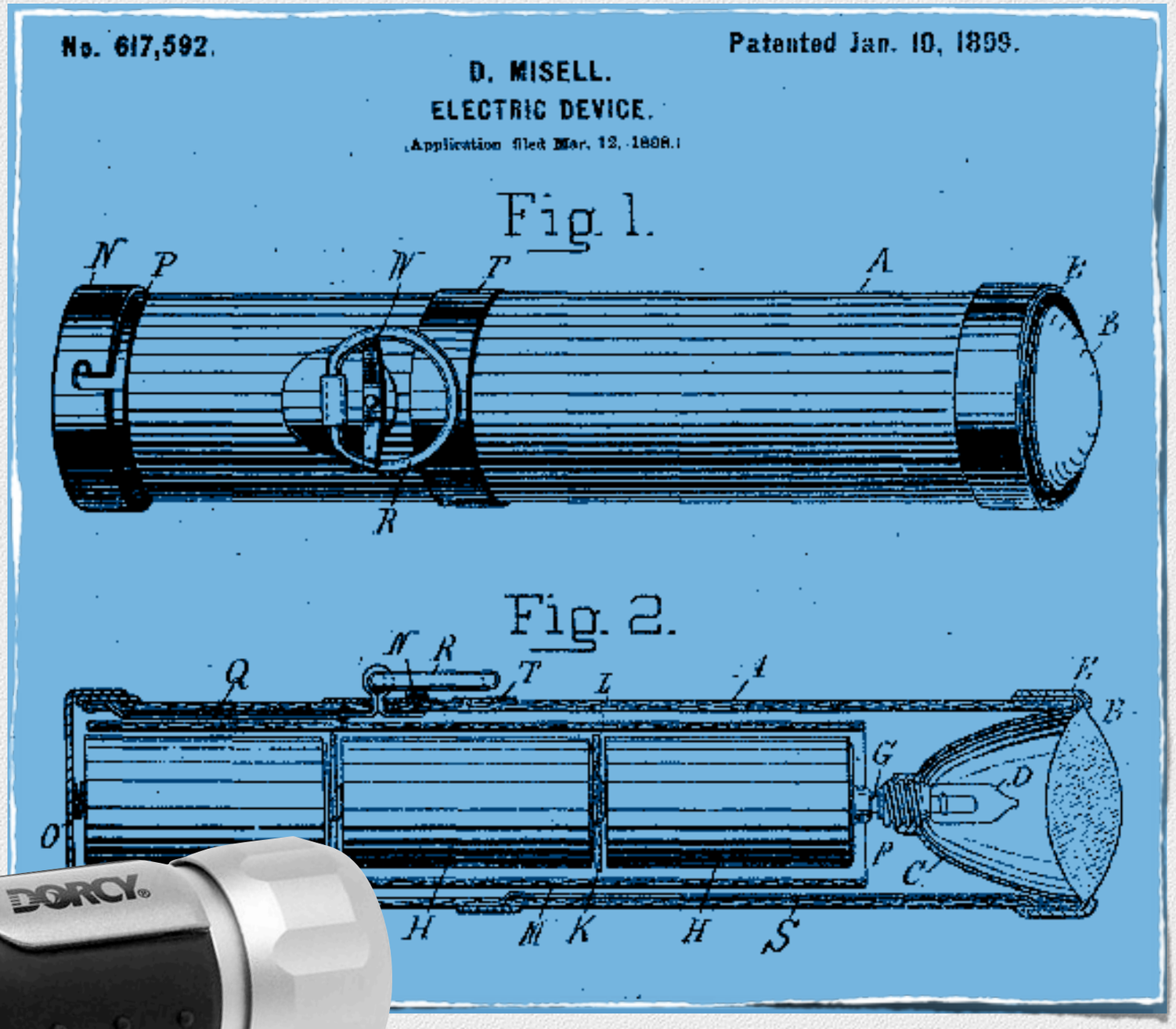
Capacitors

What is inside a flashlight?

Battery?

Bulb?

Switch?


No. 617,592. Patented Jan. 10, 1899.

D. MISELL.

ELECTRIC DEVICE.

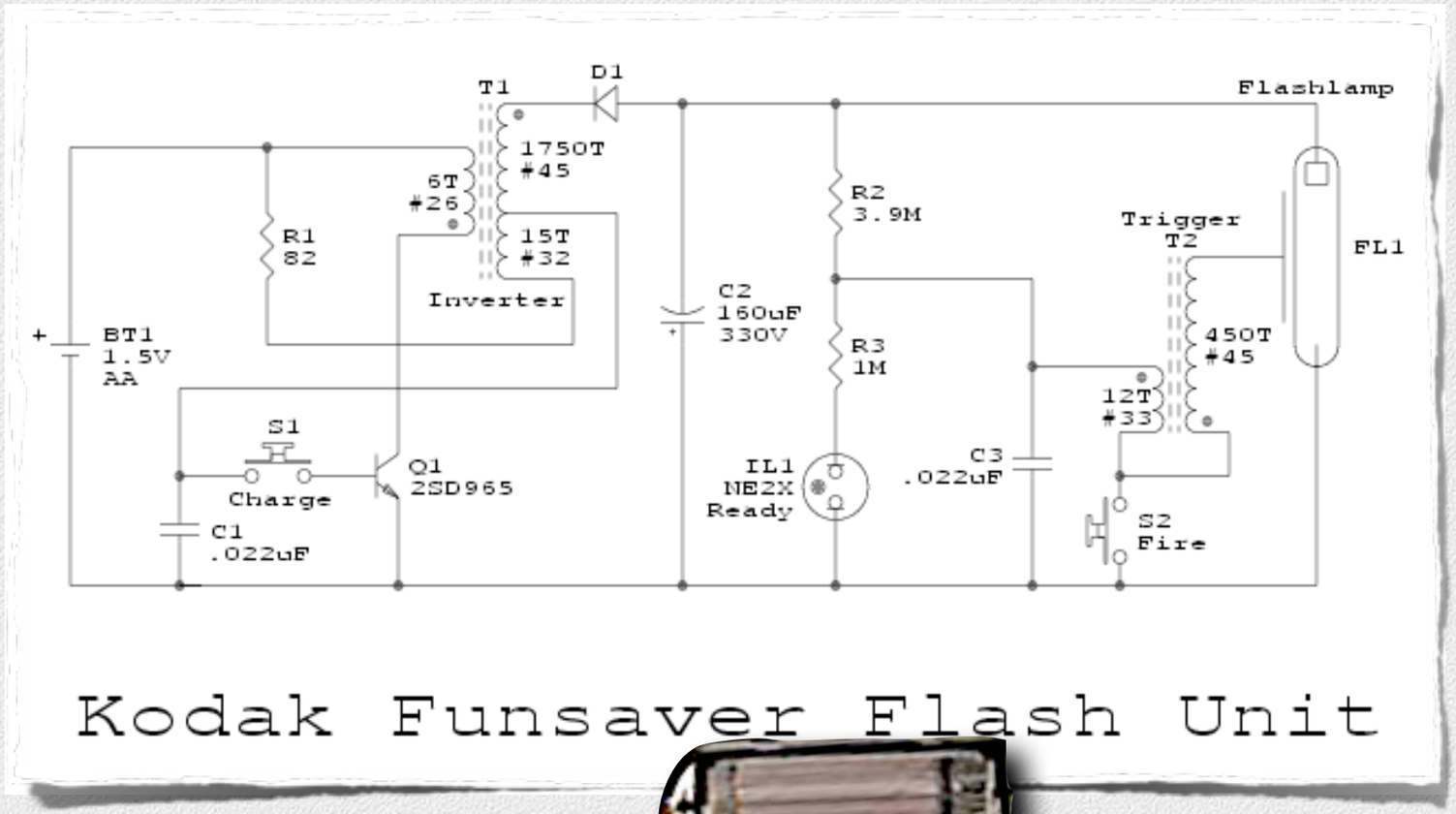
(Application filed Mar. 12, 1898.)

Fig. 1.

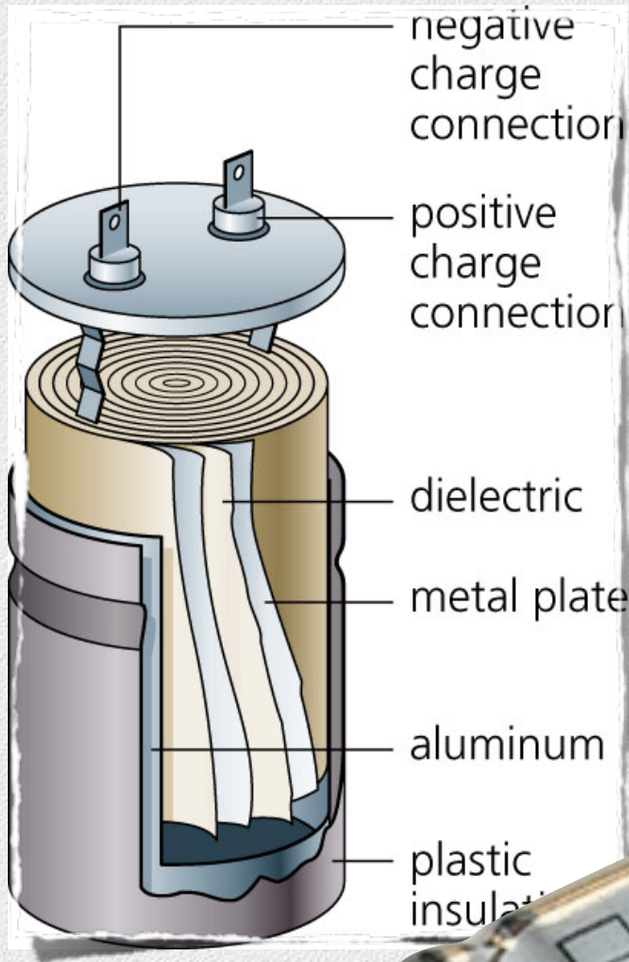
Fig. 2.

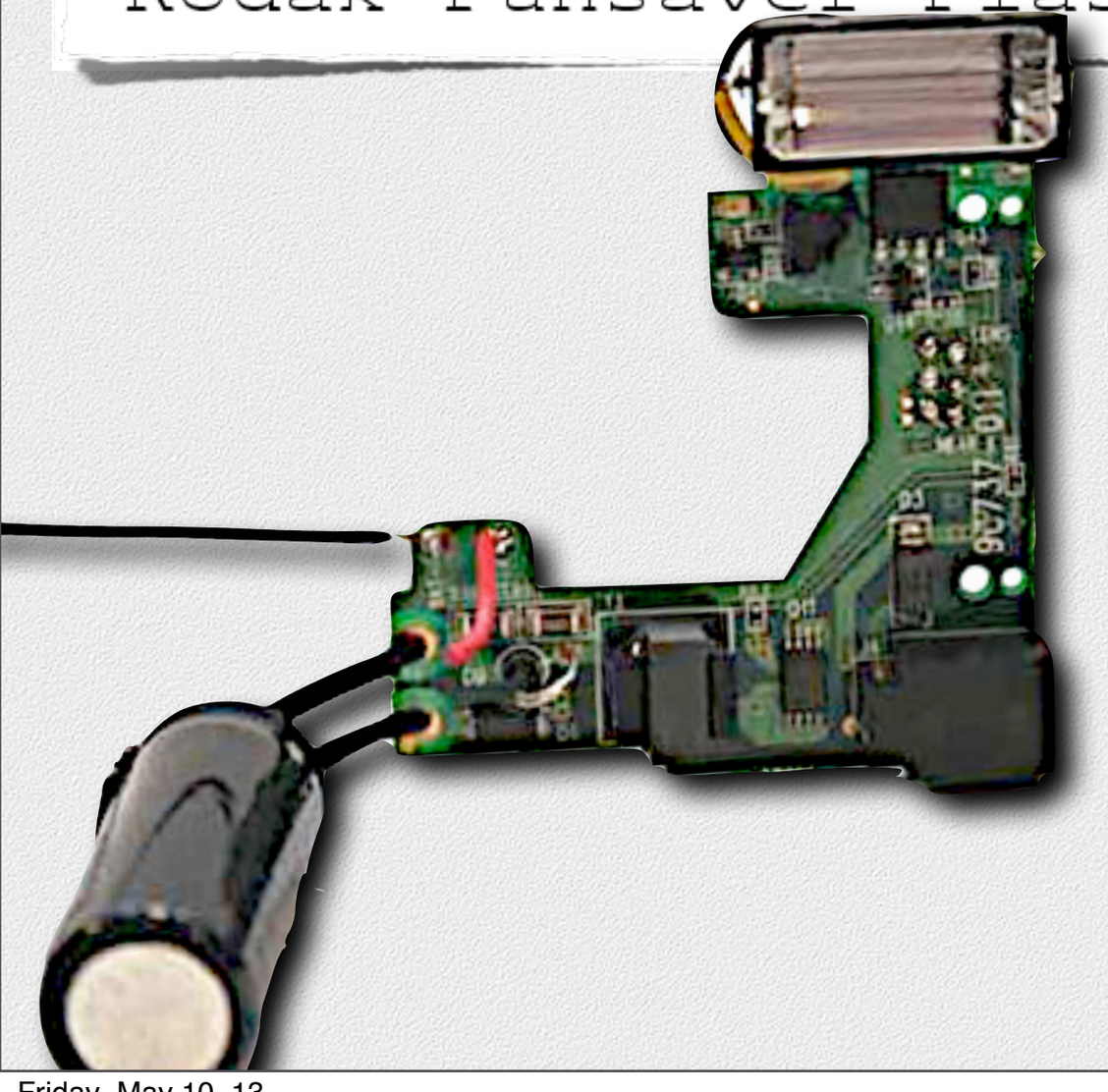
Why is a camera flash different?

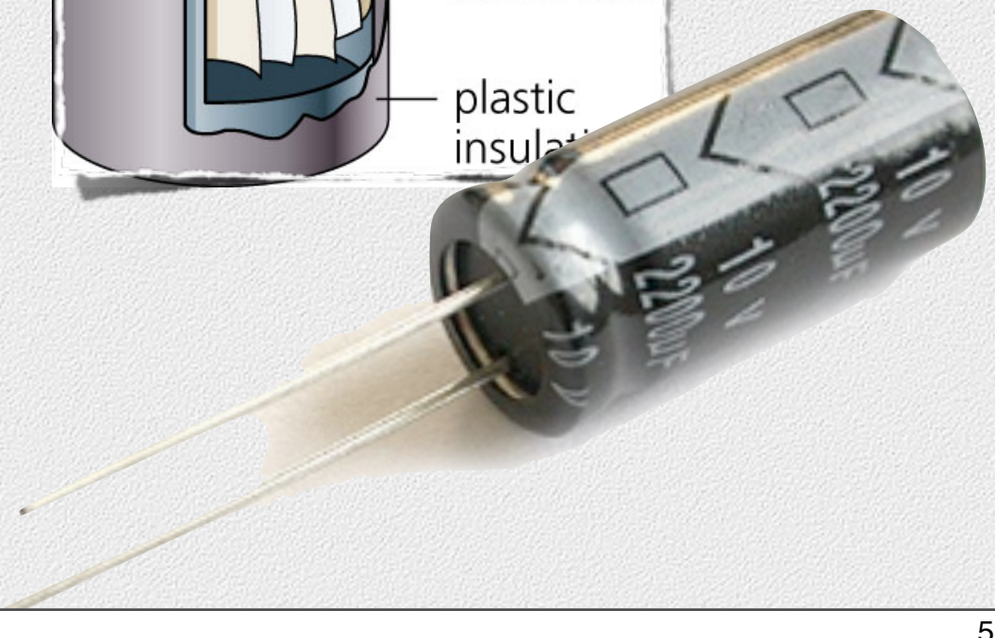
kodakfunsaverflash.gif 659×361 pixels



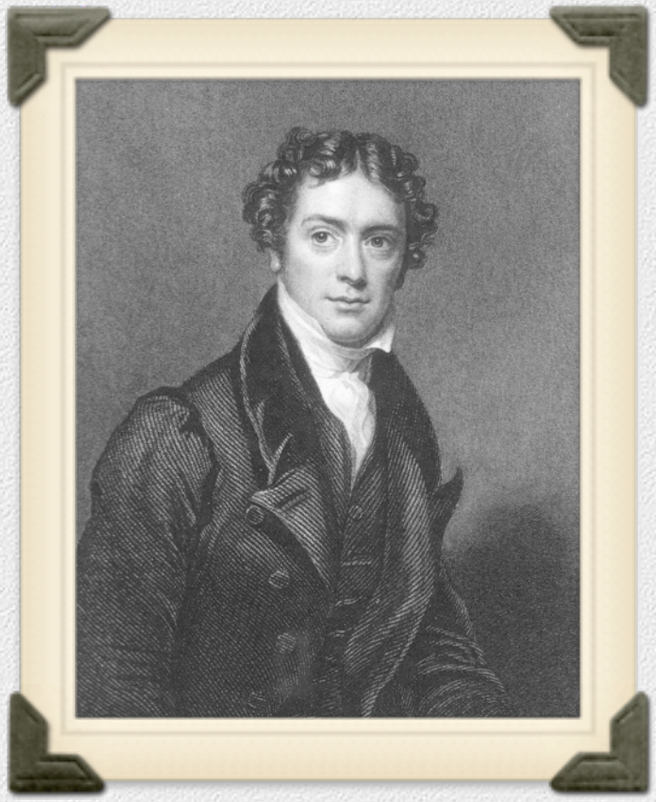
Capacitors







Unit - Farad



Michael Faraday
1791-1867

1 µF
Normal Circuits

1 F
A bit crazy

Capacitance

- C - Capacitance
  - Unit - Farad (F)
- Q - Charge
  - Unit - Coulomb (C)
- V - Potential or Voltage
  - Unit - Volt (V)

$$C = \frac{Q}{V}$$

$$Q = VC$$

Equations

$$W = \tfrac{1}{2}QV$$

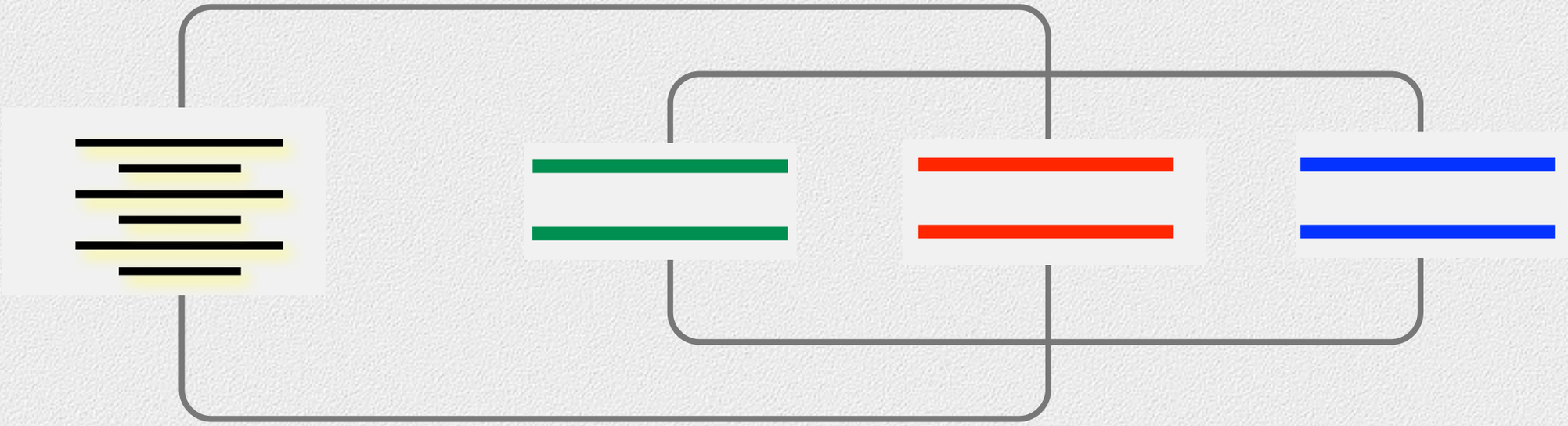
- W - Work or Energy (Joule)

- combinations include;

$$W = \tfrac{1}{2}cv^2$$

$$W = \tfrac{1}{2}\frac{Q^2}{C}$$

Capacitors in Parallel



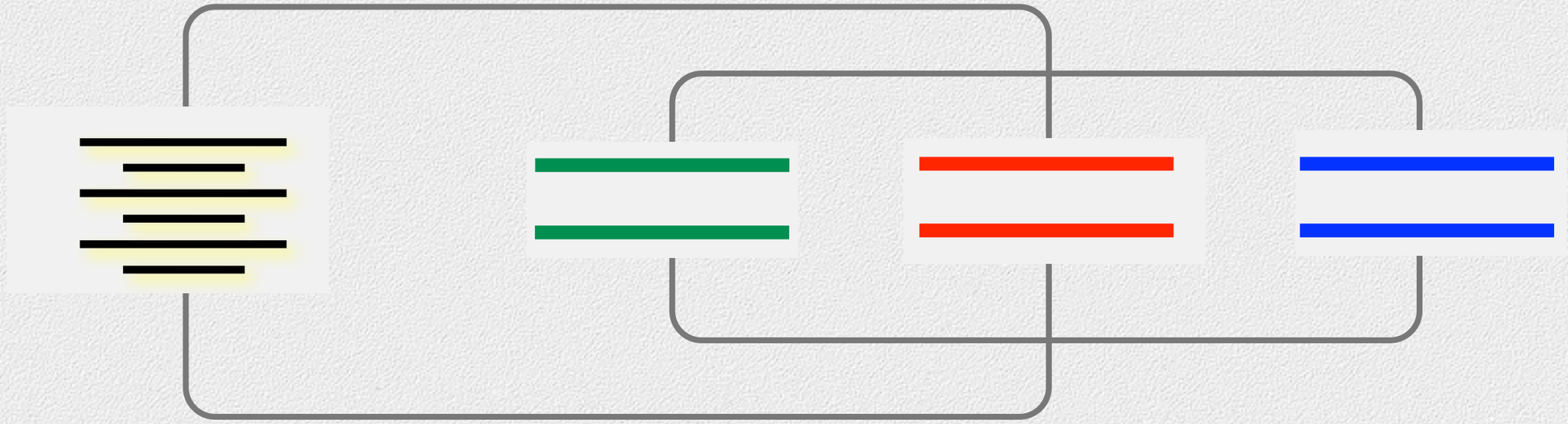
There is more room for the charges to be stored, making this a stronger total capacitance.

Voltage: $V_T = V_1 = V_2 = V_3$

Charge: $Q_T = Q_1 + Q_2 + Q_3$

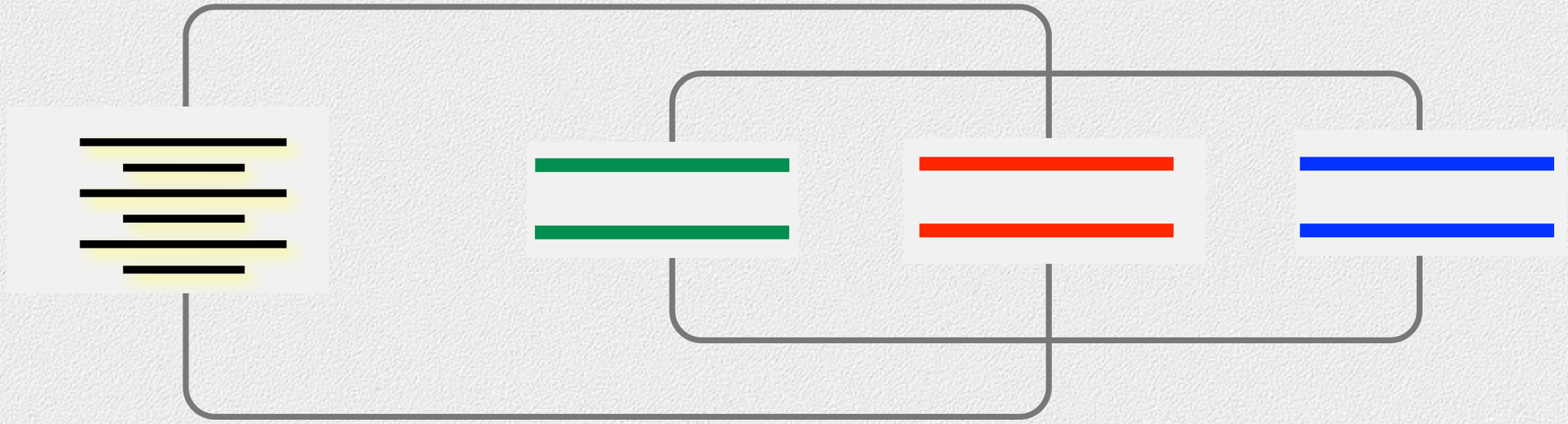
Capacitance: $C_T = C_1 + C_2 + C_3$

Capacitors in Parallel



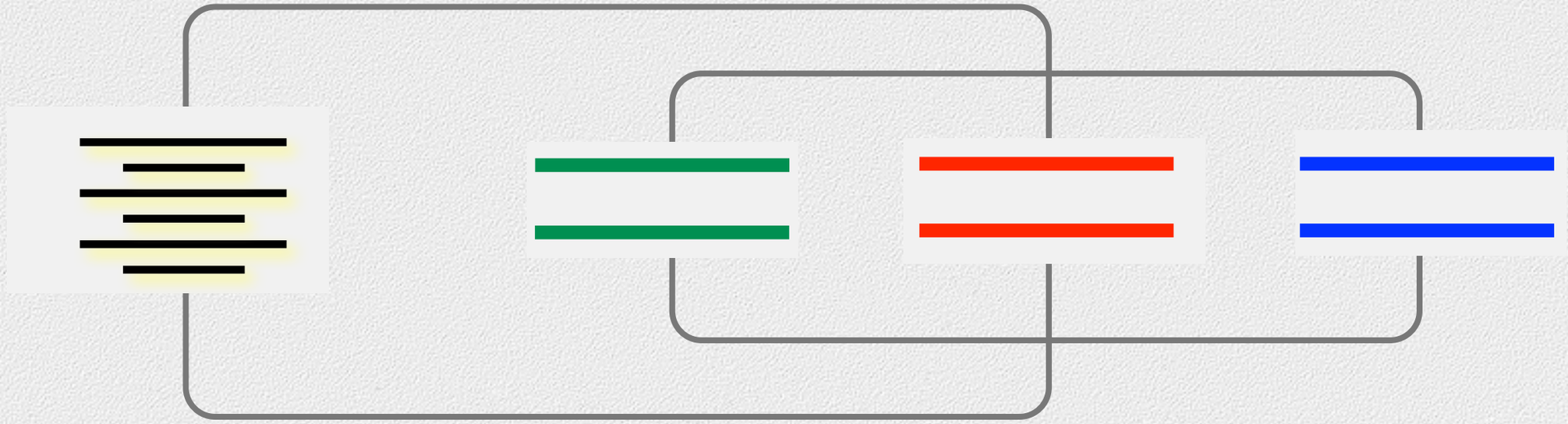
	Q (C)	V (V)	C (F)	W (J)
C_1			4	
C_2			6	
C_3			10	
TOTAL		10	**20**	

Capacitors in Parallel



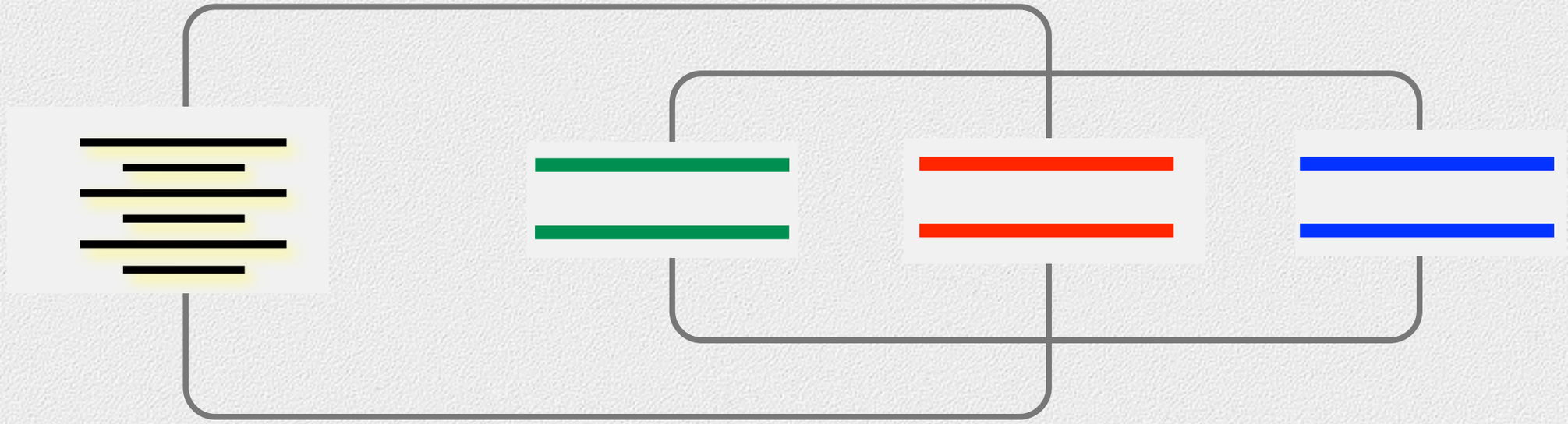
	Q (C)	V (V)	C (F)	W (J)
C_1		**10**	4	
C_2		**10**	6	
C_3		**10**	10	
TOTAL		10	20	

Capacitors in Parallel



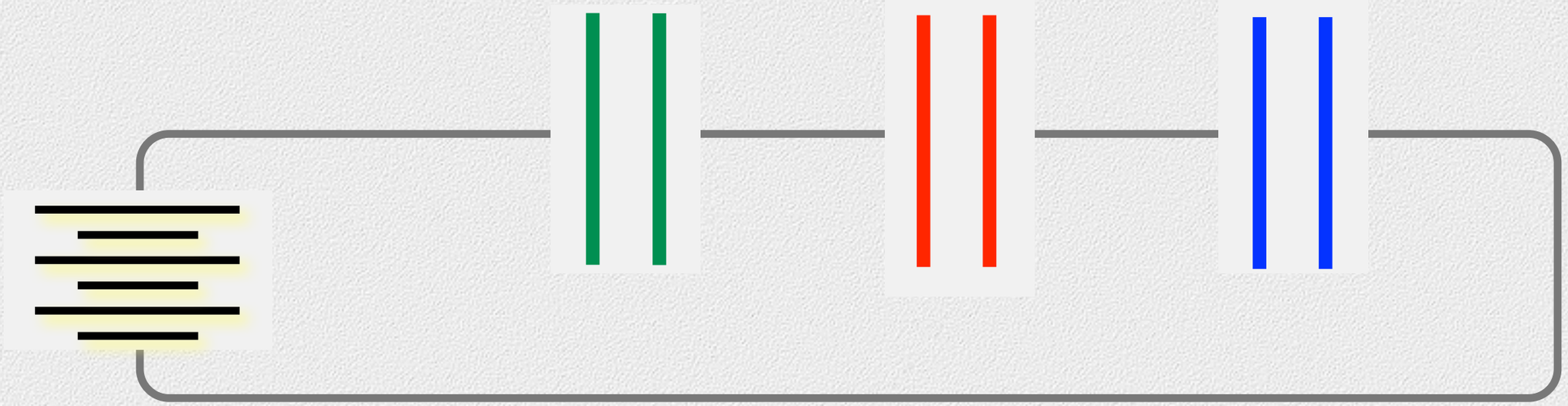
	Q (C)	V (V)	C (F)	W (J)
C_1	**40**	10	4	
C_2	**60**	10	6	
C_3	**100**	10	10	
TOTAL	**200**	10	20	

Capacitors in Parallel



	Q (C)	V (V)	C (F)	W (J)
C_1	40	10	4	**200**
C_2	60	10	6	**300**
C_3	100	10	10	**500**
TOTAL	200	10	20	**1000**

Capacitors in Series



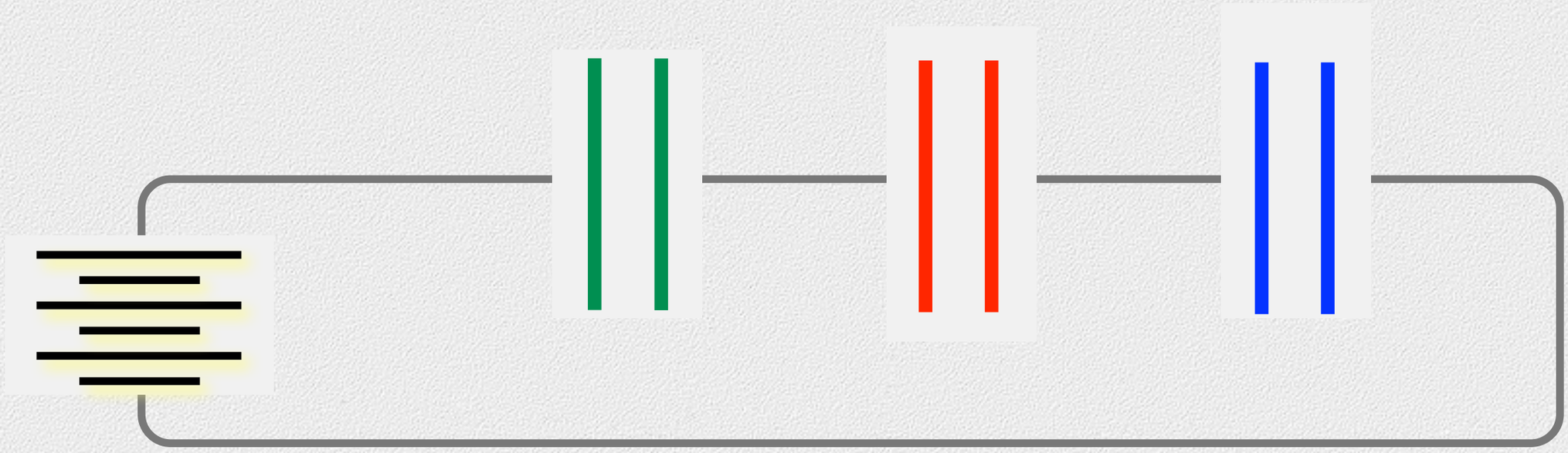
- the source for potential is separated by even more distance, this decreases the charge that can be stored.

Voltage: $V_T = V_1 + V_2 + V_3$

Charge $Q_T = Q_1 = Q_2 = Q_3$

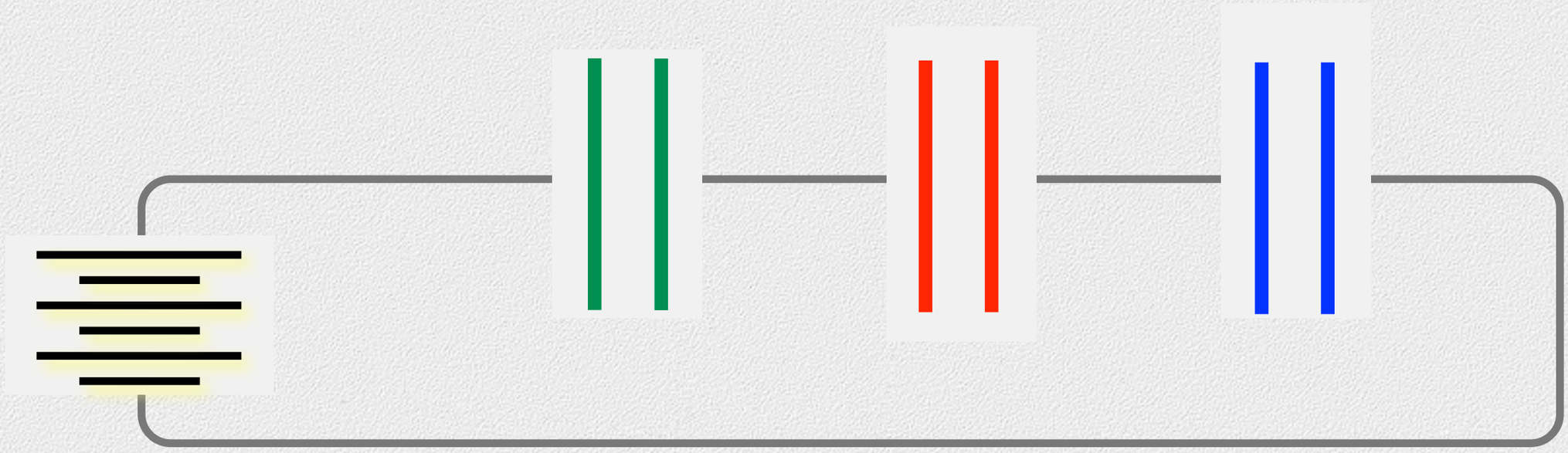
Capacitance: $1/C_T = 1/C_1 + 1/C_2 + 1/C_3$

Capacitors in Series



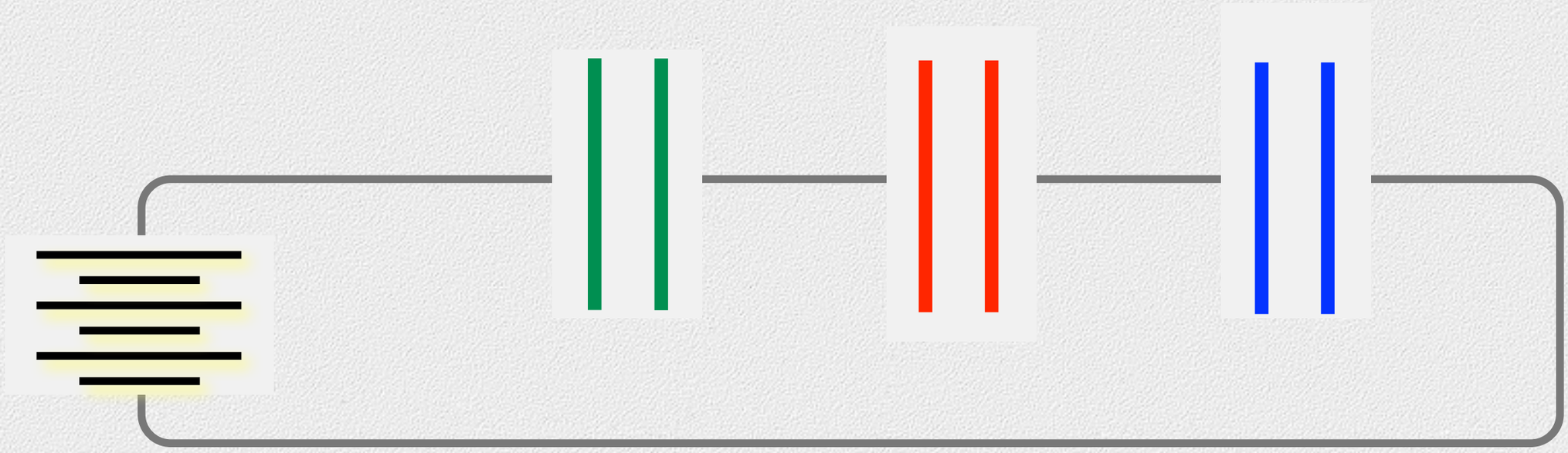
	Q (C)	V (V)	C (F)	W (J)
C_1			120	
C_2			30	
C_3			24	
TOTAL	**1200**	100	**12**	

Capacitors in Series



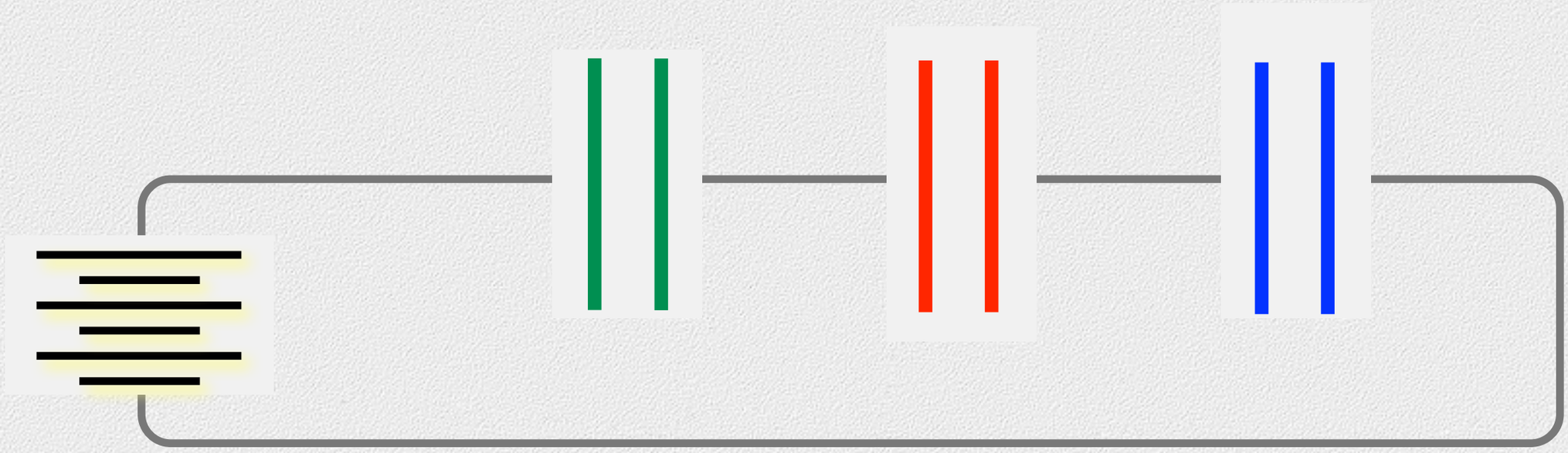
	Q (C)	V (V)	C (F)	W (J)
C_1	**1200**		120	
C_2	**1200**		30	
C_3	**1200**		24	
TOTAL	1200	100	12	

Capacitors in Series



	Q (C)	V (V)	C (F)	W (J)
C_1	1200	**10**	120	
C_2	1200	**40**	30	
C_3	1200	**50**	24	
TOTAL	1200	100	12	

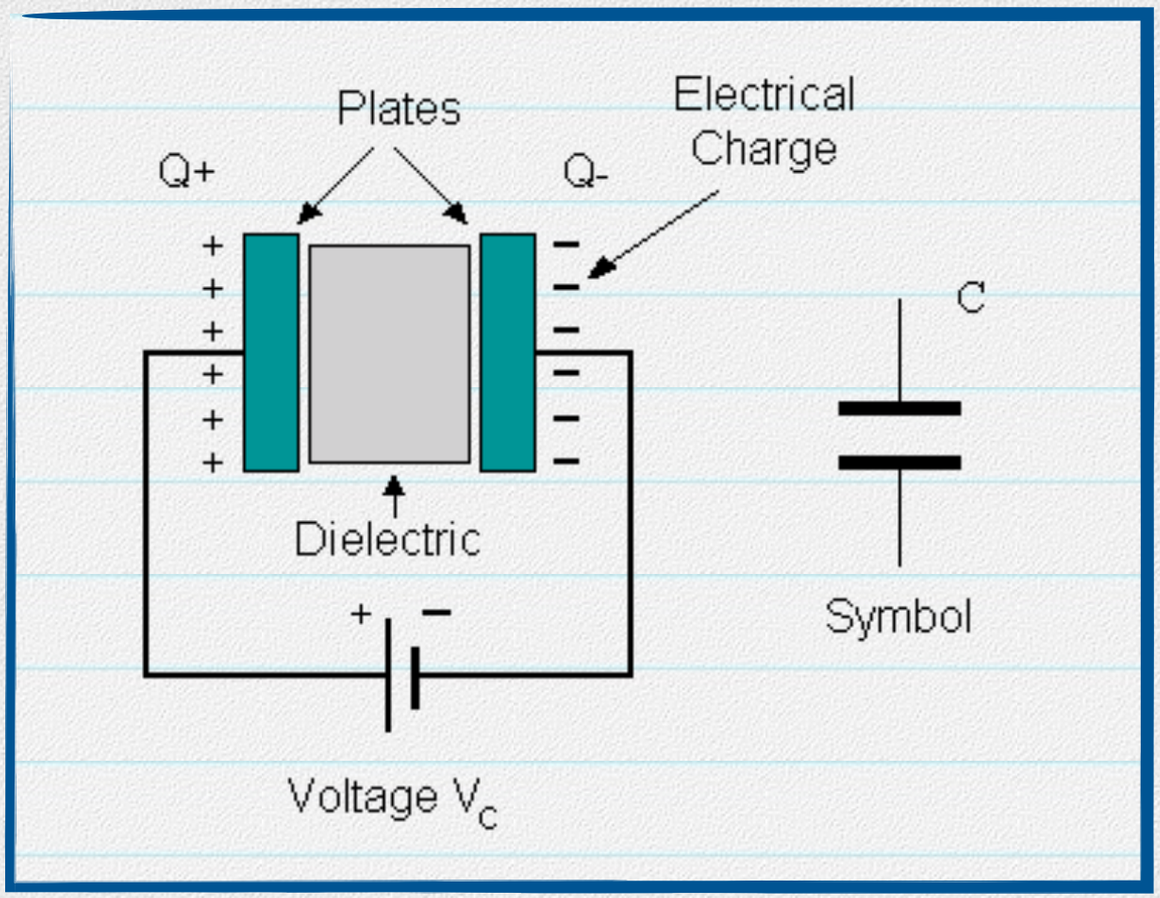
Capacitors in Series



	Q (C)	V (V)	C (F)	W (J)
C_1	1200	10	120	**6,000**
C_2	1200	40	30	**24,000**
C_3	1200	50	24	**30,000**
TOTAL	1200	100	12	**60,000**

Capacitance

$$C = \frac{k\epsilon_o A}{d}$$



- Capacitance Farad (F)
- Permittivity of Free Space
  - $\varepsilon_0 = 8.854 \times 10^{-12}$ F/m
  - k - Relative permittivity
  - Dielectric
- Area m^2
- Separation m