

# Tesla coil

- coil former:  $\phi 50$  white plastic tube, not gray waste tube, can be paper or cardboard, but with thin walls otherwise quality factor will decrease
- 12cm length of winding, wire  $\phi 0.8\text{mm}$ , length approx. 25m
- about 4.5mhz wave resonance without antenna connected (corresponds to gradient coil's half wave resonance frequency)
- about 1.5mhz with antenna connected (corresponds to 1/10 of antenna's frequency 15mhz approx.  $3 \times 4.5\text{mhz}$ ), antenna works as a top capacitance for the Tesla coil
- read about trick with 3 harmonic to increase amplitude as used in old TV horizontal deflection trafos
- power supply voltage 150-200v

## The calculation of the single layer coil on a 1/4 wave taking into account the capacity of the ground

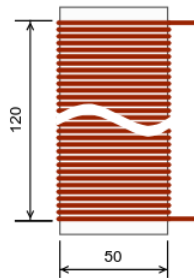
The height of the winding, mm

The diameter of the winding, mm

The number of turns

Capacity grounding, pF

External capacity: ☒ there ☐ is



Inductance,  $\mu\text{H}$ : **390.7**

The resonant frequency, MHz: **5.29**

Self-capacitance, pF: **2.32**

The ratio of the speed of propagation of the wave: **1.7**

The step of winding, mm **0.8**

no capacitance

## The calculation of the single layer coil on a 1/4 wave taking into account the capacity of the ground

The height of the winding, mm

The diameter of the winding, mm

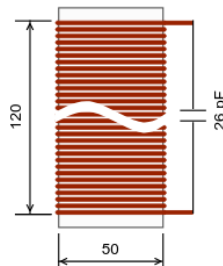
The number of turns

Capacity grounding, pF

External capacity: ☐ there ☒ is

Type external capacity: ☐ Thor ☐ Orb ☒ capacitor

The capacity of the external capacitor, pF



Inductance,  $\mu\text{H}$ : **390.7**

The resonant frequency, MHz: **1.51**

Self-capacitance, pF: **2.32**

The ratio of the speed of propagation of the wave: **0.5**

The step of winding, mm **0.8**

with antenna capacitance (simulated)

calculator: <https://gorchilin.com/calculator/coil14?lang=en>

# Gradient coil

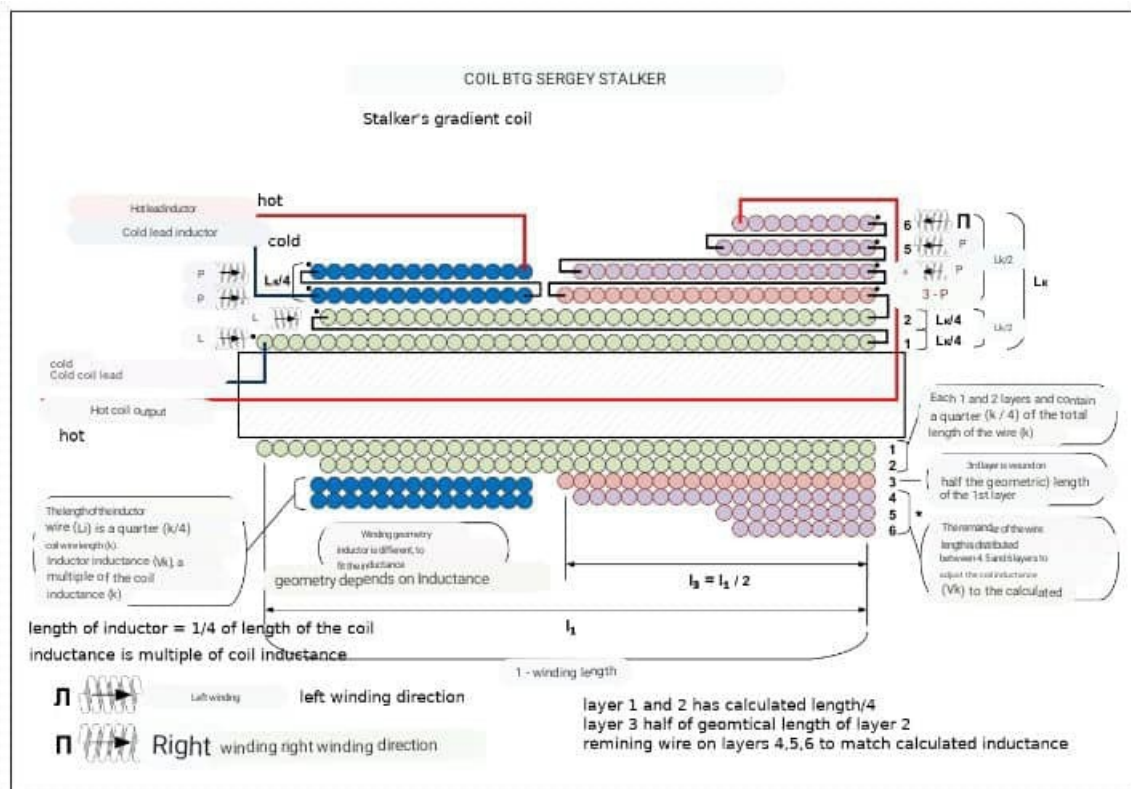
4mm<sup>2</sup> wire, it measures (caliper) 4.2mm outer diameter and 2.5mm core diameter, so insulation is 0.85mm.

Wire type: H07V-K4 BLUE

Doing some calculations with that data and.....37.5m

Length: 37.5m

inductance: 143uH



pic. One of possible winding methods

## Additional information

- wire insulation thickness is equal(close) to half wire core diameter
- half the length of the wire wound on the first two layers in one direction, the second half of the wire in the opposite direction 4 layers, this forms two “halves” of the *multilayer bifilar coil*
- inductance approximately 140 uH
- half wave resonance around 4.5 – 5 mhz
- between two halves (the first two layers and the second four) occurs beatings, frequency approximately 900 kHz (strongly depends on wire used and winding method)
- 1/10 of 900kHz = 90kHz resonance in grenade inductor
- 90/5 18 kHz push-pull frequency (could be odd harmonic 3, 5, 7 etc)
- push-pull frequency preferably below 20kHz
- two frequencies (3/5 harmonic in inductor vs push pull frequency in grenade) reduce load effect on the inductor resonance circuit
- inductor length is 1/4 of GC length, inductance approx. 70uH, resonance capacitor around 0.03uF
- GC capacitor 0.35uF (Stalker’s variant)

# Push pull transformer

A step down trafo aprox. 3:1 trafo for driving gradient coil inductor resonance circuit

Any proper size core can be used (old TV/monitor yoke, ring or E core). No magic old soviet yoke required.

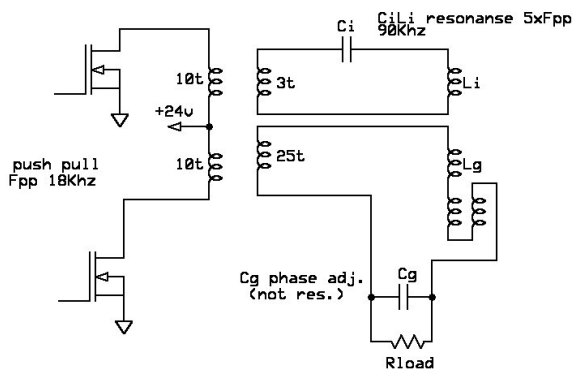
Typically 10-15 turns primary and 3-4 turns secondary works fine.

Some air gap needed to avoid saturation, but remember keep reasonable high primary's inductance (e.g. 100uH)

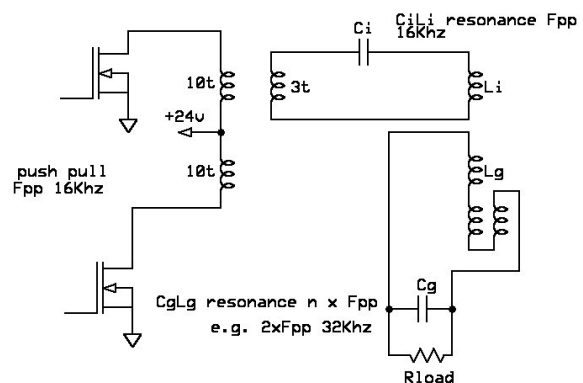
Another secondary winding (if used) approx. 25 turns

There were some confusion why Stalker's device has extra coil comparing to Alexeev's device.

Here how I understand it. Base principle is same in both devices, implementation is a little different.



pic. Stalker's setup



pic. Alexeev's setup

In both cases we make two frequencies oscillations in the gradient coil and inductor to implement a dynamic negative resistance, when oscillations with one (lower frequency) “interrupted” by oscillations with higher frequency. In Stalker's setup push pull frequency “interrupted” by inductor frequency, in Alexeev setup gradient coil itself resonated on higher frequency and “interrupts” inductor's oscillations. Frequencies in such setup can be calculated using formula for coupled oscillator circuits, see e.g. [https://www.ee.bgu.ac.il/~intrlab/lab\\_number\\_7/Two%20inductively%20coupled%20RLC%20circuits.pdf](https://www.ee.bgu.ac.il/~intrlab/lab_number_7/Two%20inductively%20coupled%20RLC%20circuits.pdf)