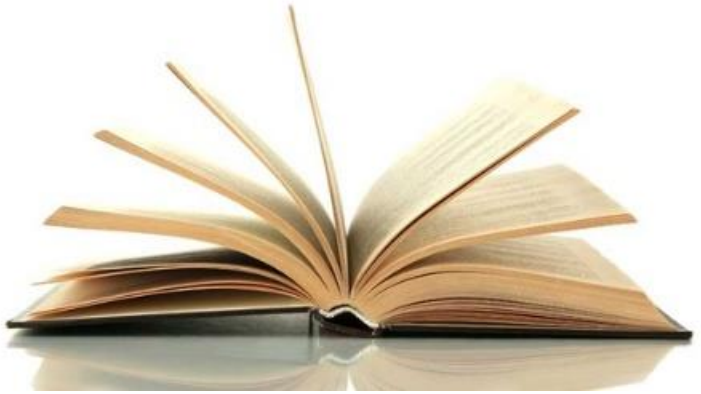

GIRL,
FAULT
INTERRUPTED

whoami

Maggie Jauregui

@magsjauregui

TECNOLÓGICO DE MONTERREY®



CEDI®

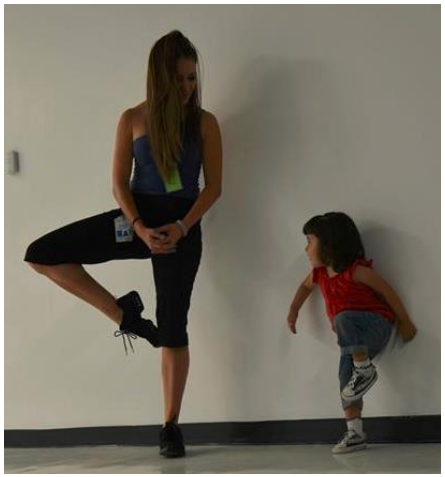
CENTRO DE DESARROLLO INTEGRAL ARBOLEDAS, A.C.

OLIMPIADA MEXICANA DE MATEMÁTICAS

UNIVERSIDAD AUTONOMA DE GUADALAJARA

CIENCIA Y LIBERTAD

fundada en 1935



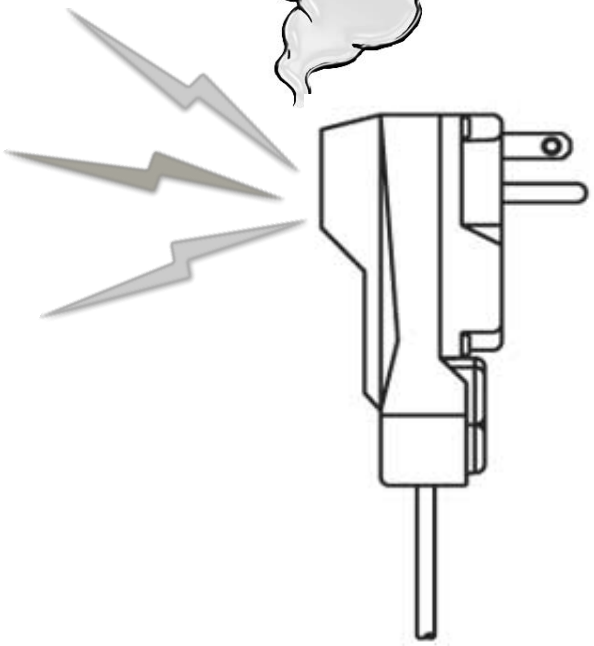
MOCKER'S
BURGERS'N ROLL

LOS AGAVERS

DISCLAIMERS

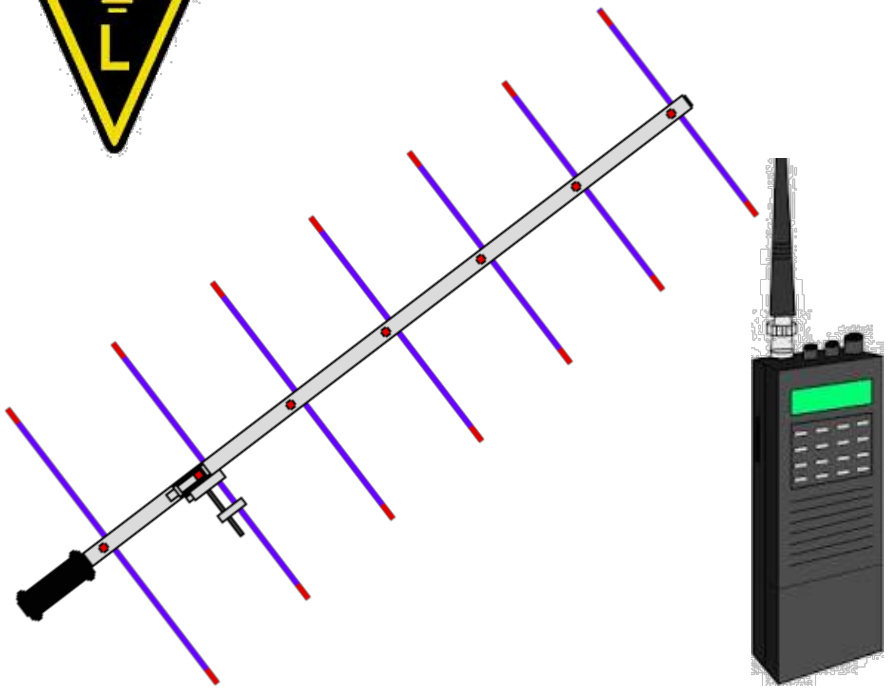
Ideas/research
my own…

Story time!

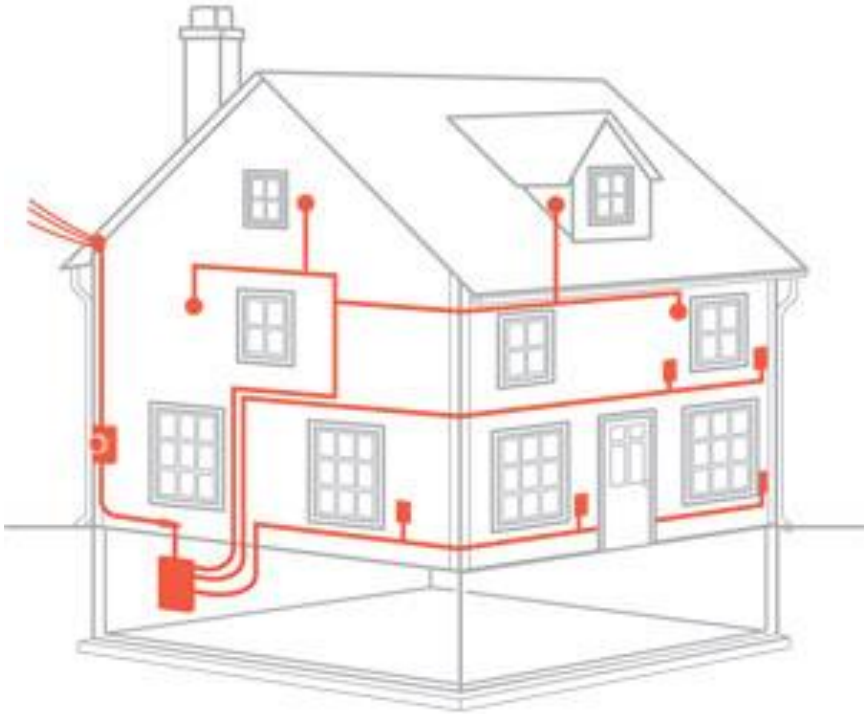


Supply Acquisition

ARRL
The national association for
AMATEUR RADIO



Circuit Interrupts around the house

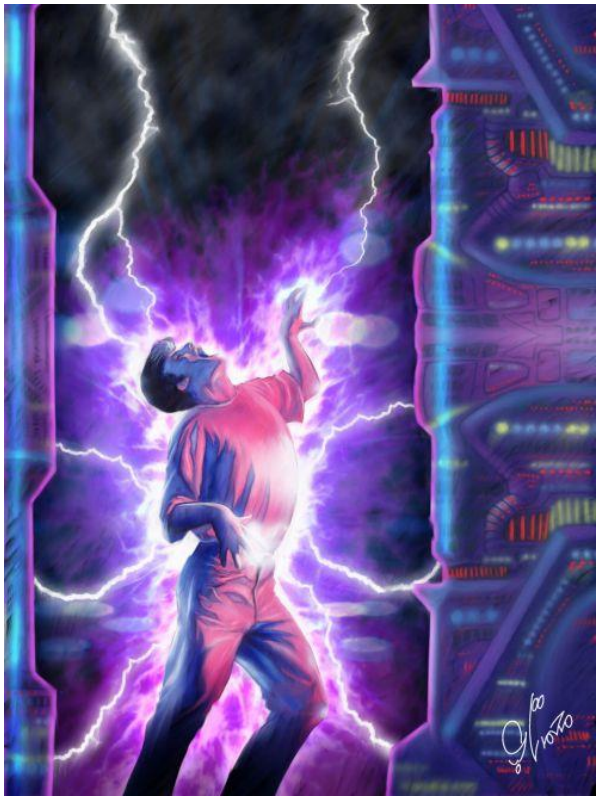


GFCI

AFCI

≠ Purposes

GFCI: Intends to prevent Electric Shock



AFCI: Intends to prevent fires

Code Requirements

GFCI's

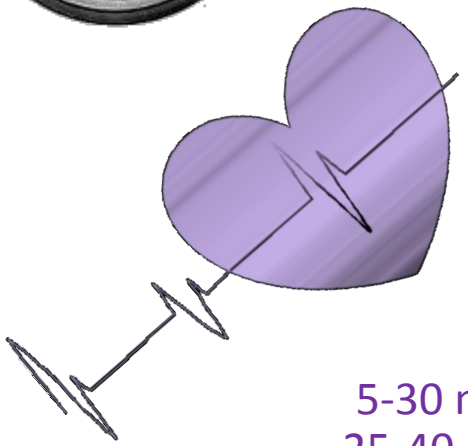
- Bathrooms/Indoor wet locations
- Garages/storage areas/non habitable areas/unfinished basements
- Outdoors/Compartments accessible from outside the unit/Rooftops/Pools/Hot tubs
- Crawl spaces at or below grade level
- Kitchen [dish washer, Refrigerator]
- Laundry Areas

AFCI's

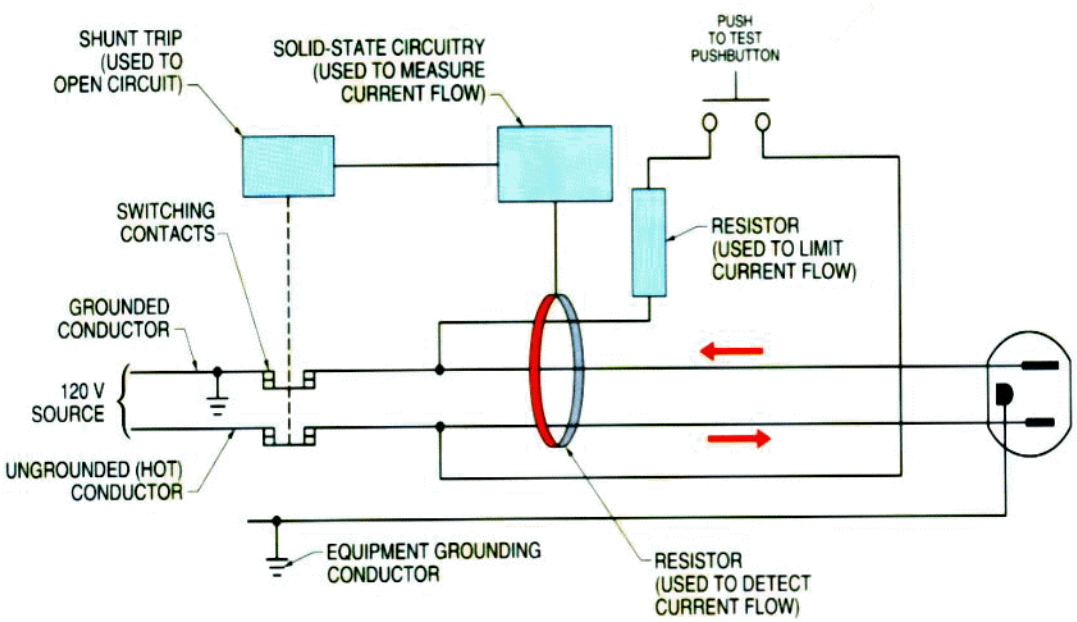
- Kitchens
- Family Rooms
- Dining Rooms
- Living Rooms
- Parlors
- Libraries
- Dens
- Bed rooms
- Sun rooms
- Recreation Rooms
- Closets/Hallways
- Laundry Areas
- Or similar rooms

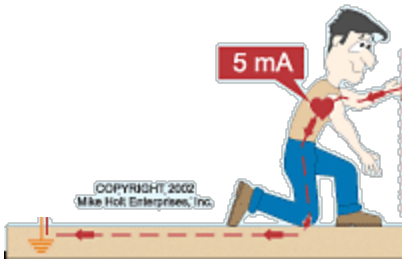
Ground Fault Circuit Interrupt

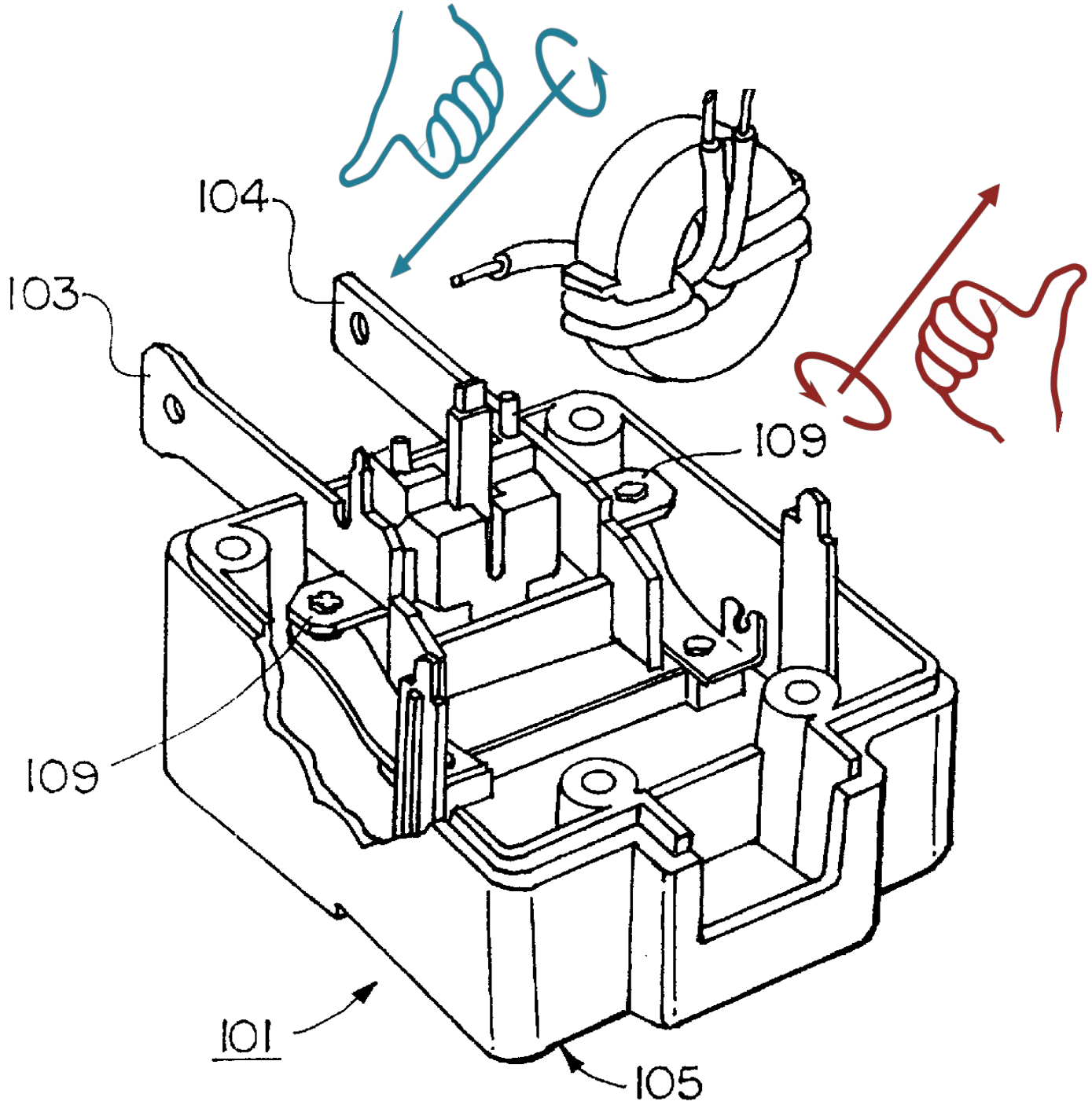
GFCI



5-30 mA
25-40 ms






104
103
109
109
101
105

Solenoid

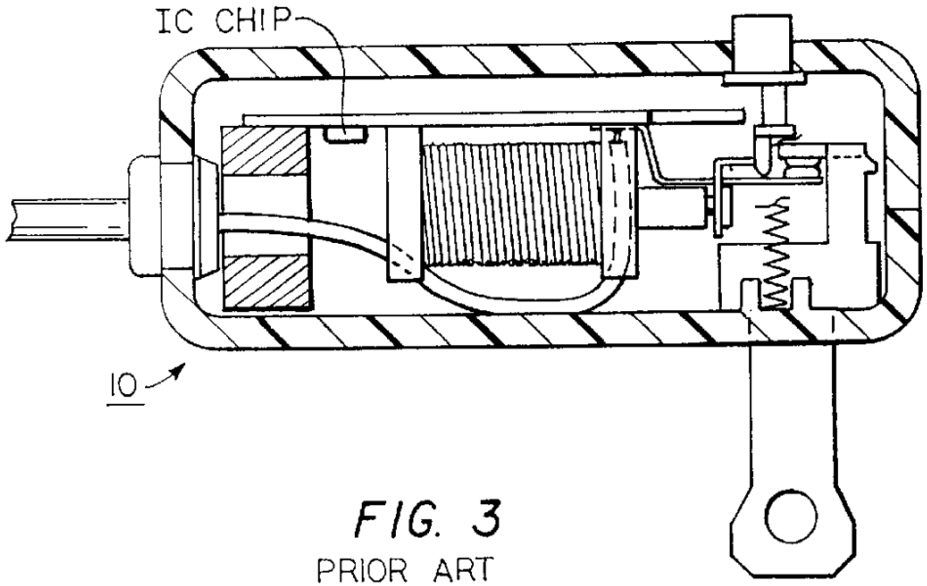


FIG. 3
PRIOR ART

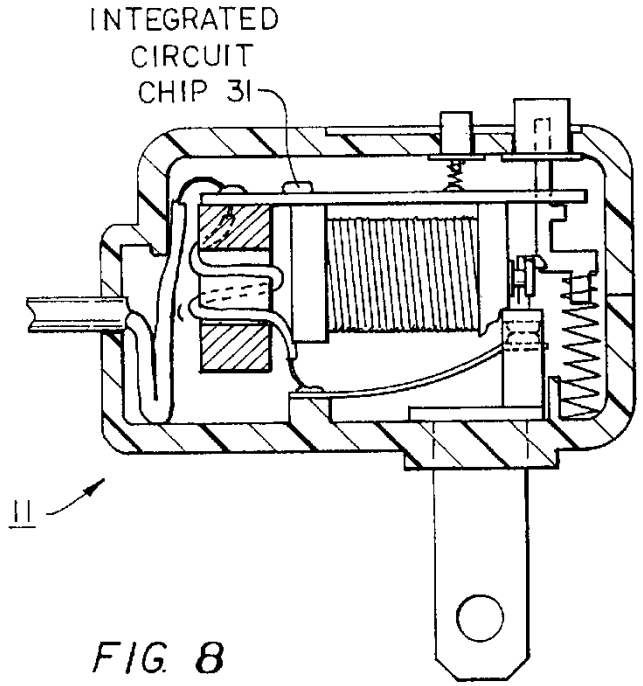
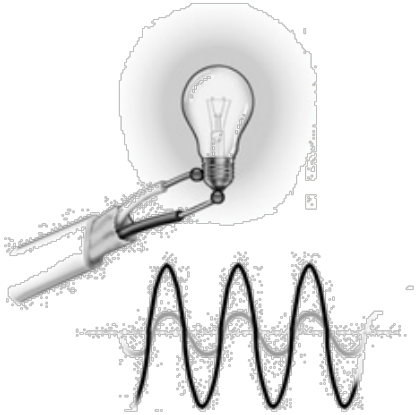
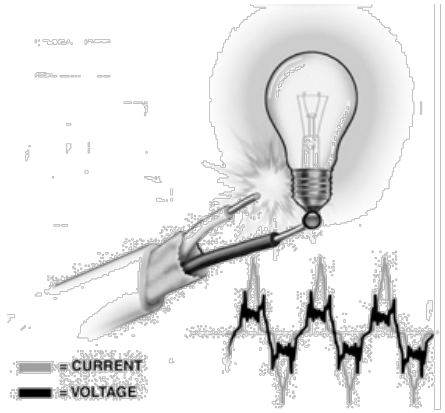


FIG. 8

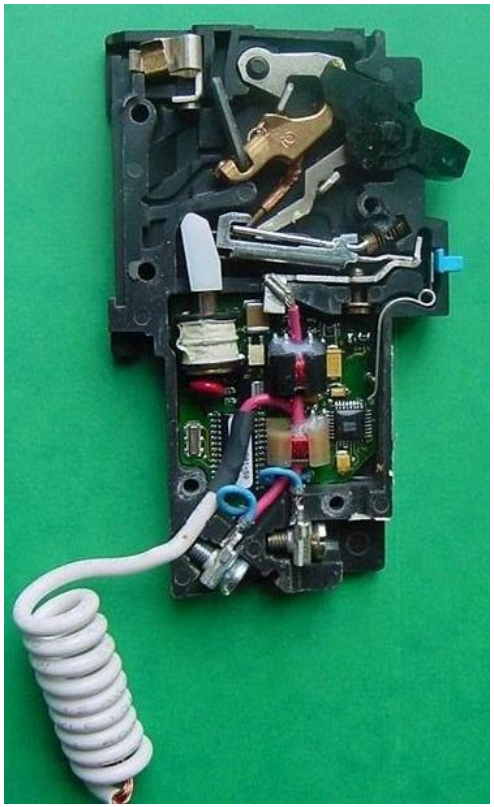
Arc Fault

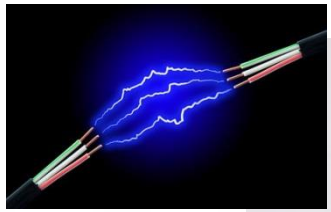


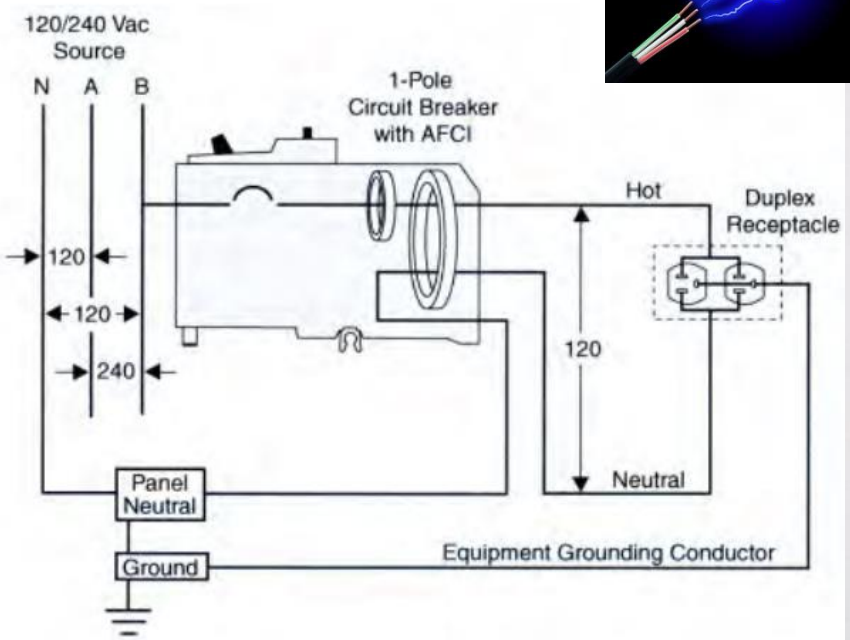


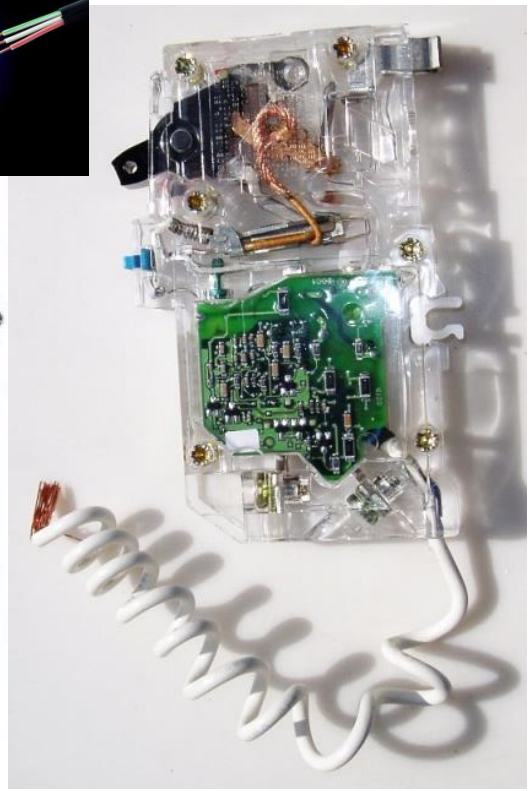
Circuit Interrupt

AFCI









GFI Demos ☺

Magic Smoke - Closed

https://www.youtube.com/watch?v=wdIDoE3rV9M

Internal Spark

https://www.youtube.com/watch?v=E-fKU9MvDjg

Close range Outlet trip

https://www.youtube.com/watch?v=21UeF_cHRxU

Close range Outlet trip

https://www.youtube.com/watch?v=7yw-DV2URE0

GFCI Outlet Trip through RF

https://www.youtube.com/watch?v=IpzHTYNK52Y

Across Walls

https://www.youtube.com/watch?v=30t50Hs0pZM

“Remote”

https://www.youtube.com/watch?v=fKxL1MMLe0I

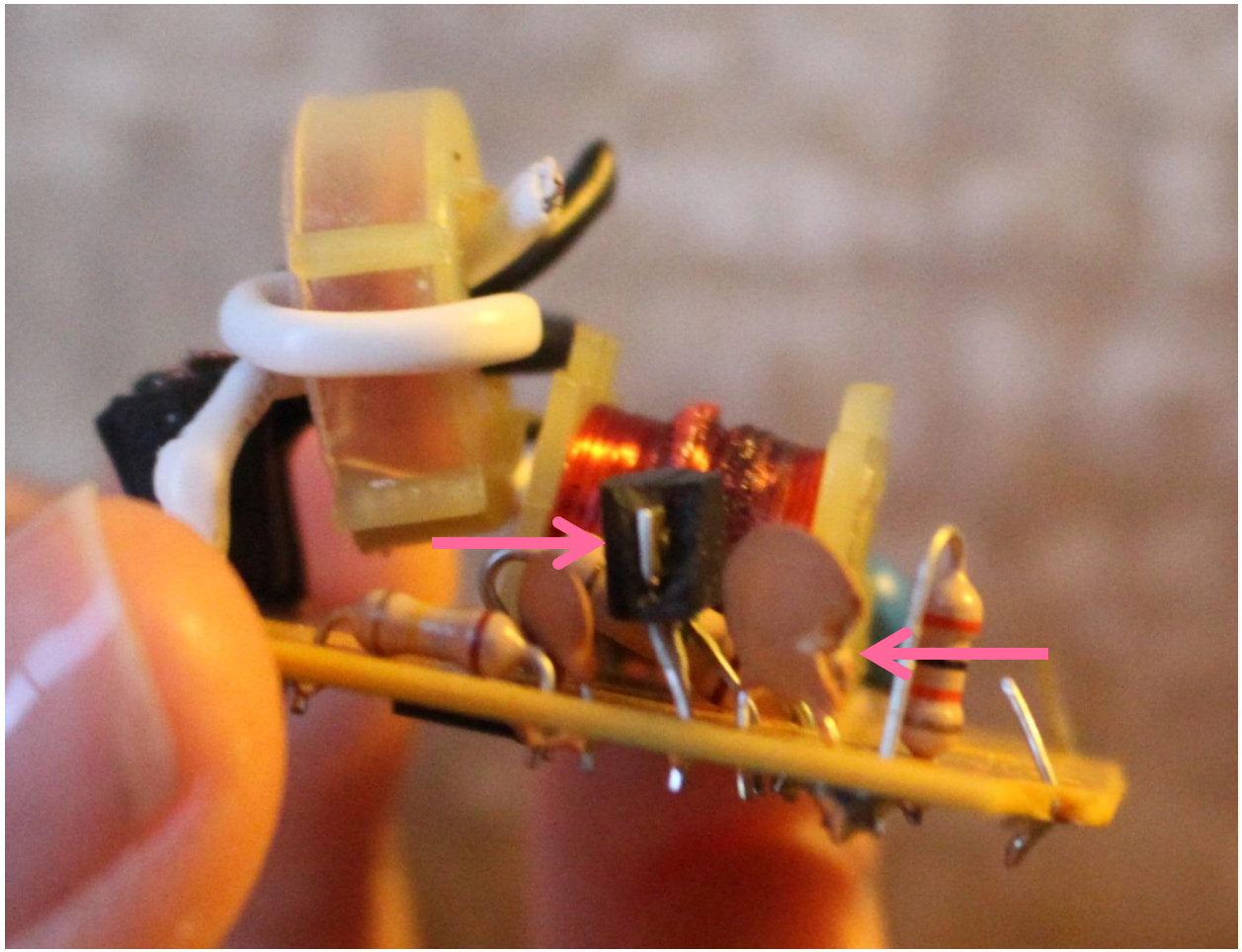
Magic smoke

https://www.youtube.com/watch?v=Nt6HiCsAKhw

Flaming flying components ☺

https://www.youtube.com/watch?v=S16zuJACdds

Result



Fried GFCI

https://www.youtube.com/watch?v=dnIJeaKOugc


Turn Down
For
WATT

AFCI Breakers vs. HAM Radio

https://www.youtube.com/watch?v=JsILD0Fce1s

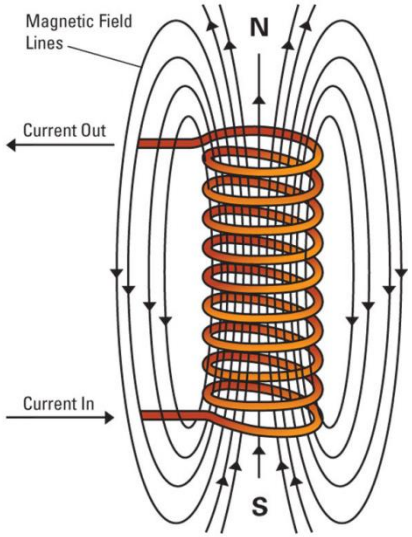
0:22 & 5:47

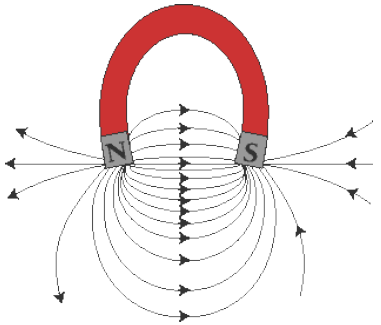
AFCI Breakers vs. HAM Radio

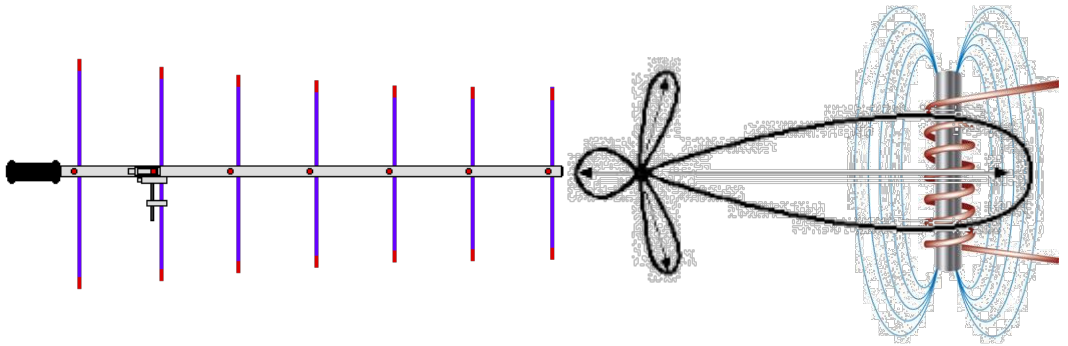
http://www.arrl.org/news/arrl-helps-manufacturer-to-resolve-arc-fault-circuit-interrupter-rfi-problems

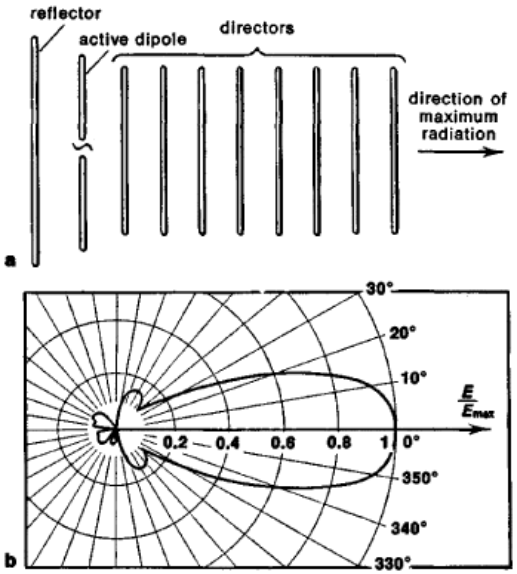
So what’s going on?

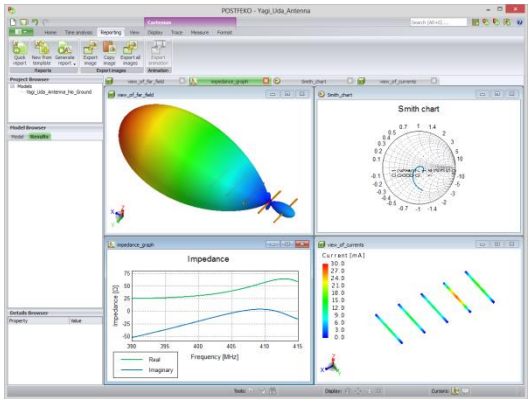
Electromagnetism

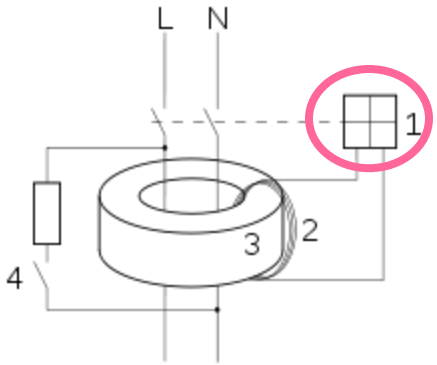


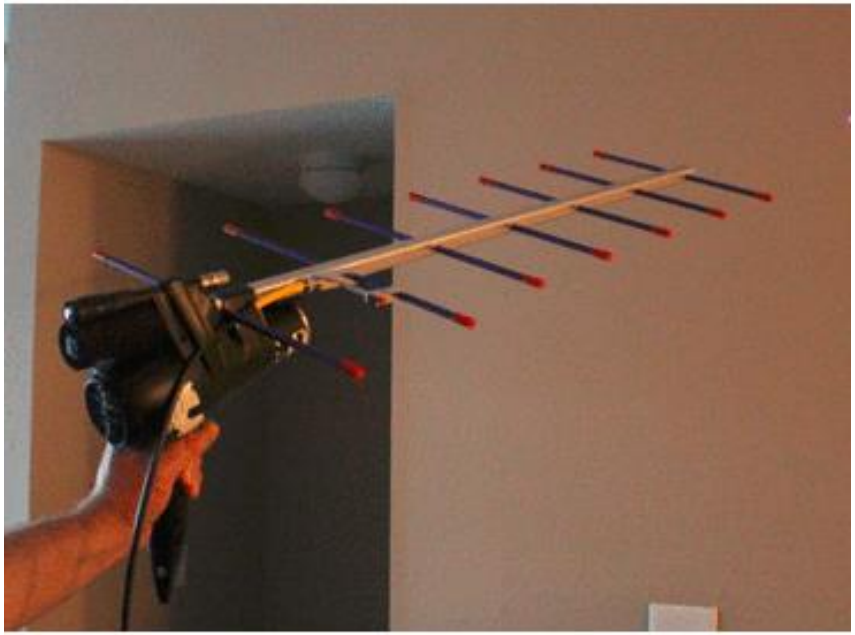




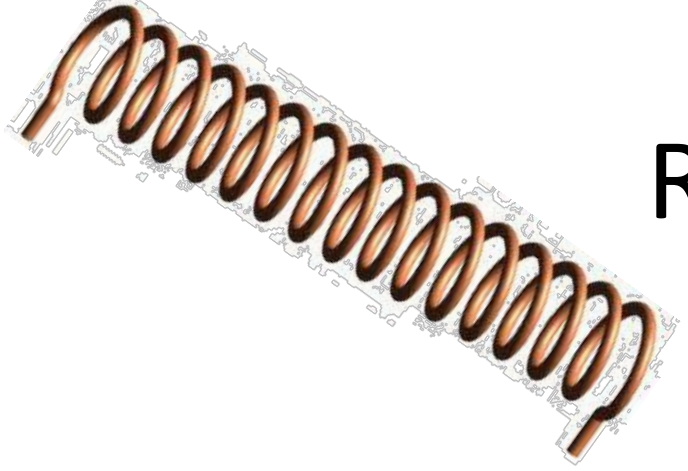









It MHz...

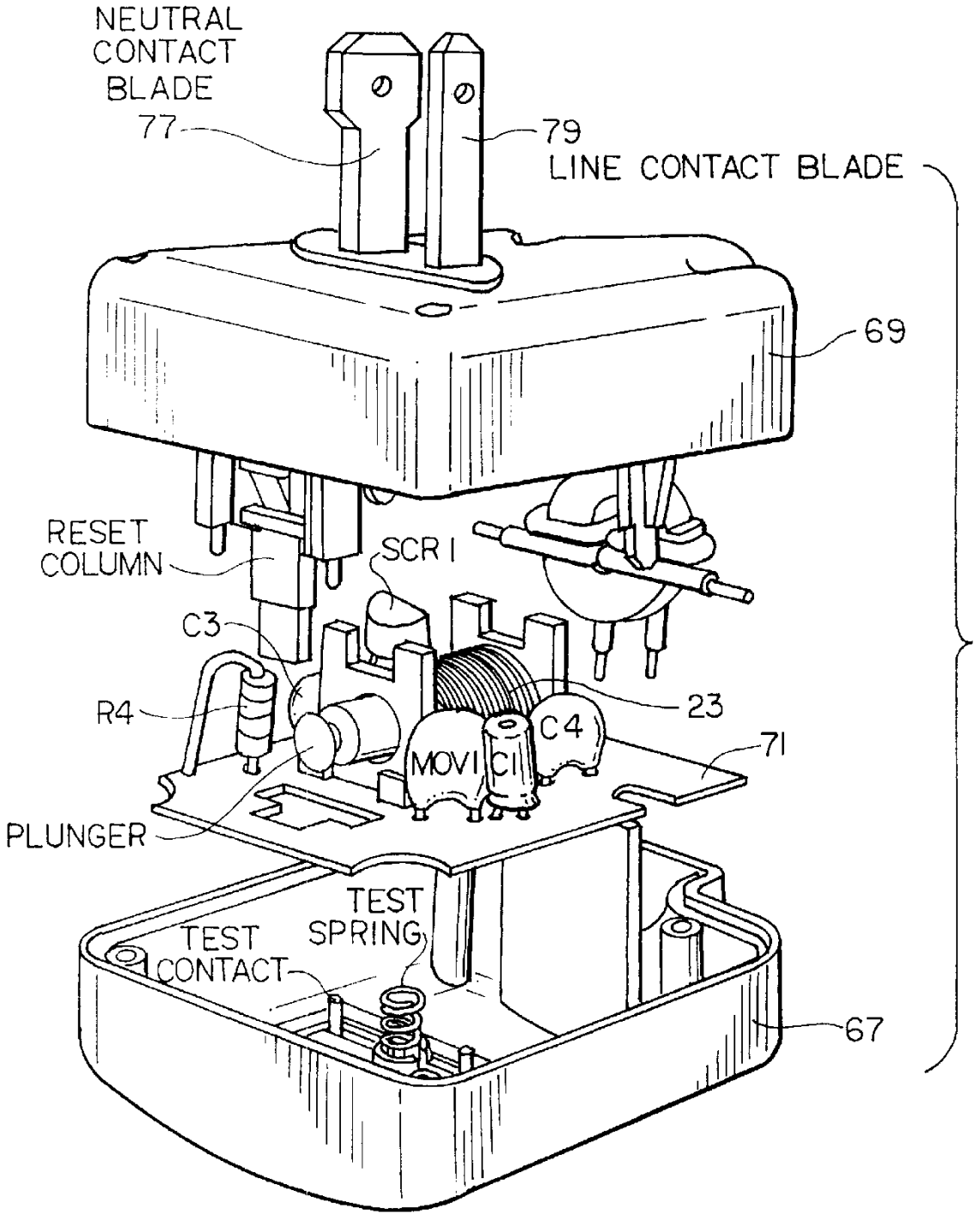


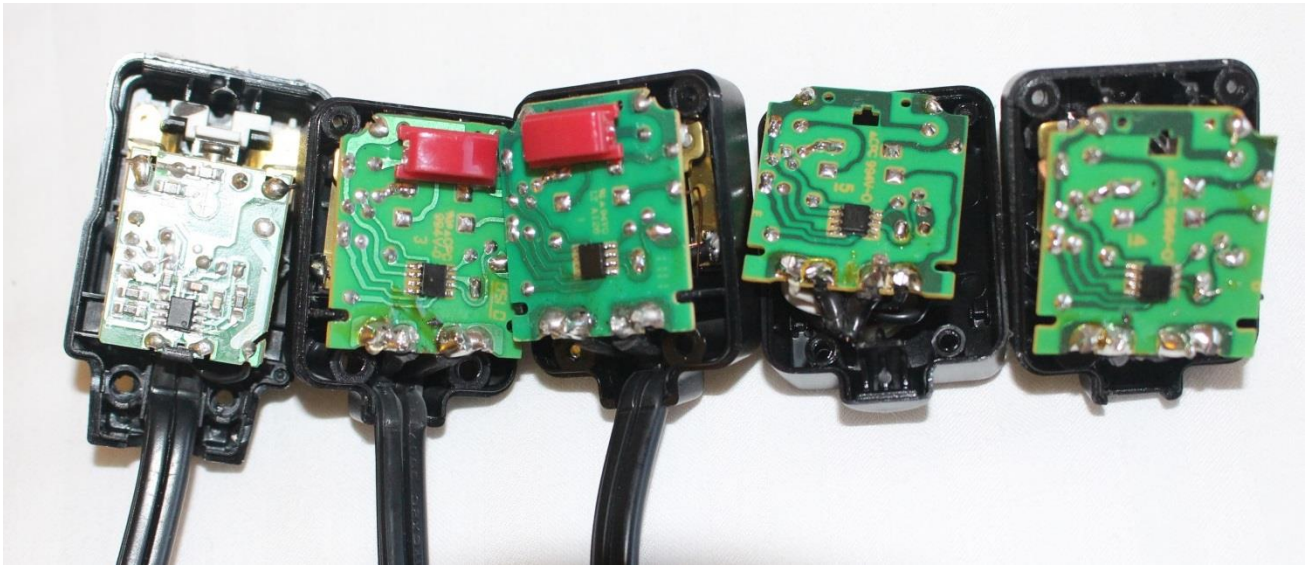
Resonance ♪

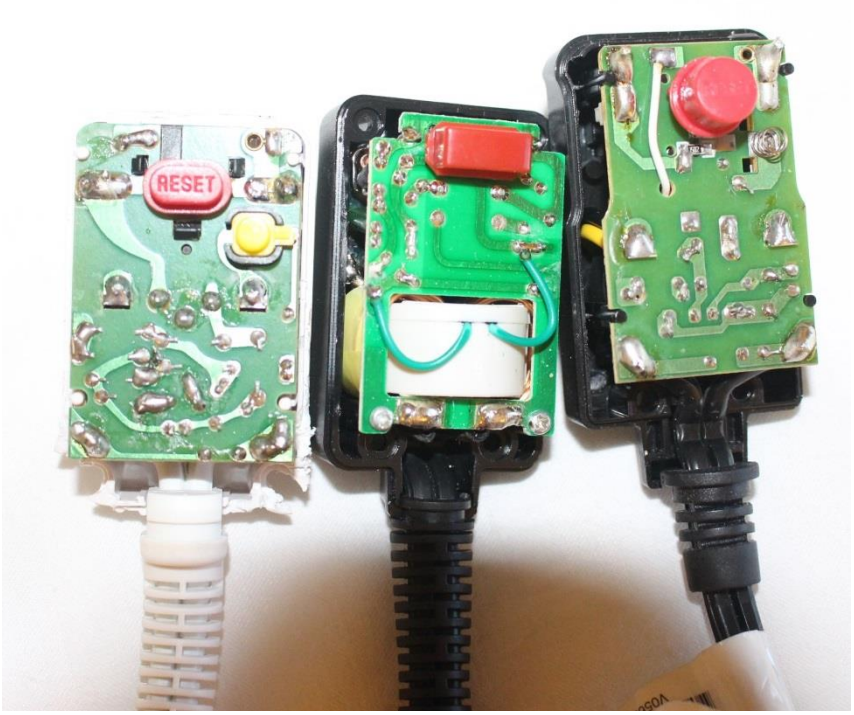
Defined by: Resistance, Inductance & Capacitance

A coil will resonate to it’s fundamental frequency (or harmonics)

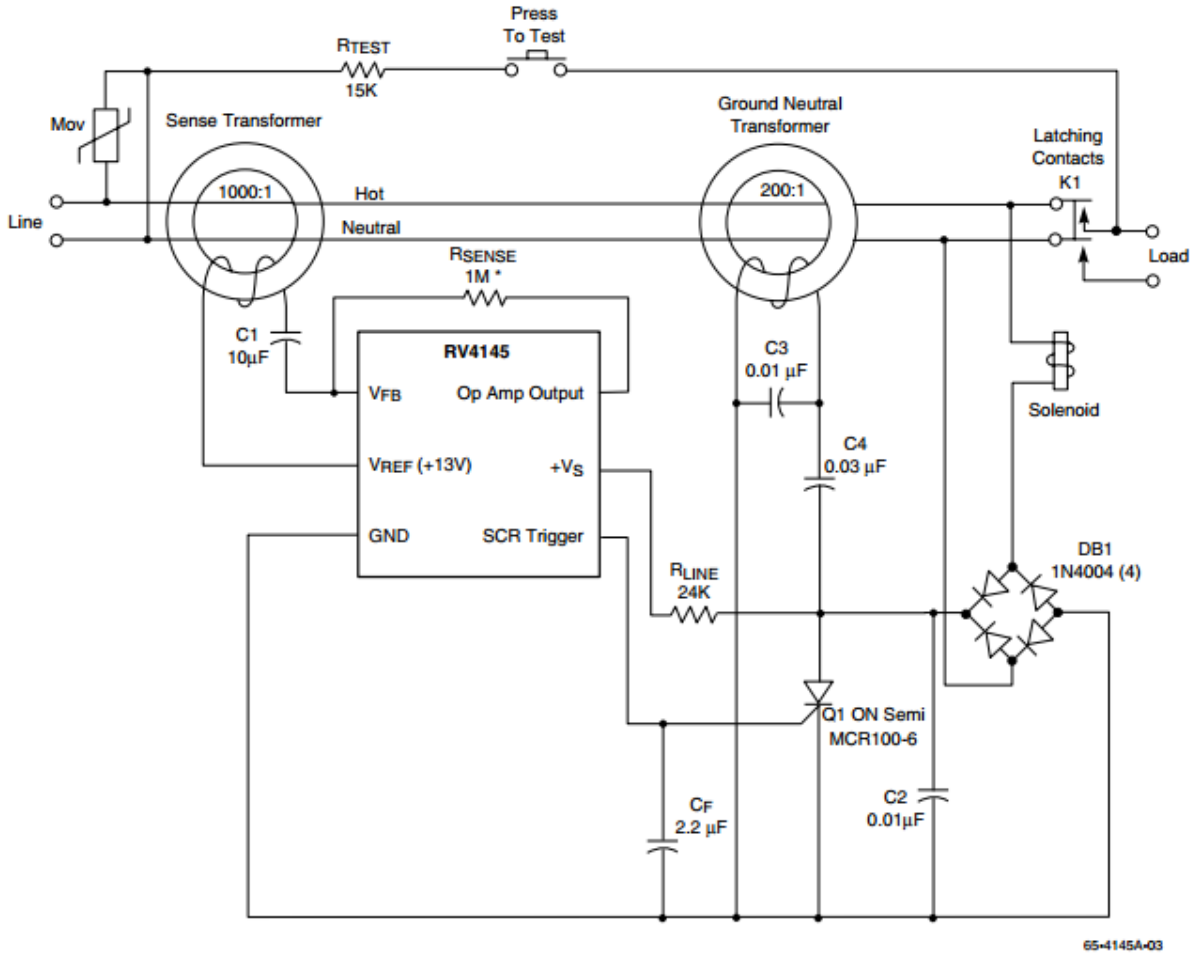
US AC works @ 60 Hz


NEUTRAL
CONTACT
BLADE
77
79
LINE CONTACT BLADE
69
RESET
COLUMN
SCR 1
C3
R4
23
C4
MOV1
C1
71
PLUNGER
TEST
SPRING
TEST
CONTACT
67




RESET

Low Power GFI



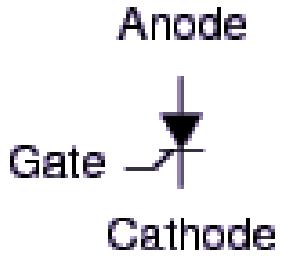
* Value depends on transformer characteristics.

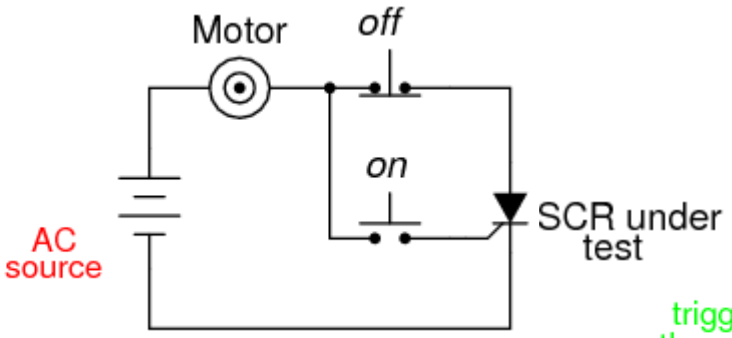
Figure 1. GFI Application Circuit (Three-Wire Outlet)

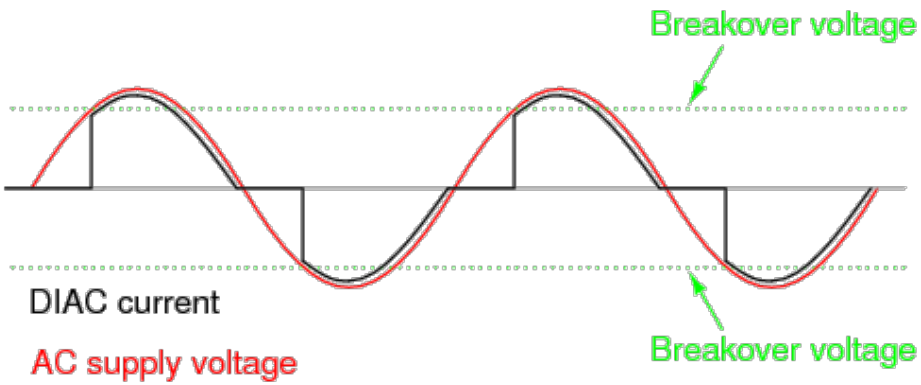
SCR's
Silicone Controlled Rectifiers

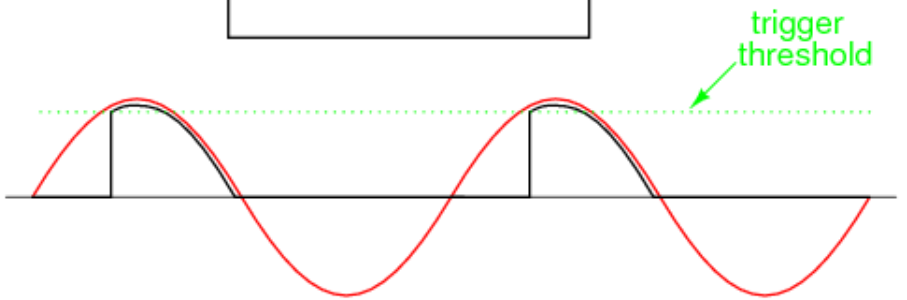
SENSITIVE GATE SCR

TO92 (Plastic)	RD26 (Plastic)	On-State Current	Gate Trigger Current
		0.8 Amp	< 200 µA
		Off-State Voltage	
		200 V ÷ 600 V	
K G A	A G K	This series of **S**ilicon **C**ontrolled **R**ectifiers uses a high performance PNPN technology.	
FS01...A	**FS01...B**	This part is intended for general purpose applications where high gate sensitivity is required.	



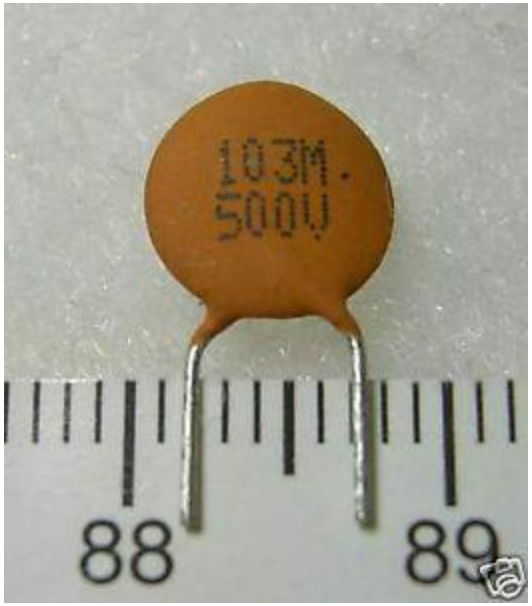




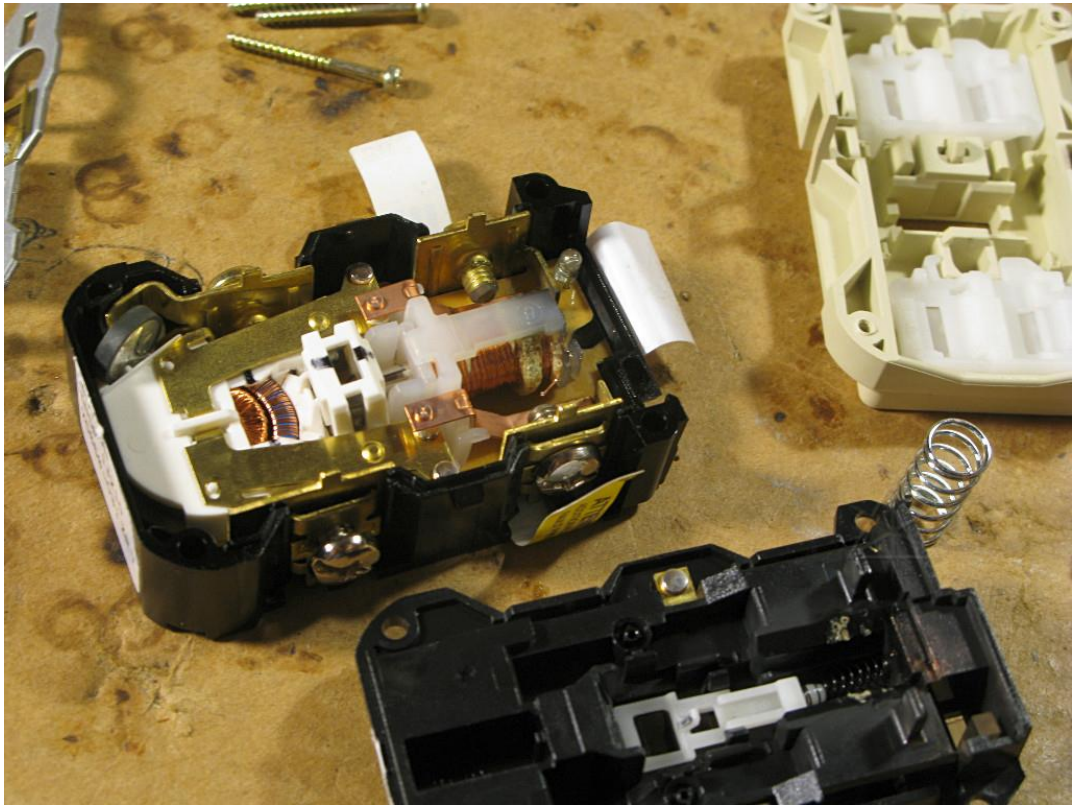


Ceramic Capacitor

- 0.01 uF
- Overheating, over current, short-circuit



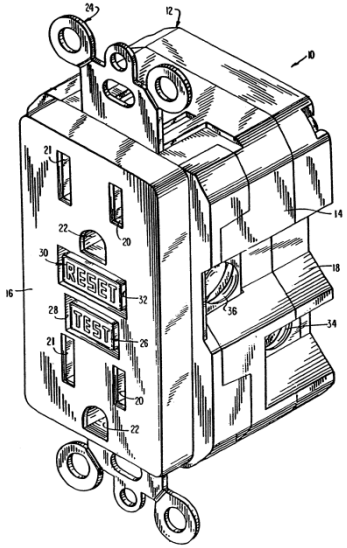
GFI Power Outlets



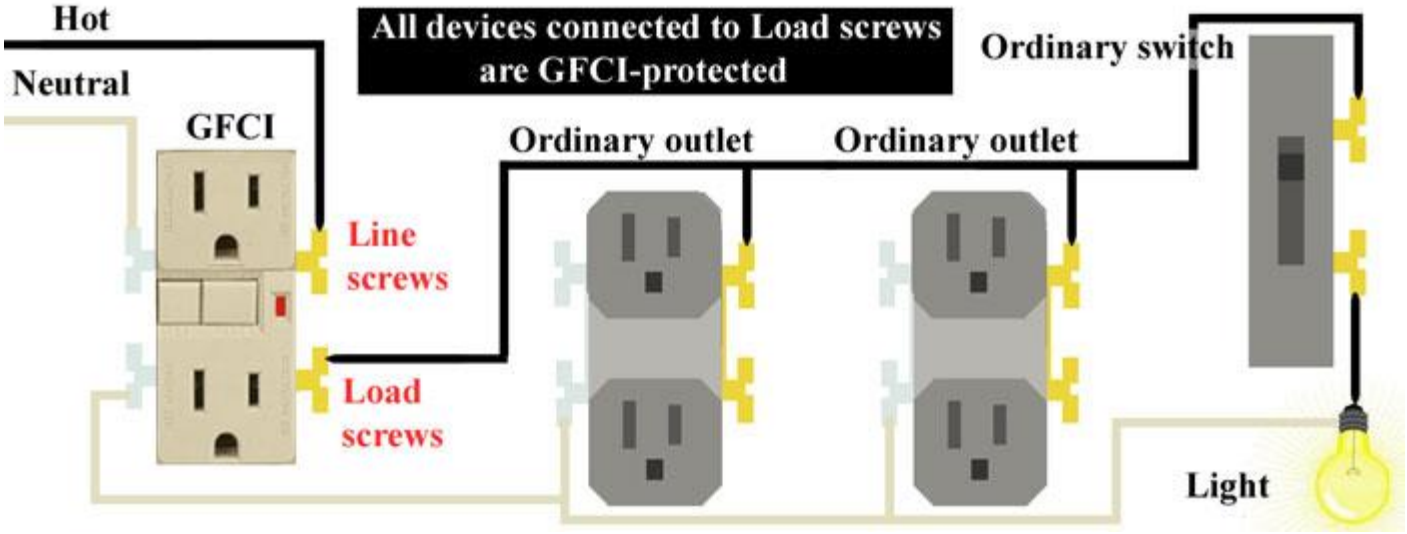
Patents

Impacted?	Count	Year	Brand	Country	Models
Y	12	1999	Tower Switches Limited	China	303 52
Y	2	2007	Luen Ming	China	LA5s, LA5D, LA5D-EMC, LA5S-EMC
Y	4	2008	Leviton	USA	B513-522
N	2	2013	Zhongshan Kaper Electrical Co.,LTD	China	XY421-DV5
N	1	2012	Wellong	China	P10D, P10S
N	1	2012	Luen Ming	China	LA2S, LA2D, LA3S, LA3D.

Certificate	Link
US5943199 A	https://www.google.com/patents/US5943199?dq=5943199&hl=en&sa=X&ei=S6rlU4PvEtLpoASNq4CYBQ&ved=0CBwQ6AEwAA
E256185	http://www.luenming.com.hk/index_topic.php?did=76074&didpath=/75489/76074
US7463124 B2	https://www.google.com/patents/US7463124?dq=7463124&hl=en&sa=X&ei=e7flU9-pM4X6oATjpoCwDw&ved=0CBwQ6AEwAA
UL E212530	http://yanyao1984.en.ec21.com/XY421-DV5--2830573_2948868.html
E130151	http://www.olilio.com/file/detail/AUHG2.E130151.html
E256185	http://www.olilio.com/file/detail/AUHG2.E256185.html



Other scenarios…



Relevance?

- RFI can be accidental or intentional
- RFI is wireless and fingerprint free
- Annoying DoS/Neighbor trolling
- Services/Devices that matter: Medical Equipment

Recent GFCI News ☹

Electrocution causes death of 8 year old boy

July 28th, 2014 – Lake Conroe, Texas

He said investigators discovered the faulty wiring on the dock at the Piney Shores Resort near League Line Road where the boy sat before falling in the water feet first. The boy was only in the water about 15 seconds before his father pulled him from the lake and began CPR. The boy was later pronounced dead at Memorial Herman Hospital in Houston.

According to Nancy Mikeska, the Montgomery County Sheriff's Office requested the city inspect the dock as part of the investigation. Mikeska said the resort and the dock are in the city limits.

"Inspectors inspected the dock and made a determination that the wiring was not to city code and was dangerous and shut the power off to the dock," she said. "The GFIs appeared to malfunction and continued to run hot."

http://www.yourhoustonnews.com/courier/news/police-electrocution-may-have-caused-death-of--year-old/article_0c6c4b56-6c57-5796-9ccb-b25bb025f780.html

Suggested Solutions

- Test your GFCI's often
- Update to newer Circuit Breaker Patents
- Back ups:
  - Power Generators
  - Batteries
  - Manual Overrides
- Grounded FC encasing

LIVE Demos

Acknowledgements

- Carlos Abad
- Larry Averitt
- Michael Demeter
- Rafael Jauregui
- Habteab Yemane
- Michael Reams
- Chris Mitchell
- Laplinker ♡

Bloopers

https://www.youtube.com/watch?v=3RvvFFfQZt8

Thanks