ARC SUPPRESSION IN SHOCK CIRCUITS[1]

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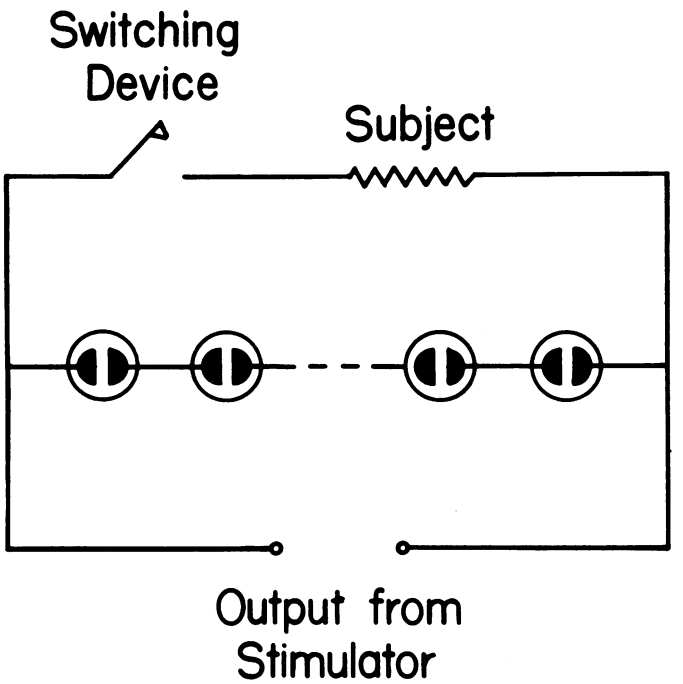
To pass adequate currents through subjects of low conductivity (high resistance) or to compensate for large current-stabilizing resistances placed in series with the subject, high potentials are often used in shock-stimulating circuits. This may result in arcing across air gaps between subject and grid, across open switches or relay contacts, or along the surfaces of insulating materials. A simple and effective way to limit this arcing is to place a shunt circuit consisting of a series of neon lamps across the output terminals of the shock stimulator. This shunt then serves as an electronic switch that instantly "shorts out" the shock current whenever the circuit through the subject is broken—i.e., at the moment when arcing would otherwise occur.



For proper operation of the circuit, the neon shunt should be placed in parallel with the branch including the subject and any switching device that may be used to control the duration of stimulation or to alternate the polarity of individual members of the grid. The parallel branches are together in series with the current-limiting tube or resistor in the shock stimulator. With this arrangement, one part of the voltage drop in the shock circuit will be across the current-limiting device and the other part across the subject and the neon shunt. So long as the voltage drop remains below a value determined by the number of lamps in the series, the shunt will not conduct. Only when the switch is opened or the subject breaks contact with the grid (resistance approaching infinity) will the full available

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voltage be applied to the lamps. Therefore, if the threshold for the firing of the neon shunt is set just below the potential provided by the shock stimulator to an open circuit (rated voltage of the stimulator), the neons will conduct only when the circuit through the subject is broken.

The number of neon lamps needed in series for a given threshold can be estimated by allowing one lamp for each 60-65 volts A.C. (85-90 volts steady D.C.) and can be adjusted empirically. For a temporary shunt, NE-2H lamps, with wire terminals, are easily strung together and mounted in holes drilled in a sheet of insulating material; for a permanent installation, NE-51H bayonet-base lamps will permit ready replacement. I have used an NE-51H shunt for several thousands of hours of conducting a 2-milliampere current without observable physical or functional deterioration.

While they are on, the lamps also provide a continuous and direct monitor on a stimulus that is not readily observed by the experimenter; and when they flicker off, they provide a monitor on the passage of current through the shock circuit. Leaks in the delivery circuit will show up in the form of a flickering or continuous darkening of the lamps at times when shock is not being passed through the subject. For a careful check, the subject may be removed from the grid.

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