Mirrored Symmetric Circuit Simulation in LTSpice. A Pair of OpAmps can Replicate a Zero Current Source. Pt. 10

Did Nikola Tesla use zero current sources to reduce the size of his coils when he purchased a dozen mysterious tubes from a seller in Buffalo, New York, for his Pierce-Arrow demonstration of 1931?



VINYASI

OCT 13, 2026

Direct link to share my dialogue with ChatGPT on replicating a zero current source:

Tube Current Sources

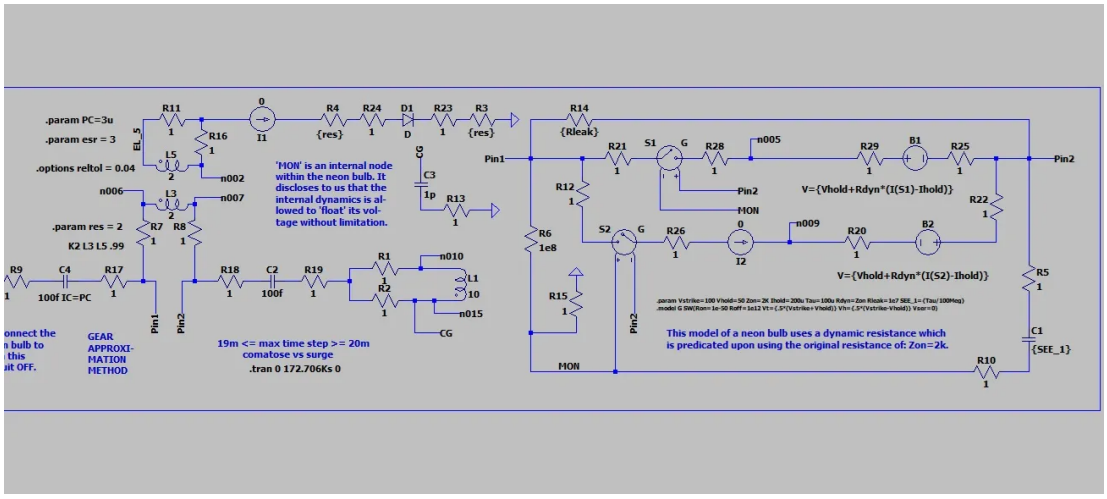
I'm intrigued with the silly notion that we may able to "get to the bottom" of this Pierce-Arrow mystery — after all — by taking advantage of the advice of ChatGPT wherein it advises that tubes, and other types of components, can replicate a current source.

And we've already seen from my prior post that a current source can reduce the size of coils:

Mirrored Symmetric Circuit Simulation in LTSpice. A Breakthrough using Zero Current

Sources to Boost a Comatose Hiccup! Pt. 9

VINYASI · OCT 12



Getting past challenges (barriers):

Read full story

And enlarged coils can get past resistive barriers to evoke, and provoke, “free” and “unconstrained” anomalous escalation of self-amplifying reactance.

I’m in bold red with yellow background in the following dialogue with ChatGPT:

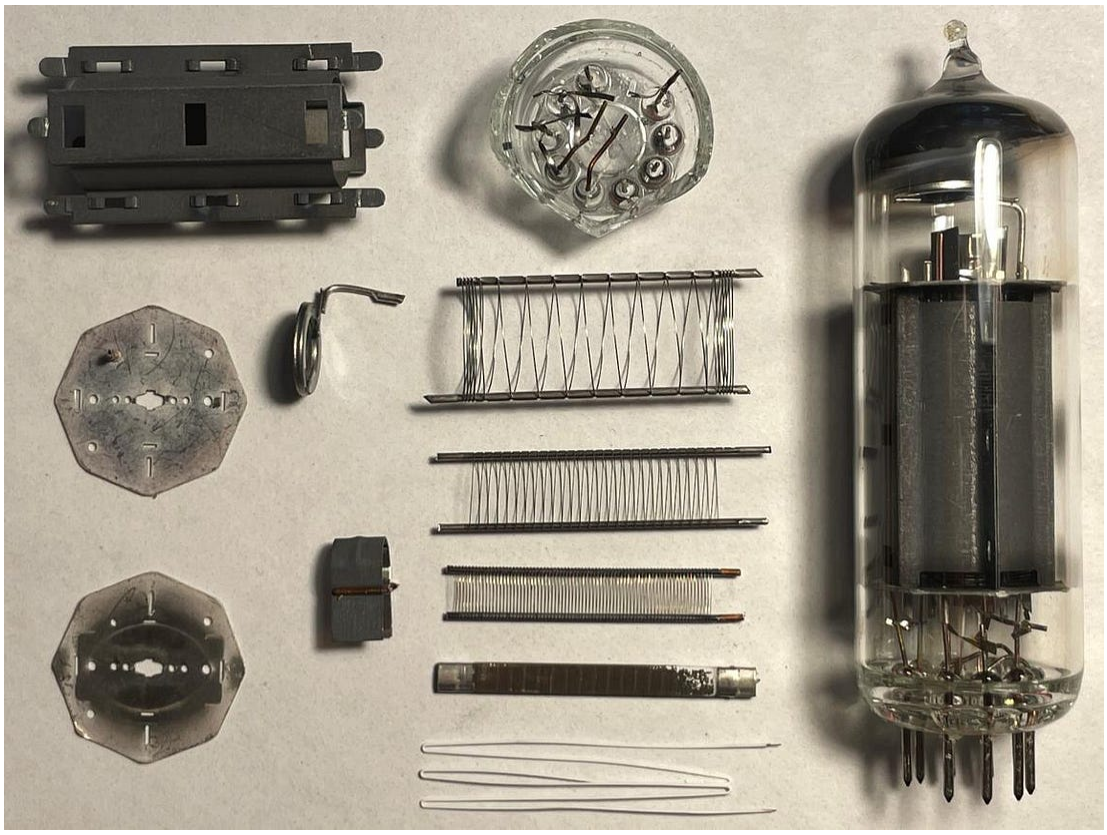
What sort of tube technology could approximate a current source in part or in full?

Several types of vacuum-tube technology can approximate a current source, either partially or quite closely. The best choice depends on

whether you want to regulate current through a load, sustain a nearly constant current during an oscillation, or produce a current that depends on another voltage.

For your oscillating, magnetically coupled circuit and your interest in reaching roughly 70 kV, **[ChatGPT got this dialogue mixed up with a prior dialogue.]** the key distinction is between a tube that behaves like a current source over part of its operating range and a circuit that actively regulates current to maintain a set value.

Four tube technologies worth considering



1. Pentode — naturally approximates a current source

A pentode's plate current can remain relatively constant as plate voltage changes, provided the tube stays in its normal plate-voltage

operating region. Its screen grid helps reduce the influence of plate voltage on current.

- Behavior: Passive, approximate current-source characteristic.
- Control: Control-grid voltage.
- Limitation: Current still changes with grid voltage, temperature, and operating conditions.

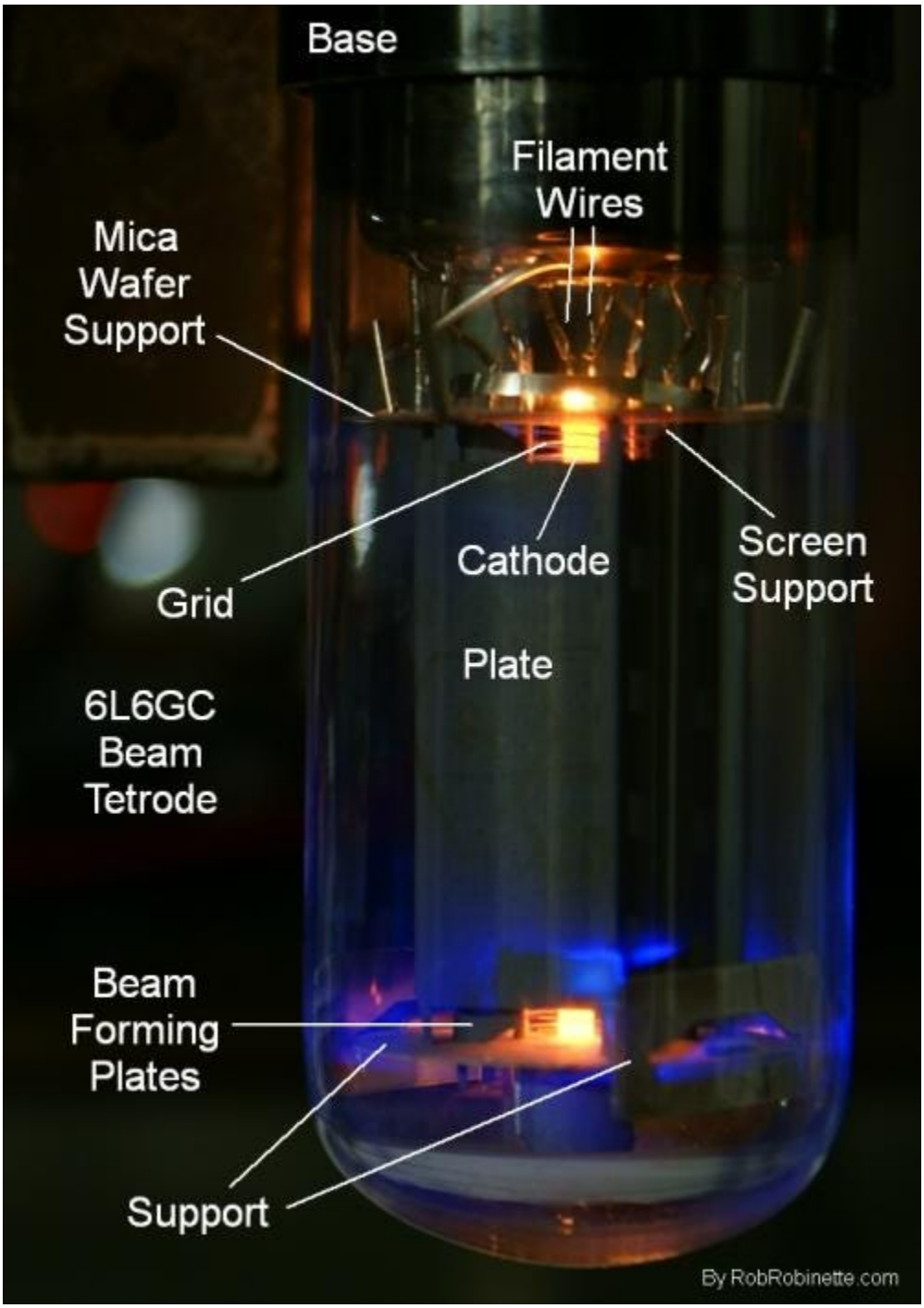
This is a strong candidate if you want current to remain comparatively stable while the voltage across the tube varies.



2. Triode with a large plate resistance — partial current-source behavior

A triode's plate current varies with both grid voltage and plate voltage. In an appropriate operating region, its plate resistance can be high enough to approximate a current source over a limited voltage range.

- Behavior: Less ideal than a pentode in many operating conditions.
- Control: Grid-to-cathode voltage.
- Advantage: Simpler electrode structure and potentially useful for nonlinear or oscillating circuits.



3. Beam tetrode — another high-output-resistance option

A beam tetrode uses beam-forming electrodes and a screen grid to obtain characteristics similar to those of a pentode.

- Behavior: Relatively flat plate-current curves over a suitable region.
- Control: Control-grid voltage.
- Potential use: Power-stage experiments where current behavior matters more than linear voltage amplification.



4. Gas-discharge tube — current-limiting behavior in a different regime

A gas-filled tube can exhibit a relatively low incremental voltage change as current varies over part of its discharge region. However, it is not automatically a constant-current source.

- Behavior: Depends on the discharge regime and ballast.
- Potential use: Discharge and threshold experiments.
- Limitation: Negative-resistance regions, striking voltage, and holding current can make its behavior quite different from a pentode.

Which one most closely approximates an ideal current source?

An ideal current source maintains the same current even when its terminal voltage changes. In practice, the approximation is determined by the tube's output resistance relative to the load.

Approach	Current stability	What establishes the current?
Pentode alone	Good over a suitable operating range	Grid bias
Pentode with cathode resistor	Better against operating-point changes	Grid bias and resistor
Pentode with current-sensing feedback	Potentially very good	Reference plus measured current
Two-stage tube regulator	Potentially very good across a wider range	Feedback and available voltage headroom

For your circuit, I'd start by examining a pentode operated as a controlled current element, then add feedback only if the tube's natural plate-current characteristic is insufficient.

One important qualification: a tube's plate-current characteristic does not make it suitable for arbitrary voltages. A circuit operating toward 70 kV would need appropriately rated insulation, spacing, and voltage distribution; an ordinary receiving tube cannot simply be connected across 70 kV.

One question that determines the best topology

Do you want the tube to act primarily as:

1. What should the current source do?

- Maintain nearly constant DC current through a load.
- Maintain current while voltage oscillates or pulses.
- Produce a controlled current proportional to a voltage.
- Provide negative differential resistance or sustain oscillation.

2. How should the tube be controlled?

- Passively, through its inherent characteristics.
- By an applied grid voltage.
- By feedback that senses and regulates current.

3. What current are you targeting?

- Microamps to milliamps
- Tens to hundreds of milliamps
- One amp or more
- Not yet determined
- Compare suitable tube approaches

The distinction matters because a tube that provides a stable current and a tube that creates or sustains an oscillatory current are fundamentally different design choices.

Can a pentode, or other, current source be emulated by transistors, caps, coils, diodes, resistors, etc?

> Yes. A pentode's current-source behavior can be emulated with transistors, resistors, diodes, capacitors, and inductors. In fact,

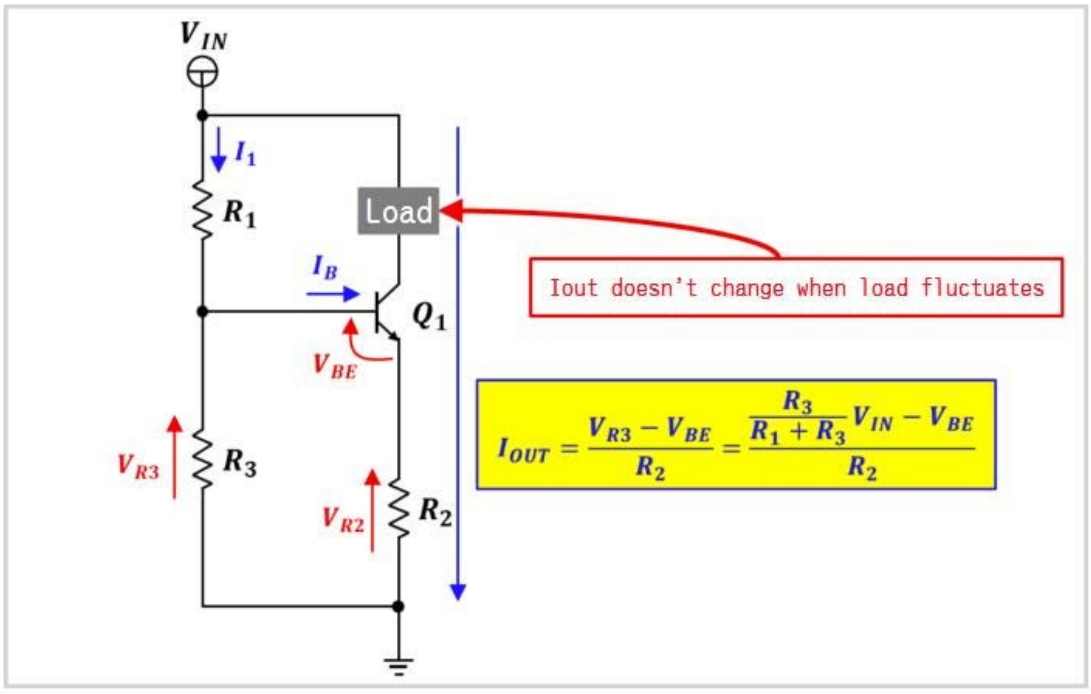
> a transistor circuit can often approximate the pentode's current-versus-voltage characteristic quite closely, and can also reproduce some of its nonlinear behavior.

The important point is that you're emulating the tube's electrical behavior, not its physical construction.

For your oscillating, magnetically coupled circuit, there are several approaches, depending on which aspect of the tube you want to reproduce.

1. Three ways to emulate a tube current source

A. A transistor as a constant-current element

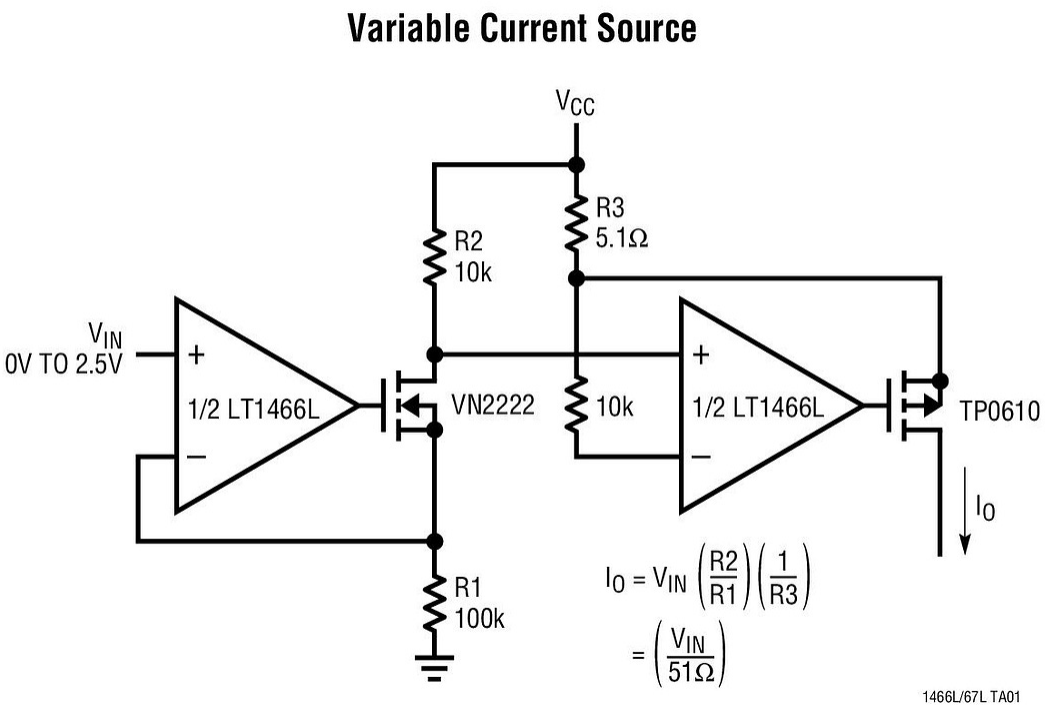


forum.arduino.cc

A bipolar transistor or MOSFET can maintain nearly constant current while the voltage across it changes. A resistor, reference diode, or second transistor establishes the current.

Closest analogy: A pentode operated in its relatively flat plate-current region.

B. A voltage-controlled current source **[FALSTAD]**



analog.com

An input voltage determines the output current. A transistor stage with current-sensing feedback can make the relationship approximately

$$I_{out} = g_m \cdot V_{control}$$

where gm is the effective transconductance, in amperes per volt.

Closest analogy: The control grid of a pentode, where grid voltage controls plate current.

C. A nonlinear current source

A transistor stage with a deliberately shaped control characteristic, possibly including feedback, capacitors, and diodes, can reproduce a tube's changing conductance, thresholds, or even negative differential resistance.

Closest analogy: A tube or gas-discharge device used as part of an oscillator rather than merely as a current regulator.

2. Can passive components alone do it?

To a limited extent, yes.

- Resistors can approximate a current source if the supply voltage is large relative to the voltage variation across the load.
- Diodes and Zener diodes can establish bias voltages and help shape current.
- Capacitors can temporarily sustain current or shape its time dependence.
- Inductors resist changes in current and can sustain circulating current while exchanging energy with capacitors.
- Transistors can actively regulate current and provide energy from a power supply to the load.

The distinction is that capacitors and inductors store and return energy, whereas a transistor circuit can control the transfer of energy from its supply. A passive network cannot maintain arbitrary constant current across arbitrary load voltages indefinitely.

3. The closest transistor equivalent to a pentode

Consider the following conceptual relationship:

Pentode behavior

$$I_a \approx f(V_g)$$

Plate current is primarily determined by control-grid voltage over a suitable operating region, with a smaller dependence on plate voltage.

Transistor equivalent

$$I_C \approx f(V_{BE})$$

A bipolar transistor's collector current is controlled by its base-emitter voltage, provided the transistor remains in its forward-active region.

With current feedback

$$I_{out} \approx \frac{V_{ref}}{R_{sense}}$$

A reference voltage and sensing resistor establish the current. Feedback corrects deviations as the load voltage changes.

The feedback version generally produces a more accurate current source than a transistor alone. The simple bipolar-transistor equation is only an approximation; temperature, device variation, and operating region all matter.

4. For your circuit, there's another possibility

Because you're investigating oscillation and magnetic coupling, you may not actually need a conventional regulated current source. You might want to reproduce only a particular part of the tube's characteristic:

- High output resistance, so current changes little as voltage changes.
- Voltage-controlled current, so one circuit section controls current in another.
- A nonlinear threshold that switches the current on or off.
- Negative differential resistance, which can help sustain oscillation under suitable conditions.

These are different behaviors and require different equivalent circuits. A pentode does not inherently exhibit negative differential resistance throughout its operating range.

You can test these alternatives in Micro-Cap using a transistor circuit or a behavioral current source and compare the resulting current-versus-voltage curves. That lets you separate the desired tube characteristic from the rest of the oscillator.

My recommendation: If you want to reproduce the pentode's current-source behavior as a building block in your existing simulation, begin with a transistor-based current source. If you want to reproduce the tube's contribution to oscillation, first identify its desired current-versus-voltage characteristic; a simple current regulator may suppress the very behavior you're trying to reproduce.

I'm interested in emulating a nearly zero, or absolutely zero, current source under conditions of voltage buildup with high V/I proportions.

What you're describing is a rather different operating condition from an ordinary constant-current source: a source that permits a very large voltage to develop while supplying almost no current.

There are two distinct electrical behaviors that can approximate this, and the distinction matters for your circuit.

1. Nearly zero current while voltage builds up

The simplest model is a source with extremely high output resistance. For example, if the voltage reaches 70 kV while the current is only 1 μA, the ratio is

$$\frac{V}{I} = \frac{70{,}000}{10^{-6}} = 70\,G\Omega$$

That is an effective voltage-to-current ratio of 70 gigaohms.

A transistor circuit can approximate this behavior, but the relevant property is extremely low leakage and very high effective output resistance, not merely the transistor's ability to regulate a substantial current.

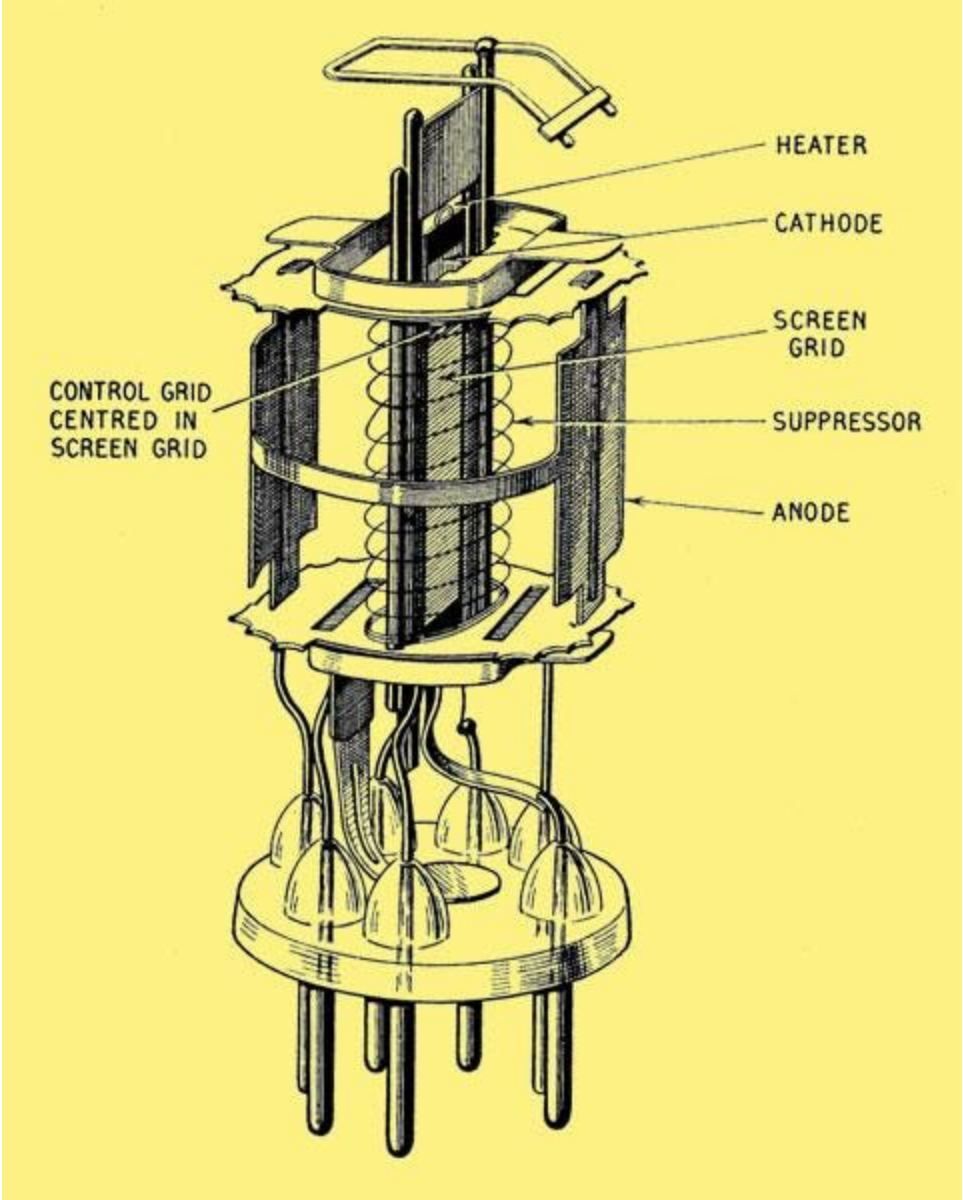
2. Which circuit elements can reproduce it?



A. MOSFET held in cutoff

The transistor is commanded off, so only leakage current flows. This approximates a nearly open circuit and allows a capacitive node to develop voltage if charge is supplied elsewhere.

It does not generate voltage by itself, and leakage increases with temperature and device characteristics.



B. Pentode operated near cutoff

The control grid suppresses electron flow, leaving a small residual plate current. This is a useful tube analogy for a high-impedance path, although a real tube is not a perfect open circuit.

C. Capacitor with a very high impedance charging path

A capacitor can hold a high voltage with no steady DC current through its dielectric in the ideal model. Once charged, it requires current only when its voltage changes or when leakage and other loads are present.

This is the most direct model if your interest is voltage buildup with negligible current.

3. The crucial distinction: zero current or zero change in current?

An ideal open circuit has

$$I = 0, \qquad V \neq 0$$

An ideal capacitor obeys

$$I = C\frac{dV}{dt}$$

Consequently, a capacitor can have a large voltage with zero current after its voltage stops changing. During voltage buildup, however, a nonzero current is required for a finite capacitance.

For instance, charging a 1 nF capacitor from 0 to 70 kV stores

$$E = \tfrac{1}{2}CV^2 = 2.45\,J$$

That energy must come from somewhere. A very small charging current can build the voltage slowly, but it cannot supply that energy instantaneously.

4. One important question about your intended behavior

When you say nearly zero, or absolutely zero, current source, which of these do you mean?

Voltage buildup: Current approaches zero while voltage continues to rise.

Voltage hold: High voltage remains present while current is zero.

High-impedance source: The source can develop voltage, but supplies virtually no current to a load.

How literally should zero current be represented?

Mathematically ideal: exactly zero current.

Physically realizable: an extremely small leakage current.

Develop the equivalent circuit

One caveat: if this is intended for a physical 70 kV circuit, insulation, stored-energy hazards, and discharge paths must be addressed independently of how small the current is. High voltage is hazardous even when the available current is limited.

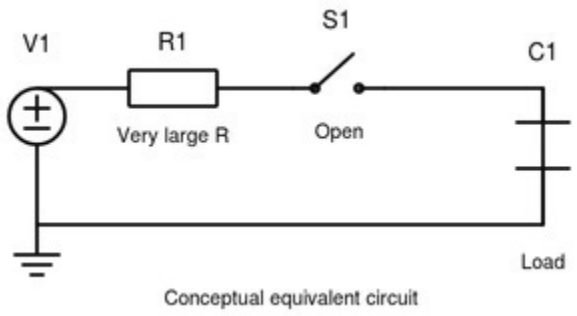
It's strange that I confirmed this canned question, which was provided by ChatGPT as one of several possible questions I could subsequently ask of it since I don't need advice on how to make an anomalous design for a circuit which delivers more "free energy" along with less "cost energy" thus making it a relatively "free lunch".

I want to emulate a zero-current/high-voltage behavior in a circuit. Intended behavior: high-impedance source develops voltage but supplies virtually no load current. Representation: mathematically ideal zero current. Recommend a suitable equivalent circuit and explain its behavior in Micro-Cap.

For your Micro-Cap circuit, I recommend an ideal voltage source in series with an extremely high resistance, or, if you require mathematically zero current, an ideal voltage source connected through an open switch.

There is an important distinction: a source with exactly zero output current cannot transfer energy to a load. However, it can maintain a voltage across its terminals, and a voltage elsewhere in the circuit can continue to build through capacitive or inductive coupling.

1. The equivalent circuit



With S1 open, the source delivers exactly zero conduction current to the load in the ideal circuit. With S1 closed, R1 limits the current.

This arrangement provides two operating regimes:

- S1 open: Exactly zero current, regardless of the source voltage, within the ideal circuit model.
- S1 closed: Very small current, approximately I = (V1−VC) / R1.

An ideal zero-ampere current source is electrically equivalent to an open circuit. It cannot, by itself, establish a specified nonzero terminal voltage.

2. Micro-Cap implementation

For a simple Micro-Cap test, you can use a voltage source, a resistor, and a capacitor:

```
V1 1 0 DC 70000
R1 1 2 70G
C1 2 0 1n IC=0
.TRAN 0 100
```

Here, `70G` means 70 gigaohms in SPICE notation.

At the beginning, the current is approximately 1 μA. As the capacitor charges, the current decreases toward zero.

The capacitor voltage follows:

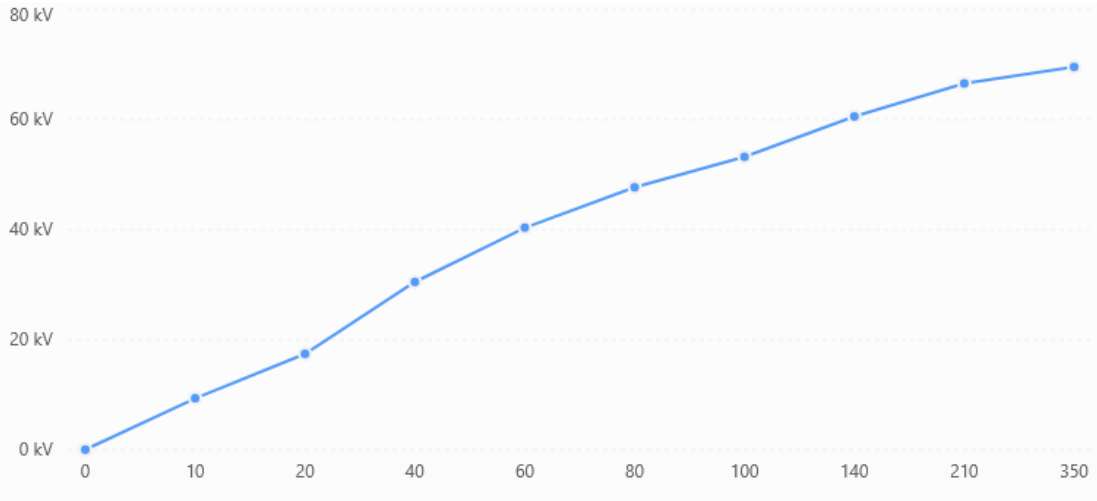
$$V_C(t) = 70{,}000(1 - e^{-t/70})$$

because

$$\tau = RC = 70\,seconds$$

Voltage buildup with diminishing current

Ideal 70 kV source, 70 GΩ resistance, 1 nF capacitor.



The current approaches zero as the capacitor approaches 70 kV. It never reaches exactly zero in finite time in this ideal RC model.

3. What if you require exactly zero current?

Use an ideal open switch or an ideal zero-current source. But then the source cannot charge C1 through that branch.

If the voltage across C1 is already established, an open switch can isolate it. If voltage continues increasing afterward, the increase must be caused by something else, such as magnetic coupling, changing capacitance, or another current path.

For your magnetically coupled circuit, this distinction is particularly interesting.

A coil can develop an induced voltage even when its winding current is zero:

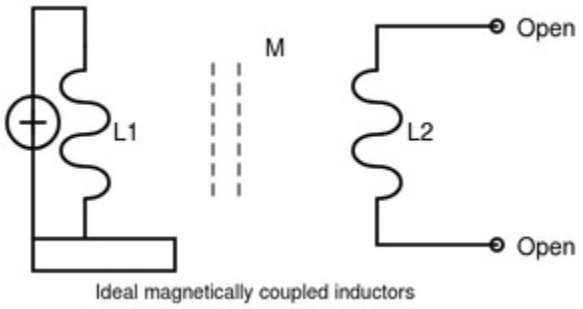
$$V_2 = M \frac{dI_1}{dt}$$

Here M is mutual inductance and I1 is the current in another winding.

Thus, a magnetically coupled winding can have a substantial open-circuit voltage while delivering exactly zero load current in the ideal model.

This may be closer to what you're trying to emulate than a pentode or transistor current source.

4. A better alternative for your three-inductor arrangement



Conceptual diagram; not a complete simulation schematic.

If L2 is left open-circuited, its current is exactly zero while its induced voltage can be nonzero. Its open-circuit voltage is determined by the changing current in L1 and the coupling between the windings.

In Micro-Cap, you can examine this with a simple pair of coupled inductors and a `K` coupling statement. Keep in mind that a real winding has parasitic capacitance and insulation leakage, so actual terminal current will not be mathematically zero during every transient.

5. My recommendation

For your specific objective, I would rank the alternatives this way:

Circuit approach	Zero current possible?	High voltage possible?
Pentode near cutoff	Approximately	Within tube ratings
MOSFET in cutoff	Approximately	Within device ratings
Ideal open switch	Exactly	Yes, if established elsewhere
Ideal current source set to 0 A	Exactly	Voltage determined externally
Open-circuit coupled inductor	Exactly, in ideal model	Yes, by induction

I would investigate the open-circuit coupled inductor first, because it permits precisely the mathematical behavior you describe: zero current at a port, but potentially very high voltage.

One question would help determine the correct Micro-Cap equivalent:

Are you trying to create a high voltage at a terminal that remains open-circuited, or are you trying to have high voltage build up across a connected load while keeping its current exactly zero?

Those are fundamentally different circuit conditions, and the first is much easier to realize mathematically.

What's the best way to use a pentode to substitute for a zero current DC source in a Mirrored Symmetric Circuit Simulation in LTSpice?

For your mirrored symmetric LTspice circuit, I would use a pentode model only if you specifically want to reproduce the tube's physical current-versus-voltage behavior. If your objective is to substitute for a mathematically ideal zero-current DC source, the best approach is to model the zero-current condition directly, then introduce a pentode model only if its nonlinear behavior is essential.

The distinction is important in your circuit because L3 and L5 are magnetically coupled through K2, with corresponding components on the mirrored side. An open-circuit output can have an induced voltage without carrying winding current. A pentode, by contrast, has residual current and parasitic capacitances, so it cannot guarantee exactly zero current.

1. The three possible substitutes

Model	DC current	Terminal voltage	Best use
Ideal zero-current behavioral source	Exactly 0 A	Determined by the surrounding circuit	Mathematical reference
Pentode near cutoff	Small, nonzero in general	Determined by the surrounding circuit and tube operating point	Tube-like behavior
Open circuit	Exactly 0 A	Determined externally	Isolating a circuit branch

My recommendation: use the ideal zero-current source as your reference case. It gives you a baseline against which to compare a pentode model without confusing the pentode's leakage, grid current, or capacitance with the behavior you're investigating.

2. How to implement the ideal source in LTspice

If the source is meant to connect between nodes `N_A` and `N_B`, use either of these:

Option A — behavioral current source

```
BZERO N_A N_B I=0
```

Option B — ordinary independent current source

```
IZERO N_A N_B DC 0
```

Both specify zero current through that element. Its terminal voltage is not fixed; the surrounding circuit determines it.

If the intended behavior is simply an open circuit, you can also remove the branch entirely. Keeping the zero-current source is useful as a named placeholder for comparing netlists and simulations.

Important placement detail

The zero-current source must occupy the same two nodes as the element it replaces. It does not force other branches connected to those nodes to carry zero current.

For example, if you place `BZERO` across L5, you have not made L5 carry zero current: L5 remains a separate parallel branch. If you want to eliminate current through L5, you must open the L5 branch itself or model the desired port separately.

3. If you want to try a pentode instead

A pentode near cutoff would need a suitable vacuum-tube model, with its plate, screen grid, control grid, and cathode connected appropriately. The control grid would be biased to suppress plate current.

However, its plate current will not generally be exactly zero. Its interelectrode capacitances can also permit transient current during rapid voltage changes. Those effects matter in an oscillating circuit such as yours.

For a fair comparison, I would run two simulations:

1. Reference: ideal zero-current source or open branch.
2. Tube approximation: pentode biased near cutoff.

Compare the voltage across the same two nodes, the current through the relevant branch, and the induced voltage associated with the L3–L5 coupling. Repeat the same comparison on the mirrored side.

One final point: an ideal zero-current source cannot establish a nonzero voltage on its own. It can sustain no current while a voltage exists across it, but that voltage must be established by the surrounding circuit, initial conditions, or magnetic induction.

Which exact branch in your mirrored symmetric LTspice schematic do you want the pentode to replace — L5/L6, a resistor branch, or a source elsewhere in the circuit? That determines the correct two nodes and whether the substitution preserves your circuit's symmetry.

Removing a zero current source component is all very well and good. Yet, it risks becoming a spark gap if built due to the buildup of voltages across that gaping hole. What do I do in the real world to prevent this? And how do I represent this under simulation?

You're identifying an important practical distinction: an open circuit can carry zero current while developing a dangerously high voltage across its terminals. Removing a component from LTspice may create exactly that condition, particularly in an oscillating, magnetically coupled circuit.

The solution is not necessarily to eliminate the zero-current behavior. It's to decide what the real circuit should do when the voltage across that branch rises.

For your mirrored symmetric circuit, I would distinguish three goals:

- Prevent an uncontrolled arc across the physical gap.
- Preserve the high-impedance, nearly zero-current behavior during normal operation.
- Represent the actual voltage-limiting or insulation behavior in LTspice rather than relying on an ideal open circuit.

1. What to do in the physical circuit



A. High-value bleeder resistor

Place a suitably voltage-rated resistor, or a series string of resistors, across the terminals that would otherwise be open. It provides a defined leakage path and discharges stored charge.

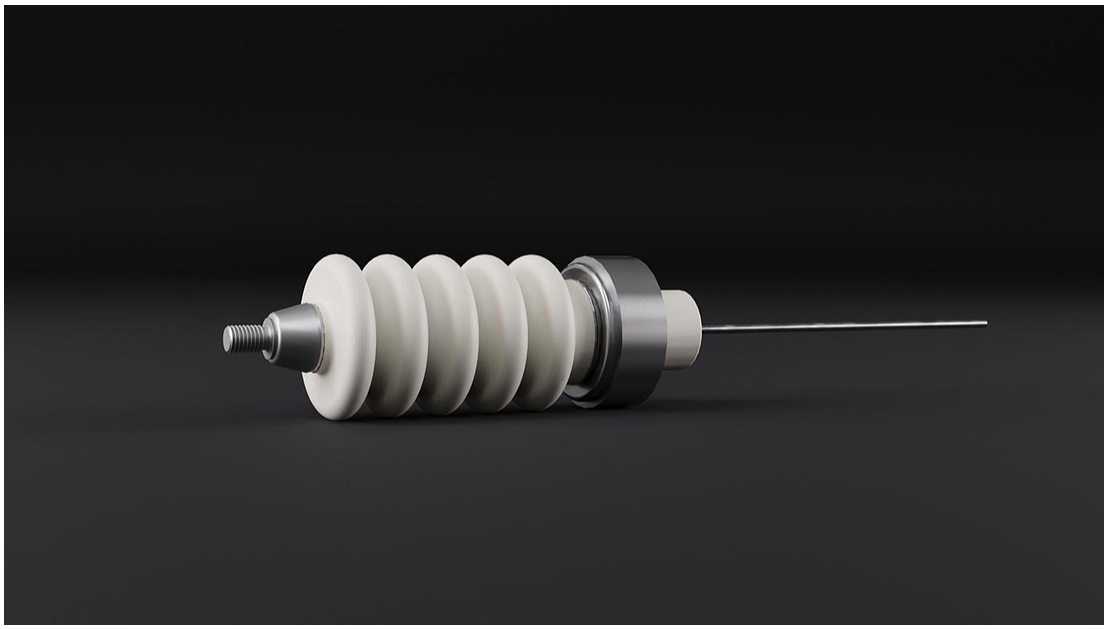
This is often the simplest way to prevent a floating node from retaining an uncontrolled voltage. It does mean the current is small rather than mathematically zero.



B. A voltage clamp or surge arrester

A properly rated clamp conducts when the voltage reaches a defined threshold. Below that threshold, its leakage can be very small; above it, it limits further voltage rise, subject to its dynamic response and energy rating.

This is appropriate when you need high impedance during normal operation but want to prevent excessive voltage.



C. Proper insulation and spacing

If the terminals must remain electrically open, use insulation, creepage distance, clearance, and feedthroughs rated for the maximum possible voltage and transient conditions.

Insulation prevents an unintended arc only within its specified limits. It does not clamp the voltage or discharge stored energy.

A resistor alone does not guarantee safety, and a clamp does not guarantee a safe voltage under every transient. For a circuit potentially reaching tens of kilovolts, component voltage ratings, transient energy, fault behavior, and physical layout all matter.

2. How to represent the real-world solution in LTspice

I would model the branch in stages, starting with the simplest physically meaningful circuit.

Model A — Open circuit with a leakage path

Conceptual model: a high-value leakage resistance and parasitic capacitance across the isolated terminals.

For example, suppose you want the branch to behave as though it were nearly open at 70 kV, with no more than 1 µA of resistive leakage.

$$R_{\text{bleed}} \geq \frac{70\,000}{1\ \mu\text{A}} = 70\ \text{G}\Omega$$

In LTspice:

```
Rbleed A B 70G
Cstray A B 5p
```

The 5 pF value is illustrative, not a measurement of your circuit. You should use a realistic estimate of the physical gap, wiring, and component capacitance.

This model lets you observe both the small resistive current and transient displacement current. The resistor dissipates V^2/R; at 70 kV and 70 GΩ, that's 70 mW in the ideal resistor model. A physical resistor string must be rated for the total voltage and distributed power.

Model B — Add a voltage-triggered clamp

If you want the branch to remain nearly open below a voltage threshold but conduct above it, add a nonlinear clamp in parallel with the leakage path.

A conceptual LTspice behavioral model is:

```
.param VCL=60000
.param RON=1000

BCLAMP A B I={if(V(A,B)>VCL,(V(A,B)-VCL)/RON,if(V(A,B)<-VCL,
(V(A,B)+VCL)/RON,0))}
```

This illustrative model begins conducting above +60 kV or below −60 kV and approximates a resistive clamp beyond that threshold. It is an idealized model, not a specification for a physical arrester. Its abrupt transition may also require smoothing or a more realistic device model for numerical convergence.

You must choose `VCL` based on the intended insulation and component ratings, not merely to make the simulation converge. The clamp's current and energy ratings must be adequate for the transient.

3. What I would do in your mirrored symmetric simulation

Since your circuit uses magnetically coupled inductors, I would preserve the same protection topology on both mirrored sides.

1. Keep the branch electrically open in the ideal reference simulation.
2. Add identical high-value leakage resistances and realistic parasitic capacitances to both sides.
3. Monitor the differential voltage across each open branch, as well as current in L3 and the other coupled inductors.
4. Add matching voltage clamps only if the intended physical circuit really includes such protection.
5. Compare the unclamped and clamped results, including peak voltage, peak current, and energy dissipated by the protection element.

Do not simply remove a branch and assume its voltage remains zero. Nor should you connect a resistor to ground unless that is the actual physical return path you intend to build; doing so may alter the circuit's symmetry and magnetic behavior.

One more important distinction: a high-value resistor limits steady leakage current, but it does not necessarily prevent a fast transient from exceeding the insulation breakdown voltage. A clamp must respond quickly enough and withstand the available energy.

For your circuit, the most useful next step is to identify the exact two nodes where you intend to substitute the zero-current source. If those nodes are across L5, for example, the correct model may be different from a protective gap connected between two otherwise isolated circuit sections. If you share the relevant netlist lines or schematic crop, I can show exactly where to place the leakage resistance, parasitic capacitance, and optional clamp without disturbing your mirrored symmetry.

Thanks for your advice. But I discovered that it is far simpler, and elegant, and efficient, to simply remove the branch which is clamped to zero amps by the zero current source and make a few other minor adjustments to accommodate this new situation since I have already accepted this subcircuit as a legitimate part of its surrounding circuit rather than continuing to view it as a neon bulb. So, I can do anything I want to it since it is no longer virtual.

Netlist:

*** D:\Documents\Sims\LTSpice\2026\10 - Oct\13\1diode2g2+gdt_cg-watts-CS-sub.asc**

*** Generated by LTspice 24.1.9 for Windows.**

L1 n010 n015 10 Rser=0.3125

R1 n010 CG 1

R2 n015 CG 1

R5 Pin2 N018 1

C2 N017 N016 100f Rser={ESR}

C4 N014 N013 100f IC=PC Rser={ESR}

L3 n007 n006 2 Rser=62.5m

R7 n006 Pin1 1

R8 n007 Pin2 1

L5 n002 EL_5 2 Rser=2

R11 N003 EL_5 1

S1 N004 N005 N011 N012 G

R6 Pin1 MON 1e8

C1 N019 N018 {SEE_1} Rser={ESR}

R9 N013 CG 1

B1 N008 N009 V={Vhold+Rdyn*(I(S1)-Ihold)}

R14 Pin2 Pin1 {Rleak}

R16 N003 n002 1

R17 Pin1 N014 1

R18 N016 Pin2 1

R19 CG N017 1

R21 N004 Pin1 1

R10 N019 MON 1

R25 N009 Pin2 1

R29 N005 N008 1

R3 0 N003 1

R4 N011 Pin2 1

R12 N012 MON 1

R13 N011 0 1

.param PC=3u

.tran 0 86.65k 0

K2 L3 L5 .99

.options reltol = 0.04

* Disconnect the\nneon bulb to\nturn this\ncircuit OFF.

* ‘MON’ is an internal node\nwithin the neon bulb. It\ndiscloses to us that the\ninternal dynamics is al-\nlowed to ‘float’ its vol-\ntage without limitation.

.param Vstrike=100 Vhold=50 Zon=2K Ihold=200u Tau=100u Rdyn=Zon Rleak=1e7 SEE_1={Tau/100Meg}

.model G SW(Ron=1e-50 Roff=1e12 Vt={.5*(Vstrike+Vhold)} Vh={.5*(Vstrike-Vhold)} Vser=0)

.param esr = 3

* GEAR\nAPPROXI-\nMATION\nMETHOD

* 19m <= max time step >= 20m\n comatose vs surge

*** This model of a neon bulb uses a dynamic resistance which\nis predicated upon using the original resistance of: Zon=2k.**

.backanno

.end

Output log:

LTspice 24.1.9 for Windows

Circuit: D:\Documents\Sims\LTSpice\2026\10 - Oct\13\1diode2g2+gdt_cg-watts-CS-sub.net

Start Time: Tue Oct 13 17:33:41 2026

Options: reltol = 0.04

solver = Normal

Maximum thread count: 4

tnom = 27

temp = 27

method = Gear

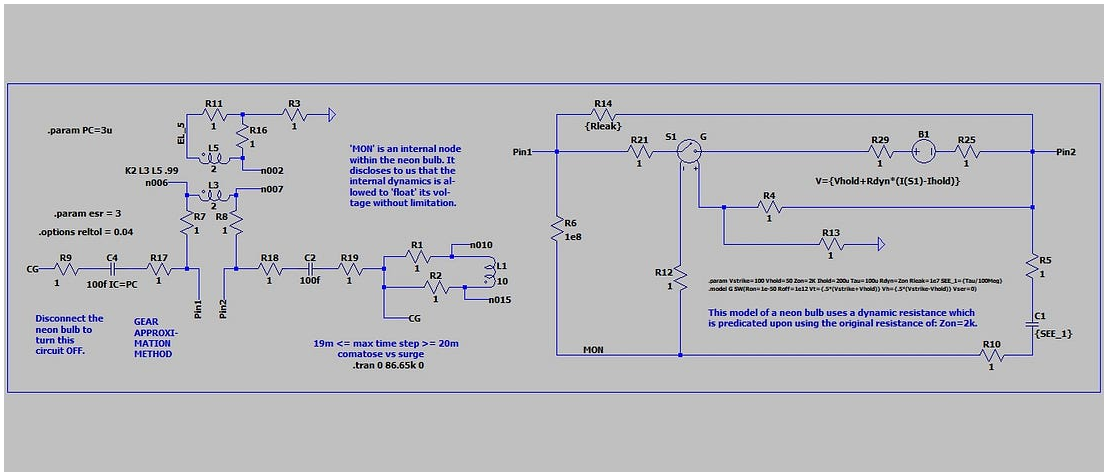
reltol = 0.04

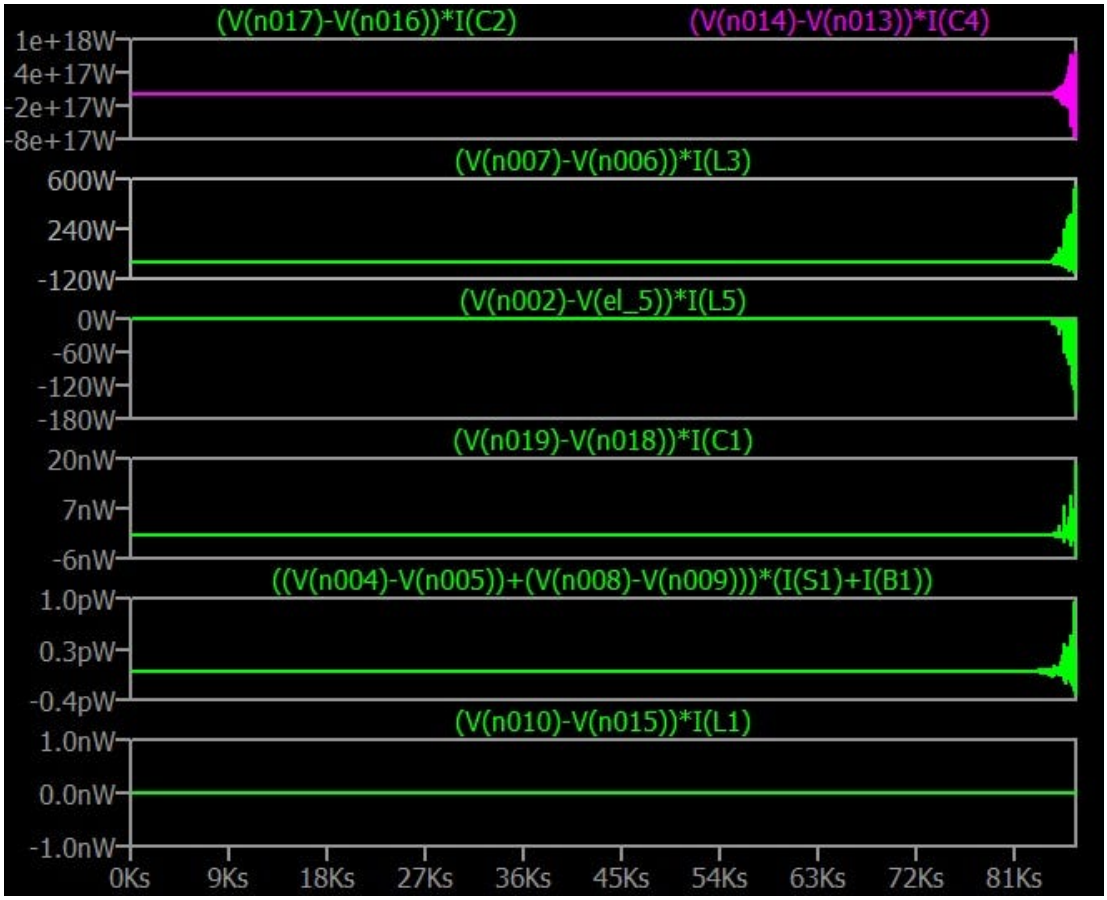
Direct Newton iteration for .op point succeeded.

Total elapsed time: 12.961 seconds.

Files loaded:

D:\Documents\Sims\LTSpice\2026\10 - Oct\13\1diode2g2+gdt_cg-watts-CS-sub.net





Download this experiment from my Google Docs account or from my website.

List of: Mirrored Symmetric Circuit Simulation in LTSpice - a dialogue with ChatGPT, pts. 1-10

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