Telephone Electronics Line

TEL

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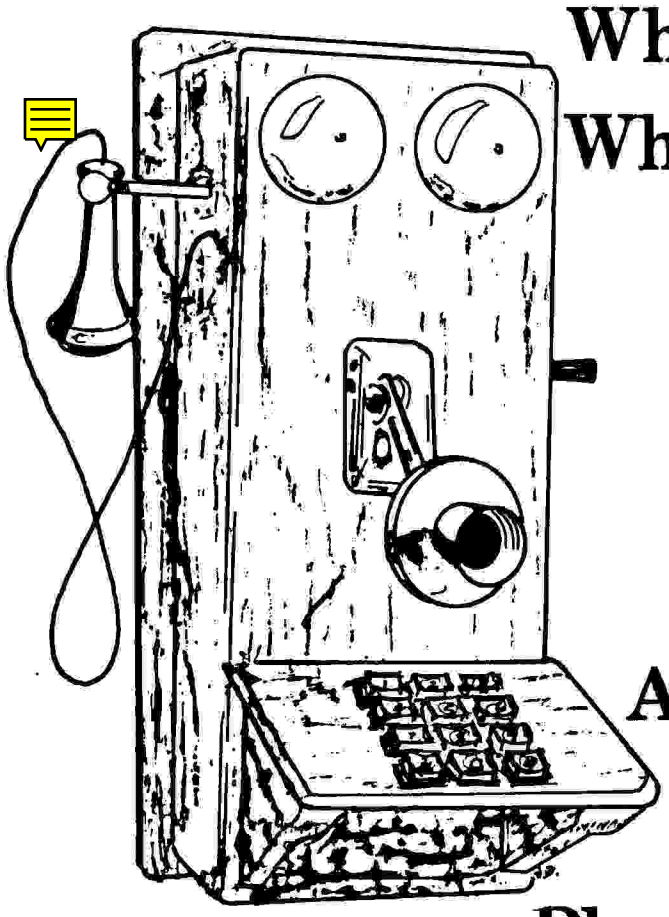
TOUCH TONE SPECIAL



What It Is

What It Does

Anatomy Of A Phone Bust

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Telephone Electronics Line

APRIL 1975 **Published Monthly** VOL 2, NO 3

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Editorial

By Jack Kranyak

It has recently come to TEL'S attention that Pacific Telephone has more than passing interest in our publication. About two weeks ago we recieved, in the space of a half an hour, two rather disturbing phone calls. Neither caller identified himself but both conveyed similar messages. The gist of which was that the Pasadena office of Bell telephone security was expressing the view that TEL would soon be out of business. Both callers had been told that telco security and legal departments were aware of us and "going to do something about it."

After a few moments nervous chatter we decided that the best aproach would be to confront Ma Bell's agents ourselves and find out what was up. The first call to the Pasadena number found the security officer "out for a second" and illicited a promise that he would return our call on his return. Two hours later we tried again, this time the object of our inquiry was "in". We mentioned the phone calls we had received earlier in the day and asked what it all meant. The reply was not what we had expected. We were told that there was no move afoot to close TEL down, but that the security department was of course aware of us. Upon further questioning it was admitted that the telco legal department was working on something but what it might be was not disclosed.

We assumed that our informants had misunderstood or over reacted to their conversation with the security department. However, when later that same day one of the original callers reached us again, he played us a tape of his conversation with Pasedena.

On that tape it was very clear what Bell's intentions were. They mean to close TEL down by whatever means possible. It is their contention that we are advocating defrauding the phone company as well as other illegal acts. Let us take this opportunity to "make this perfectly clear" TEL publishes it's articles for the purpose of informing the interested public what is happening in the world of telephony. It is a fact of life that toll fraud exists. The telephone is perhaps the most common thing in America, just about everybody has one. The average subscriber spends well over $90 a year for the use of this magic communications device. It is also a fact that for all intents and purposes the Bell system has a monopoly on telephone and long distance communication. Even where independent telephone companies exist, they must use Bell trunk lines to communicate with phones outside their own area. It is no wonder that so many Americans are fascinated with the Telephone system. "Cheating" the phone company while "that wouldn't be right" is a fact of American life.

Our magazine is about the telephone, and we report on all aspects connected with it. We epmhasize, TEL does not in any way encourage any illegal actions directed toward the phone company, or for that matter toward anyone. But just as America was spellbound by the cheating of "Watergate" so is Ma Bell just as alluring to many of us. There is a small pleasure felt by many in reading that someone has put it to her. □

Touch-Tone:

what it is

what it does

by JOHN REYNOLDS

Touch-Tone dialing has now been with us for over ten years. In that time it has made great changes in our telephone system. Many of these changes are not at first obvious to the average subscriber. The sittuation is analagous to putting a turbine engine in a regular auto body, the controls remain basicaly the same, but the machine is totaly different. What is Touch-Tone all about? Read on!

The need for the pushbutton telephone, as opposed to the standard rotary dial is not based on any one factor. Important considerations in the development of a push-button system were the need for faster dialing as well as the need for more accurate dialing. But an even more important reason was probably the greatest factor in creating Touch-Tone; the need to be able to transmit information (data) over the telephone lines.

The signals generated by a rotary dial are DC pulses that can only control local central office equipment, opening and closing circuits each time a digit is dialed. Further dialing after a connection has been made results in interruptions in the voice pathway. Even more important is the fact that there is no DC continuity between the calling and called telephones. This makes it impossible, without special equipment, to transmit the DC pulses.

Touch-Tone phones, however, generate AC signals in the voice frequency range that come out sounding like musical tones. These tones, or signals, pass through the central office equipment just as regular conversation would. They can therefore be transmited nationwide or worldwide. With a device at the other end to interpret these additional tones, the line can be used for functions other than talking. The banking business was one of the first to to put Touch-Tone data systems into operation and is using them for handling account transactions, billing and credit authorizations.

Touch-Tone dialing is an offshoot of Multi-frequency (MF) switching, which has been in use on toll and dial service assistance (DSA) switchboards for many years. It was never adapted, however, to consumer telephones because the system required proper filter circuits to guard against voice interference. A further reason for adopting a different pushbutton system for consumer use was that special equipment would have been required to keep subscribers from using the original MF tones to place free long-distance calls. Phone Phreaks have none-the-less managed to create their own tone encoders and are a constant irritant to the phone company. The original MF tones are shown in the following table.

MULTI-FREQUENCY SIGNALING CODE

Digit	Frequencies (Hz)	Digit	Frequencies (Hz)
1	700 + 900	7	700 + 1500
2	700 + 1100	8	900 + 1500
3	900 + 1100	9	1100 + 1500
4	700 + 1300	0	1300 + 1500
5	900 + 1300	KP	1100 + 1700
6	1100 + 1300	ST	1500 + 1700

Eight frequencies in the 700- to 1700-Hz range (the same range as for MF) comprise the four-by-four code designed for Touch-Tone dialing. The 8 frequencies, selected to avoid harmonically related interference from speech signals, are divided into 4

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Construction Project

add four new tones to your telephone

by MONTI RIEMAN

Have you ever heard anyone talk about 1633Hz. The 1633Hz tone is one of the Touch-Tone signaling tones used by the telephone company. It, when paired with other tones, can be used to access computors, loop-arounds for call conferencing, and a variety of other uses. Now the question is, how hard is it to get the 1633Hz tone? If you have a special use for it, the telephone company will install 16 button Touch-Tone pads. Or you can modify your existing Touch-Tone phone. Once you have the 1633Hz tone, you will have four new numbers on your Touch-Tone pad.

The first questions that come to mind are, how hard is it to modify the Touch-Tone pad? How long will it take? How much will it cost? Simple, 30 minutes, and about $1.00 to $2.00 for a SPDT toggle switch (Radio Schack Cat. No. 275-613, cost $1.29) or similiar. First you obtain a switch, how it is done follows.

First unscrew the screws on the bottom of your telephone which hold the cover and remove it. Look for the Touch-Tone pad and the supporting bracket it is on. Loosen the screw holding the Touch-Tone pad on its supporting bracket. Carefully remove the pad (be sure not to remove any wires) and remove the thin plastic protector on the top of the pad. Undo the protector on the bottom of the pad and let it stradle the wires leading through to the Touch-Tone pad.

Locate the two toroid transformers that generate the Touch-Tone frequencies. They are the big doughnut shaped things on the underside of the pad. If the transformer on the left has a plastic protector on it, take it off. Now locate the 3-pole terminal strip on the bottom edge of the pad about one-inch down from the toroid transformers. Find the terminal on the left and separate the two pieces of joined metal being careful not to break them off. Take a one-foot piece of insulated wire and strip about 1/8th of an inch off both ends. Take one of the ends and solder it to the outside half of the separated terminal (it is slightly off the edge of the P.C. board). Take another piece of wire the same length and solder it to the other half of the terminal. You should have some way to identify this wire from the frist one. Make it another color or put a piece of tape on the end of it. Twist these two wires together for now.

(Note: On some Touch-Tone pads the terminal strips are replaced by a yellow-orange wire. If this is the case, cut the wire in the middle and strip the two new ends. These two ends will correspond to the above mentioned terminals.)

Locate the toroid transformer on the left. There should be two strips of five solder

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CENTRAL OFFICE OPERATIONS

step-by-step exchange

by DAVID REESE

In a step-by-step office each telephone number has a location in a large matrix called an *intermediate distributing frame* and from there it is connected to a device called a *line finder.*

The line finder is a piece of equipment with ten steps up and ten steps accross. At each of these steps accross a customers line from the intermediate distributing frame is connected. The line finder has a pointer (called a wiper) which can make contact with each of the ten steps across. You might think of it as a ladder such as used in libraries, which allow the user to climb up as well as roll the ladder along to a different position. A linefinder may serve as many as two hundred customers, depending on the class of service and average percentage of calls.

When the telephone receiver is taken off the hook the line finder is alerted that you wish to make a call. The unit then searches for your line and connects it to a first selector, which when selected produces dial tone. This is an indicator that the selector is ready to receive dial pulsing. Each linefinder is connected to a first selector.

The selector is also a piece of equipment with ten steps up and ten accross. The wiper rotates accross the contacts until it finds an idle one. This process is a search for a second selector. If, for example, the first number dialed was a four, the wiper of the first selector steps up to the fourth level or step. The wiper then rotates accross the contacts until it finds an idle or unused second selector. This process is repeated as you dial, each digit signalling a position to a stepping switch. or first through fifth selector, until the connector *stage is reached.*

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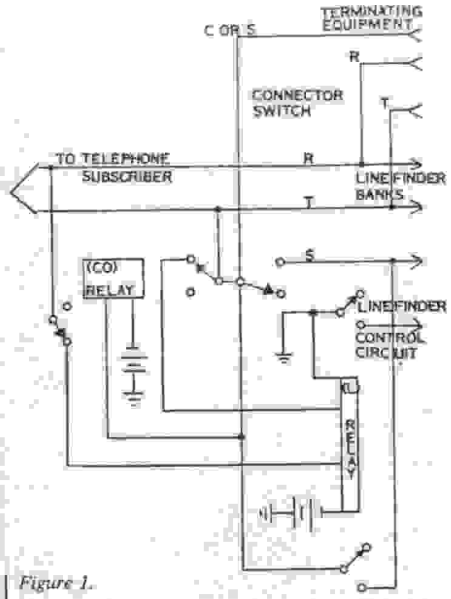

Figure 1.

T and R... Talking leads commonly called Tip and Ring
S..... Make-busy control lead
C..... Make-busy control lead associated with connector switch

Note that the circuit for operation of (L) is through the normally closed contacts of (CO). If relay (CO) should be operated on an incoming call (L) cannot operate. And, when (CO) operates in the first stage of an outgoing call (L) will release.

On an originating call, the operation of relay (L) usually causes the following actions:

1. *It connects the battery potential through the normally closed contacts of the (CO) relay to mark the calling line's position on the linefinder banks.*
2. *It grounds the ST or linefinder control lead to start a linefinder selector hunting for the calling line.*
3. *It prepares a circuit to make-busy the calling line to other calls. When the linefinder selector connects to the calling line terminals on the linefinder bank the (CO) relay will be operated, removing (L) from accross the subscriber's line and will make busy the calling line to incoming phone calls by extending the ground condition of the S lead to the terminating equipment. The release of the (L) relay will remove the ground state from the ST lead to free the linefinder control circuit.*

Anatomy Of A Phone-Bust or "how to get caught"

by BENJAMIN DOVER

I started phreaking several years ago as a result of an article in the October 1971 issue of Esquire magazine, but I was never in contact with any other "phone phreaks". I designed and developed my own "box" which was about 6 x 3½ x 1½ in size. After getting the bugs out, I used my box for about a year and a half.

Then, in the winter of '73 my Uncle got busted (I had made him a box too). Since my wife worked for Ma Bell it didn't ta[ke] long for them to get their suspicions [up] and put a tap on our phone. Then [on] March 10th, our apartment was raided [by] Bell and their gestapo stooges. Fortunate[ly] I had a little warning because they a[lso] tried on March 9th at 7 o'clock in the morning but didn't get an answer.

After tearing our apartment apart, and in the process stealing some good porno that they had no damn business taking, I was told that probably nothing else would happen. Let this, however, be a lesson— on March 20th I went to work at 11pm. (The D.A.'s office knew I worked nights) and at 11:45 the local cops arrested my wife on California Penal Code 702 (b) fraud, a misdemeanor. I went to bail her out as soon as I heard what had happened and they arrested me too! The bail was $300 each, more than we had, so I had to get a bondsman to bail us out.

I asked the cops why they had served the warrent so damned late and they said that the D.A.'s office had given them those instructions.

On March 24th my wife was suspended from her job as a frameworker at Pacific Bell. This job had nothing to do with phreaking, there were no parts or information which she could have supplied me even if she wanted to, she simply didn't have access to such things. (The phone company security people admitted this as well).

I saw no easy way out and hired the Law Offices of Richard Monroe in Los Angeles since they were reputed to have wild courtroom luck in fighting the Big Bell. After over $1,000 in attorney's bills, I found out that "hard evidence" (ie. a Blue Box) wasn't necessary for conviction. The tapes of five phone conversations, including codes and routings was evidence enough and was legal evidence in court.

Monroe told me that with expert witnesses and about 6 to 7 days in court, and a bill for about $5,000, I *might* beat the rap. So I changed my plea to "no contest" as part of a plea bargain. I was to pay the phone company what I owed them (about $140) and serve a little summary probation. They would in turn dismiss all charges against my wife.

With that settled, we went to court and appeared before Judge Beverly Rance, who incidently had signed the search warrant. She was willing to accept the plea as applied to my wife but balked when it came to me. I was referred to the probation department prior to sentencing and ordered to appear before her again in one month.

The probation officer tried to get me to admit that I still had a box, was still operating and that I had, in fact, made more calls than I had been charged with. I refused to play his game so he decided to stick it to me. He recommended both jail and probation, even though the phone company didn't want to press for jail at the time.

Back in court Judge Beverly, who has a reputation for being an old battle-ax, was

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DIAL TONE SPEED MEASUREMENT

part three

This article is the third in a series of articles dealing with telephone company plant engineering and maintainance. It is primarily intended for knowledgeable enthusiasts and plant employees who have a background in this field.

Each month a topic will be investigated as we progress into the field of telephony.

TIMING CIRCUITS

Testing and Calibration

Effects of Timing Error

If the effect of the fourth source of measurment error is to be minimized, attention to maintaining an accurate three-second timing interval is required. The effect of timing circuit errors on measurement error is illustrated below using a No. 5 Crossbar situation. In this demonstration two important assumptions are made:

1. The other sources of measurement error are ignored.
2. Dial Tone Delay is caused entirely by one component or groups of components. (The No. 5 Crossbar Origination Registers in this instance.)

Neither of the above can be totally ignored in considering the Total Measurement Error. In considering the measurement error of the DTS timing circuit alone, the second assumption becomes less appropriate as overloads increase because other components such as Channel Blocking and Dial Tone Marker Delay do contribute significantly to Dial Tone Delay. The additional assumptions that have been made for this illustration follow:

1. No. of Originating Registers. 25
2. Register Holding Hours. . 12" Variable
3. Service . . . . . Order of Arrival
4. Delay Curve
5. Number of Sources . . . . . Infinite
6. Timing Circuit Settings
   A. 3.0" (Correct)
   B. 2.7"
   C. 3.3"

The illustartion gives a comparison for the three occupancy levels (.70, .80 & .90) corresponding to typical ABD and 10-high day loading conditions. A comparison of the apparent DTS% over 3 seconds as measured by the DTS register circuit is made as shown below:

Step 1: Compute T/H for

the apparent DTS% over 3 seconds as measured by the DTS register circuit is made as shown below:

Step 1: Compute T/H for each Timing Circuit as follows:
   A. For 3" setting. T/H=3/12=.250
   B. For 2.7" setting, T/H=2.7/12=.225
   C. For 3.3" setting, T/H=3.3/12=.275

Step 2: From Approximiate Delay Curve Determine the % over T/H for each set of conditions.

The results are tabulated below:

Apparent DTS% over 3" from DTS register circuit (D/T x 100) for Timing Setting of:

Seconds: (T/H)	3"* (.250)	2.7" (.225)	3.3" (.275)
Occupancy			
.70	1.0	1.2	0.8
.80	6.0	7.0	5.4
.90	28.0	30.0	26.0

* correct setting

Recall that these are aproximate, for illustration purposes only, and substantially less appropriate for the higher occupancy levels wherein overloading occurs and other components inroduce actual delays. However, they do demonstrate the effects of inaccuracy in the 3" Timing Circuit. It is for this reason that precision in testing the Timer Circuit is essential.

METHODS OF DETERMINING ACCURACY OF TIMING CIRCUIT

The accuracy of the timing circuit can be appraised both by observing the number of tests shown by the Test (T) Register and more accurately by using a stop-watch and observing the stepping of the selector switches.

Observing the number of tests in one hour is simple and should be done for every day the dial tone speed is measured. To do this it is necessary to compute the the number of tests to be expected in the measurement period and to compare the actual number of tests to this standard.

A more exact test is one which will disclose the need for re-calibrating the timer of the vacuum-tube timer, or servicing or replacing the synchronous timer. It is done by using a stop watch. Recognize that the central office maintainance forces will be involved in this procedure.

Because of the differences between the two timing circuits, the procedure for applying these two techniques are described separately.

Cold Cathode Tube Timer SD-96403-01, using the number of tests (T) registrations:

1. General–The timing device of tube-type dial tone speed equipment is variable. It can be calibrated so that the dial tone speed tests will be made at approximately 3 second intervals.

   The maximum theoretical number of hourly tests registrations is 1200. The actual number, however, depends on:
   1. Number of test line assignments
   2. Distribution over DTS machine arcs.
   3. Number of Delays

   The expected number of hourly registrations must be computed separately for each DTS machine and must be taken into consideration in judging the validity of dial tone speed results.

2. Frequency of computations–The expected number of hourly tests registrations should be computed at the start of each busy season for various delay conditions expected during the coming busy season; after an equipment addition and after a change of assingments.

3. Method of computation–To compute the expected number of registrations for one hour the time interval for four steps of the operation of the equipment must be considered.

   Test of assigned terminal. . . 3 seconds
   Transfer to next assigned arc 1 second
   "Delay" encountered . . . . . 1 second
   "Sweep" of arc with less than 10 terminals assigned . . . . . 1 second

Table 1 shows a sample computation for an office which averages 24 busy hour dial tone delays.

Time per cycle = 173 seconds

Cycles per hour =

$$\frac{\text{Seconds in One Hour} - \text{No. of Delays}}{\text{Seconds Per Cycle}} =$$

$$\frac{3600 - 24}{173} = 20.6$$

20.6 cycles means that in the 21st cycle 6/10 or 34 (.6 x 56 = 33.6) of test terminals were scanned. Therefore, in the last cycle scanning was stopped after the fourth terminal af arc A–4 was tested.

4. Daily Check of Calibration
   A. Make daily comparison of the actual number of hourly test registrations with the expected number of registrations. Comparison should be made of both the

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Frame Class of Service: FLAT RATE MESSAGE RATE COM

Loading Division: T	26 SEL 373	30 SEL 375	26 SEL 377		15 SEL 379	Total
Register Assignment: D	374	376	378		380	
Arc:	A–2	A–3	A–4	A–5	A–6	
Number of Terminals	20	20	20	20	20	100
No. Assigned	20	10	20		6	56
Test Time (seconds)	60	30	60		18	168
Transfer Time (seconds)	1	1	1		1	1
Sweep Time (seconds)	0	0	0		1	1
TOTALS (in seconds)	61	31	61		20	173

Construction Project • tv remote control

by FRED BLECHMAN

For years inventors have been trying to devise a system that would "kill" television commercials *without* "requiring" viewer control. At last this has been accomplished and TEL now furnishes you with an exclusive description of the first Automatic TV Commercial Silencer. Using the latest state-of-the-art methods in digital technology, and utilizing regenerative circuits incorporating iterative logic, the Silencer automatically senses when a commercial is being broadcast, and "kills" the speaker of the TV. When the regular program material returns to the screen, the sound comes back on automatically.

Operation of the Silencer sensing network is based upon time-scan sequenced search-mode discrimination, allowing it to distinguish between the normal telecast and the commercial. The commercials are invariably a complete and radical departure from the regular program; if you're watching a wild western, the commercial is a sneaky, quiet one; if you're watching a tense, quiet drama, the commercial will feature sirens and gunshots. It is this programming contrast which forms the basis for the mode discrimination circuits in the Silencer.

Obviously, there are many types of TV shows, and the Silencer must be able to work with them all. The Silencer is "programmed" at the beginning of each show for the characteristic content and format. Notice the telephone dial in the photograph of the unit, by dialing the proper digital sequence, you program the Silencer to differentiate the commercials from the regular program material. Actually, when you dial the 3-digit code for the type of show you are watching, the dial contacts configure the logic matrix to accept certain key sounds, words and phrases from the program in progress. If these key indicators are not received by the unit repeatedly within discrete time periods, a commercial must therefore be in progress, and the TV speaker is disabled.

Some examples of the program parameters will help explain:

TYPE OF SHOW	KEY SOUND(S)
Mystery	3 gunshots in rapid sucession
Western	6 gunshots, followed by 6 dull thuds
Medical	"We'll have to operate"
Drama	Sobs, followed by hysterical nervous breakdown
Psychiatry	Hysterical nervous breakdown, followed by sobs
Adventure	Lion's roar, tiger's snarl, elephant's charge
Cartoon	Mel Blancs voice, any version
Comedy	"canned laughter"
Panel Show	Buzzer or bell
Wrestling	Grunts, groans and cat calls
Baseball	"...bullpen..."
Football	"...bench..."
Golf	....plink!
Tennis	....plink - plonk!

A different code number is dialed for each type of program you watch. This sets the logic and time-scan networks to discriminate the key sounds in the program material, and silence the commercial.

Unfortunately, while the system papameters and concept have been carefully worked out, some work remains to be done to complete the actual prototype. Based upon the latest estimates on the availability of the requisite quasi-metric filters, snitlatch memory cores and micro miniture laser modules, completion is expected around .... April Fools Day! □

PUC vs Telco

california ruling on interconnection

Consumers and businesses may soon be able to buy telephone answering machines, automatic dialers, data terminals and similar devices and connect them to their phone lines without paying installation fees or monthly charges.

The California Public Utilities Comission has issued an interim order that in effect undercuts the Bell System's near monopoly on telephone auxiliary equipment.

Until now, phone users who wanted to hook up their own equipment had to rent a protective "coupler" from the telephone company for $3.50 to $5 per month plus a $20 to $30 installation charge. The unit was intended to keep stray signals and high voltages from customer-owned equipment out of the utility's system.

But the PUC plan would eliminate the expense of the coupler—and thus encourage the use of non-utility equipment by making sure that independent manufacturers meet the technical standards set out by the agency in a 35-page manual.

If certified as safe by a registered electronics engineer or by American Telephone & Telegraph Co., the equipment could be hooked up without a protective coupler, the PUC said.

(Last summer AT&T said it would allow telephone answering machines with special circuitry approved by the PUC's order.)

Pacific Telephone & Telegraph Co., San Francosco, said after the PUC decision on Tuesday that it still believes the use of non-utility equipment will lead to service problems and higher costs.

The PUC order is subject to appeal to the courts, a company official noted, and PT&T's legal department is studying the matter.

It will be some months before devices bearing certification labels will appear on store shelves even if the issue does not go to court said Frank Widener, PT&T's director of regulatory activities.

The PUC order does not become effective until May 12. After that, registered electronics engineers will have to file their professional qualifications with the PUC, and manufactures will have to have their equipment checked and perhaps redesigned.

Meanwhile, the phone company will have to do some work of its own, Widener said. Its engineers are now desigining a special jack that will act as a "demarcation unit," he said.

If a customer reports trouble on a line connected to non-Bell equipment via a demarcation unit, Widener explained, repairman will be able to check the line up to these units without having to leave the central office. If the line is good, the company will tell the customer the trouble is in his equipment.

There probably will be a "token installation charge and maybe a small monthly charge" for the demarcation units, he said. These charges would have to be approved by the PUC.

The regulatory agency's order affects all the telephone companies in the state, not just PT&T.

It does not mean that customers who now have their own equipment connected to protective couplers can have those couplers removed, the PUC said, because there is up to the new standards.

The interim order is only part of a major-policy review now being conducted by the PUC. Still to be decided by the agency is whether switchboards and other business telephone equipment should be connected directly to phone company wires. That decision is not expected for many months. □

Dear TEL,

I am in touch with a large number of muffers in both Canada & America and regularly contact muffers in the U.K., France, Singapore and Cyprus.

"Phone Phreak" is strictly a U.S. Telephone Company term that is promulgated widely and whose intention it is to denegrate the Blue Boxer. In Canada we use the term Muffer derived from Multi-frequency (MF).

One article on MFing that you failed to mention was published in the Toronto Sunday Sun in December of last year. It gave a detailed description of a blue box.

I and others up here are more than prepared to assist in the defence of any poor soul who might be caught practicing their art here in Canada. It has to be limited to Canada since our laws are very different from those in your country.

I think that's it for the moment, I am prepared to handle inquiries as regards Blue Boxing, routes etc., except for overseas routings—it's hard enough already. I would ask anyone writing to me for information to include a dime for the return mail.

For an excellent selection of telephone directories from all over the world, in the Toronto area, go to the reference section of the Roberts Library. They even have a Moscow (not Idaho) phone book. Also, the Bell Library has copies of the restricted DDD information—it's located on University Ave., in Toronto.

Jon Hewson
Box 757, Station B,
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TEL is pleased to announce the addition of Monti Rieman to it's editorial staff

COMING NEXT MONTH

"TRASHING THE PHONE COMPANY"

CO OPERATIONS – CROSSBAR

CONSTRUCTION PROJECT: PHONE BEEPER

Dear Sir,

I found your Vol. 2, No. 2 issue of TEL very interesting! I would like a personal response to a few questions. Would you please explain the legal and illegal aspects of the "blue box" and/or "black box"? Also, could you please tell me the differences between these two units? Further, is it illegal to use a device that allows you to make long-distance calls toll free?

I have heard that people who used "blue boxes" or similar devices to make toll free calls, and were caught, were fined something like $10,000! Wow! thats quite a stiff fine. Does that sound logical to you?

Anyway, keep up the good work. I'm sure glad someone has the power to make such a publication.

R.F.F.
VT

Sorry, we can't write personal replies, so here's your answer in print. A "blue box" is a device which duplicates the telephone company's switching tones, allowing the user to "route" his own calls. The term "black box" is used to describe two different devices. One, also known as a "mute", allows a phone to be answered without charge to the calling party. The other, for monitoring telephone lines, is better known as a "tap". Further, it is quite illegal to use a device to avoid paying long-distance charges, it is known as "toll fraud".

P.S. Logic has nothing to do with the phone company!.

Phellow Phreaks,

I am interested in computer games, and attend science-fiction conventions. I am also very interested in telephones and the TWX teletype network. For those who have teletypes with programmed answerback wheels, try (201) 279-5956 for Western Union's FYI news service for TWX subscribers. Otherwise enter random garbage after it prints out "WU FYI MAWA" on your terminal. It will give out it's own instructions from there, if you get into it!

If there are any other TWX freaks out there, especially in the DC area, please contact me. I think my P.O. Box is safe, but I don't suggest a return address on the envelope. My answerback is TWX R4 PHREAKS.

Your phriend,
Osbert Kilgallen
P.O. Box 9486
Rochester, NY
USA 14604

Dear TEL,

Here is a tip on how to save money on an unlisted phone. Telco usualy charges NOT to list your telephone; on the theory that not doing something somehow costs more than doing it. You can, however, list your phone under any name you choose with your one free listing. For years my phone was listed to Bruce Wayne. My friends knew, and as for others, well my number was better than unlisted, not even the emergency operator could find it.

B.W.
Rough and Ready, CA

Gentlemen,

I am having a friend check the method described by H.S. of Mamaroneck, New York (TEL, Feb. '75) for accuracy. He could be wrong or he could have a freak system or he could have a wide open door—you never can tell!

On WATS lines—in the USA a "2" in the third digit of the exchange (800 - XX2 - XXXX) means that the number is valid for only one state. In Canada the one province code is the second exchange digit, I think it is "5" but I'm not sure.

For Western Electric equivelent equipment try Smith-Gates Corp., Farmington Conn. They make non-Bell equipment to Bell specs or better.

In the area of design, a Read-Only memory could be used to convert a Touch-Tone phone into a MF pad with a 2600 Hz mute tone.

Also, a shift register has the ability to store information and give it out in order, a MF pad with a "memory" is one such application. You might try a Texas Instruments TMS-3123 hex 32 bit shift register.

One further note. On some exchanges you can access the exchange and "walk around" in that exchange by modulating a 2600 Hz tone with a telephone dial and dialing the last four digits of the desired number in that exchange.

I enjoy reading your magazine. Keep up the good work.

X Sawyer
Wisconson, USA.

TEL welcomes letters from readers on all topics of interest, however, we regret that due to the huge volume of mail we cannot answer each letter individually. Letters of general interest will be printed as space allows, but we simply do not have the time to reply to the myriad of requests for technical information that arrive each day. We do, of course, appreciate your comments and try to slant our articles to your interests.

(Continued from Page 4)

low-band and 4 high-band tones as illustrated in Figure 1. Pressing a pushbutton results in the generation of two tones, a high- band and a low-band frequency. Pressing number 8 (TUV), for instance, causes the generation and transmission of the 852- and 1336-Hz frequencies. For the 10 pushbuttons corresponding to the 10 holes in the rotary dial only 10 frequency combinations are required. A four by three code is adequate, omiting the 1633-Hz frequency.

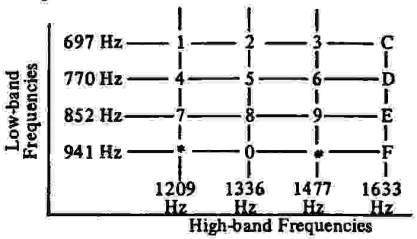
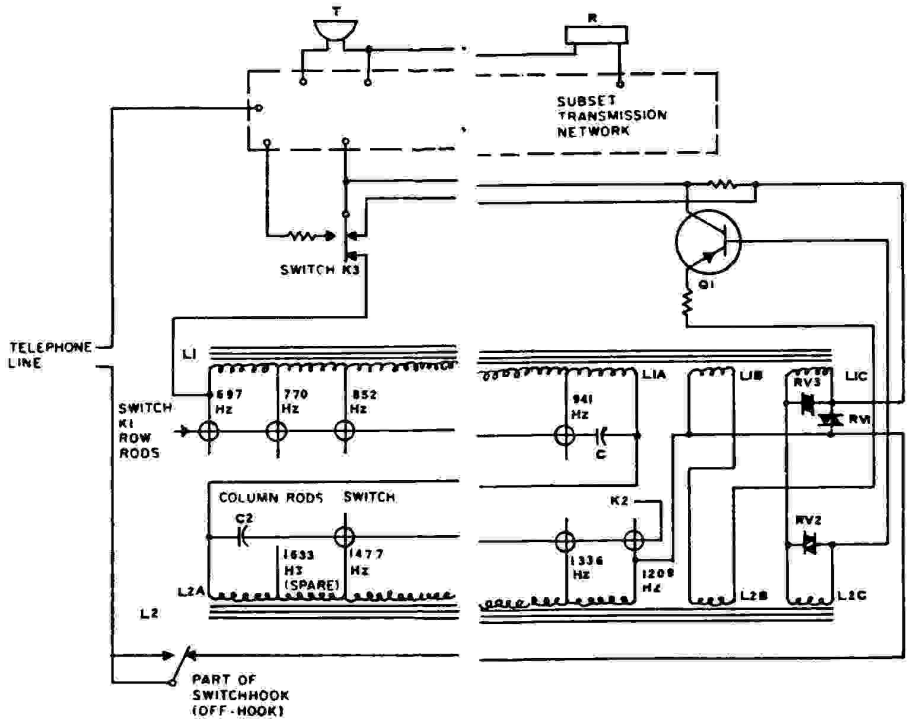


Figure 1: Touch-Tone Frequencies

The faceplate of the Touch-Tone set is planned for a capacity of four rows and four columns, or 16 possible pushbuttons. However, three rows and four columns are currently all that is needed for domestic subscriber use; ten for the digits 1 to 10 and two special functions designated by * and # which are used primarily for electronic switching offices.

The design of the Touch-Tone faceplate was not a simple task. In studies dating as far back as 1955, tests were made on various pushbutton arrangements—rows, circles, triangles, crosses, even one resembling the layout of the rotary dial. The different formats were tested for speed error rate and customer preference. Largely affecting the decision was the necessity to keep letters on the new pushbutton "dial". It was felt that any arrangement other than normal reading sequence (left-to-right and top-to-bottom) would be confusing. People used to adding machines will most notice this difference. It did not seem, however, to create problems for persons who used both the telephone and 10 key adding machines. There are now on the market, for those few people who demand such, special calculators with Touch-Tone format keyboards.

After design of the Touch-Tone pad the standard telephone was also re-designed to reflect the new square format. In marketing studies conducted by the Bell System 96% of the test subjects felt that Touch-Tone was an improvement.



GENERATION OF TOUCH-TONES

The Bell Touch-Tone telephone sets employ inductor-capacitor (LC) resonant circuits to generate the required tone frequencies. Recent electronic developments have introduced the use of integrated circuits reducing the 15 components in the inductor-capacitor network to six. In fact, Motorola and Mostek now produce IC chips which need only a keyboard and power source to produce all 16 tones. One reason why the Bell system uses the outdated LC system is that it cannot be retuned to the MF frequencies. But even that would be almost impossible because of the design of the Touch-Tone matrix. The tone pairs for the MF system, if diagrammed out, will give a triangular matrix, with some tones on both the vertical and horizontal axes. The Touch-Tone system, however, uses tones exclusive to either of the two axes, but not on both, resulting in a box matrix.

In the Bell LC system, pressing a pushbutton causes the rotation of two rods. One rod is associated with a row of pushbuttons, the other with a column. The pushbutton that is pressed determines which of a pair of rods will be rotated, resulting in the generation of two audio tones.

In Figure 2, a 500-type telephone unit is shown, equipped for Touch-Tone dialing with the frequency generating unit which includes two tuned circuits. Each circuit consists of an inductance coil (toroid transformer) of the *ferrite cup core* type, which has three windings and a capacitor. The windings are designated L1A, L1B, L1C and L2A, L2B, L2C, for the two inductors. Capacitor C1 is associated with inductor L1A and C2 is associated with L2A. Taps on the coil L1A are connected to the four rods linked with the rows of pushbuttons. The tuned circuit of L1A and C1 controls the generation of the low-band frequencies. Similarly, the taps on L2A and C2 form the tuned circuit to produce the high-band range of frequencies.

The operation of any pushbutton activates sets of contacts on switches K1, K2, and K3. One set of contacts on K1 is connected with each rod of the rows of pushbuttons. The contacts of K2 connect to the rods linked with the columns. K3 is common to all pushbuttons and is activated only during the later part of the sequence of events. In the normal position of K3, most of the current drawn by the transmitter T, will flow through RV1. Some current will also pass through L1A and L2A.

Assume that pushbutton 2 (ABC) has been pressed. The rod linked with the first row will close the contacts of K1. At the same time, the rod of the second column will close the contacts of K2. Activation of the contacts of K1 connects C1 to the first tap on L1A. Similarly, the operation of K2 connects C2 to the second tap on L2A, establishing the tuned or resonant circuits for producing the 697- and 1336-Hz frequencies. These frequencies correspond to the pressed digit 2 (ABC) but the tone signals have not yet been generated by the action of K3.

Not until the pushbutton is pressed all the way down does K3 operate, interupting the direct current flowing through L1A

(Continued on Page 15)

MEMPHIS– Larry Manning has been convicted of cheating the phone company of $1.86 in long-distance toll charges. Manning, a former South Central Bell employee, was sentenced by Federal Judge Robert McRae Jr.

"It may seem trivial to him", the judge noted, "but I think he still doesn't realize there was anything wrong with cheating the telephone company". Manning said he would appeal the two-year prison term.

(Continued from Page 14)

the pressed digit 2 (ABC) but the tone signals have not yet been generated by the action of K3.

Not until the pushbutton is pressed all the way down does K3 operate, interrupting the direct current flowing through L1A and L2A, causing shock excitation of the two tuned circuits, and thereby generating the 697- and 1336-Hz frequencies. At the very same instant, the central office battery on the subscribers line will be connected to transistor Q1, sustaining the 697- and 1336-Hz oscillations. The speech circuit in the telephone set will be shunted by the action of K3, but the subscriber will be able to hear the outgoing tone signal. Tones are not always heard by the subscriber. In Europe, for example, there is no audible output while dialing.

(Some people are bothered by the use of a single transistor to generate two audio frequencies, so the lower tone can be considered the frequency of oscillation while the high tone is called a parasitic oscillation, for the purposes of explaination.)

Additional equipment is needed at the central office for handling the Touch-Tone signals. Two principal types of receivers have been developed for use in existing electro-mechanical offices. One converts the tone signals into direct-current dial pulses, and the other signal detector translates the tone signals into a form which can be used by the common-control switching equipment. The Touch-Tone receiver and adapter units in central offices are designed to handle both rotary dial and Touch-Tone telephone sets.

USING TOUCH-TONE

Because Touch-Tone signals can be transmitted over any audio, carrier, or radio circuit, many persons—including radio amateurs—have adopted the system for control of various devices, such as FM remote-base stations and repeaters.

Because two tones are used for each function in the Touch-Tone system, reliability is excellent even when used on radio circuits that are noisy or fading. Another that has made Touch-Tone popular with some radio users is that many use *autopatch* connections to the public telephone network. By simply ordering a Touch-Tone line for the autopatch, the same encoders and decoders can be for both phone patch and repeater control.

For such applications it is necessary to have a Touch-Tone pad that is portable, i.e. not tied to your telephone. The pad from your telephone can be removed and used away from your phone. (Warning: Do not tamper with any instrument belonging to your local phone company.) The connections for Touch-Tone pads manufactured by Western Electric and Automatic Electric are shown in Figure 3. These Touch-Tone pads will work with as little as nine volts or as much as 24 volts DC applied. Either a high- or low-impedance output may be employed, as shown in Figs. 3 C and D.

Touch-Tone also has the advantage, due to it's audio characteristic, of being recordable. This use lends itself to autodialers and remote dialers. And, for those musically inclined, the Touch-Tone pad is a miniature electronic organ.

To get even more out of your Touch-Tone phone read the accompanying article for directions on how to add the 1633-Hz column to your present phone. □

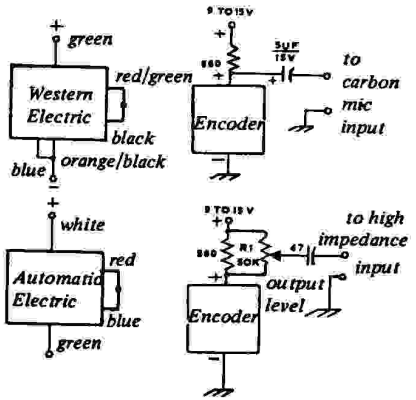


Figure 3: Typical connections for the encoders manufactured by Western Electric (A) and Automatic Electric (B). If low-impedance output is needed to drive a carbon microphone input, the circuit at C can be employed for either encoder. Likewise, the circuit at D will provide a high-impedance output. R1 can be any miniture composition control; the types made for mounting on circuit boards are ideal.

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(Continued from Page 4)

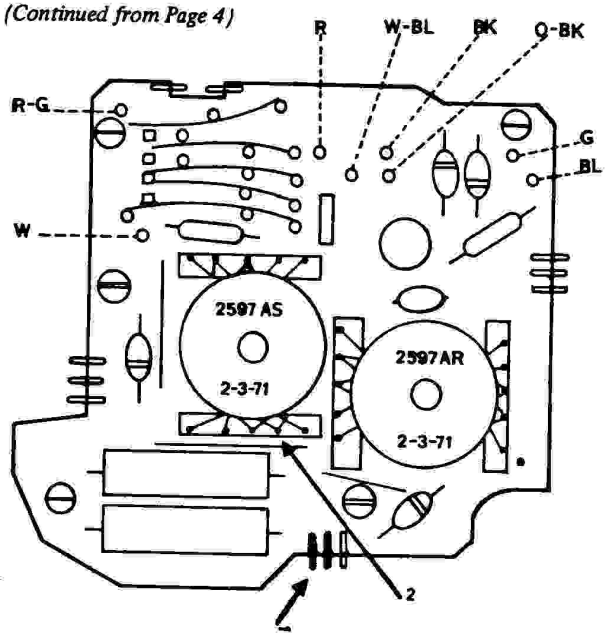


Figure 2: This drawing of a Western Electric 35 Y 3A Touch-Tone pad shows the terminal on the toroid transformer (1) and the connector (2) for modification of the pad.

The terminals indicated by letters represent the wire connections. Where only one letter is shown, the wire is solid color. 2 letters indicate that the wire is multi-colored. The first color is the basic color and the 2nd is the stripe color. R-red, W-white, G-green, O-orange, BK-black, BL-blue.

terminals at the base of the transformer. Locate the solder terminal strip closest to the bottom of the pad. It should be across from one or two yellow capacitors depending upon the specific model of your pad). Find the 4th terminal from the left. This terminal is the tap-off for the 1633Hz tone. Take another piece of one-foot wire and strip off about 1/8th of an inch. Solder one end of this wire to the 4th terminal on the toroid transformer. Make sure it is a good clean connection and not touching any other terminal. Take the three wires and run them through the hole in the plastic protector with the other wires already coming from the Touch-Tone pad.

Repalce all the plastic protectors. There should be one for the toroid transformer and two for the Touch-Tone pad. When all the protectors are replaced, put the Touch-Tone pad back in position on it's support bracket and screw it in place.

The switch may be installed anywhere but we recommend the following location. Look on the underside of the telephone's cover and find the two plastic hang-up pegs. Between them and about one-inch down, there should be a metal screw. Unscrew this screw and remove the plastic part. Be careful not to lose the screw, the part, or the two plastic hang-up pegs which will now come out with the absence of the plastic part. In the middle of the part drill a hole the right size for your particular toggle switch. Install the switch and put it in so that it will flip left to right. Now take the wire that you soldered to the tap on the toroid transformer for the 1633Hz tone and solder it to the left terminal on the toggle switch. Now take the two wires that were twisted together and untwist them. Take the wire that went to the outside terminal (that you created by separating the two pieces of joined metal) and solder on to the middle terminal on the toggle switch. Put the two plastic hang-up pegs (the part that now has the switch on it) and the screw back in place. Put the cover back on the phone. When you do this, be sure that the wires you replaced are under the hang-up switch. If they are on the top of the hang-up switch they will hinder its operation.

If you carefully followed the above directions, this is how your modified Touch-Tone pad will work: when the switch is thrown to the left your telephone is in normal Touch-Tone operation. When the switch is thrown to the right the last four numbers on the touch tone pad will be converted to your four numbers. What happens is that the four low tones, 697, 770, 852, and 941 will be paired with the 1633 Hz tone instead of the normal 1477Hz tone. When the switch is thrown to the normal position, it switches between taps on the toroid transformer. The reason that this circuit works is based upon the Bell Systems method of production. The basic Touch-Tone pad consists of a 4x4 matrix (see fig. 2), while the normal phone is equipped with a 3x4 matrix. In order to save money, the Bell System uses the same toroid transformer in both pads.

	1209	1336	1477	1633
697	1	2	3	FO
770	4	5	6	F
852	7	8	9	I
941	*	O	#	P

Always be sure that the switch is in the normal position when the four new numbers are not needed. If you leave the switch thrown to the right and forget about it, when you try to dial a number in the last row it will not be the proper digit signaling tone. If you forget and use the 1633 Hz tone instead of the 1477Hz tone you will probably get what appears to be a busy signal. If this happens enough you might receive a call from the phone company asking if anything is wrong with your phone. They may even send out a repairman to check the phone.

Sometimes, one may see a phone man pull up and not wish to see him for one reason or another. If someone under 18 goes to the door and says that no-one else is home, phone company regulations prohibit phone men from entering a dwelling under these circumstances. The repairman will go away—never to return. The phone company, most likely, will never send out another repairman. □

A LITTLE LEXICON

(A Continuing Feature from TEL)

Cable: A collection of telephone wires in a protective covering. Cables may contain up to hundreds of pairs of such wires.

Central Office (CO): A building where customers' telephone lines end and where those lines are interconnected with each other.

Dial Tone: An electrically generated sound which is heard when the telephone handset is removed from it's hook. It signifies that automatic switching equipment is ready to receive dialed numbers. Dial tone is generally a mix of two frequencies, 350 and 440 Hz.

Director: A device used in transmitting long-distance calls. It receives impulses from numbers dialed and activates other units of equipment which provide a route for a call to follow.

Distributing frame: The structure in the central office where customers' wires are joined with other wires so that cross-connections can be made.

Dropline: Paired insulated wire which leads from a customers' house to the nearest telephone pole or underground cable outlet.

Linefinder switch: The first switch in the step-by-step dial system used for connecting one telephone with another.

Pair: The two wires of a telephone line which handle various electrical impulses including dialing, ringing, and communications.

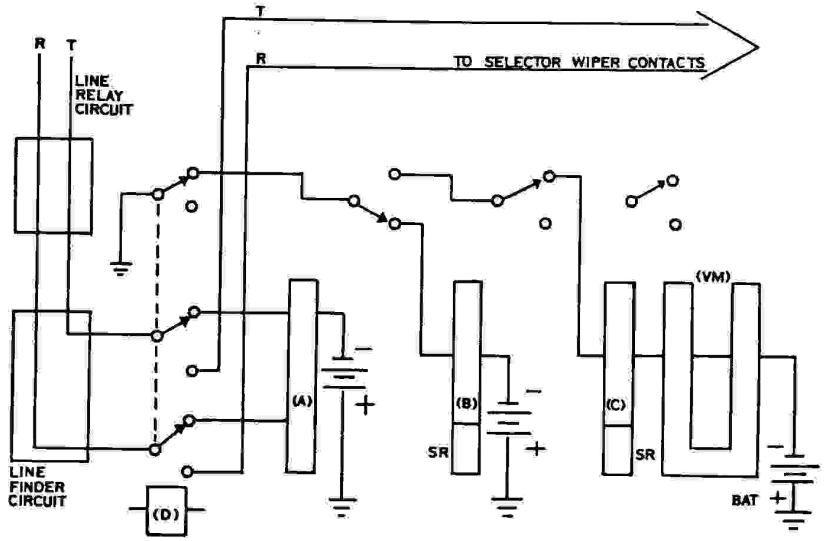
Test board: Equipment used for making tests of customer lines to aid in determining the cause of service breakdowns.

Terminal Box: The container, frequently on poles, where customer drop lines are connected. From this box, connections are made to lines in a cable. □

(Continued from Page 5)

After dialing the fifth digit you are connected to an item of equipment called the connector, or *final selector*. Again, there are ten steps up and ten accross. The sixth and seventh digits are both dialed on the final selector. The wiper of the final selector steps up to a level corresponding to the digit dialed. Say, for example, the sixth digit is a three and the seventh digit is a seven. The wiper of the connector steps up to the third level and rotates accross to the seventh contact. Thus, one connector takes care of the last two numbers dialed. It also serves to control all of the line relay reception functions such as ringing and supervision (supervision is used in signalling over inter-office trunks to indicate that the called party has answered).

In a step-by-step office, all the equipment –the line finder, the selectors, and the connector–are in use until the calling party hangs up. This is called *direct control switching*. With direct control switching there is always the possibility of all the equipment being in use at once, therby leaving some customers without service for periods of time. This problem is most severe in the early evening and is called a lock-out chain.□



BAT - Central office battery (48 volts)
T - Tip side of line
R - Ring side of line
SR - Denotes slow release relay
VM - Vertical magnet of selector
(A), (B), (C), AND (D) - Relays in the first selector circuit. Relays (A), (B), and (C), are operated during make interval of dial pulse

Relay (A) is held energized over the subscriber loop through the normally closed contacts of the dial. Relay (B) is a slow release (SR) type having a copper sleeve around the end of its core. Therefore, when (A) momentarily releases during the first break interval of the dial pulse, the current induced in the copper sleeve of (B) will keep it energized. At the same time that (A) momentarily releases, (C) and the vertical magnet (VM) of the selector will operate. Relay (C) is in series with the vertical magnet and both operate through the back contact of relay (A), during its initial release interval. The (C) relay is also slow release and will remain operated during the make intervals of the dial pulses of each digit. The vertical magnet raises the selector mechanism vertically in step with the break interval of each dial pulse. At the completion of the pulses, relay (C) will release because of the longer make interval between digits. This pause is due to the time required to pull the dial to the next numeral. The release of (C) allows the selector circuit to advance and initiate rotary motion in order to find an idle path or trunk. When this action has occured, relay (D) will operate, cutting through the circuit to the succeeding selector in the switch train.

(Continued from Page 6)

given the probation officer's report. She was visably pleased and told my attorney that the only thing wrong was that she had considerably more time in jail figured for me. (The report had reccomended 5 days.) So I ended up with a fine of $375; six days in jail (to be served on weekends); six months probation *and* restitution to Ma Bell in the amount of $145.27. Last of all I had to promise never to indulge in such activity again.

One interesting fact came out during this affair. My attorney and a friend of mine went to examine the phone company's evidence. Part of this was in the form of computer print-outs and revealed that in addition to my apartment, 12 others in our building had also been tapped. (A fact that is now denied, and probably erased from the computer in any case.) The purpose of the multiple taps is to see if you are, perhaps, using someone else's line to commit illegal acts.

In trying to analyze why we got caught, I can only tell a story of my own stupidity. First of all, we had an unlisted number for years and never had trouble. It wasn't untill my wife listed the phone in order to take her company discount that we stood out like a red flag. Ma Bell was checking up on the numbers we were calling. Second, we got careless with the passing time to the point of using names while calling. Third, some of my wifes calls were to Finland (where she comes from) and lasted in excess of an hour, which of course sounds the gong when they start checking for 800 numbers. And finally we were damned fools for calling from home at all! Once or twice a month, in an emergency, for 5 minutes or so probably would have been allright, but with modern detection equipment anything from home is really foolish.

I am now a little wiser, and out of the phone phreak business. I am still fascinated by the phone company, perhaps more than ever as a result of what has happened. I now collect what information I can on phreaking and the law. Take my advice, if you want to play with Ma Bell, get to know her first.□

(Continued from Page 8)

total test registrations and the test calls for each loading division.

B. Investigate any deviation between actual and expected which exceeds three percent.

First, re-compute the expected registration for the hour being investigated using the actual delays encountered. (As opposed to the average.)

If actual differs from expected as re-computed, perform a stop watch timing to determine if trouble is calibration or registers.

(Continued next issue)

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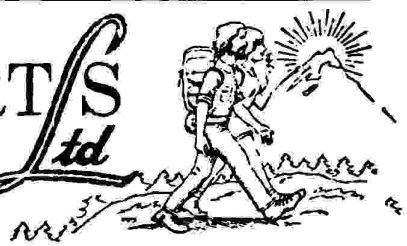

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