DEMONSTRATION OF A CHAIN REACTION ON A MODEL

S. N. Sokolov and L. N. Érastov

Usp. Fiz. Nauk **70**, 377–379 (February, 1960)

This article describes a simple model device for demonstrating a chain reaction.

The device operates with the aid of moving colored light signals obtained by momentary mechanical switching of electric bulbs suitably arranged on a demonstration panel.

Figure 1 shows the electric circuit of the device. A series of metal blades, whose purpose is noted in the caption of Fig. 1, is arranged in concentric circles on an insulating panel. A nonconducting disc which can be turned about the common center of the blades is fixed on the panel. Two interconnected electric contact brushes are fixed on one side of the disc. The brushes on this half of the disc adjoin blade 4 and the momentary contacts of the "neutron" (a,c,e,m) and "nucleus" (b,d,f) bulbs. Four brushes are attached to the second half of the movable disc and are connected to each other. These brushes are meant for switching on the "nuclear-fragment" bulbs (n,t,h). When the movable disc is rotated clockwise (Fig. 1), the first white bulb a, representing a neutron, lights up as soon as brush K_1 touches contact A. Further rotation of the disc in the same direction causes a successive lighting-up of bulbs a, imitating thereby the movement of a "neutron." As soon as brush K_1 reaches contact B, the red bulb b, representing the first "nucleus," lights up. When the brush reaches contact C, the first "nucleus" is extinguished but three "neutron" bulbs c light up. Simultaneously, as a result of the contact between the brush K_2 and blade 1, two green bulbs n, "nuclear fragments," light up around the first "nucleus." Further clockwise rotation of the movable disc causes the "neutrons" to move in the direction of three "nuclei." At the moment of contact between brush K_1 and point E nine "neutron" lamps e light up, and, since brush K_2 touches at that moment blade 2, two green "nuclear-fragment" bulbs t light up around each "nucleus." The resulting "neutrons" move toward the next group of nuclei, and contact between K_1 and F causes nine red "nucleus" bulbs to light up. Upon moving brush K_1 to M, 27 "neutron" bulbs m light up simultaneously, and in addition, because of contact between brush K_2 and blade 3, two green "fragment" bulbs h light up around each "nucleus." On moving K_1 further, "neutrons" m move away from the second group of "nuclei." After K_1 passes the last contact the "neutron" bulbs are extinguished. Simultaneously brush K_2 is disconnected from blades 1, 2, and 3, whereby the "fragment" bulbs are extinguished. When brush K_1 reaches point A, the process is repeated.

The wires of the device are connected to the "neutron," "nucleus," and "fragment" bulbs suitably arranged (Fig. 2) on a demonstration panel of the necessary dimensions. A similar demonstration of a "chain reaction" took place in the physics department of the Moscow Institute of Aviation. The rotation of the movable disc was effected with the aid of an electric motor through a reduction gear. The use of a

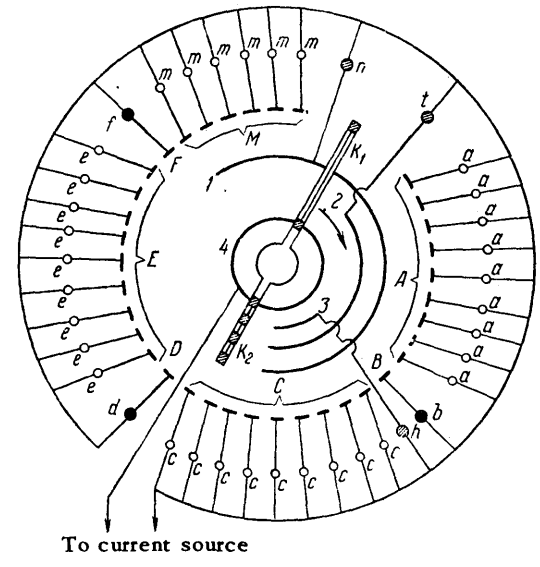

FIG. 1. Principal electric diagram of the device.

1 -- blade for switching on "fragment" bulbs during the "fission" of the first "nucleus" (two green bulbs n); 2 -- blade for switching on "fragment" bulbs during the "fission" of the first group of "nuclei" (six green lamps t); 3 -- blade that switches on the "fragments" during the "fission" of the second group of "nuclei" (eighteen green bulbs h); 4 -- blade for the supply to brushes K_1 and K_2; A -- contact that causes movement of the first "neutron" (one white bulb a); B -- contact that causes "fission" of the first "nucleus" (one red bulb d); C -- contacts that cause "neutron" movement after the "fission" of the first "nucleus" (three white bulbs c); D -- "fission" contact of the first group of "nuclei" (three red bulbs d); E -- contacts that cause "neutron" movement after the "fission" of the first group of "nuclei" (nine white bulbs e); F -- "fission" contact of the second group of "nuclei" (nine red bulbs f); M -- contact for "neutron" movement after the "fission" of the second group of "nuclei" (twenty seven white lamps m).

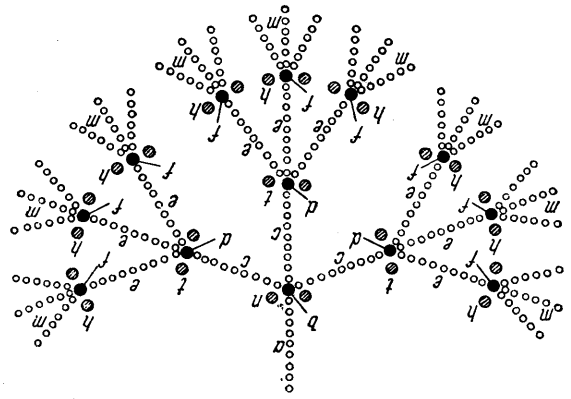

FIG. 2. Arrangement of bulbs on the demonstration panel. Black circles denote "nuclei", cross-hatched circles denote "fragments," and white circles denote "neutrons."

motor is, naturally, not essential; smooth rotation of the moving part of the device can be effected by some other acceptable method. We used 6.3-volt lamps and a step-down transformer. We suppose that a similar simple demonstration of a "chain process" can be useful for general physics courses in institutions of higher learning.

Translated by Z. Barnea