Charge pump and its use as an energy amplifier

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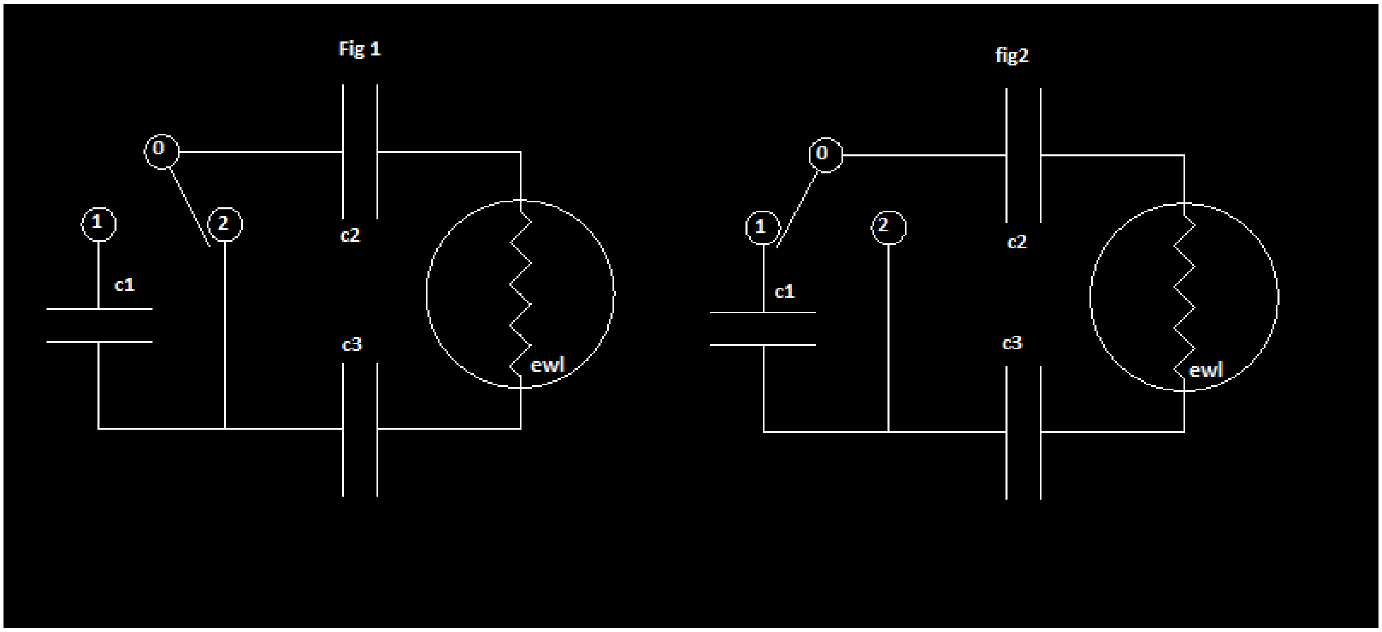
Doc#82117 ref2.21



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

In the above video 2 24V 1 farad caps were used for testing with a 12v battery in place of C1, C1 in this example is used for the ease of calculating the outcome. The math isn't meant to be precise, simply "close enough" to present this example. Assume C1,C2,C3 are 1 farad and charged to 12 volts. This gives us an initial energy storage of 72 joules in each of the 3 capacitors and a total energy of 216 Joules. Fig 1 represents an initial state where C1,C2,C3 are at rest, fully charged and in balance as a starting point.

Referring to Fig2 the switch is moved to the #1 contact placing C1 and C2 in series. This creates an imbalance and the energy is forcefully moved to C3 through the load. This state of balance leaves the following charges in the capacitors…

C1 = 9 volts 40.5 Joules remaining

C2= 9 volts 40.5 Joules remaining

C3 = 18 volts which now contains 162 joules

We used 31.5 joules from each of the capacitors (C1,C2) to shift and store the energy in C3 through the load. Note that C3 now has 90 joules of energy greater than its original charge.

The switch is now moved to position #2 where C2,C3 are forcefully balanced through the load once again. The energy is returned to C2 for the next cycle. This completes one full cycle.

The only energy depleted was the original 31.5 joules from C1. At 1 full cycle per second we have successfully moved approximately 180 joules of energy through the load at a cost of 31.5 joules.

C2,C3 are in a constant state of **increasing** and **decreasing charge** while seeking balance as they're being switched between contacts 1 and 2 **– never discharging –** C2 is always returned to a full charge in the re-balancing stage allowing us to reuse this energy in combination with C1.

C1 functions by discharging between its positive and negative poles in order to create an imbalance in C2,C3, unfortunately C1 must deplete its charge in order to create a new balanced state. The energy depleted is still far less than the energy moved between each imbalanced state.

Exploring the possibilities further, we know if we double the voltage in the capacitors we can store 4x more energy. If we can shift the voltage between C2,C3 by a factor of 2x we can move 4 x the energy.

As a simple example, charging the 1 farad caps (C2,C3) to 24 volts increases the stored energy to 288 joules in each cap. If we use the same 12 volt shift we end up with 112 joules in C2 and C3 now contains 450 joules or 162 joules over its original charge. A full cycle moves 324 joules through the load. Charging C1 to 24 volts as the working voltage an increase to 720 joules can be moved through the load at a cost of around 125 joules.

The amount of energy that can be moved through the load is based on the capacitance and working voltage in combination with the resistance of the load. The speed at which this all takes place would be dependent on the variables of the components. The current generated is based simply on the discharge through the load. For instance with 5 – 12 volt 50 watt bulbs in parallel have a resistance of approximately 0.6 ohms, a 9 volt average discharge would develop 15 amps.

It basically boils down to how we store and reuse existing energy, the initial energy investment becomes less relevant as we find ways to utilize the energy available in more efficient ways. By simply shifting the balance of energy stored in 2 capacitors we can move the energy as needed for the load. Finding more effective ways to generate an initial imbalance can increase the overall efficiency of this simple circuit.