The Golden Age of Telephone Set Development

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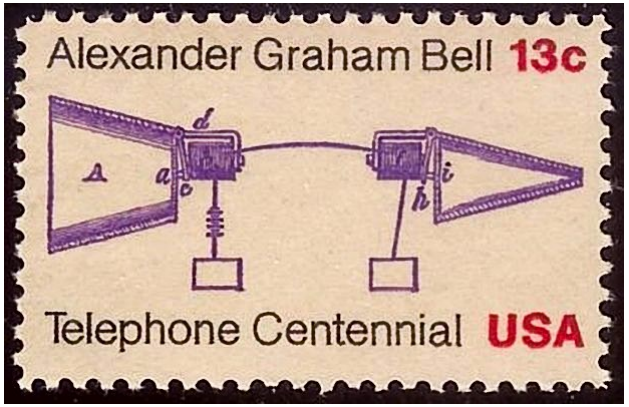
History

Fig. 76. Trådtelefon.

Lover's Phone 1860



Bell's Phone 1876

Edison Carbon Microphone 1877

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History

1876 No switching, telephones were sold in pairs

1882 Telephone Exchange (Central Office), only two calls at a time
50 customers: police, post office, doctors, 11 residences.

1891 Automatic Strowger Switch Central Office
http://www.technology.niagarac.on.ca/staff/mcsele/TelephoneSwitch.html

Common Battery in Central Office
Rural Telephones used Magneto Generator

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History

- 1881 Bell acquired Western Electric
- 1885 Northern Electric and Manufacturing Company.
- 1913 Northern Electric and Western Electric
- 1930 Anti-sidetone circuitry, Model 202 telephone
- 1947 The invention of the transistor
- 1955 Family Fallout Shelter
- 1956 Consent Decree Western Electric divest Northern
- 1962 Bell Canada purchased remainder of Western's interest
- 1965 No. 1 ESS
- 1968 the Federal Communications Commission: Carterfone

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History

- 1969 Apollo 11 lands on the Moon
- 1971 Northern Electric and Bell Canada merge R&D: BNR
- 1971 The Intel 4004 4-bit CPU
- 1972 Electronic Calculator HP-35
- 1973 Novation CAT
- 1977 Apple II
- 1977 BNR developed DMS-10
- 1979 Bell Canada shares reduced to 54.5 percent
- 1981 IBM Personal Computer
- 1987 Wireless phone company Fleet Call is founded

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Operator Headset

Switchboard

Traditional

Venture 1

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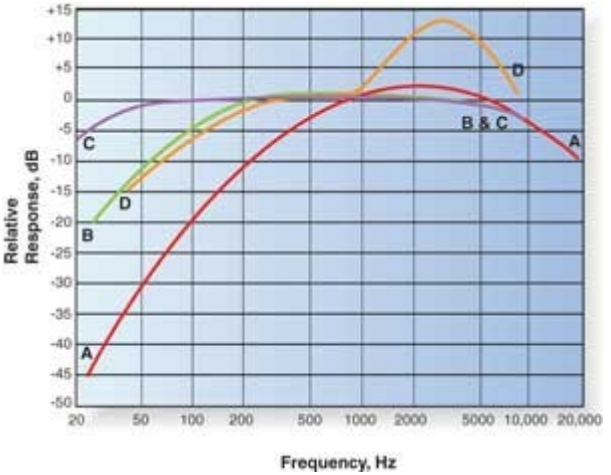
Electro-Acoustics



C Message weighting
Specification response to tenders for telephone sets

Telephone Set Testing

CCITT Reference Equivalent Testing
Subjective test
Only recognized standard
Panel of eight trained speakers in Geneva

Objective Loudness Rating equipment by Brüel & Kjær
Rotate handset four times to condition carbon microphone

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Interconnect Standards

FCC C.F.R. 47 Part 68 (1977)
DOC CP-01
DOC CS-03 Part I
CSA T510 (1987)
CSA T515 (1985)

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Contempra Telephone

Western Electric style Dial-in-Handset

Northern Electric style

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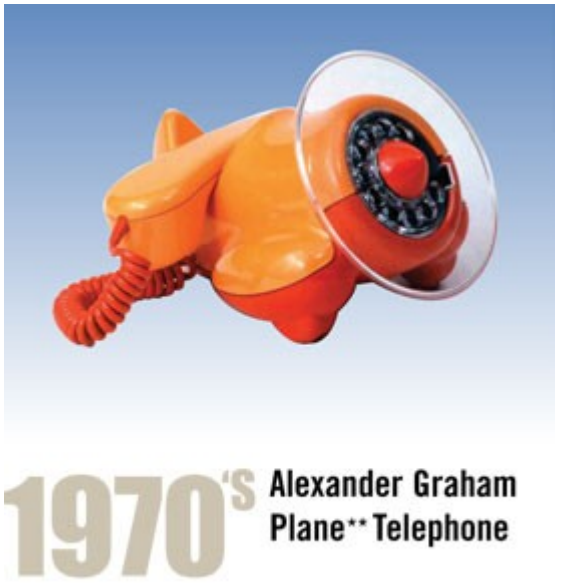
Decorator Telephone
Alexander Graham Plane



Just styling

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Decorator Telephone
Antique Look

Getting the microphone placed right was tricky

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Speakerphone

Companion II with Logic 10 with Extended Lines

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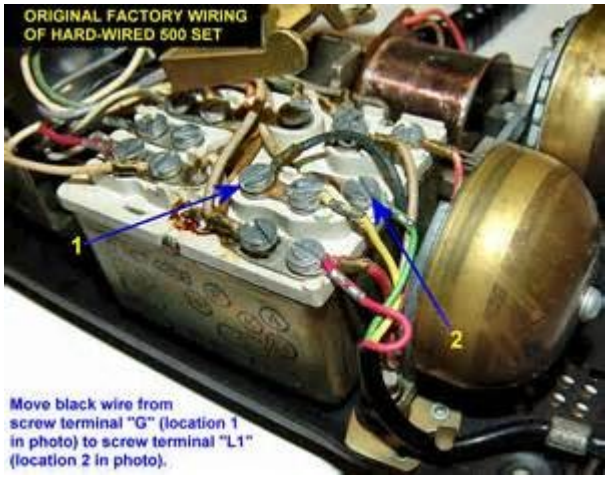
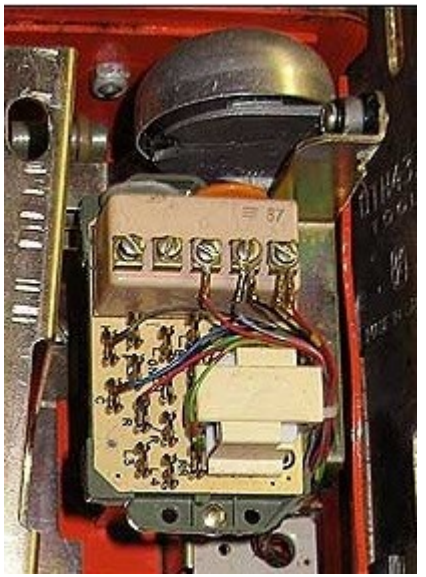
Cost Reduction - Anti-sidetone Network





Cost Reduction - Anti-sidetone Network

Convert to PCB design
No design information available
Used Campbell's monograph from 1949
Non standard component values
Single sided through-hole. Wide tracks and spacing
Punched PCB, not drilled, panel of 16
Highly reliable pick and place manufacture
Reliability calculated 19 FIT

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Patent – Transformer Cover

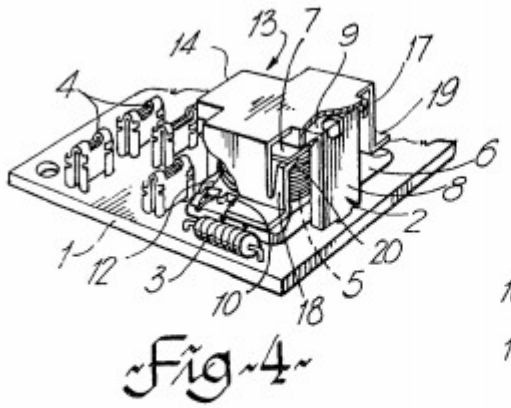

Fig-4-

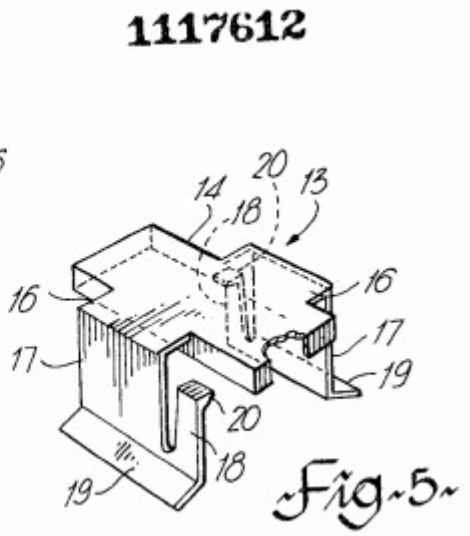

Fig-5-

Basically Bell installers were afraid of screwdriver slipping
Marketing wanted it patented, as a selling point

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Cost Reduction - Earphone

Ring Armature

Flux for Hearing Aids

Balanced Armature

Smaller
Cheaper
Plastic donut to position

No Flux leakage
Added coil to donut for deaf

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Cost Reduction - Ringer

Brass for ringer was expensive
Try to replace with aluminium

- Loudness
- Locate-ability
- Urgency
- Frequency

Didn't sound right

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Vantage 12 Key System

Central Controller with 8080 and two 8041 processors
Four 2kx8 memory chips (Last almost empty)
Each telephone had 8048 processor

I was buying masked ROM by 1000
BNR was using 2716 EPROM

I wanted redirection table and patches all in last ROM

Settled for function location at ROM border, so I only had to replace two ROMS at a time

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Visual Ear
Teletype for the deaf

Small box with 2 line 40 character LED display
Met CS-03 standards with respect to line levels
There was no crosstalk

Competed with homebrew teletypes
Designed by people that did not know specifications
Alternate devices had too high transmit levels
They had poor sensitivity to incoming signals

Our device didn't work with them

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Carbon Microphone

Essentially a sound controlled variable resistor

Anthracite from Morgan Mine in Pennsylvania
Rhingsdorf Mine in Germany

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Electret Microphone

Needed for Electronic Telephone
Current for carbon microphone now used by circuitry

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Electronic Telephone

3 Integrated Circuits

Ringer – High Voltage FET
Network – Low Voltage Bipolar
Dial – Low Current Integrated Injector Logic

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1st Electronic Telephone Set

Porcelain-on-steel dial, elastomer keypad
Mechanical Ringer
Sounded “funny”; people missed the 20% distortion of the carbon

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Cost Reduction - ICs

Original circuits made with 6 µm technology
BNR did a cost reduction die shrink to 3 µm technology
New ICs met 2000Vstatic voltage test
Telephones started to have failures
Evaluation showed input pin structures destroyed
Restored pin interface to old size, just internal shrinkage

BNR did not like being told what to do, but: Problem solved

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Cost Reduction - Electronic Telephone Harmony

New look
Snap together (No screws for repairabilty)
Piezo tone ringer
Flexible PCB in handset
Assembled by customer

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Ringtones

Piezo ringer hard to locate

Office: One telephone per two desks
Office: Desks clustered in groups
Which telephone was ringing?

Added user control for warble tones

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Symphony Telephone Set

Smart phone with memory dial and Flash button
Original design used TI 8-bit processor
Cost reduced to custom IC

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Electronic Telephone - Solo

Electronic Telephone

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Voice Mail

- Compete with answering machines
- Pay per use feature
- Stored in Central Office memory
- Message from any phone
- Available when line busy

Bell Canada mindset: office features
NT DMS mindset: office features

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Caller ID

Time was right
Electronic end-to-end signalling for packets
Sophisticated telephone set circuitry

Hard to sell Bell Canada on telephone set feature
Hard to sell CO switching people to send information

https://www.youtube.com/watch?v=2HNBvRdhO9o

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Caller ID Telephone
Maestro

Single Line Phone
Hearing aid compatible

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Caller ID Telephone
Maestro

Name and number Call Display and Visual Call Waiting
Two-line display Callers List
Four feature keys for one-button access to network services
Visual Message Waiting indicator
Preferred Name Match
Flash key for Call Waiting or Three-Way Calling
Separate handset and ringer volume control
Desk or wall mountable

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Payphones

3-slot

Centurion

Millennium

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Payphone - Centurion

Single coin slot
Armoured case
Decorative cover
Handset 2000 g impact test
Blue grommet indicates Hearing-aid compatible
Jumper to change rate in 5¢ increments to 40¢

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Payphone - Millennium

Part of integrated CO computer system
Millennium Manager is said to cost around 1 Million $US

Vacuum Fluorescent Display
Single coin slot
Credit card reader
Power fail internal memory
Prompts in four languages, two Telco selected
Automatic error reporting

Big savings in Telco service trucks