

Trigger Unit for High-Speed Camera

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The trigger unit produces a spark image near the edge of the film to indicate the instant of occurrence of an external event. A thyatron is fired by interruption of a light beam falling on a nonmicrophonic photocell through a shutter which can be opened at any convenient time prior to the event. With small modifications the unit can be used to fire wire-filled expendable flashbulbs.

A USEFUL ACCESSORY for a high-speed camera is this simple trigger unit which generates a small spark to indicate the instant of occurrence of an event related to the one being photographed.

The spark may be initiated by the interruption of a light beam, by making or breaking a contact or by a microphone or other pulse input. It is produced in a

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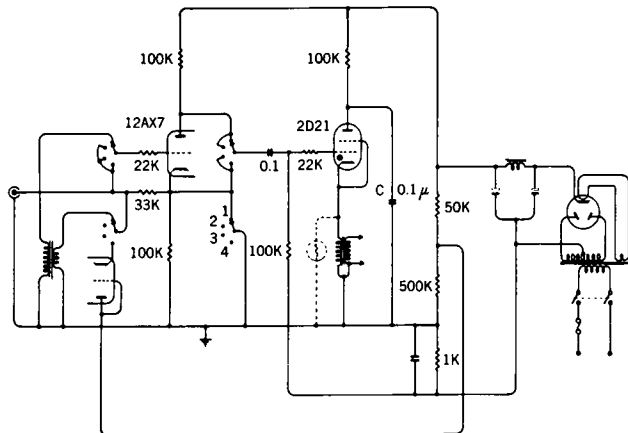


Fig. 1. Circuit diagram of trigger unit: position 1, microphone; 2, make contact; 3, break contact; 4, photocell.

miniature sparking plug mounted with an optical system in the space available in the Kodak high-speed camera Type III.

Circuit

The spark is generated by the discharge of a capacitor C (Fig. 1) through the primary of a standard 12-v automotive ignition coil, the resulting secondary high voltage being applied to a miniature sparking plug (KLG Mini. 2) with its points opened and offset slightly in order to give a satisfactory light source.

The discharge is controlled by a thyatron V2 set to strike on a positive going pulse of 6 v. Triode V1B is arranged by simple switching to give this pulse from the desired input connection. In the *microphone* position, the valve is used as an amplifier with a negative going input. In both *make* and *break* positions the valve is switched by the grid connection between cutoff and conducting conditions, with the positive signal selected from anode or cathode. The *photocell* position is the same as the *break* position, with the addition of a biasing diode V1A which maintains the photocell voltage at 3 v when illuminated. A germanium junction photocell is used because of its convenience and nonmicrophonic properties. If there were no biasing, the voltage across the photocell when illuminated would fall to about 0.3 v, which is not sufficient to collect all the carriers produced. Then, because of the finite carrier lifetime, a short duration interruption of the beam would not produce an output pulse, resulting in missed sparks.

Circuit constants have been chosen to suit the photocell operation, which has been the usual method of use.

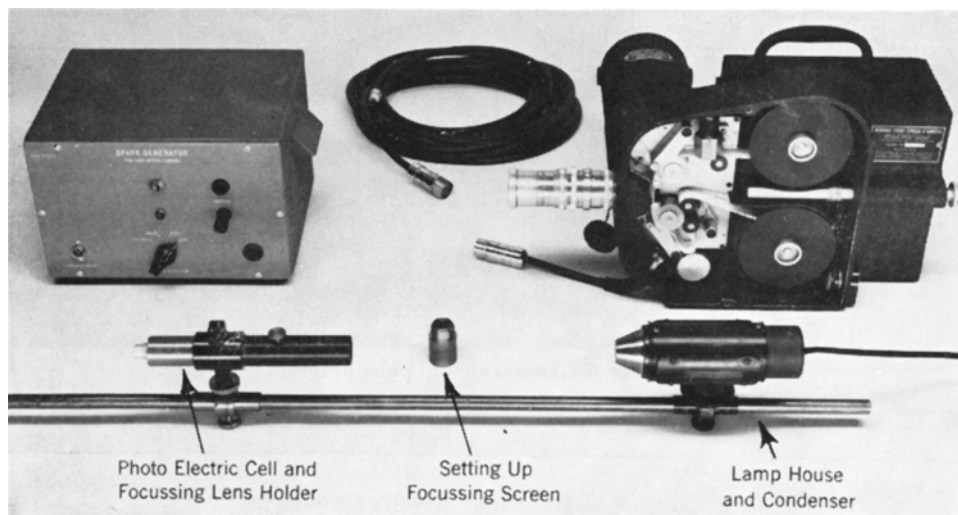


Fig. 2. General view of parts of trigger unit for high-speed camera.

Camera

Figure 2 is a general view of the whole equipment; and Fig. 3 shows the method of mounting the sparking plug and lens system in the camera. The gate in the high-speed camera has been reduced on one side, allowing the image of the spark to be placed in the frame area, in order to be seen in an editing viewer or on projection. See Fig. 4.

The spark is produced three frames ahead of the picture because of its location in the camera, and allowance can be made if necessary for the delay between interruption of the beam and initiation of the spark. This delay is $50 \mu\text{sec}$, of which $10 \mu\text{sec}$ is due to the 25-ft coaxial input cable.

Application

The unit has been used over the past two years on gun studies, where the movement of the ejector mechanism (50 ft/sec) was to be related to the projectile position (2700 ft/sec) from round to round, during firing at 10 rounds/sec. Any technique of photographing the mechanism and projectile simultaneously with a mirror system would be complicated, and also during the ex-

posure time of one frame at 3000 frames/sec the projectile moves 2.2 in. The spark produced by the projectile interrupting the light beam, together with the normal time-base recording on the edge of the film, gives adequate accuracy for the analysis of results.

Although originally made for producing a time-indicating spark, the unit has been used for firing wire-filled expendable flashlamps by any of the initiating methods previously described. Two modifications required were: the addition of extra capacitance to the condenser C, and the omission of the ignition transformer. When the unit was modified in this way and used with a light-beam initiation, it was helpful in selecting a single cycle of a repetitive operation. In such cases triggering by means of wires or contacts may interfere with the operation. The built-in camera time switch opened a shutter to allow light to fall on the photocell. The next interruption of the light beam fired the flashlamps, which provided an efficient source of 20 msec duration.

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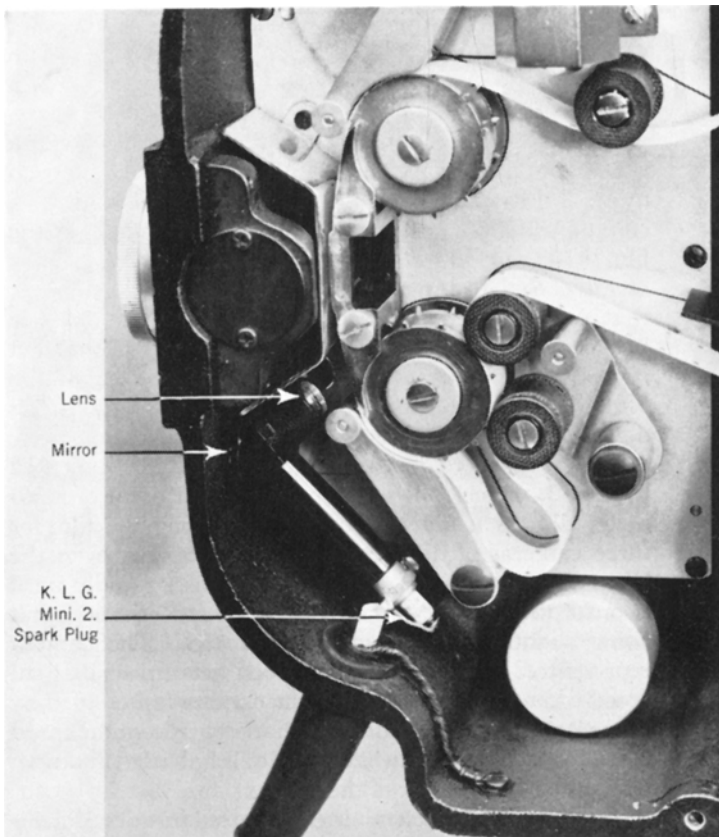


Fig. 3. Mounting of spark plug and lens system in the camera.

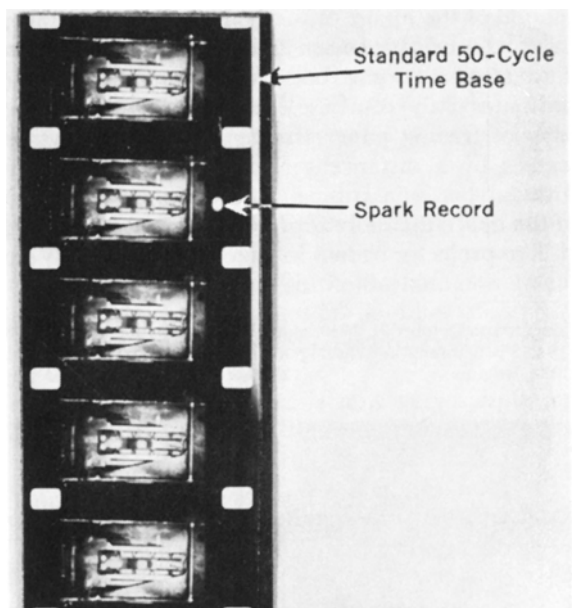


Fig. 4. Inclusion of image of spark in frame area.