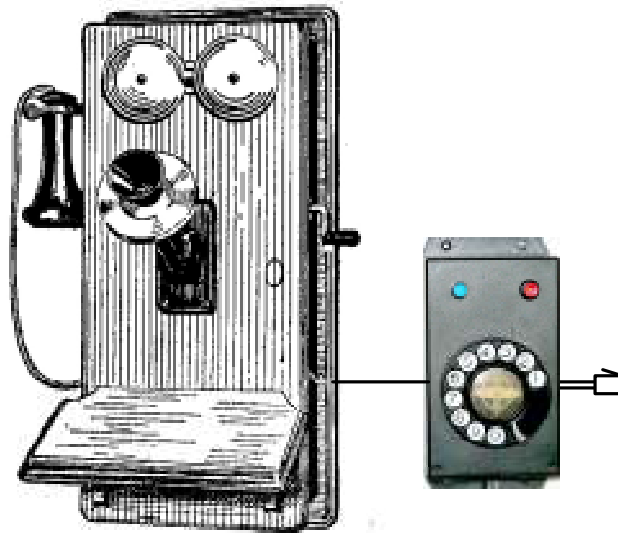

Local Battery to Common Battery Conversion

Convert a Wooden Crank Phone to Work on a Standard Phone Line

This is an Advanced Project

Detailed Explanation



Version 2.0 - July 5, 2011

Colin T. Chambers

Bill Geurts



My Background -- Colin

I “officially” started in the telephone business in 1958 by doing a traffic study in my local Step-by-Step office. I was in the 10th grade. I plotted a graph showing traffic over a 24 hour period. Prior to that I had installed a telephone in my bedroom (you could not do that back then!).

My parents advised me not to go to work for the Telephone Company, so I went to college and became an Industrial Arts Teacher for LA City Schools for 13 years. After that, I switched careers to Telecommunications. Two years later I was responsible for getting Pacific Telephone out of the station wiring business, now you could run your own wires and install your own telephones. This soon spread to the rest of the United States and is now common in the rest of the world.

I taught 1A2 Key Systems, went to work for a hospital and wrote an RFP for all the communications wiring in the new big building, then worked for a bank and eventually ended up at IBM. I was designing voice networks and doing technical management. When I retired I was one of the two people doing that for a number of call centers that on a daily basis exceeded 600,000 calls every day, Monday to Friday.

In all this I had a variety of experiences in Telecommunications. More information is on my web site.

Colin T. Chambers - oldphoneguy.net



My Background – Bill

Bill has been active in telecommunications since the mid 1960’s, when he and his neighbor first ran a private telephone line between houses and then to some other neighbors in the neighborhood. Using surplus phones, a 6-volt lantern battery, and magnetos for signaling, they had their first telephone system and ran it for several years.

Bill got his General Class Amateur Radio license in 1967 as a sophomore in high school, and studied electronics. In 1972 he joined the Oregon Air National Guard as a ground radio repair technician and repaired HF and VHF radios for six years in that capacity. Radio technology was learned through Air Force communications classes and on-the-job experience. For a number of years he was a hi-fi technician for a local hi-fi shop.

Professionally, he has gone into the world of corporate accounting, but radio and electronics have remained his hobby all the time.

In the last several years, he has been active in both the Telephone Collectors International and the Antique Telephone Collectors Association, and currently serves as a board member and treasurer of TCI.

His recent activities include repair and restoration of antique telephones, and recently built a working step-by-step (SXS) electromechanical demo switch using old central office parts.

“Most of the 100-plus antique phones I have are functional”, Bill has said on many occasions.

Much of the restoration work Bill does is to restore the electronic functionality of the phones.

Bill Geurts

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The next page is a sheet of graph paper to make notes or drawings.

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Composed in Microsoft Word 2010. Drawings made in Visio 2003.

Local Battery to Common Battery Conversion

Notes:

Local Battery to Common Battery Conversion

Convert a Wooden Crank Phone to Work on a Standard Phone Line
This is an Advanced Project

Introduction

Local Battery Telephones are telephones that have a set of batteries, usually large #6 dry cells, providing the talk battery. They are most often associated with long open wire telephone lines and were used in rural areas. A crank magneto, AC generator, was used to ring other telephones on the line and the operator. They are rarely used today.

CAUTION: Old wooden wall telephones often had metal parts connected directly to the telephone line. It was also common to use the hinges on the front cover to act as connections to the transmitter and bell circuits. This can result in electrical shocks if you touch metal parts on the magneto telephone when it is ringing.

In the early days, there were many manufacturers of wooden wall phones and many variations. They all worked about the same. One of the big differences between them was the number of magnets (bars) on the magnetos. Telephones were known as 3 bar or 5 bar, with the 5 bar ones being used on longer lines or lines with more telephone sets. Some sets had anti-sidetone coils and are not specifically covered in this document, but the conversion circuit will work the same.

This booklet is generic and the circuits presented here should work on all of the older magneto telephone sets. Drawings shown here for the magneto telephones are also generic and may not match your specific telephone. This is an advanced project, so you should be familiar on how to wire telephones and follow a diagram and build simple electronic circuits.



This is a wooden wall telephone, batteries were in the bottom of the wooden case. ----- >>



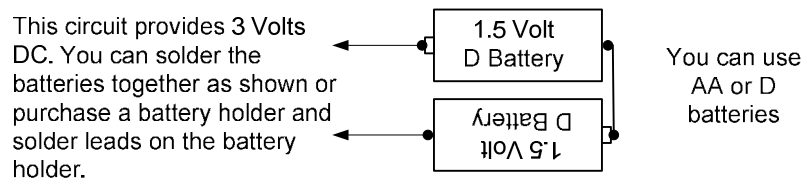
^^^ A more modern desk telephone that used an external battery box and an anti-sidetone coil. This is not covered in this document, but the circuit will work with this phone.

This project attempts to keep the telephone as original as possible with a minimum of changes so the telephone remains a local battery telephone. Many of these sets simply had the wiring ripped out and components from a modern telephone installed to convert them.

Getting Started

It is vital that your old wooden telephone work, as originally intended, BEFORE you attempt to convert it to work on your common battery telephone line! It is rather doubtful that you have a telephone that was removed from service years ago, and, has not been modified in some way, the magnets have not become weaker over time or there is not some other problem. To confirm that your phone is in good working order you will need to test it completely.

Battery power will be needed to test your phone. You can get a simple battery holder for 2 flashlight cells at Radio Shack or you can tape two batteries together and solder wires on them. I would suggest D cells as your testing may take longer than you think. This will give you 3 Volts DC. The original #6 Dry Cells provided the same voltage but would last longer, they had a higher amount of energy for those long calls.



It would be best to solder insulated alligator clips on the wires, it will make it easier to test. I have shown a drawing of what the test battery looks like.

You will also need a standard telephone, typically a WE 500 and another battery circuit (for common battery simulation, not local battery) to set up a test circuit. This will allow you to set up a talk and ring path to check all functions of your old wooden telephone.

This sounds like a lot of work, but it is necessary to make sure your old wooden telephone will sound good when you do the conversion.

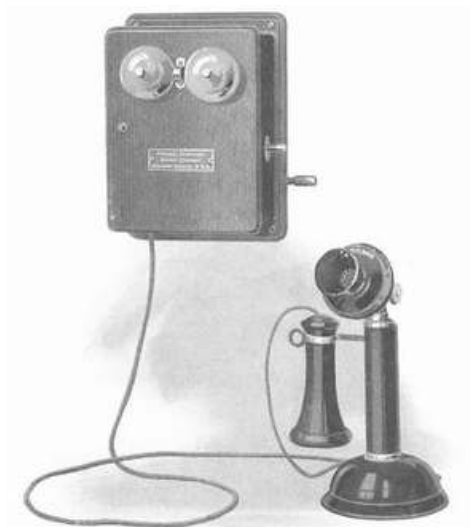
Go to this link – and read the section on Magneto Telephones:
http://www.telephonetribute.com/pdf/rpr_ot21.pdf

For more general information look at:
<http://oldphoneguy.net>

Wiring diagrams for Magneto Telephones can be found at:
<http://www.telephonecollectors.info>

When you connect your converted phone to a standard common battery telephone line and place a call, it will sound like on old phone. Consider this a “classic old phone” sound.

If you have any old batteries in your phone, save them as they may have an antique value.



Initial Testing

Only a minimum of trouble shooting information is included in this section, the next section has more information and help.

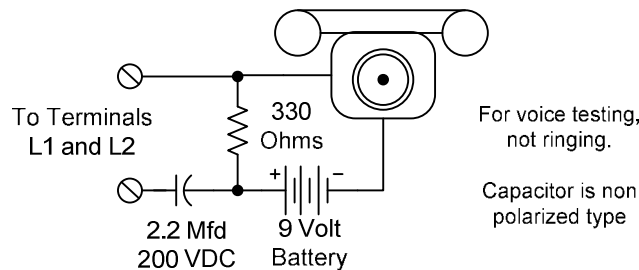
1. Inspect the phone for broken wires and compare the wiring to a diagram for your specific phone or use the generic diagram, be sure you are using the right diagram. A generic diagram for a basic Magneto Telephone is on the page 29 of this document. Keep in mind that wiring changes and parts substitutions were common when these set were in service.

2. Identify the line terminals, probably labeled L1 and L2, and the battery terminals or battery wires. There may be another terminal labeled G and there may be a ringer wire on it. This was an option for grounded ringing. The G terminal may need to be connected to L1 or L2 when testing ringing.

3. Turn the crank on the magneto, the bell should NOT ring, if it rings the phone may have been re-wired. Almost all phones removed the bell in the set from the circuit as soon as the crank was turned, this was to apply maximum ringing power to the local battery line. The receiver should be on hook during this test.

4. Connect a standard telephone with a mechanical bell to the line terminals of the set, turn the crank. The bell in the standard telephone should ring. If not check the wiring in the magneto telephone or measure the voltage output on the magneto. You should get a minimum of 70 Volts AC. Check for grounded ringing. At this point the talk circuit and battery are not connected. With a meter measure AC voltage across L1 and L2 when you turn the crank, it should be 70 to 100 Volts AC.

5. Set up this circuit for the standard telephone:



Connect the above circuit to the L1 and L2 line connections on the magneto telephone. Connect the 3 volt battery, from page 6, to the battery terminals or wires in the magneto telephone. You should be able to talk from one telephone to the other telephone. You MUST stand your magneto telephone upright for the transmitter to work properly.

Now your Magneto Telephone Set is fully tested and it will now be 100% in working order and ready for a conversion.

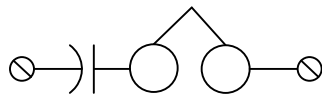
Your Magneto Telephone not working? Something not quite right? Continue reading, you may have a few repairs to do.

Testing Individual Components

Tests in this section are based on the assumption that the wiring in the telephone has not been changed. If you can find a diagram for your telephone verify the wiring is correct. This section will explain how to test each individual part. Look for broken wires first if your telephone does not work. The objective is to get your phone to work the way it did originally and then convert it.

The Bell:

Disconnect the bell from the circuit. You will need a source of ringing current to test the bell. If you have a Key System power supply with ringing, you can connect the bell to the ring generator and see if it rings. The bell can be connected to a standard telephone line, with a ringing capacitor, 0.47 Mfd 400 VDC, in series with it, and tested that way. If it does not ring, try one coil at a time, one of the coils may be bad. If you have a good magneto it can also be use as a source of ringing power. You can also check the coil resistance with an ohm meter to see if one of the coils is bad, each coil should be the same.



Screws are the Common Battery Line
Capacitor is 0.47 Mfd 400 VDC

Common problems are, one bad coil, or a weak magnet. Magnets are not easy to replace or re-magnetize. One possible solution, that may work, is to place a Neodymium magnet about 1 ½ inches long on the existing magnet. This only works if the existing magnet is very weak and then only about 20% of the time.

If there is a spring on the bell and the magnet is weak, adjust the spring for minimum tension or no tension on the clapper. You may need to make the phone ring a number of times while you are adjusting the spring tension and the gongs.

The Hook Switch:

Make sure the contacts touch each other when the receiver is off the hook. The contacts should be cleaned, even if they look good. Cut an index card in one-eighth inch strips. Place one of the strips between the contacts and hold the contacts closed, draw the strip between the contacts so the strip acts as an abrasive cleaner. A black line will appear on the strip, continue until the black line disappears, it may take several strips to do this.

The Magneto:

The magneto generates 20 Hz (approximately) at 70 Volts AC or more to ring the bell. Voltage output and frequency depends on how fast you crank it. A coil is rotated in a magnetic field. The more magnets on the magneto the stronger the output and the more bells it will ring. In the early days the alloys used for the magnets would loose magnetism after many years. Magnets are not easy to replace or re-magnetize. CAUTION: One side of the magneto circuit is connected to the metal case.

There are two parts to the magneto, the “magneto” part and the switch on the back of the magneto. Inspect the switch to make sure it is operating properly, when you turn the crank the switch should operate, make sure the contacts operate properly. Clean the contacts like you did for the hook switch.

Output can be checked with a meter, set to 200 Volts AC, measure the output, it should be at least 70 volts, more if you crank fast. Or, connect a standard telephone bell to the output of the magneto to test it. You can also use a 4 Watt 120 Volt light bulb (night light) connected across the magneto, it should light about half brilliance and you should measure at least 50 Volts AC on your meter.

A drop of oil (small drop) on the bearings will make the magneto easier to turn. Also add a drop of oil to the gears, do not over lubricate. If it turns VERY easy, the magnets may be weak.

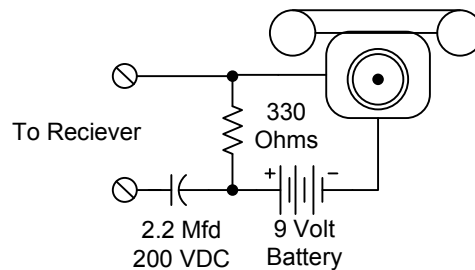
Remember, the magneto never rang the bell on the phone, all power was used to ring the other telephones on the line and the operator. If the bell in your old phone rings, it is probably wired incorrectly.

The Receiver:

First check the cord connecting the receiver, use an ohm meter or a simple continuity tester. Look at the oldphoneguy.net web site under "Telephone Projects" for a continuity tester.

Other than the cord, the two most common problems are a bent diaphragm or a weak magnet in the coil. In either case it would be best to replace the receiver with a new one or a capsule receiver from a Trimline® or similar phone. You may need to add a weight as modern receivers are lightweight.

Another test is to use the test circuit:



Attach the receiver to the test leads, the lines with the screw symbols. Talk into the standard telephone and you should hear your voice loud and clear in the old receiver. You may need a friend to help you, it works best with one person talking and the other person listening, if you run 25 feet of wire to do this it would be a much better test, as talking next to a person that is listening via the receiver confuses things. You can judge the voice level better from far away

The Transmitter:

As carbon transmitters get old the carbon gets packed and dirty and is not as loose as it should be. You can remove the carbon "button" and tap it firmly on all sides and put it back in the phone and try it again. The tap is more of a bang to jar the packed carbon grains and break them up if stuck together.

To test the transmitter, use the test circuit. In the above diagram, with clip leads connect the transmitter across the resistor in the test circuit and listen in the standard phone. The 25 foot rule applies. Listen for

quality, if bad, remove the transmitter button and tap it some more, if no improvement you probably need to replace the transmitter.

It is possible to remove the carbon grains from the transmitter and clean them with 90% rubbing alcohol but this is a very advanced operation. You can also replace the carbon grains using some from a T1 element. The G handset has a T1 transmitter element. T1's are high output transmitters, more volume.

The best solution is to replace the original transmitter with a T1 element. This is a bit tricky, you need to carefully clip the perforated cover of the T1 element, making a 1" hole in the cover, allowing more sound waves to enter the T1. You will also need to solder wires to the back of the T1 element, do it quickly so as not to overheat the T1.

Spacing the T1 and getting it in the proper place is somewhat tricky. The easy solution is to use a simple cardboard gasket between the front of the T1 and the back of the screw in plastic "funnel", a folded 3X5 card with 1" hole works good and hold it in place by stuffing the transmitter with a paper towel or plastic foam. This is crude, but effective.

Some older transmitters do not have a removable button and attempting to repair them may damage them. Replacing them with a T1 element may be the only solution.

The Induction Coil:

If the phone does not have a battery attached and the receiver is on the hook, an ohm meter or continuity tester can be used to see if the windings are intact. There is no repair for the coil or easy substitution. Check for wires that are broken where they solder to the terminals. A bad induction coil usually means you will need to abandoned this project and simply install a modern network and components from a standard telephone. Perhaps with some good luck you can find exact replacement for the bad induction coil.

If you have a 3 winding coil and the circuit is different from what was shown in the drawing in this booklet you will need to remove the connections from the coil (in most cases or the handset) and make continuity tests. This type of coil is present in desk magneto telephone with handsets.

This completes the testing of your magneto telephone. Hopefully you did not find too much wrong and were able to repair what minor problems you had.

Next, several types of conversions will be presented. Carefully consider your options. You can be 100% authentic using the original wiring on your phone and the conversion circuit, or 100% new or something in between. #6 dry cells are no longer available easily and do not provide adequate voltage for the conversion circuit. For the conversion design you will need to use a wall wart. Telephone collectors sites have a "drawing" of the #6 dry cell to print out and wrap over a piece of plastic pipe or a mailing tube , and you can even build the circuit inside the fake battery and make it look "authentic".

Conversion – General Information

There are number of things to consider when you convert a magneto telephone to work with a common battery telephone system:

- 1) It was never designed to work this way. Safety is important, the magneto set must be “isolated” from the common battery line.
- 2) Some wiring changes may be necessary. Several options on ringing are presented.
- 3) You cannot have the ringing power from the magneto go out over the common battery line. Do not make an attempt to ring the other common battery phones on your line.
- 4) The bell on the magneto set may take a lot of power from your common battery line if rung at full volume. REN (Ringer Equivalence Number) is important. You are limited to 5 standard ringers on your phone line and the magneto bell may be has high as 2 or 3 standard ringers.
- 5) Batteries are impractical, a wall wart solution is necessary.
- 6) Very old transmitters and receivers tend to be poor sounding compared to an F or G handset. Replacing the old units with modern units, such as in a G Handset, may be necessary. Some modern phones have a much smaller receiver element that can be used.
- 7) Ignore all the problems, convert it by installing a network from an old WE 500, put it in your hallway or by the front door and make it ring. It will cause your friends to make a lot of comments and compliment you on your work. But, it will no longer be an original local battery telephone.
- 8) Don’t convert it, just make it work, get a second magneto phone and connect both of them with a pair of wires.
- 9) The sound of the old transmitter may sound like you are talking in a tunnel, this is normal. The sound in an old receiver may sound “tinny”, this is also normal.

Several possible conversions with options will be presented.

Parts Sources:

All Electronics allelectronics.com

Mouser mouser.com

Jameco jameco.com

All Electronics has surplus parts, often costs are lower.

Magneto Table Telephone



STANDARD equipment furnished as follows:
 No. 1 hand microphone, resting on cradle switch, mounted on black enameled steel case, containing generator, ringer, and induction coil. Terminal block and lightning arrester supplied with each instrument.

No.	Description	No. Parts Constituted	Approx. Price
500	Series	3	300
500K	Bridging	3	300
500L	Bridging	3	1000
501	Bridging	4	1000
502	Bridging	4	1600
503	Bridging	5	1600
504	Bridging	5	2000
505	Bridging	5	2500

MODEL 11 THREE

The Battery Feed Circuit - Power

To provide the basic conversion, a battery feed circuit is needed. This will provide power to the transmitter and detect when the receiver is off the hook. A relay will detect off hook and the contact on the relay will connect the common battery line (dial tone) to the magneto telephone, via an isolation transformer.

A good source of DC is needed without any "hum". You will add a filter to the wall wart power supply.

A 12 VDC or 14 VDC wall wart will be used. It should be rated at least 0.2 Amps (200 Milliamps). Typically the voltage, without the load, will measure about 13 to 16 VDC. This should not be a switching power supply but a standard one with a transformer, rectifier and a filter capacitor, they are heavy compared to a switching power supply. Do not use a regulated power supply.

Filtering will be done with a 12 VDC miniature solenoid, it looks like this:

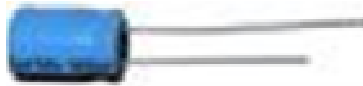


12 V 40 Ohms
\$3.00

Parts Source
allelectronics.com

Note that it has a metal shell around it, this will shield the magnetic field from the solenoid so it does not cause interference with the transformer. Typical resistance of these solenoids is under 100 Ohms. A standard choke filter coil would be better but they are not readily available. A surplus one from All Electronics, \$3.00, was used. It is more expensive at Jameco. Almost any 12 VDC solenoid will work.

This will be the same type of circuit found in a standard telephone power supply for talk battery. You will also need a filter capacitor, 1000 Mfd at 50 VDC. It looks like this:



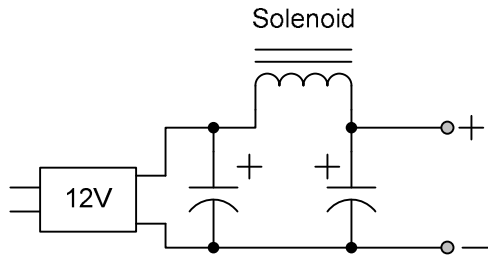
The power supply filter and other parts will be mounted in a plastic box, a larger box is preferred, about 5" by 6". Or, you can put the parts on a circuit board in one of the "fake" dry cell batteries.

Your wall wart will look something like this:



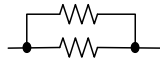
This is the circuit you will build and you can build it without the box and test it.

Filtered DC Power Supply for Talk Battery

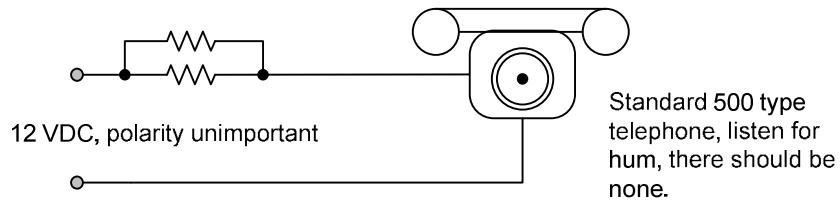


The solenoid is a coil of wire over an iron core, very similar to a filter choke. In this design it functions like a filter choke, tape the plunger in place. The capacitors are 1000 Mfd or 2200 Mfd at 50 VDC. The circuit is similar to that used in a standard 1A2 Key Power Supply

To test for hum, use two 1000 ohm resistors in parallel like this:



And, connect them like this:



Listen for hum or noise in the telephone you should not hear anything but your voice.

At this point the power supply circuit is only "bread boarded" for testing. If you find you have hum, increase the capacitors to 2200 Mfd.

Safety First

Get a ½ Amp fuse and in-line fuse holder. Install this on one lead of the wall wart. This will protect against a short circuit that can overheat the wall wart.

This is a REQUIREMENT!

The Battery Feed Circuit - Relay

The relay serves two functions, it limits the current to the transmitter and it detects when the telephone goes off hook. The contacts on the relay, and the transformer, will connect the common battery line to the magneto telephone.

Every magneto telephone is a bit different and the current needed by the transmitter may vary depending on if it is the original transmitter or a T1. This circuit will allow you to adjust the current, and the transmit volume.

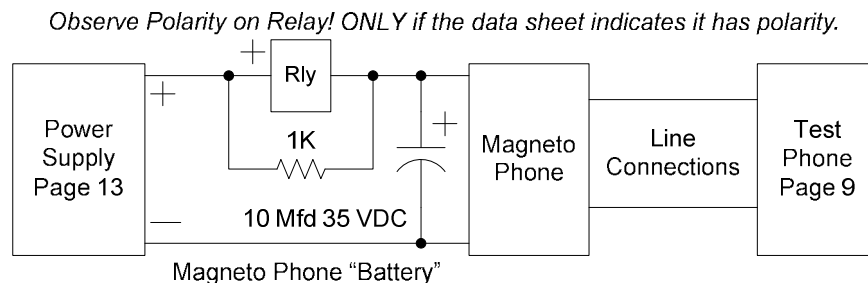
The relay is a small relay, 12 VDC, Double Pole Double Throw (DPDT) DIP package, 720 Ohms. It is a very common miniature relay, The relay may not allow the current to be high enough for the transmitter so an additional resistor(s) will be placed across it to allow more current to flow and simulate the 3 Volt batteries. The one used was a Jameco Part – search the catalog, cost was about \$3.

1000 Ohm resistors will be placed across the relay to increase the current. Approximate transmitter circuit current is:

Relay alone about - 17 Milliamps	
w/ 1 Resistor	29 Milliamps
w/ 2 Resistors	41 Milliamps



The current may be less if the transmitter has a high resistance. Set up this test circuit:



Listen in the test phone (Page 9) and determine how many resistors to use, if any, based on how the transmit volume sounds in the test phone. Remember it should be a bit loud to compensate for the loss on an actual call. You may need a friend and a 25 foot cable to do this.

The relay may have a polarity to it and you must connect it properly. Consult the data sheet on the relay, unless it is marked on the relay. All these relays are the same layout so any manufactures data sheet will work. Jameco.com sells the relay and has a data sheet.

The relay will operate when you go off hook. The relay makes very little noise, so you may not hear it operate.

Try one, two or three resistors across the relay and see how the magneto phone sounds in the test phone. The 25 foot rule with a friend applies here. It might be a good idea to make it sound a bit louder compared to a standard telephone.

The 10 Mfd capacitor is for audio bypass.

Once the test circuit is set up and you have gotten your magneto phone to work, you are ready to decide how you want the ringer to work and the options you want.

Typically this will be the voltages in the circuit:

Wall Wart	15 Volts	
Voltage on Relay	12 Volts	Relay will work 10 to 14 volts
Voltage on Transmitter	3 Volts	Could be 4.5 Volts

The Wall Wart is 12 Volts DC, but at the rated current. The transmitter circuit will not use that much current, so the voltage will be above the rated 12 Volts.

Dry Cells shown in the next few pages represent this power supply and relay.



Ringer Options – General Description

(A) Leave things alone. The bell will not ring (a non-ringing pass thru transformer is used and you CANNOT send ringing from the magneto to the phone line!). If you turn the magneto when you are off hook you could disconnect the common battery telephone line. This is the suggested option.

(B) Move the ringer to the common battery phone line. The bell on the old phone will ring, the magneto operates like option (A). You will need to add a 0.47 Mfd 400 VDC capacitor in series with the bell and it will add between 1 REN and 2 REN to your common battery phone line. REN is ringer equivalence number. *If you want your phone to ring Option (B) is probably the best and easiest solution.*

(C) Add a relay and make it work like in the movies. Typically in the movies when you see the phone cranked the bell rings. When an inbound call comes in, the bell rings. A relay is needed to make this work and isolate the local battery circuit from the common battery telephone line.

This also means wiring changes to the local battery telephone. This is necessary to prevent shocks, as some of the local battery metal parts may be connected to the phone line. This is true for all magnetos and sometimes the hinges on the door were used for transmitter and bell connections.

Option (C) is invasive and you loose authenticity, which to some collectors means you will be struck down by a falling telephone pole with open wire telephone lines and shocked to death by people cranking their unmodified local battery telephones.

A Note About Ringers

There were a number of ringers that could be used in magneto telephones. If you look at some of the old catalogs, the lowest resistance is 150 Ohms for each coil, this is 300 Ohms total. Compare this to a C4A ringer in a 500/2500 telephone that has a total resistance of 3650 Ohms. The C4A ringer has a ringer equivalence of 1.0 REN. You are limited to 5.0 REN (five standard ringers) on a common battery telephone line.

If you have a low resistance bell, the one with two 500 Ohm coils, then when you connect with a ringer capacitor of 0.47 Mfd your REN may be as high as 2.5, and this the limit the number of ringers you can have on your standard common battery line. You may want to use a 0.33 Mfd 400 VDC capacitor to reduce the ringing load on the common battery line and adjust the bell for minimum bias (make the spring tension very light). The web site oldphoneguy.net has information on how to determine REN. Do not connect ringers to the common battery line if the total resistance is under 1000 Ohms of both coils. The REN will be too high.

Before Construction

Before starting construction of the LB to CB Converter take a look at this site:

http://www.radiolaguy.com/info/No6_A_cell.htm

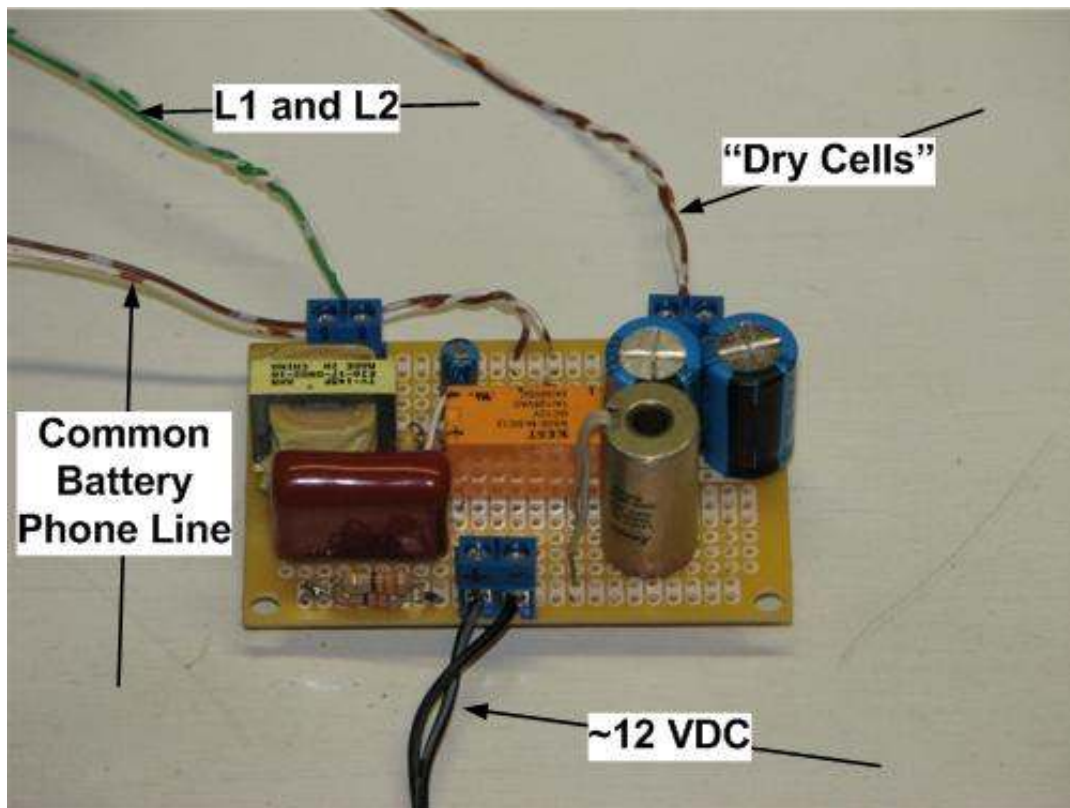
You can easily construct a replica battery and use the battery case put all the parts in. This way it will look very authentic and everything can be built into the magneto wall telephone. You only need to run in the common battery telephone line and the leads from the wall wart..



This site charges for labels. You may be able to find one for free if you search the internet.

The last page of this booklet also has a drawing you can use.

If you want to build the entire circuit on a small circuit board, you can do that. But, look at building it in the fake battery case, and make it on a circuit board that could fit in a battery case.



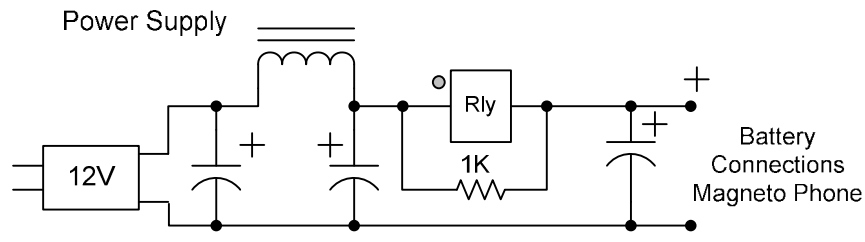
Construction by Bill Geurts

Construction Diagrams

Construction will be presented step by step.

Decide if you are going to make a fake battery and build your circuit in that or if you are going to build it in a small project box. The first part of construction is the power supply and the battery feed circuit. It is suggested that you construct two fake batteries. On the back of the fake batteries, make a small hole to interconnect the circuit and the wiring needed.

First is the power supply. Build this in the first battery and run in the DC from the 12 VDC wall wart on the yellow black of the line cord.



Refer to the Page 13 for the parts values. Observe polarity on the relay, if it has a polarity, and of the capacitors. See Page 14 about the 1K resistor and using additional resistors.

Next to construct is the interface between the Magneto Telephone Set and the Common Battery Phone Line. For this you will need a miniature repeat coil. This is a 1:1 transformer and is also known as a 600 Ohm to 600 Ohm audio transformer. Look at:

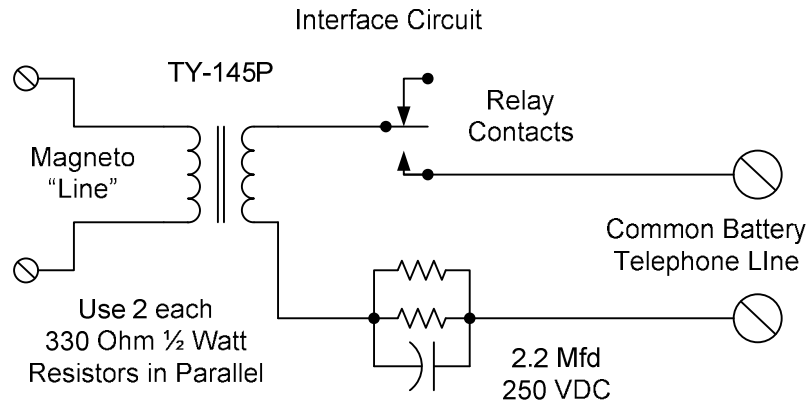


TRIAD MAGNETICS TY-145P Part no. 630459
Jameco www.jameco.com

This is a miniature version of a telephone repeat coil – It will not pass ringing. 600/600 Ohms

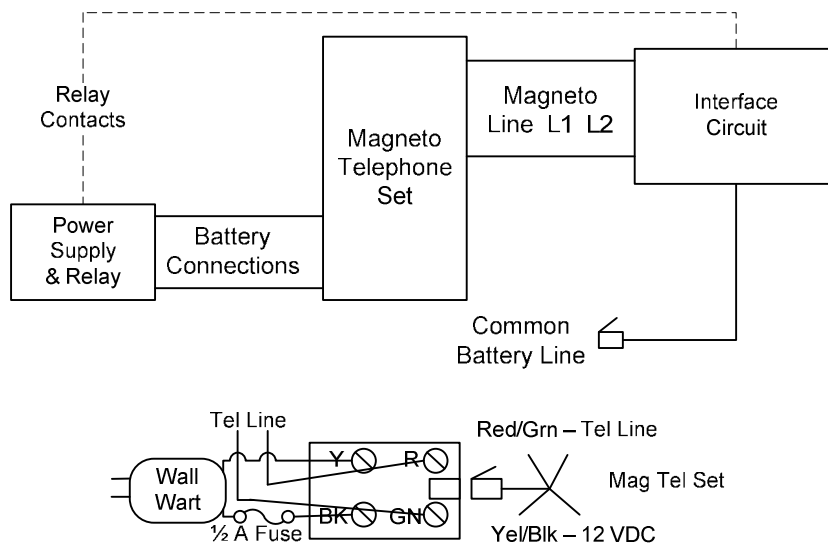
Second, construct the interface between the Magneto Telephone and the Common Battery line.

The data sheet for the transformer will state that it may not work with moderate DC current in one of the windings. This would be the current from the common battery telephone line. However, this does not seem to be an issue in this design.



The resistors are used to simulate the resistance of a standard telephone and the capacitor is used to prevent audio loss across the resistors.

Connect these circuits like this:



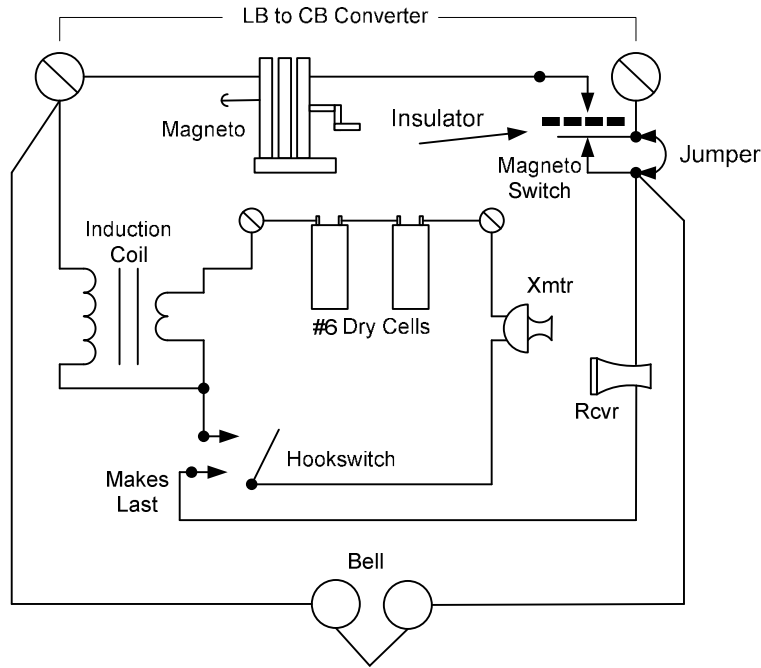
You will now have a working telephone that will pick up the Common Battery Line and you should hear dial tone in the Magneto Telephone Set. At this step in the process the Magneto Telephone will not ring. This is just to test the operation of what has been built so far.

No modifications have been made to the Magneto Telephone and it can be left this way and used to answer telephone calls. **DO NOT TURN THE CRANK!** Keep reading.....

Turning the crank may disconnect the common battery line and send ringing to the transformer. In most cases it should not cause any damage, but it could burn out the transformer. The transformer does not pass ringing to the telephone line, just a sound like 20 Hz ringing. All of this depends on the exact wiring of your magneto telephone set.

Minimal Changes

If you want to leave your magneto telephone set the way it and not make any modifications and you are happy with the bell not ringing and not responding to the magneto (as it should) then you only need to make one more change. Add an insulator on the magneto to prevent the voltage generated by the magneto from doing anything. This is a simple piece of electrical tape or a small cardboard spacer. Look closely at the diagram:



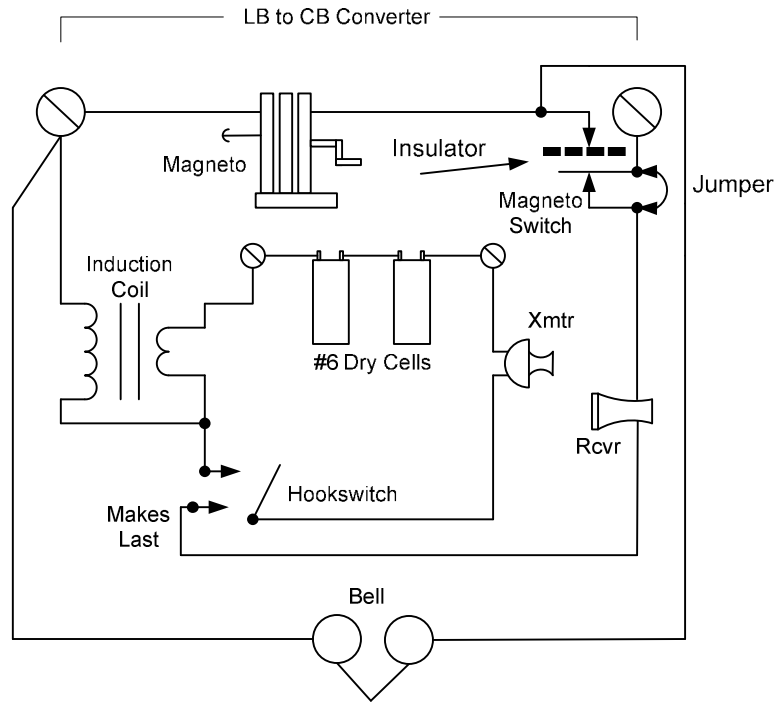
Note the placement of the insulator, usually just a piece of duct tape or electrical tape to prevent the magneto voltage from doing anything. A jumper has been added across two contacts on the magneto to prevent disconnection from the transformer, the audio path will be maintained. If you do not want to make any changes to the original wiring, use a short clip lead with alligator ends. This way you can restore your telephone at any time to the original wiring by removing a piece of tape and a clip lead.

Compare this diagram to the diagram on the last page and compare the changes. This is Option (A).

If you want to make a minor wiring change you can make the bell ring on the magneto telephone when you turn the magneto. You need to move one wire on the bell to the magneto. The bell does not ring on the common battery line, but it will keep your friends happy when the turn the crank and bell rings.

Compare the diagram on the next page with the diagram on this this page.

Local Battery to Common Battery Conversion



Anything beyond the above change is "major", well in the eyes of the old telephone collectors. This change will ring the bell when you crank the magnet. This could be called the "Movie" conversion, or it will be what people expect when they use the phone and crank the magneto. The bell will not ring when the common battery line rings.

Open Wire – Rural Service

Magneto Telephones communicated over a pair of open wires, the wires were not in a cable. Each wire was attached to an individual insulator on the pole. The pair of wires was transposed (twisted) every few poles.

A telephone circuit was miles long with a number of parties. Coded ringing was used. You could be two short rings and your neighbor, perhaps 5 miles away might have been one long and one short ring.

At the end of the call you placed with the operator you had to "ring off" with one long ring.

Ringling the Bell

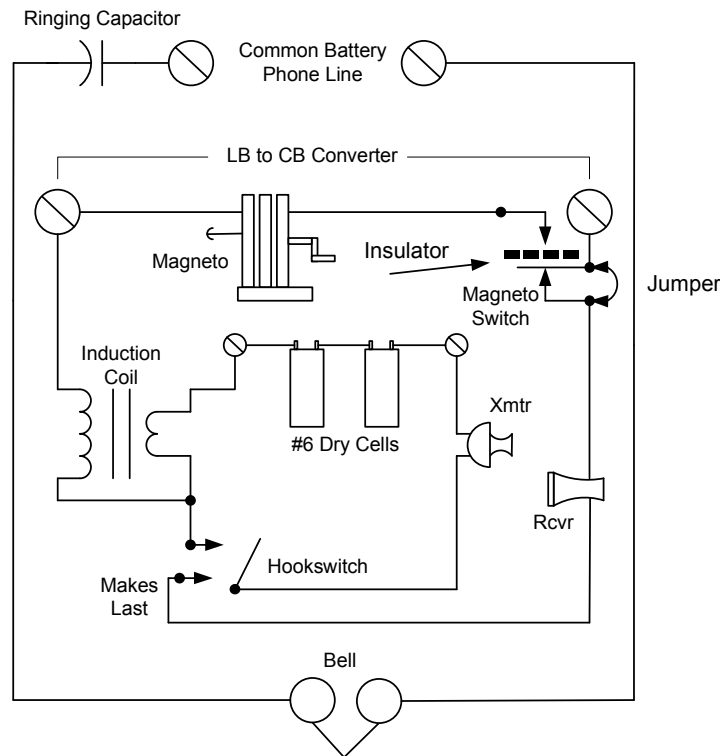
There are several choices if you want the bell to ring. The first is Option (B) moving the ringer from the magneto telephone to the common battery phone line.

Before doing this you need to determine the ringing load that the magneto set bell will present to the common battery phone line. You do not want to do this if the overall ringing load on the common battery phone line is close to 5 REN. Be sure to count everything that rings.

The ringing load of the magneto set bell is dependent on two factors, the ringing capacitor and the resistance of the coils on the bell. The lower the value of the ringing capacitor, the less of a ringing load, the lower the resistance of the bell coils, the higher the ringing load. This can get confusing.

A standard ringer (500 or 2500 Phone) uses a 0.47 Mfd capacitor and has a coil resistance of 3650 Ohms for an REN of 1. If you were to reduce the capacitor value to 0.33 Mfd the ringer load would be less, and the volume of bell would be less (the clapper will not be as vigorous). Capacitors are rated 400 VDC.

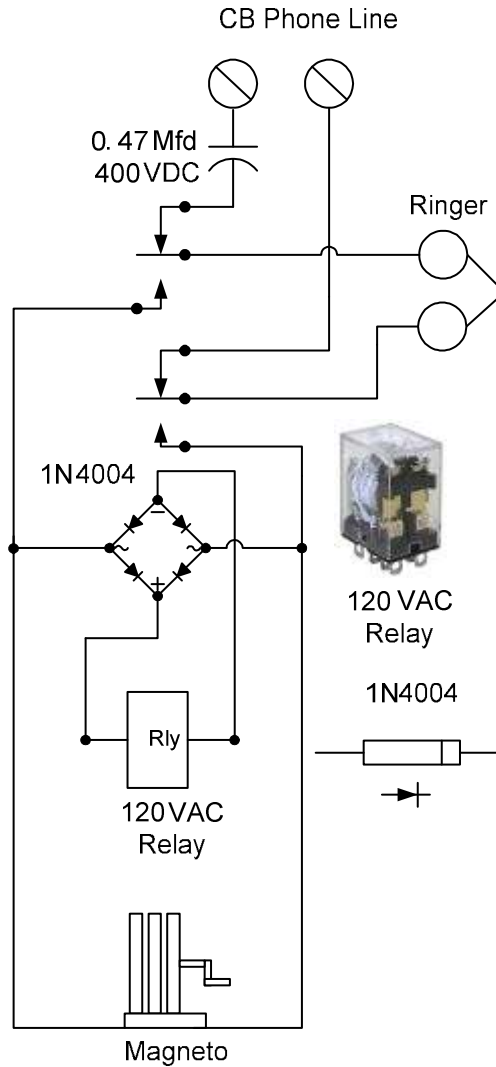
In most magneto bells you can adjust the spring for minimal tension or no tension, letting the clapper float. You can then use a lower value ringing capacitor, 0.22 Mfd or 0.33 Mfd, and the REN will be under 1 or perhaps 0.5 REN. You do loose volume, but if the magneto telephone set is not your primary ringer on your telephone line it will not matter. The ringer should ring for "effect".



CAUTION: If the ringer leads are attached to the metal hinges on the front panel you will need to re-run separate wires so there are no connections to the hinges.

Crank to Ring and Common Battery Ringing

Option (C) is invasive, as re-wiring is necessary. The bell will ring when you crank the magneto fast and will ring when the common battery telephone line rings. A relay is added, when the magneto is cranked it operates and transfers the bell from the common battery line to the magneto.



For the relay use a DPDT 120 VAC relay, it may click a bit if the generator is turned slow. The diodes are arranged in a Bridge Rectifier configuration. If you have a low output magneto you can lighten the spring on the relay to make sure it operates. Bend the hook at the bottom of the spring to do this.

Weak Magnets – A Possible Solution – Weak Magnetos

This has been placed at the end because it is a last resort. First look at these links:

http://www.ehow.com/how_4878360_old-magnets-using-neodymium-magnets.html

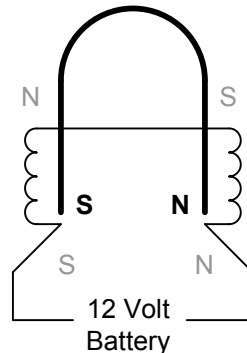
<http://www.nostalgiaair.org/References/Articles/TheFlash/Flash06.htm>

This will give you general information on re-magnetizing old magnets. Old magnets are made from materials that did not retain their magnetism. While they were called “permanent” magnets the metal alloys in use at that time were not as good as those today.

The article “Remagnetizing Early Horn and Paper Speakers” talks about winding a coil. In the original article it was used with a magnet that was not a horse shoe shaped magnet.

BEFORE removing the magnets from the magneto, mark each one with a TINY drop of nail polish, both on the magnet and on the magneto.

You will need to wind two coils, each with half the number of turns as discussed in the article.



Determine the North Pole of the magnet by checking it with a simple magnetic compass. Mark the North pole with medium size drop of nail polish. Connect the coil (wound over a cardboard tube) to a 1 ½ Volt dry cell and mark the North Pole with a drop of nail polish. Assemble your “magnetizer” as show above and follow the directions in the article.

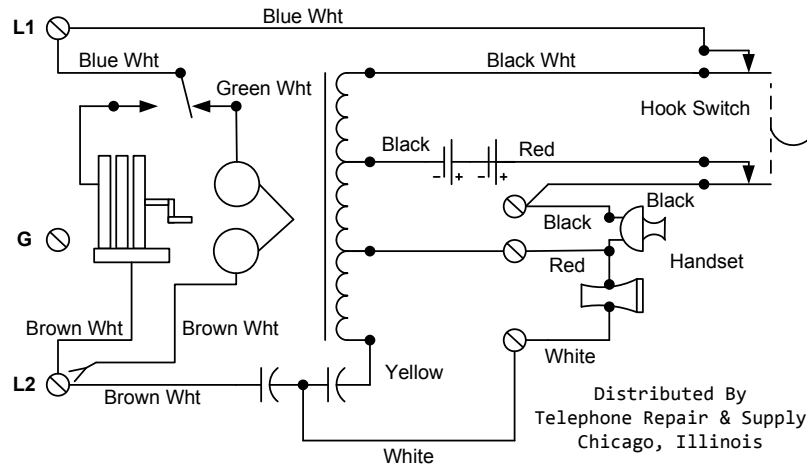
Note: When testing the individual coils you may need to reverse the way you have them connect together to make the magnetic poles as shown. Mark the positive connection to the battery with nail polish (hopefully you are using red to indicate positive). Each coil is 100 turns of #22 enamel copper wire. The cardboard tube should be a tight fit on the horse shoe magnet.

This circuit has not been extensively tested. But, it cannot hurt to try. You can try this with a “U” bolt from the local hardware store. Try to magnetize it. See if you can make it into a weak magnet, this will ensure you have the coils connected properly.

Other Magneto Telephone Circuits

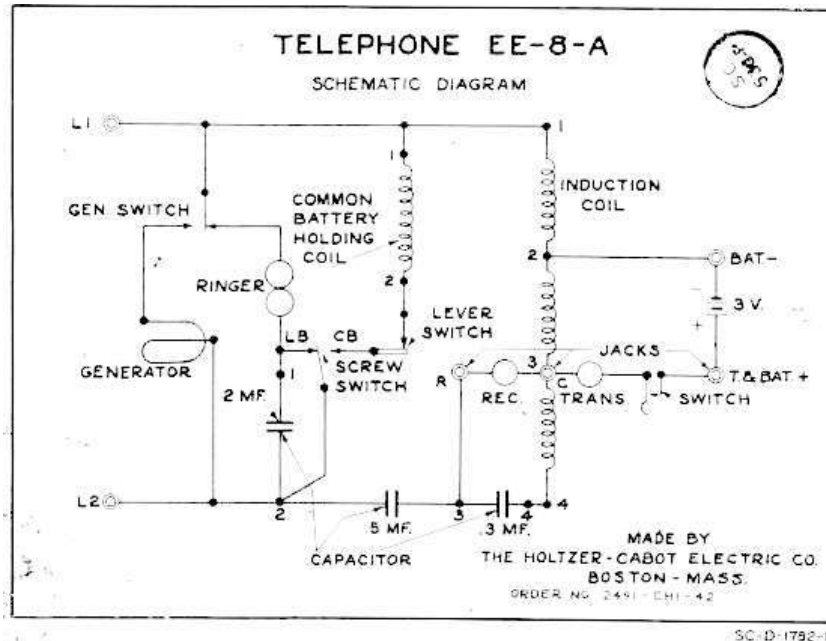
This is an example of the three winding induction coil.

Continental – 145-W-M Wall Type Magneto Telephone



For diagrams of other telephones look at this site:
<http://www.telephonecollectors.info>

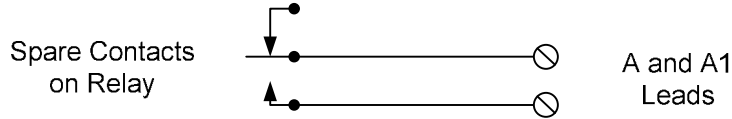
One of the classic magneto telephones is the EE-8 U.S. Military Telephone. It was often featured in the TV Series "MASH" and it will work either on Local Battery or Common Battery Telephone lines.



Both of these circuits are similar. The EE-8 has added a holding coil for common battery lines and a ringer capacitor.

1A2 Key Systems

1A2 Key Systems require an A lead or A Lead Control. This is a contact that closes when the telephone is off hook. There is a spare contact on the 12 Volt Relay and this can be used as an A Lead.



If this were Line One on the key system the wiring assignments would be:

Tip – White Blue Ring – Blue White A – White Orange A1 (Common) – Orange White

For other lines, consult a wiring diagram for a WE 565 or WE 2565 Telephone Set or similar AE sets.

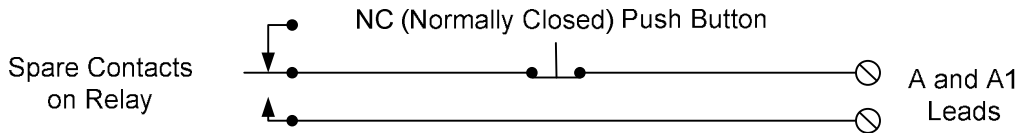
The other change is the ringer. If you want to connect it as a bridged ringer, meaning a connection on the telephone line itself, then just follow the instructions in the previous sections of this document and connect it across the Tip and Ring of the line with the dial tone. If you want to use it as a common bell then you will need to run an extra pair of wires from the ringer to the common bell line, powered by the Key System ring generator. While a ringer capacitor is not necessary, a 0.33 Mfd 400 Volt capacitor is suggested in series with the bell.

Ringing Leads on the 1A2 Key Cable: Slate Yellow and Yellow Slate (The common ringing pair on 1A2 Key Systems)

Ringing generators in Key Systems are limited in the amount of power they produce and it would be a good idea to decrease the ringing load, similar to REN, that the magneto bell puts on the line. If you have matrix ringing with diodes the magneto ringer will add a 2 ringer load, put a 1500 Ohm resistor in series with the magneto ringer.

There is no provision in the above arrangement to put a line on hold.

It is possible to add a small push button in an external box. When off hook, press this button, holding it pressed, hanging up the phone, then releasing the button you can put the line on hold.

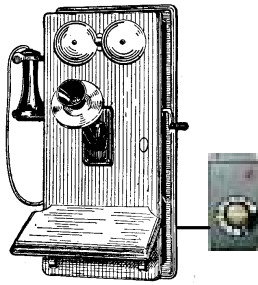


If you build the dial box in the next section it is easy to add this button and a line lamp.

There is another alternative, if you just want the hold button (or a way to put the line on hold) you can use a standard doorbell push button. The old fashioned simple ones work best and you can mount it on the wall by the hook switch. Arrange it to short the tip and ring of the common battery line. The sequence is: Push the button, hang up the phone and release the button. The line will go on hold.

Adding a Dial

Adding a dial to the Magneto Telephone can easily be done EXTERNALLY without any modification to the magneto telephone set. The external mounting should be something attractive that looks “telephone company” like. Most telephone collectors have an extra rotary dial of some type. To make this look authentic you need to do something like this:



The box is a black plastic box, the typical electronic project box. Mount the dial to the front of the box. If you want it to look “real” then get a decal used by telephone restorers with a manufacturers name, i.e. Western Electric if you have a Western Electric Magneto Telephone and apply it to the box to make it look real. The size of the box depends on your dial.

This is a bit of stretch But, with a little work it can be made to look very authentic and no modifications to the telephone are needed.

You need to identify two sets of contacts on the dial, the pulse contacts and the receiver contacts. There are two types of receiver contacts, shunt (shorting) and open. The shunt contacts short out the receiver, typically on an Automatic Electric Dial, and the open contacts break the circuit to the receiver, typically on a Western Electric Dial. Make sure these two sets of contacts are isolated from each other and not connected in any way. On Automatic Electric dials, there is a small metal jumper between the sets of contacts that needs to be removed, it is attached under the screws and is easily removed.

The dial pulse contacts are wired the same for each version of the receiver contacts.

You may want to connect a resistor capacitor filter across the dial contacts to prevent bell tinkle on the other phones on the telephone line. This will also increase the life of the dial pulse contacts. Use a capacitor value of 0.1 Mfd 400 VDC and resistor value of 220 Ohms ½ Watt.

Diagram for Receiver Shunt Contacts (AE Dial):

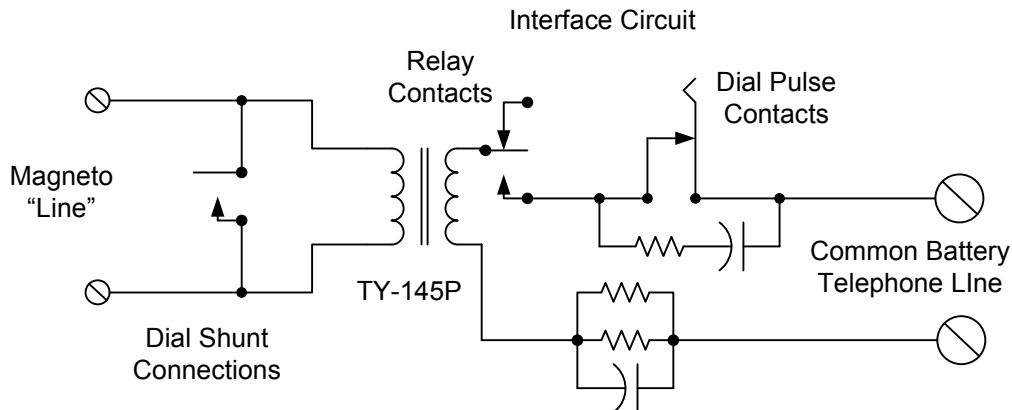
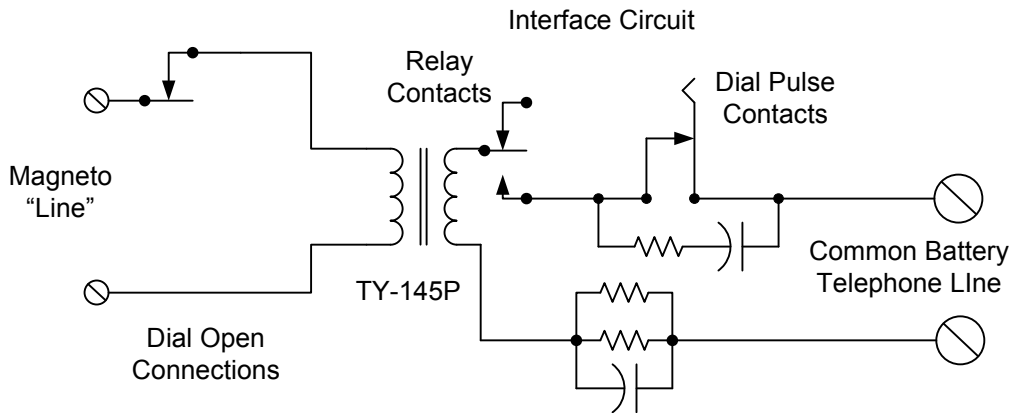


Diagram for Receiver Open Contacts (WE Dial):



Many older conversions installed a wood panel in the battery compartment and the dial was mounted to the panel. A magnetic cabinet catch was added to the front cover of the telephone set. This is also an option.

Selecting the right plastic box, adding a rotary dial and a decal makes the conversion look more authentic. The one shown in this booklet is for a 1A2 Key System, and had an indicator lamp and a hold push button.

The first attempt at mounting the finished unit to the wall, after testing the cords were moved a bit and the mounting was done a little better.



Final Thoughts

The goal of the conversion presented here is to convert your Magneto Telephone Set to work like a standard telephone on the common battery line that feeds your home. All this can be done without any serious changes to the original wiring, thus preserving your telephone.

By the time you take into considerations the number of manufacturers of these types of telephones, the options in the sets that were available, the field changes and sometimes the mixing of various parts from different manufacturers that were common by independent telephone companies, the number of possible combinations is almost endless.

The authors have over 100 years of telephone and electronic experience between them. It is our hope that this document lasts for another 100 years and that all those old magneto telephones out there are converted and brought back to life in the next 100 years.

Information on Your Telephone

Manufacturer _____

Date(s) _____

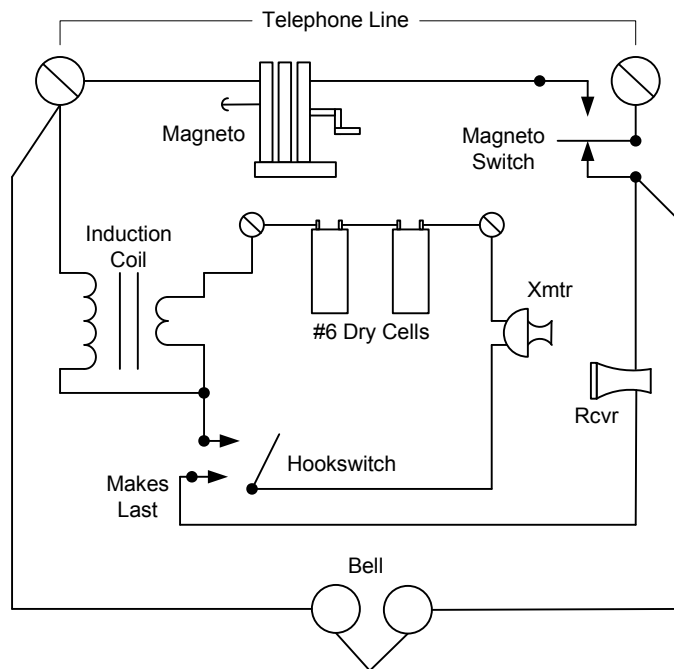
Original Owner/Location _____


Converted by _____

Date _____

Notes:

Generic Diagram – Typical Older Wooden Wall Telephone





Western Electric®

Dry Cell Battery

A Superior Product Designed for Telephone Applications and for Magneto Telephone Sets

Number 6 Dry Cell Battery
1 ½ Volts

KS-44-53573

This battery is manufactured to the highest standards and is designed for long life when used according to the specifications of the Western Electric Company

1 ½ Volts
Outside Terminal is Negative

Date Installed _____

Installed By _____

Made in the USA

Fake Dry Cell Label – Mailing Tube is 2.5 Inch Diameter by 6 Inches Long – Print on Gray Paper

http://www.radiolaguy.com/info/No6_A_cell.htm for information on how to construct the battery.