telegraph Company. The leases were supposed to last thirty years, but were cancelled in 1914 (Oregon) and 1917 (Washington), and the properties transferred to The Pacific Telephone & Telegraph Company.

NEW MEMBERS:

Ted Cowell, 4391/09
2335 Scottwood Ave, Old West End
Toledo, Ohio 43620
419-344-0099

Bill Baggett, 4392/09
5722 Rally Ct
Rex, GA 30273
770-474-3935

Emmanuoli Fakinos, 4393/09
6 Zogou Grigoriou Str. Goudi ,
Athens, 15773 Greece
+306977263629

Darrin Dodson 4394/09
1007 Stoneport Ln
Allen, TX 75002 USA
972-977-7464

Colin Boucher, 4395/09
607 Digby ave #5
Oshawa, Ontario L1G1W7
Canada
905 571 6948

Larry Sackett, 4396/09
6333 Lenox Rd
Bethesda, MD 20817 USA
(301) 320-2991

Jim Starnes, 4398/09
2756 Park West Dr.
Cookeville, TN 38501 USA
931-319-1928

Craig Parrish, 4397/09
184 Locust Ave
Babylon, NY 11702 USA
516 805-2004

Dick Erickson #23
Namrebos@sbcglobal.net
949-369-9499
For Sale

Strowger Automatic 11 hole dial candlestick circa 1905. Dial runs smoothly, original nickle covers most of phone but some bleeding of brass in a few places. There is a small ding and depression on the bottom base and a hairline fracture on the pot below the dial. The dial number card is original but missing about 20% of the card near the bottom. This is a rare sought after piece of history and can be put into pristine shape with a little work.

Accompanying this phone is an original letter by Mr. A B Strowger dated 1882 on his undertaker stationery to his dear brother Charles H. Strowger in New York. The letterhead features in very large print: A B STROWGER UNDERTAKER

No.114 Kansas Ave. No. Topeka,Kansas

Undertaker Goods Constantly On Hand

Calls Attended Day Or Night

Free custom packing and postage in the USA by UPS or USPO

Larrykolb@comcast.net
(703) 754-3832

For Sale

Still have Dial Pulse to Touch Tone converters for sale for your rotary phones. Great for Internet phone service where the service provider does not support dial pulse. Easy to install, plug and play. No external power required. The price is $47.00, which includes shipping in the U.S.

John Huckeby
2440 W. CR. 150 N.
New Castle, IN 47362
765-686-0189
For Sale
Chrome door and lock for AE payphone, $45

JOHN PRUSAK # 4365
2000 Woodbridge Dr.
McKInney, TX 75070
972-542-8567
jjprusak@aol.com

FOR SALE

I am offering for sale the " OLD TELEPHONES SCRAPBOOK" ," History & Identification", by Ron Knappen. This is 2 volumes of over 800 pages tracing the history of phones and includes letters, articles, advertisements and numerous photographs. I have found this to be a valuable source of information and I am now offering to share this document with the ATCA members at the same price that I paid. Asking $65, including shipping.

DAVID KUNS (4030)
P.O. Box 1852
Chino Valley, AZ. 86323
cell: 928-710-3631
home: 928-636-1588
kooonzeee@yahoo.com
Check out site: www.phonemandave.net

WANTED

□ WE party line porcelain dial face-132E NOTCHED (#4 type); □ Nickel (preferred) Amer Elec manual stick shaft with washer shaped ring located below hook cutout; □ American Electric (#52 style) common battery fiddleback-good wood; □ Keystone receiver or anything older Keystone.

BRUCE BIANCHI
mrlinefinder@verizon.net

WANTED

□ 1-Red AE 34 transmitter cap and spitcup □ 2-Mohogeney AE 34 transmitter cap and spitcup □ 3-Ivory AE 34 handset □ 4-International candlestick transmitter. (marked with a 'C' under mouthpiece □ 5-Kansas City transmitter used on stick phones. □ 6-Modern Telephone name tag. □ 7-Ivory Kellogg 1100 redbar handset □ 8-Any and all parts for a Western # 9 potbelly

---

DONALD A. PRICE #853
417 Ledge Road
Crocker Hill, N.B.
Canada E3L 3N5

WANTED:

□ Bottom cover with good leather for a NORTHERN ELECTRIC 20 PC Stick. NE haas a brown swede leather cover rather than red. I have the cover and ring but no bottom cover, so will take the complete bottom. □ TT North Ericafon base, electronics can be shot, but need the small pieces to actuate the line switch.

RICHARD ROSE #1920
651-429-9322
richard@pressenter.com

WANTED:

□ Oxford gray handset cord for my 1955 blue Western Electric 500. □ High quality reproduction receivers. Accepts variety of magnets or U1 receiver element. Only $19.95. Order online at at www.oldphoneworks.com or call 1-800-843-1320. □ Cloth Covered Telephone Cords. Available in Black, Brown, WE Green, 302 Green, Red, Rose, Blue, White, Pink, Orange. Custom made for AE, WE, NE, SC, and Kellogg with correct lead lengths and appropriate restraints. Choice of cloth or vinyl covered inner conductors. Custom orders accepted. Order online at www.houseoftelephones.com or call 1-800-843-1320.

GENE DOOM 4013
Phone 616-842-8327
email springdoom@aol.com

WANTED

small AE line / cutoff relay

GORDON R. PARKER 4361
540.562.2059
grparker@parkerengineering.com

FOR SALE

□ Clean # 30C Western Electric Company Locks for single slot Pay Phones each with one key. Will fit the upper case and lower (cash vault) $17.00 each or 2 for $32.00. 4 for $60.00. 8 for $115.00. □ Several NOS 30C locks available, please E-Mail or call for price □ 1 # KS8028 NOS Western Electric Company Lock and Key (Brass) for WECo # 525 or Northern Telecom weather proof telephone enclosure. $50.00. □ 1 # 7301 (catalog #) Sears Roebuck & Company Silvertone Sound Powered Telephone with ringer generator. Black -clean. Photos available. (I am told manufacturer is Kellogg or Stromberg Carlson/ I do not know). $40.00 All items plus shipping and insurance at exact amount to buyer. No packing charge.

STEVE HILSZ
PO Box 429
Salome, AZ 85348
(928) 859-3595
jydsk@tds.net
Don't give up on your rotary dial just because it's sluggish or gives wrong numbers. Repair is still just six dollars (major parts additional) per dial plus postage.

JON KOLGER #561
6906 Meade Drive
Colleyville, TX 76034
(817)-329-5262
jkolger@gte.net

WANTED

□ As always, seeking quality vintage COLORED telephones from all manufacturers, particularly Automatic Electric Monophones, round or square base, desk or wall sets. □ COLORED Western Electric 302 variants, such as those with the two-line switch on the left front corner. I am in desperate need of a blue 302 with blue plungers, dated 1941 or earlier, to complete a set. □ Always buying NEW OLD STOCK Western Electric COLORED clothcoiled cords still on their wooden dowels. □ Still seeking a BLUE North Electric desk set, or any COLORED North Electric wall set. □ Dark BlueStromberg-Carlson 1543 as pictured on page 58 of Dooner's blue book. □ COLORED cradlephones from other manufacturers such as Stromberg-Carlson oval base, Leich, Connecticut, Kellogg Masterphone and Redbar, as well as interesting vintage COLORED foreign telephones. □ Vintage COLORED cradlephone literature such as catalogs,color charts, samples, etc... □ COLORED dial blanks for vintage AutomaticElectric Monophones such as type 40, 50, etc... □ Matte gold-plated trim in good condition for vintage AE Monophones. □ Also always looking for unusual acoustic "string" telephones, particularly those with magneto-signalling and/or speaking/listening tubes. Also seeking primitive, homemade, acoustic telephones, the stranger the better. □ Wanted to buy acoustic telephone literature such as catalogs, flyers, instructions, etc... Thanks!

JOHN WILEY #1116
6642 E. Vanguard St.
Mesa, AZ 85215
(480) 924-7062

FOR SALE

B.S. 139-B test set $10 □ W.E. 3-A Central Office Tulip Horn 13"x20" $95 □ W.E. Power Room gauges, handles etc. 13 pieces $95 □ W.E. 211 Dial Space Saver $85 □ W.E. 684-BA sub-set $75 □ W.E. 211 N/D Space Saver $25 □ T-26 Operator breast plate (NOS) $20 □ W.E. 509 Receiver $10 □ W.E. F-3 Handle with Push Button $10 □ W.E. Dial Conversion (BSP) Hand Book 1930's-40's-50's $95. All plus shipping.

SELMER R. LOWE JR.
490 Bank Dr.
Fall Branch, TN 37656
423-348-6494

srljr@embarqmail.com
I'm looking for some items to finish a couple of projects that I have going on. First; I need an element for the short North receiver. See Photos. Second; I'm in need of a Swedish American top box and transmitter mount. The top box mounting hole dimensions are 6 1/8" across the top and bottom and 10 7/8" down the sides. The transmitter measurements are 2 3/4 inch across the top and bottom and 3 3/4" down the sides. I'll buy a two box phone for the parts if the dimension are correct. Measurements may vary a little. I have a nice seven digit transmitter for trade for the Swedish American parts. See photo. Any help would be greatly appreciated. Thanks and God Bless, Selmer

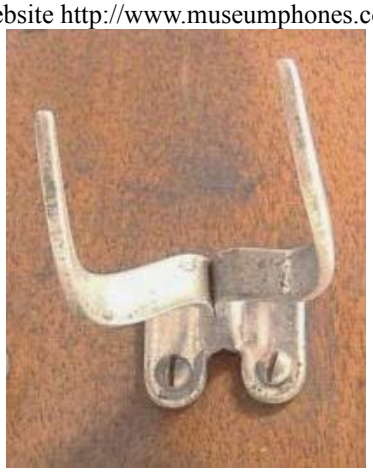
---

VERN POTTER #1435
2940 S. 500 E.
S.L.C, UT 84106
(801) 486-6794 after 7pm please
email VERNP@WEBTV.NET
Please note ATCA in header, or it may look like spam.

FOR SALE + SHIP

□ # NOS ITT 564's in Beige. $15 These are military still sealed. The box is marked 056413-MBA-40M Key Telephone, date 12/86. These weigh 6 lbs each. □ # NOS WE mod hand set in Green. These are complete and still sealed in the pouch. $4 each or 25 or more @ $3.50 These are military and marked WE only, no Bell System mark. 25 weigh 21 lbs packed. □ # NOS AE dials. This is a true 3" dail, with finger stop on the inside on the body. These are military and still sealed. date 8/86 The dial has a "numbers" only plate, with clear plastics finger wheel. include are dial center card and sticker, back cover over contact, and a 1/4 thick spacer like you would find in a North set. □ Special price: 4 shipped in flat rate box for $60 pp. Limit 4 per order. □ As for shipping. I use PO for small boxes and larger boxes I use FedEx. Please check with them for shipping rate, from 84106

RON CHRISTIANSON #822
P O Box 43
Cave Junction OR 97523
Home 541 592 4123
Wireless 541 287 0169
Email ron@museumphones.com
Website http://www.museumphones.com



WANTED:
Stationary hook as seen in photo.

DAVE MARTIN #278
6016 Sheaff Lane
Ft. Wash., PA 19034-1815

FOR SALE

□ Pink dial 500, $50 □ Pink dial desk Trimline W.E. $45 □ Pink dial W.E. princess phone 9/66 $40 □ Oak Stromberg Carlson non magneto fiddleback phone, 18: long, with decal $300 □ Walnut Kellogg non magneto fiddleback phone, 24 1/4" long $300 □ Oak Connecticut 12 position annunciator switchboard $450 □ 5"x7" cardboard sign, blue and white, New York Telephone Company 21 bell logo, WET PAINT Please be Careful, 12/28 $35 □ Receive-Ease Telephone shoulder rest for an early G type handset, in its box, with picture and description on the outside of the box, green black and white box, green plastic with white advertising print, Baker-Bohnert Rubber Co. Inc. 131 Bernhelm Lane Phone 6343661 $50 □ Round flange mostly blue porcelain sign, Public Telephone Bell System Connections 11" round, 3 1/4" chips $175 □ Western Electric black ringer, single gong, on a 3 1/2" round base that is 3" deep W.E. decal on the side, 2 1/2" gong $40 □ W.E. single gray toggle switches new in the box, KS19504L1, 400273942 Arrow Hart, three for $10

JOSEPH D. UHLER #170
Box 126
Ingomar, PA 15127
724-940-4331
No tire kickers please.

COLLECTION FOR SALE

Wall telephones, lifetime collection. Various woods, styles and manufactureres. Approximately 35, all restored and in original working condition. Will consider any fair and reasonable offer from a serious collector.

BUTCH SCHWARTZ
2222 Cardinal Av
Faribaunt, MN 55021
507-323-4368

FOR SALE

For old cord boards from answer service 1-OKI CrossBar PBX Old Horizon Demention Equip lots of new spade cords handset and base new plstic ITT-NT 1A2 Power Supples and Equip Cards - etc. Rotary 500 Type bases and TMLS. Buy part or all - also 3 old teletype machines 28-33-15.

Quotations subject to change without notice and prior sale. All agreements are contingent upon strikes, accidents and other delays, unavoidable and beyond our control. All contracts are subject to approval by the Home Office. The Company will not be responsible for any obligations contracted in its name by agents or for clerical errors. All goods sold F. O. B. Factory.

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"UREKECTRIC" CHICAGO

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WESTERN UNION
HARVEY COMPACT

INDEPENDENT LOCAL AND TELEPHONE LONG DISTANCE SYSTEM

LONG DISTANCE
TELEPHONE
MAIN 3909

EUREKA ELECTRIC CO. INC.

143, 145, 147, 149 SOUTH CLINTON STREET

TO AVOID DELAY ADDRESS
ALL COMMUNICATIONS
DIRECT TO THE COMPANY
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MANUFACTURERS OF

HIGH GRADE TELEPHONES, SWITCHBOARDS
AND EXCHANGE APPLIANCES,
CENTRAL ENERGY SYSTEMS.

MULTIPLE,
EXPRESS,
FLASH LIGHT.
SWITCHBOARDS

TELEPHONES
FOR ALL SYSTEMS

CHICAGO, U. S. A.

Jan. 27, 1902

Mr. John A. Miller,

New Lisbon Tel. Co.,

New Lisbon, Ind.

Dear Sir:-

We are in receipt of your esteemed favor of the 25th inst. enclosing draft for $68.11 in payment of your order #10,801, for which we thank you.

We note that you have received the bill for the 20 Telephones, but that up to the present time the telephones have not arrived. However, we wish to state that these telephones have been shipped, as we do not bill goods until they have been shipped from the factory.

In regard to the new lightning arresters we are placing on our telephone, we state that this is without question the best arrester on the market today, and we feel that the same will satisfy you.

Thanking you for past courtesies and soliciting a continuance of the same, we are,

Yours very truly,

EUREKA ELECTRIC CO.

C.B.-M.

GOAR & SHAFFER,
GENERAL MERCHANDISE,
NEW LISBON, - INDIANA.

New Lisbon Independent Telephone Co.,
To Goar & Shaffer,

NEW LISBON, IND., Oct 30 1901

1901			
Apr 20	To	30 # Nails	1.50
" 20	To	2 Post-hole Diggers	1.50
May 6	"	Screws	.20
June 15	"	Nails	05
" 22	"	Sulphate Copper	30
" 22	"	Nails	5
" 28	"	Gasoline	2
July 16	"	6 # Sulphate Copper	72
Aug 2	"	1 gl gasoline	3
" 2	"	5 — 7x12 Bolts	15
" 2	"	2 # Nails	7
" 2	"	1 doz 2x12 screws	10
Aug 12	"	Bolts	36
" 14	"	10 # Sulphate Copper	1.20
" 16	"	3 dz Screws	30
" 17	"	1 Bit	20
" 17	"	Bolts	46
" 17	"	"	05
" 19	"	Screws.	24
" 22	"	Gasoline	02
Sept 14	"	"	02
Oct 3	"	"	03
Oct 5	"	Nails	07
" 18	"	10 # Sulphate Copper	1.20
" 18	"	Bolts	08
		Dec 14.1901	$8.92

Received of New Lisbon Independent Telephone Co Eight Dollars and ninety two cents. $8.92. Goar & Shaffer per S.

THE PORTER CEDAR COMPANY.

PRODUCERS AND MANUFACTURERS OF

TELEPHONE POLES, RAILROAD TIES, FENCE POSTS, SHINGLES,

AND ALL CEDAR PRODUCTS.

MAIN OFFICES, EDDY BUILDING.

YARDS ON PERE MARQUETTE AND
G. R. & I. RAILROADS.

SAGINAW, MICH., Feby 26th. 1902.

New Lisbon Telephone Co.,

New Lisbon, Ind.

Gentlemen:-

We received to-day your valued favor enclosing check for $112.92 in payment of our invoice of Feby 12th., for which we thank you.

We can furnish you 100- poles 25ft 5" top @ 1.15 each, 50- 20ft 5" poles @ 85 ¢ f.o.b.New Lisbon. Since we sold you the other poles prices have advanced quite materially and we look for a still further advance before many days. We regret that you found any of the poles in the last order which were not straight and should you favor us with another order, we will try to see that the poles are perfectly satisfactory. We do not understand how you got any crooked poles as we make it a point to ship only first class stock.

Yours truly,

The Porter Cedar Co.

H. Heyer Treasurer.