Energy Gain using Dielectric Displacement

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1. Introduction

The displacement of electric charge within a dielectric that takes place when a capacitor is conventionally charged is caused by the electric field in the dielectric from charge accumulated on the electrodes, the accumulations coming from the charging current. Recent work has shown how displacement can also be caused by an electric field induced magnetically via d**A**/dt where **A** is the magnetic vector potential. In this paper we show how this effect can be used to gain energy via the reversed twin capacitor paradox. This paradox has two identical capacitors; one fully charged and the other fully discharged. When connected so that the first one discharges its energy into the second, the result is always a loss of half the energy regardless of the resistance of the interconnecting wire. This comes about because the conservation of charge takes precedence over the conservation of energy. By the same token, if you start with both capacitors having the same quantity of charge Q, then you pump charge Q from one into the other, the final charged capacitor has twice the stored energy than that supplied originally to the two. Until now all methods of doing this pumping action have required input energy that at least matches the energy gained.

2. Method

Figure 1 shows a capacitor being charged conventionally via a single secondary turn on a transformer using a ring core (primary coil not shown). We wish to see what happens when the capacitor is moved into the centre of the ring core where the electric field E exists as shown. The capacitor must be of the simple form shown, cylindrical electrodes, spiral electrodes or multi-plate electrodes won't work. Of course, this is resonant charging, and we have chosen to look at the instant in time where the capacitor is fully charged; at this point, ignoring losses the primary input has supplied the energy in the capacitor.

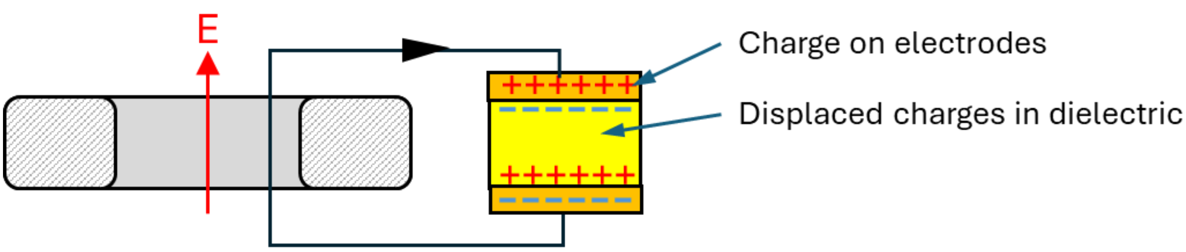

Figure 1. Capacitor charged through a transformer

We indicate the quantity of charge on each electrode by the number of + and – symbols. Also shown is the effect of the induced charge displacement in the dielectric as an equivalent surface charge there.

The next figure shows the capacitor moved into the centre of the ring core while retaining the single turn. Here the dielectric displacement is driven directly by the E field, which is the dominant effect, the drive from the outer single turn being now small.

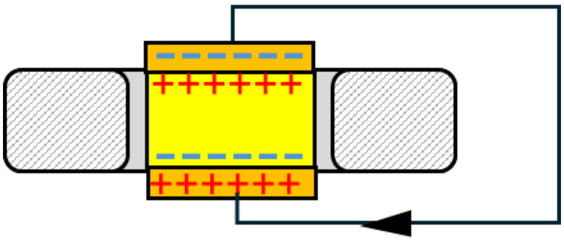

Figure 2. Capacitor moved into ring core

It is expected that the capacitor charge is the same for both cases.

Of interest here is what happens to the dielectric if the outer turn is not present, as shown in Figure 3.

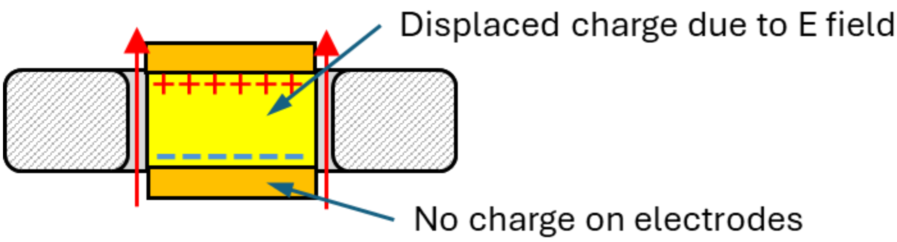

Figure 3. Dielectric charged without conductors

The dielectric displacement by the E field still takes place, the dielectric is storing energy that is supplied from the primary as before. The electrodes do not hold charge as there is no means for charge to be carried there (the adage of a charged body inducing equal and opposite charge to one nearby is false, that body only gets polarised by charge separation within it). We now move on to Figure 4 which shows the same situation but now the capacitor has previously been charged, and the transformer action is adding energy.

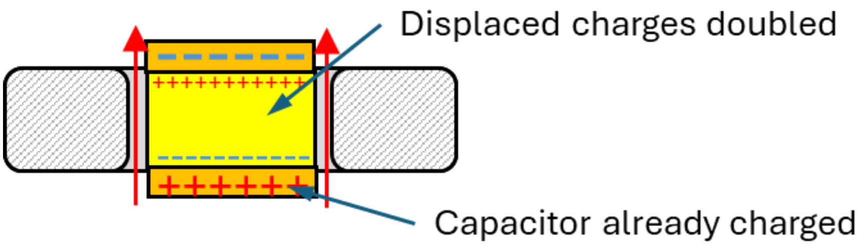

Figure 4. Charged capacitor receives extra dielectric charge

Note the number of + and – signs in the dielectric, the dielectric displacement is doubled. We are showing the effective charge stored in the dielectric at an instant in time where we have flux in the core changing with time to create the E field. The amount of charge stored in the dielectric has doubled, and the energy stored has quadrupled; we have achieved our objective, the energy stored there is twice the total supplied by the two energy inputs. The question now is can we develop on this to extract that double amount, and that leads on to Figure 5.

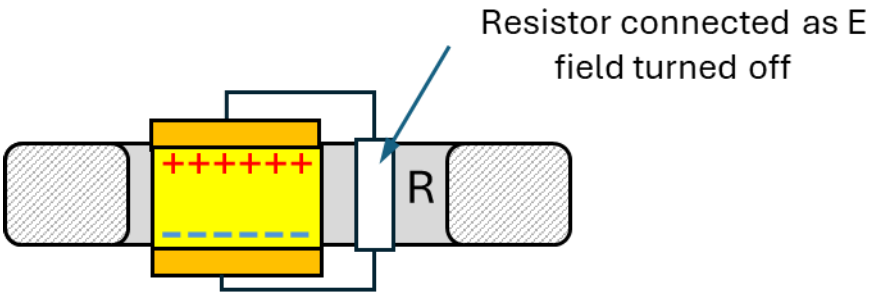

Figure 5. Discharge of energised dielectric

Here we show the case for an uncharged capacitor (Figure 3) where the E field has been instantaneously switched off and at the same time a resistor is connected across the electrodes. This synchronisation will be a challenge to achieve but we might note that the flux in the core could be passing through zero at that point so it could all come down to timing and ensuring the flux then remains at zero. The dielectric will try to lose its polarisation, and it starts by pumping current through R to create charge on each electrode to equalise the electrode charge with the effective opposite surface charge on the dielectric. Thereafter we get the normal discharge of a capacitor. The current pulse will look something like Figure 6 where there is an initial spike followed by a reversed exponential discharge current.

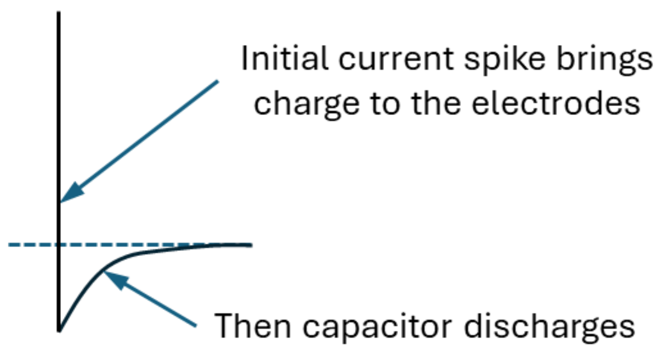

Figure 6. Current waveform for Figure 5

The total energy delivered to the resistor, ignoring losses, has been input to the primary.

Moving on to the case of the previously charged capacitor (Figure 4) connected to R we expect the current pulse to have the same initial spike as the quantity of charge initially delivered to the electrodes to equalise is the same. This is followed by a capacitor discharge at double the voltage.

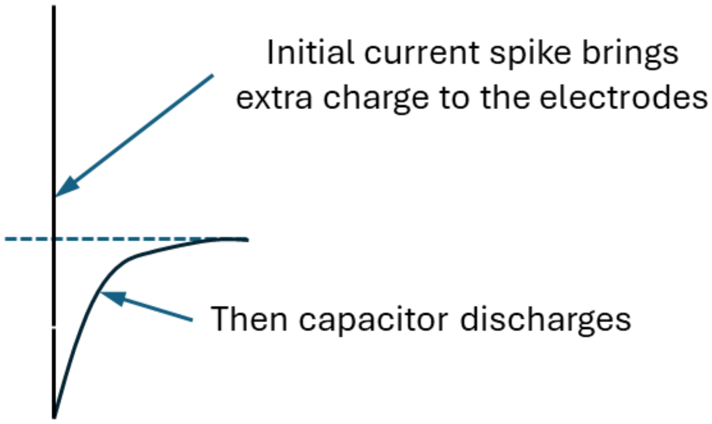

Figure 6. Current waveform for extra dielectric charged capacitor