Experiment of the Biefield-Brown Effect using Symmetric Plate Capacitors Charged below 35kV

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Since at least as early as the 1920's it has been documented within the literature that asymmetric capacitors exhibit a net force in the direction of their charges when high voltages are applied. It also has been demonstrated that certain electrode shapes have an impact on the effectiveness of this effect, that which is called "the Biefield-Brown Effect". The author herein explores the limitations of certain designs in order to better understand the physics of this phenomenon, as well as to add measurable data to this study. Nine designs are considered and strict controls are applied to the experimental steps in order to provide the best possible data and analysis for this research. It has been found through this research that the "skin effect" of a charged metal can give insight into better designs, as well as the electrical breakdown distances of the dielectric materials of such capacitors. While this paper does not rule in (nor out) the exclusivity of ion wind in such designs, it does bring into account where and when such ion wind factors are a critical block to future technologies in this regard, as well as to where and when they are not.

1. Introduction

It has been explained to this author that there is a net thrust in the direction of the fixed positive electrode of a symmetric capacitor when a high voltage electric field is applied, and that the force behind said thrust is not related to ionic wind. The reference provided to the author was that of Thomas Townsend Brown [12], where he used +100kV in order to apply a measurable net thrust independent of the fixed distance between the two electrodes. In other words, by placing the capacitor on a weigh scale with the positive electrode facing down (toward the Earth's center of gravity), the capacitor itself is said to gain weight. Brown claimed to have used spherical lead electrodes, weighing 40 pounds each [12] and not plates; thus, this seemed to the author a valid new approach to determine whether or not such effects (provided are accurate) really had anything to do with symmetry and high voltage electric fields. It was well understood by the author that asymmetric capacitors do indeed have such a net thrust, as numerous experimenters have demonstrated this effect over the years [11]. The purpose of this experiment is to determine if there is any measurable force using a solid dielectric material between the symmetric electrodes.

1.1. Hypothesis

The author did not think there will be any considerable weight change of the symmetric capacitors, because the various apparatuses he has read about that were built by the various experimenters [11] since the time of Brown's filed patents [10], those yielding measurable thrust, have always involved asymmetric capacitance of some form or another, usually having the cathode angled in line with the direction of charge toward the anode, and he suspected that there was significant reason for such designs.

2. Experimental Design

2.1. The Symmetric Capacitors

Four symmetric capacitors were constructed, each with different diameters and none of the symmetric capacitors had air dielectrics except one. Two were constructed having Styrofoam as a dielectric material with spacing well beyond the minimum electrical breakdown distance [5].

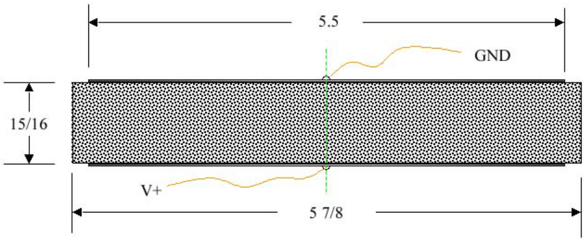


Fig. 1. 5 ½ inch symmetric capacitor drawing, C_1.

Fig. 2. 5 ½ inch symmetric capacitor photo, C_1.

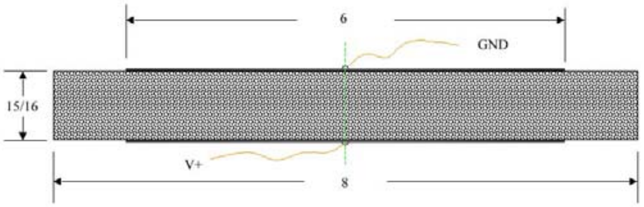


Fig. 3. 6 inch symmetric capacitor drawing, C_2.

Fig. 4. 6 inch symmetric capacitor photo, C_2.

Two of the symmetric capacitors had polystyrene as a dielectric material, separated very close to (but slightly greater than) its minimum electrical breakdown distance.

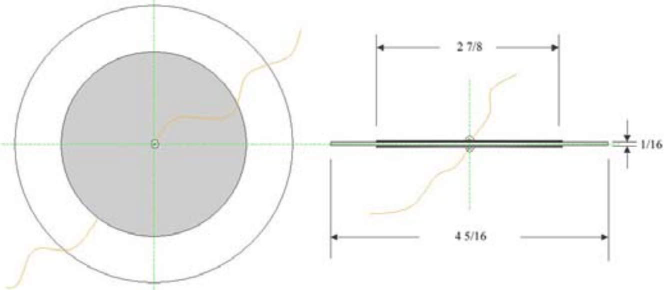


Fig. 5. 2 7/8 inch symmetric capacitor drawing, C_3.

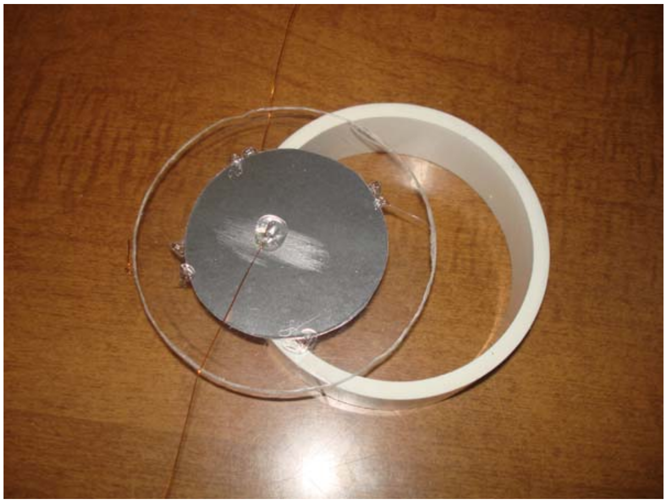


Fig. 6. 2 7/8 inch symmetric capacitor photo, C_3.

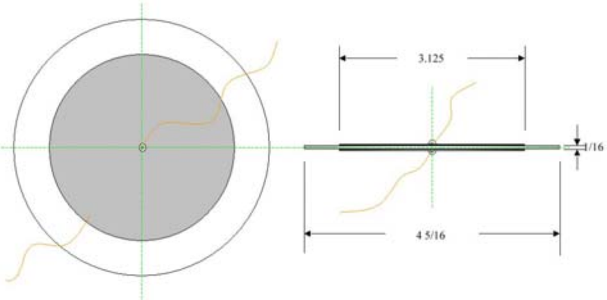


Fig. 7. 3 1/8 inch symmetric capacitor drawing, C_4.

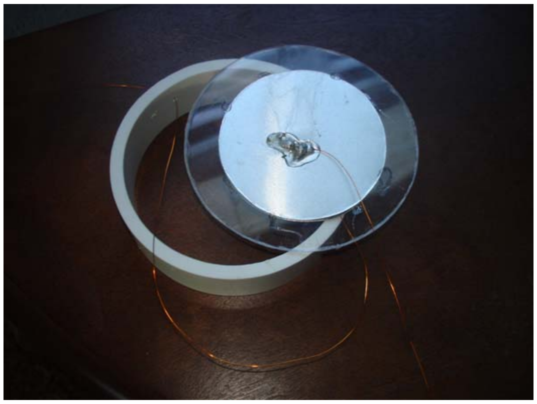


Fig. 8. 3 1/8 inch symmetric capacitor photo, C_4.

Five asymmetric capacitors were constructed as controls, the purpose being that at least some measurable weight change would be required in order to demonstrate that the setup used was acceptable. One asymmetric capacitor included a flat disc anode and a tungsten needle cathode separated by polystyrene.

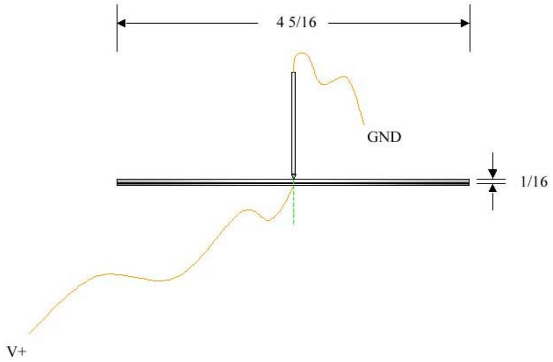


Fig. 9. Perpendicular capacitor drawing, C_5.

Fig. 10. perpendicular capacitor photo, C_5.

Note: the Styrofoam in the image was for structural purposes, and was not between the shortest distance of the electrodes (i.e. it is not a dielectric in this capacitor).

An asymmetric capacitor was constructed of a conical brass cathode and aluminum wire circling the perimeter for the anode.

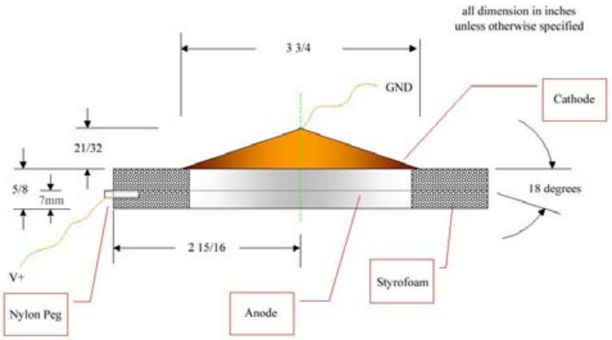


Fig. 11. Conical capacitor drawing, C_6.

Fig. 12. Conical capacitor photo, C_6.

Note: the vice in the photo was only being used as a weight while the glue dried.

An "adjustable" asymmetric capacitor was constructed of a bent piece of sheet aluminum anode and a tungsten needle cathode, having a Styrofoam dielectric. The adjustments were possible by changing the distance between electrodes, as well as the angles of the bend in the anode and angle of insertion of the cathode.

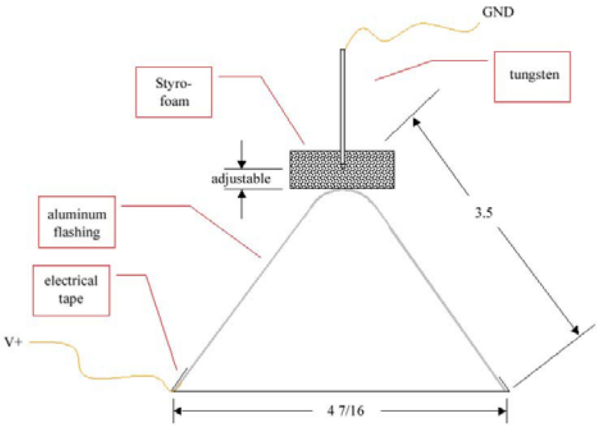


Fig. 13. Adjustable capacitor drawing, C_7.

Fig. 14. Adjustable capacitor photo, cathode at some arbitrary angle, C_7.

A similar asymmetric capacitor (but non-adjustable), as that above, was also constructed with a polystyrene dielectric disc.

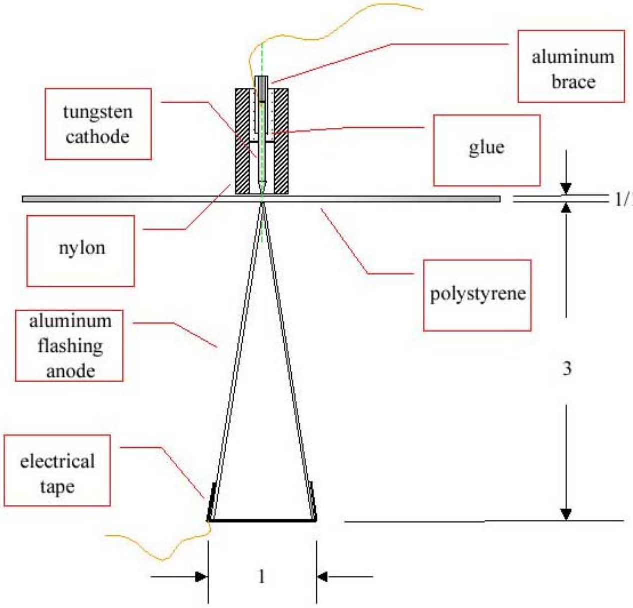


Fig. 15. Non-adjustable capacitor drawing, C_8.

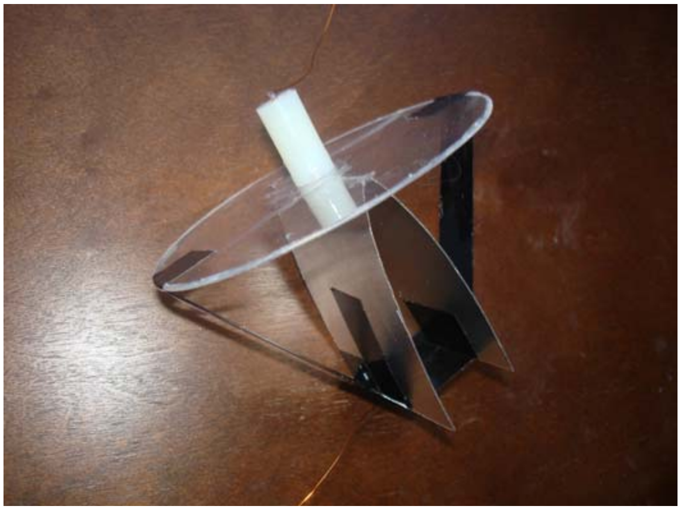


Fig. 16. Non-adjustable capacitor photo, C_8.

Lastly, a triangular ("lifter") asymmetric capacitor with an air dielectric was constructed, but *not* following any outside inventors' specifications [11].

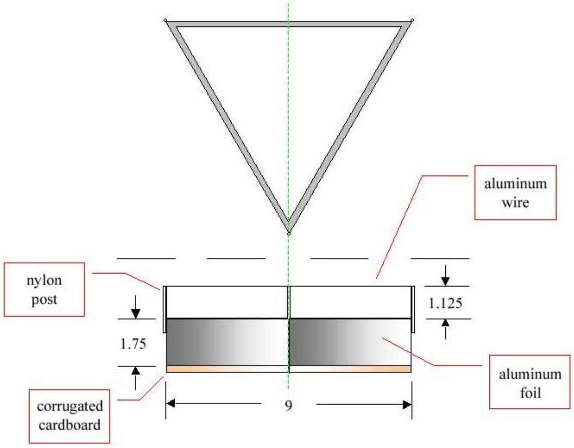


Fig. 17. "Lifter" capacitor drawing, C_9.

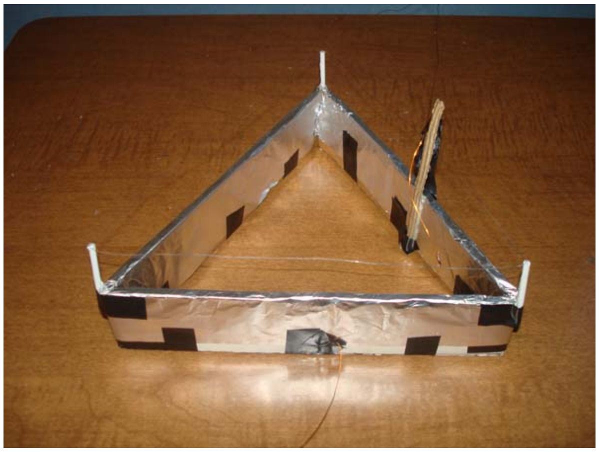


Fig. 18. "Lifter" capacitor photo, C_9.

The electrode plates of all but the lifter and the conical capacitor were cut from a roll of aluminum flashing, the type used for duct work.

The conical cathode of the asymmetric capacitor was constructed from a flat, circular sheet of brass with an 18 degree angled piece cut from edge to center, bent, soldered on the inside to maintain an even electrical contact from the edge to the center and then supported with glue ("Amazing E-6000") on the outside. The cathode was then attached to the Styrofoam using the same glue, but the glue was placed on the outside of the joint, rather than directly between the cathode and the Styrofoam, so as to utilize the dielectric constant of the Styrofoam only. The aluminum wire anode was also secured around the perimeter of the Styrofoam with glue, but only with dots in certain places in order to maintain the dielectric constant of the Styrofoam.

All plates were drawn in circles with a compass and carefully cut out using tin snips.

The plates edges were sanded down considerably and then buffed for smoothness and pressed in a 2-ton press in order to prevent buckling--in order to obtain as even as possible separation between the plates and the distance between the symmetric plates with the Styrofoam dielectric (the thickness of the Styrofoam disc) was 15/16", which is a significantly greater distance than electrical breakdown (discharge between the plates) occurs for this material [5]. The diameter of the Styrofoam discs between all the electrodes was chosen to be distinctly larger than the electrodes themselves, in order to rule out the transmission of ionic wind (with the exception of the "lifter") .

Additionally, the plates were glued rather conservatively (in order to not alter the value of the dielectric constant significantly) to the Styrofoam and allowed to dry for +24 hours.

The 28 AWG wire attached to the electrodes was accomplished with the following: 1) solder, then 2) glue, then sometimes 3) electrical tape for additional stability. Lastly, four additional drops of glue were applied to the perimeter of the plates, attaching them securely to the Styrofoam and/or polystyrene.

2.2. The Scale

A digital scale (with means to calibrate) with a 6" glass plate was used, rated with a sensitivity of 1g to 5kg and a PVC mount was constructed to hold the capacitors off the glass plate evenly at a distance of 1.5". The mount also aided in holding the lead wires out of the way by means of an 1/8" hole through its side.

Fig. 19. The scale and mount.

2.3. Power Supply

A 35kV rated DC power supply was used and attached to a transformer (12V, 3A), that in turn attached to the standard U.S. household AC current. The supply required the use of an earth ground; in the event the maximum voltage rating was exceeded, the unit discharged to it (and only discharged in such event).

Fig. 20. The earth ground.

The power supply itself consisted of an air-gap safety discharge to send to this ground, which was adjustable. It is commonly known that the breakdown voltage distance for 30kV is inch [2], and since the unit was rated up to 35kV, the gap was adjusted to 1 3/16″.

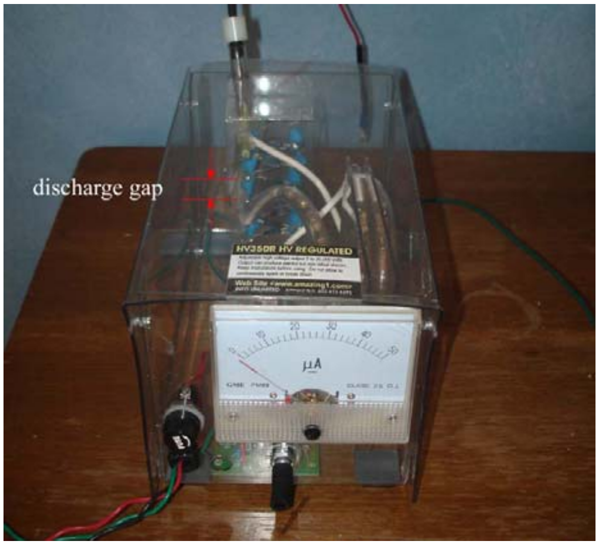


Fig. 21. The power supply's discharge gap.

However, it was noted that *if* the air gap discharged, then considerable time was required to pass in order to allow the internal resistors to cool enough for the unit to meter the voltage accurately (in other words, the unit might discharge again at 10kV or less at 1″ or more if the resistors were still hot). The meter on the unit was originally designed for measuring micro amps, but was modified to read kilovolts, thus, if the meter read 30uA, it was assumed to be outputting 30kV.

2.4. Dielectric Materials

Three different dielectric materials were used in the experiment: 1) air, 2) Styrofoam and 3) polystyrene. The dielectric constant of Styrofoam ~ 1.03…, polystyrene ~ 4 and dielectric constant of air = 1 [1, 2, 5, 6]. It was determined after numerous discharge tests for the various materials, that the capacitor plates needed to be at least a certain distance *r* to avoid electrical breakdown up to 35kV, whereby capacitance would be lost: 1) for air, $r \geq 1.2''$, 2) for Styrofoam $r \geq 3/16''$ and 3) for polystyrene $r \geq 1/32''$.

2.5. Assumptions

It was assumed that the power supply rating per meter was accurate to within 5kV, the glue between the aluminum plates and the Styrofoam did not significantly affect the dielectric constant with the amounts used, the precision of the disc cutouts were adequate to consider them symmetric and that the distance between different points (perimeter, center, etc.) on the plates were even enough to not effect capacitance.

2.6. Controls

Styrofoam and polystyrene were both used instead of air in order to rule out ionic wind and five asymmetric capacitors were constructed (in addition to the symmetric plate capacitors) in order to see roughly how much weight change should be expected for a measurable reading. The distance between the plates was limited (for the polystyrene capacitors), so as to not diminish the overall capacitance, which might in turn negate any effect, but large enough to prevent discharge. Additionally, the diameter of the Styrofoam disc was larger by at least 0.5″ than the discs they were sandwiched between, so as to prevent bowing and/or ionic air around the circumference to have any effect on the results. Also, the edges of the electrodes were sanded and plates pressed so as to have an even distance between them. All edges were buffed smooth so as to better prevent arcing (even invisible arcing) and the maximum sized discs at my disposal were used so as to create as large an electric field as possible for the desired effect, but still small enough to fit on the scale. Lastly, the wire leads to the capacitors were taped down both near the power supply and near the scale, so as to not move or shift excessively during the measurements, so as to better prevent weight changes.

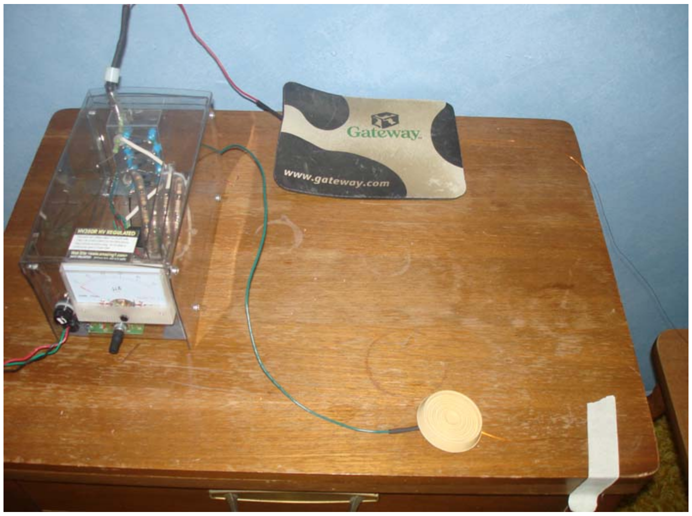


Fig. 22. The taped set up near the power supply.

Fig. 23. The taped set up near the scale.

2.7. Independent Variable

Changed the voltage applied to each capacitor for each of the iterations up to 35kV.

2.8. Dependent Variable

Measured the weight of each capacitor.

3. Data Collection

3.1. Experimental Steps

- Placed the mount on the glass plate of the scale
- Turned on the scale, which auto-calibrates the weight to zero when turned on
- Placed the finished capacitor onto the mount
- Turn on the power supply to the required voltage
- Weighed each capacitor in grams *g*

3.2. Discharge by Skin Effect

Before data collection was obtainable, the two symmetric capacitors with the polystyrene dielectric arced from the edges, *around* the polystyrene disc dielectric material, despite this distance being a total of 1 ½".

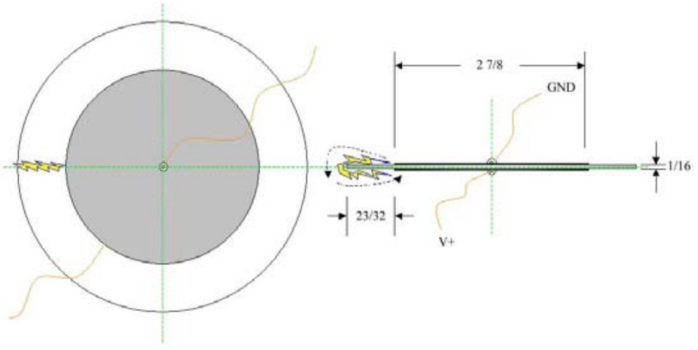


Fig. 24. Symmetric capacitor discharging from edges drawing.

Thus, electrical tape was added to the design (from the edges of the aluminum discs, around the dielectric) for these, restricting any air discharge for the tests. The added weight of the electrical tape *was* duly accounted for in the results below.

This effect (only partially a side note) that the electrical discharge occurred well beyond the discharge distance of air, suggests at least to this author, that the common electrical breakdown distance of a dielectric (in this case: air, the dielectric that the path of least resistance of charge chose) is only relevant for *straight lines*. Since the total distance the charge traveled through air well below 35kV was 1 ½" and the discharge distance is between 1-1.2" for a voltage of 30-35kV (with the exception of some sudden pressure changes, which did not occur), further study (or a more in-depth investigation into the literature) would be required to determine the actual breakdown distances involving curved lines of charge.

3.3. Experimental Results

Only two capacitors showed any weight changes with the experimental setup herein: C_7 (the adjustable asymmetric capacitor) and C_9 (the "lifter"). Both these capacitors showed that this weight change was controllable with the voltage and numerous reproductions were taken with those in order to rule out anything like the capacitors shifting weight on an uneven surface, as the changes in weight were considerably small. By turning the voltage up, however, the weight would change; by turning it back down, the weight would return to its original. C_7 gained weight with its anode *below* the cathode and C_9 lost weight with its anode *above* the cathode.

Capacitor	g @ 0-15kV	g @ 15-25kV	g @ 25-35kV
C_1	32	32	32
C_2	49	49	49
C_3	31	31	31
C_4	33	33	33
C_5	18	18	18
C_6	26	26	26
C_7	20	21	22
C_8	24	24	24
C_9	42	42-41	41

Table. 1. Capacitor weight changes.

3.4. Additional notes on C_7

Again, C_7 was the adjustable asymmetric capacitor described earlier. The results were taken at various angles, placements and distances sporadically, some yielded no weight changes, others less or more of the effect. The optimum distance showed to be somewhere between 3/8" to ½". The exact angles are unfortunately uncertain at this time, but were not far off from the drawing (since this capacitor was only used as a control, further study into this was not taken).

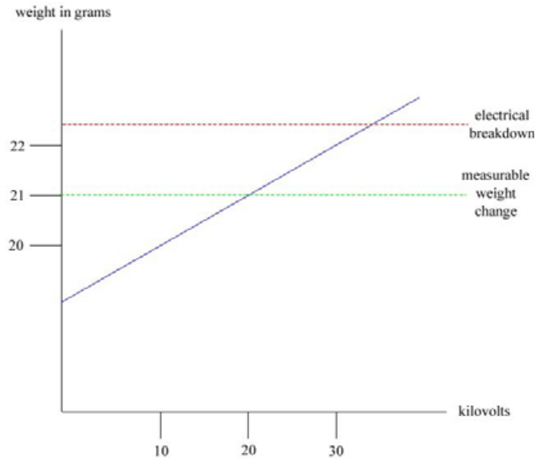
3.5. Additional notes on C_9

One may also recall that C_9 was the "lifter" setup. While it is commonly known in the field of this study that "lifters" can achieve complete weight loss [11], this author's results were far less significant (likely due to design / construction errors, but again, this was a control capacitor only). This was the only capacitor to use an air dielectric and this was also the only capacitor whose anode was above the cathode.

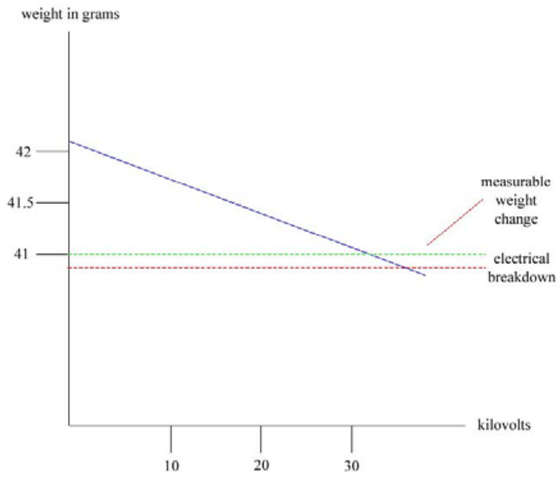
4. Data Analysis

Due to the minimal weight changes measured below 35kV, it would be rather difficult to determine whether the weight change was truly linear in direct proportion with the voltage with this experiment alone. However, it did seem certain that even if it *were* truly linear, a *single* capacitor would not be able to achieve changes in weight infinitely with voltage, as electrical breakdown would occur even with the "perfect" design, a design accounting for all angles.

To help explain this, the author followed this boundary limit of his devise for optimum performance:



Graph. 1. Graph of the weight and voltage changes, and limits of C_7.



Graph. 2. Graph of the weight and voltage changes, and limits of C_9.

However, this does *not* suggest a limit for capacitors *in series* and/or *in parallel*, as capacitance could be increased by adding them in parallel and adding capacitors in series would allow the above zones of optimum performance to increase.

This is crucial for considering the above results with the symmetric capacitors. For every material, the dielectric constant and electrical breakdown voltage is not at all proportionate. For example, the dielectric constant for air is 1 [2] and that of Styrofoam is almost the same 1.03…[1]. However, the electrical breakdown voltage of Styrofoam is some 6.5…times greater than air [2, 5, 6]. This allows this zone of optimum performance to increase with Styrofoam over air, as this electrical breakdown voltage is directly proportionate with distance (or thickness of the material) [3, 4]. Thus, one cannot gauge the effect of force and capacitance with voltage and distance alone; rather, this zone of interest needs to be accounted for. With that said, it cannot be completely ruled out that symmetric capacitors have zero thrust in this experiment—with this alone. If this were the only factor, one could argue that the zone of optimum performance for polystyrene could be considerably small, and therefore higher tolerances of the dielectric material between needs to accounted for (one would need to get much closer, yet not too close). It also could easily be argued with this point *alone* that there can be no force at all, as the force on capacitors is due to ionic wind and ionic wind only, and with no air—no wind.

Thus, to make any serious determination, the final point in the above paragraph needs to be reviewed. Some may at first suspect that because there was Styrofoam between the two electrodes that ion wind has been ruled out, but this is not the case actually, as Styrofoam is largely *air* bubbles anyway.

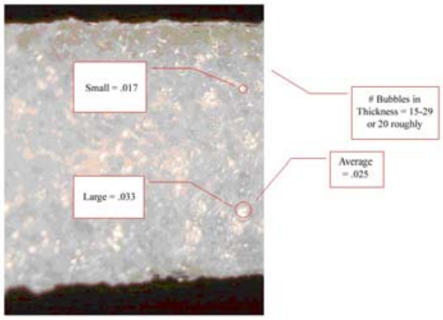


Fig. 25. The bubbles of Styrofoam.

Considerable ionization occurs well within the material serving as the dielectric [1]. While arcing begins and ends with the electrodes, it is not instant, though occurs quickly [3]. It requires a build up within the material itself [6].

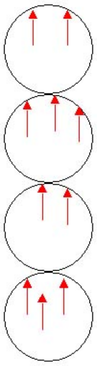


Fig. 26. Ionized air in the bubbles of Styrofoam.

These moving molecules within the bubbles still could theoretically account for all the weight change observed.

Thus, it seems to this author that the significant remaining problem for the symmetric disc capacitors is what was discovered as almost a side note in figure 24 above. With this noted in the experiment, the results do become supportive of the hypothesis. Due to the right and left hand rules (depending upon polarity), the lines of force from the moving charges would be in a straight line. This is well known within the literature to be due to the "skin effect" [4, 7]. With the symmetric parallel plate capacitors, this straight line is perpendicular to the direction one would need to measure any weight change. However, this is not the case with the two capacitors that *did* show weight change. The others can simply be ruled out by the fact that the electrodes would be too far apart, outside the zone of optimum performance. But again, even with the proper zone defined for a given material, the lines of force would consistently be curved and perpendicular to the direction one would want for actual thrust on a symmetric, parallel plate capacitor, ionic wind or not.

5. Conclusion

This experiment does support the author's hypothesis, there was no measurable weight change on any of the parallel plate capacitors used in this experiment. It has been discussed that improvements could be made in construction of these capacitors to further this study, but due to the results collected, along with the discharge direction of parallel plates that no such force need be hypothesized for further work in this area; that is, unless some new aspect or factor is raised.

However, it does seem that due to the same reasons, asymmetric *non-parallel* plates could harbor significant force with the proper designed (and angled) electrodes by adding them in series and/or parallel, and at the same time reducing their size. There has been significant research done in the area of nanotubes (bucky tubes) [9] and nano-rings [8], that could be a key feature to the application of this effect on a large scale, as nanotubes and nano-rings conduct electricity along the tube [9]. This is the exact angle this experiment has suggested is optimum. Thus, if one were to consider the "lifter" and then straighten out its edges to form a cylindrical tube, the shape would be the same as a nano-tube and a nano-ring. Separate the two by a dielectric (diamond perhaps, so as to maintain an all carbon system), one gets a perspective of the ideal setup. Expand these integrations in series and/or parallel and one could have an actual material useful for this science. Additionally, this material could be bent and shaped (with a dielectric other than diamond of course), as nano-tubes are flexible along their length [9]. Thus, the key in the future of this research might very well lie in the layering of these asymmetric capacitors, and not a single capacitor in and of itself.

The author herein believes that further experimentation should follow in this regard. Whether or not ion wind is the sole factor in this force is irrelevant, as gaseous molecules could certainly be allowed to pass through the cores of the rings and tubes. It also is unclear to what the effects of magnetism are in these systems in regard to this experiment, as it wasn't accounted for.

Lastly, follow-up data on the symmetric lead ball experiments Brown used where he measured force should be obtained if possible [12], but that experiment does not rely on flat plates, where the direction of force is negated with the design. Spherical electrodes would not share this same principle, as their lines of force would be appropriate at least at some angle from a perfect circle. It seems to this author at least, that whether or not the forces at play in the Biefield-Brown Effect are ion wind or some form of electro-gravitational force, matters little in terms of technological application involving thrust. The results from this experiment do provide some support that further improved designed would hold merit on the scalability of this effect, but that it probably would not lie in a single capacitor and certainly not with flat, parallel plate electrodes.

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