SPARK CHAMBER FOR ELECTRONIC INFORMATION RETRIEVAL. II*

In a paper given at the IRE Scintillation and Semiconductor Counter Symposium [1], work on a wire plate spark chamber for electronic rather than optical information retrieval was reported.

We noted that the signal obtained electronically from the wire chamber was often much wider than the apparent optical width of the spark. We stated that we believed that this was probably due to electromagnetic coupling between adjacent wires in the chamber. Two experiments were performed to check this assumption, and it proved to be in error.

We found that the disturbing spreading of the signal can be completely eliminated if the duration of the spark is shortened.

In the first experiment, the total signal from one gap of a wire chamber was sent through a single wire of a separate wire system, constructed with the same wire spacing and the same type of wire as in the first gap (Fig. 1). The circuit parameters were chosen so that when a spark occurred in the first gap, it gave a signal width of five or six channels on the magnetic tape used to record sparks in this gap. However, a tape placed on the end of the second wire system showed a signal of only one channel width, corresponding to the single wire into which the signal was fed.

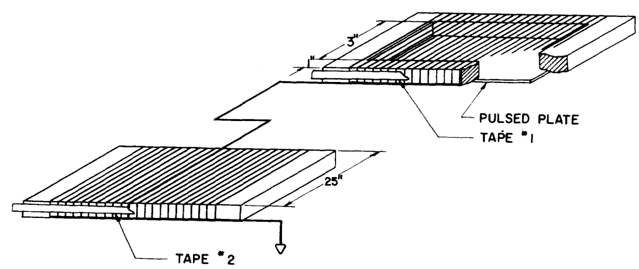

Fig. 1—Apparatus described in text to investigate possibility of electromagnetic coupling between adjacent wires in the wire chamber.

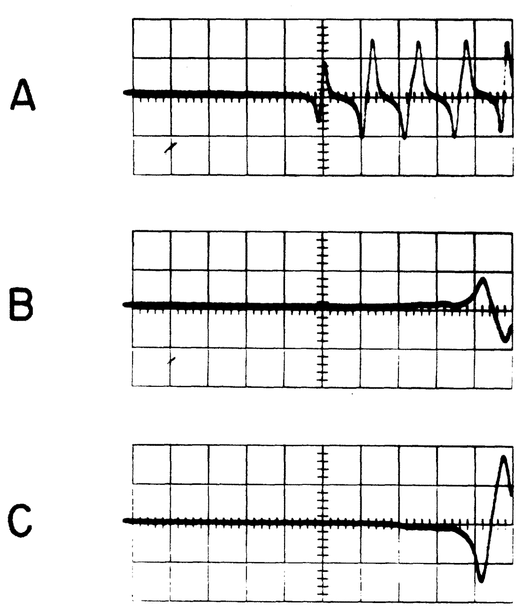

Fig. 2—Oscillograms of signals obtained with the apparatus shown in Fig. 1. Taken at 0.2 msec/cm with a Tektronix 543A scope. a) Five channel wide signal from Type 1 - 50 mv/cm. b) Single channel signal from Tape 2 - 50 mv/cm. c) Same signal as (b) shown in the opposite direction - 25 mv/cm.

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In the second experiment, two identical wire systems were placed adjacent to each other, with a sheet of .005'' Mylar separating them (Fig. 3). When one of these wire systems was used as a gap in a wire chamber, a spark which gave a signal of five channels in this gap left no apparent signal on the tape which was placed on the other wire system, even when read out with fifty times higher sensitivity than was used to observe the signal on the first tape.

Since both the above experiments indicated that electromagnetic or capacitive pickup was not an important factor in the spread of the signal, it was decided to investigate the other possible causes of the phenomenon. The most likely of these appeared to be the diffusion of ions produced in the spark. An experiment to check this hypothesis was designed and carried out.

This experiment involved building a single gap wire chamber which would have some sort of obstruction between the individual wires to block the ion diffusion. The gap which was built was made from a solid piece of Lucite into which a separate groove for each wire was machined (Fig. 4). This gap gave an improvement of approximately fifty per cent in the signal spread when compared to another gap using the same kind

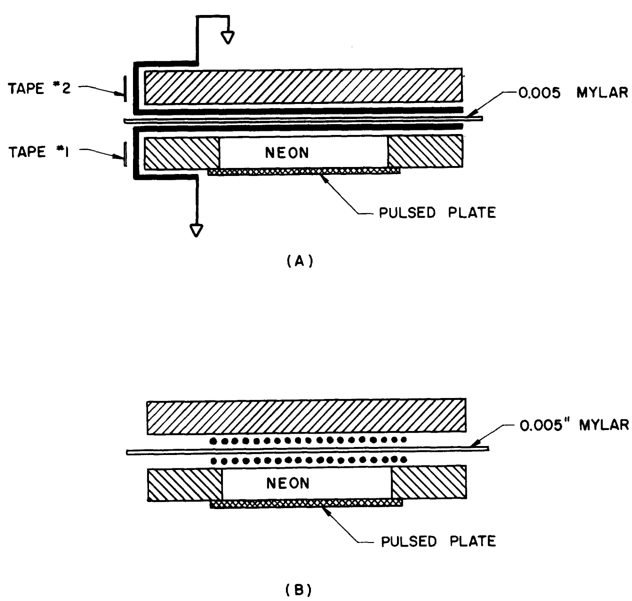

Fig. 3—Perpendicular cross-sectional views of the experimental spark chamber setup described in the text to investigate the possibility of pickup of a strong spark signal from a wire to another closely adjacent wire. Both wire systems are .004" Nichrome wire, spaced 52 lines/inch.

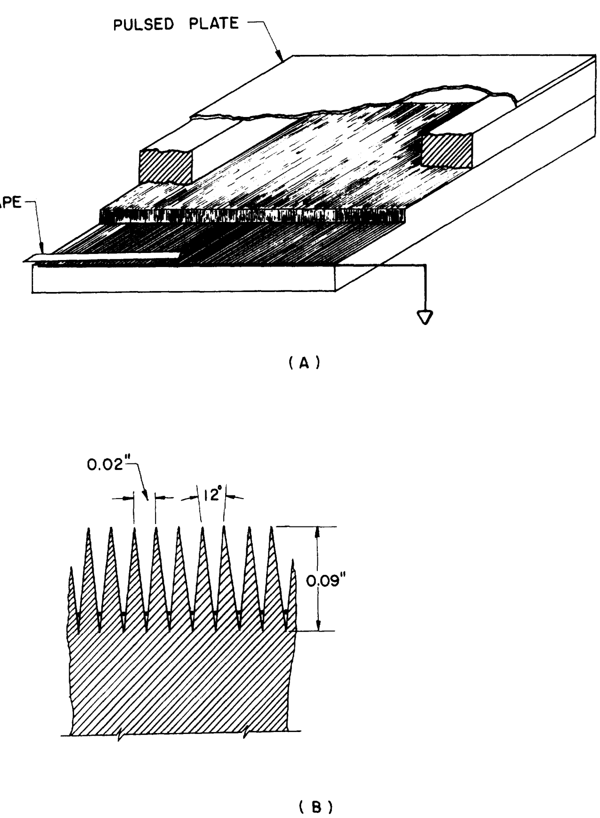

Fig. 4—Grooved Lucite spark chamber used to decrease diffusion of ions produced in a spark to the adjacent wires. A 0.002" Tungsten wire was placed in each groove, fastened with an insulating epoxy at end and grounded at the opposite end.

of wire at the same spacing but without grooves, and operated under the same circuit parameters.

This pointed to ion diffusion or photoionization as the cause of signal spread. It was decided that the best method to decrease diffusion was to decrease the length of time during which current flows through the spark. This would reduce both the number of ions and the time during which ions might diffuse away from the center of the spark.

The circuit that was chosen to give a precisely variable pulse length is shown in Figure 5. The pulse length is controlled by the length of coaxial transmission line which discharges through the thyratron supplying the grid pulse to the 4PR60A hard tube.

With the circuit described, it was found that the signal did become narrower as the pulse length was decreased. The narrowest signal was achieved when the length of the pulse on the grid of the hard tube was set slightly shorter than the delay between the rise of the voltage on the chamber and the breakdown of the spark. Under these conditions, the spark current can come only from the discharge of the chamber capacity, since by the time the spark starts to draw current, the tube is cut off and no energy can be drawn from the dumping condenser.

With the circuit operating as described above, a small wire chamber, constructed with 0.003" tungsten wire at 52 lines per inch, and with an applied field of six kilovolts per centimeter, consistently gave signals with a width of one or two channels.

Several methods of transferring the information to a computer were described in the recent

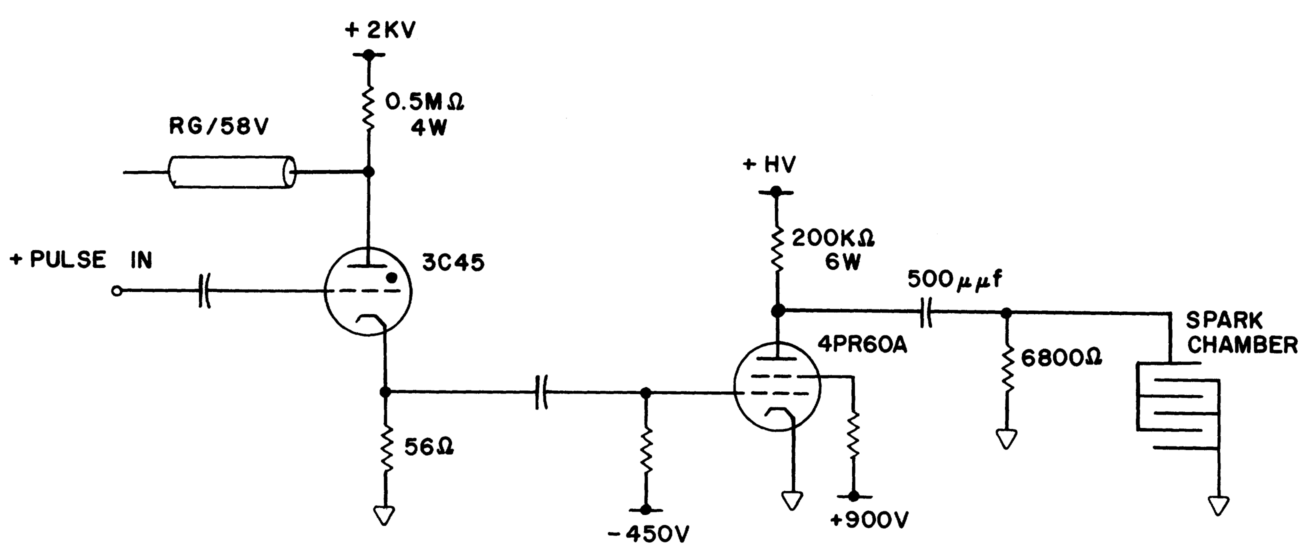

Fig. 5—Hard tube pulser circuit with variable pulse length used in wire chamber experiments.

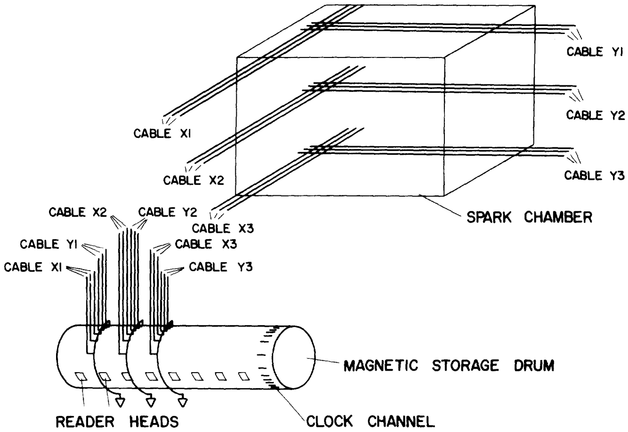

Fig. 6—Drum storage of spark chamber information.

literature [2, 3]. While the fastest up-to-date solution seems to be that of ferrite cores, a magnetic drum storage system (Fig. 6) appears practical for event rates of hundred per second.

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