tracks could have been expected, although it is difficult to make a very good estimate.

The only real experimental evidence against the suggestion given here appears to lie in the above authors' determination of the absorption coefficient of 17 Mev γ-rays in lead.[7] This comes out lower instead of higher than the theoretical value, the latter lying just within the estimated probable error. However, the choice of odd masses, for example, instead of all integral ones would lower the expected excess absorption from 23 percent to only 6 percent, or about half the probable error. The foregoing hypothesis, then, offers a possible interpretation of the "new particle" difficulty, which has yet to be examined adequately by experiment.

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December 14, 1937.

[1] Anderson and Neddermeyer, Phys. Rev. **50**, 270 (1936).
[2] Neddermeyer and Anderson, Phys. Rev. **51**, 884 (1937).
[3] Street and Stevenson, Phys. Rev. **52**, 1003 (1937); see also Corson and Brode, Abstract No. 27, Stanford Meeting of the Physical Society, December 18, 1937.
[4] Paper to be published.
[5] Heitler, *Quantum Theory of Radiation*, p. 201.
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Multivibrator Geiger Counter Circuit

The mechanism for extinguishing the arc produced in a Geiger counter discharge resulting from the passage through it of an ionizing particle is simply the lowering of the voltage across the tube to a value below that necessary to maintain the arc. A condition of stability is that the duration of the lowering of the voltage be long enough to permit the removal of the ions produced in the discharge. The standard procedure has been to use a resistance in series with the tube sufficiently large (10^8 to 10^{10} ω) to produce the necessary drop. The relatively slow recovery is insured by the time needed to charge up the counter through so large a resistance.

Neher and Harper[1] have described a much more efficient circuit which possesses the characteristics that it is extraordinarily fast, but has the cathode of the counter at a high impedance above ground, and in addition requires the first vacuum tube to stand the entire voltage of the counter. Another fast circuit has been described by Libby, Lee, and Ruhen.[2]

The circuit here suggested employs a multivibrator so biased that it cannot oscillate. The circuit possesses the novel feature that the length of the pulse is limited by the vacuum tube circuit and not by the counter. The mechanism may be described by stating that the counter momentarily upsets the stability of the circuit by varying the voltage on one of the grids of the multivibrator so that one pulse takes place.

Alternatively, the action may be described as follows. The passage of the ionizing particle causes a sudden lowering of the voltage on the wire electrode and hence of the grid of the first tube. The change is twice amplified, and the amplified pulse of correct phase is fed back to the counter producing a regenerative effect. Whereas the initial lowering of the grid, resulting from the counter current through the megohm resistor, would not have been sufficient to extinguish the arc, the regenerative effect of the coupling throws the entire available voltage drop of the vacuum tube circuit on the wire electrode. The recovery of the circuit is fixed by the resistances and capacities of the circuit, compared to which the capacity of the counter is negligible. The shape of the pulse is rectangular, the wave shape being fixed by the multivibrator.

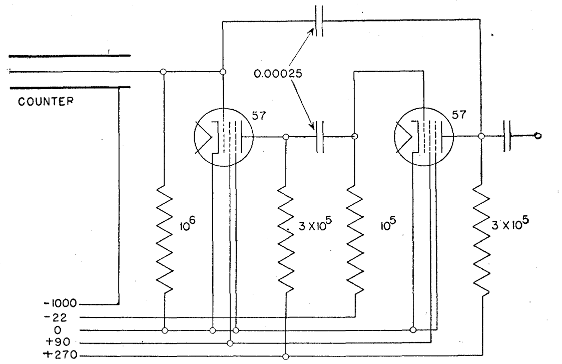

FIG. 1. Diagram of counter circuit.

With small counters, the length of the pulse has been reduced to as much as 10^{-4} second, but only at a loss of the voltage range of the counter itself. With the constants shown on Fig. 1, the circuit will count as many as 2,000 random counts per second. It should be pointed out, however, that the statistics of this counter are entirely different from those of previous circuits.[3] Here the maximum counting rate is the oscillation frequency of the multivibrator, independent of the Geiger counter. The passage of an ionizing particle while the wire is on the crest of the rectangular pulse has no appreciable effect because the counter is below its critical voltage and because the grid of the first tube is already so negative that the first tube cannot respond to any further small pulses were they forthcoming.

The advantages of the circuit are: (1) the highest resistor ever needed is 10^6 ω; (2) the outside electrode of the counter is insensitive to pick-up as it is connected directly to the high potential; (3) different counters may be used without altering the resolving time of the circuit; (4) all tubes are used within the manufacturer's ratings; (5) the pulse on the counter wire can be studied with an oscilloscope by connecting it directly through a reasonably large condenser; and (6) either sign pulses may be taken off by connecting either to the first or to the second tube. A disadvantage of the circuit is that the high potential must be turned on rapidly to prevent a continuous discharge. This results from the condenser coupling between the tubes of the multivibrator.

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[3] Schiff, Phys. Rev. **50**, 88 (1936).