FROM the response to earlier articles on electronic aids for the amateur photographer, it is obvious that a large number of readers are interested in both subjects. This is not surprising as the photographer of today relies largely on mechanical and electronic skills for the high standard of his end product.

Impact photography, as shown in photographs in this article, relies very much on electronic circuitry to get the striking effects required.

Find out now how you can make a . . .

SOUND TRIGGER FOR *PHOTO FLASH*

By R. Fletcher

A FEW YEARS ago the problem of recording impact phenomena was considered to be a laboratory project using specialised equipment, but thanks to the availability of thyristors and inexpensive silicon planar transistors, this is no longer the case.

This easily constructed self-contained synchroniser unit can be built for about £3 and enables the photographer to fire his electronic photo flash by the sound emitted at the instant of impact. To obtain this synchronisation, the positive side of the electronic flash trigger lead is connected to the anode of a thyristor and the negative side to its cathode. The impact sound is picked up by a miniature crystal microphone insert, amplified by the multistage silicon planar amplifier, converted to a rectified pulse which in turn fires the thyristor and operates the flash gun.

SOUND TRIGGERING

The low priced resin encapsulated silicon planar transistor type 2N2926 is chosen for the synchroniser as it possesses a low noise factor and is obtainable in the high h_{FE} ratings desirable for the early stages. The first three stages provide a high voltage gain at a total supply current of less than one milliamp.

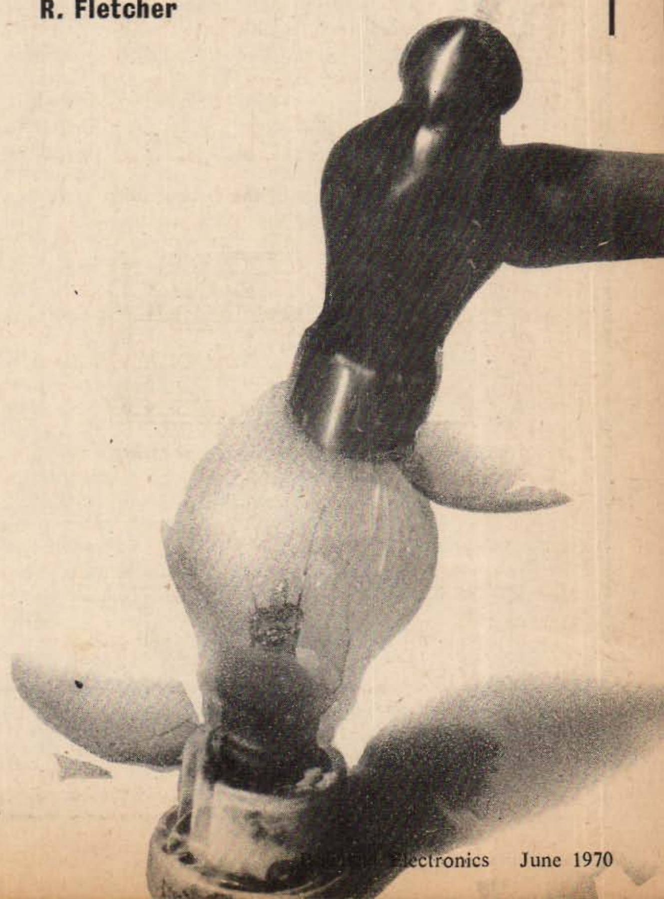
It is possible to couple the base of a silicon transistor directly to the collector of the previous stage as the working base-emitter voltage (V_{BE}) of a silicon transistor is of the order of 0·6V. These devices will function with a base voltage equivalent to, or even higher than, their collector voltage.

The amplifier is quite stable with the components specified, d.c. feedback being effected over R2 and VR1. The simplest form of gain control is to bi-pass the a.c. component via C1 to the negative rail. This also ensures that no d.c. changes occur if adjustments are made in sensitivity with the equipment switched on, which could result in spurious operation of the flash unit.

The amplified signal across the collector load of TR3 is applied via C2 to the unbiased transistor TR4 where rectification takes place and feeds a pulse of current via the gate and cathode of the thyristor SCR1. Provided correct polarity exists across this device from the photo flash, it switches on and the flash is fired. The thyristor is automatically reset after firing as, during conduction, the trigger coil voltage is reduced to zero.

CONSTRUCTION

The circuit is constructed on a 2½in × 1in 0·15in matrix Veroboard. Fig. 2 shows the underside of this board and it will be seen that six breaks have to be made in the copper foil strips in the positions shown. This can readily be undertaken with the aid of a spotface cutter or ⅛in drill. A sharp knife can be used but care must be taken not to damage the adjacent copper strips.



It will be seen that each hole in the board is code numbered and the ones used for a soldered connection have been blacked in.

After preparing the board, it is turned over and the components are mounted on its face as illustrated by Fig. 3. It may be necessary to solder wires on to the tags of the pre-set skeleton potentiometer VR1 if they do not coincide with the holes specified for its fixing. A short jumper lead is connected from its slider tag to hole *9D*. The strap between holes *16D* and *16G* completes the negative rail connection of C1.

It is advisable to fit a short length of thin sleeving on the centre (collector) leads of the transistors, especially in the case of TR2 and TR4 where the sequence of lead connections is different from the *e—c—b* sequence from the transistor.

External connections can be made after the components have been mounted and soldered on the board. Usually one lead of the crystal microphone insert is connected to its metal case (black on the type specified). This should be soldered to the negative rail, i.e. strip *G*. The battery connections are self explanatory, the positive on *A* and negative on *G*, wired via the on–off switch.

CONNECTION TO FLASH GUN

The seven-feet long flash extension lead calls for comment, as this must be correctly connected polarity wise. First, trim off the connector not required for coupling to the flash unit, a few inches from the end of the cable and bare the two centre conductors. Connect the other end of the lead to the electronic flash unit and switch on.

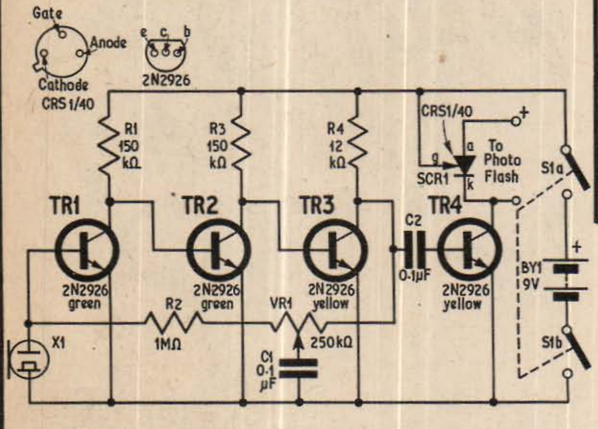


Fig. 1. Circuit diagram of the trigger unit

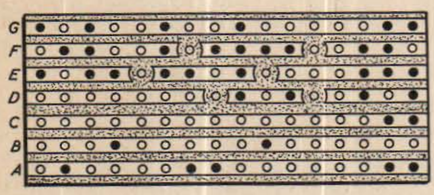


Fig. 2. Underside of the board showing breaks in the copper strips

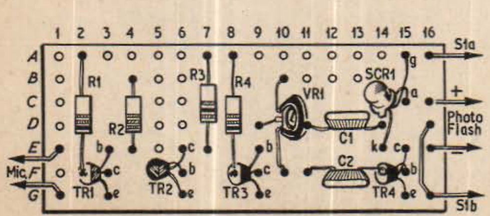


Fig. 3. Components assembled on the top of the board

COMPONENTS . . .

Resistors
R1 150kΩ R3 150kΩ
R2 1MΩ R4 12kΩ
All 5%, ¼ watt carbon

Potentiometer
VR1 250kΩ carbon skeleton preset

Capacitors
C1, C2 0·1μF polyester (2 off)

Transistors
TR1, TR2 2N2926 (Green) (2 off)
TR3, TR4 2N2926 (Yellow) (2 off)

Thyristor
SCR1 CRS 1/40

Switch
S1 Double pole, on-off, slide switch

Microphone
X1 ¾in crystal insert

Battery
BY1 9V (type PP3)

Miscellaneous
Veroboard 0·15in, matrix 2½in × 1in
Battery connector
Flash extension lead 7 feet
Plastics Box 4⅜in × 3in × 1¼in

With the aid of a voltmeter switched to the 250 volt range ascertain the polarity of the bared conductors. Be prepared to disconnect the meter quickly if reverse polarity is indicated. The measured voltage will vary with different flash units, but the object of the exercise is only to check polarity. The positive lead must be connected to foil strip *16C* (anode of thyristor) and negative lead to *16E*.

Most modern flash units have the positive side of the trigger coil primary wired to the centre of the connector but it is as well to check. Actually a reversed connection will not damage the semiconductors in the synchroniser, but of course the thyristor would fail to conduct.

On completion of the wiring, the unit should be checked for any obvious errors, dry joints, or bridging contacts between the foil strips. If all is well, VR1 should be set to mid-position and a milliameter connected in series with one of the battery leads before connecting to the 9V battery.

on–off switch and crystal microphone insert together with the completed unit board. The simplest method of securing the various items is with strips of $\frac{3}{8}$in expanded polystyrene ceiling tile as shown.

A $\frac{1}{4}$in hole is drilled in the end of the plastics box to coincide with the aperture in the face of the crystal microphone insert. The miniature slide switch is secured at the opposite end by two 8B.A. countersunk screws, after a slot has been filed for the knob.

SEQUENCE OF OPERATION

The photographs must be taken in the dark using the open shutter flash technique. If a slow speed film is used, a dark room safe light may be utilised to assist the operator. This technique is recommended as the use of say a 50 A.S.A. film facilitates the production of needle sharp enlargements and allows a normal powered flash gun to be placed reasonably close to the subject.

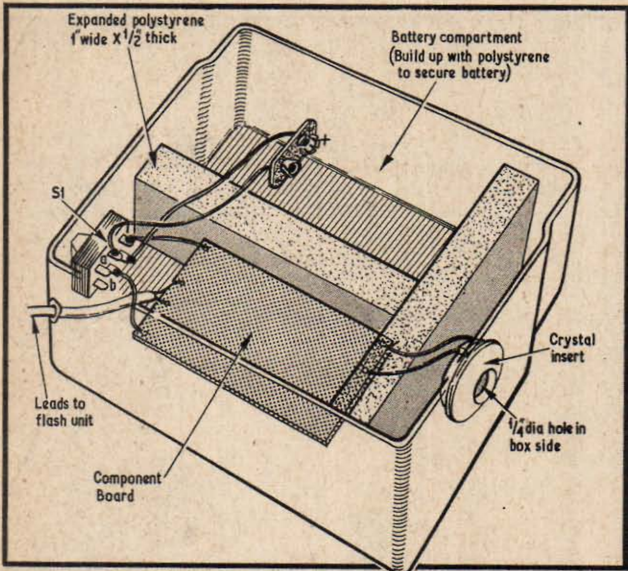
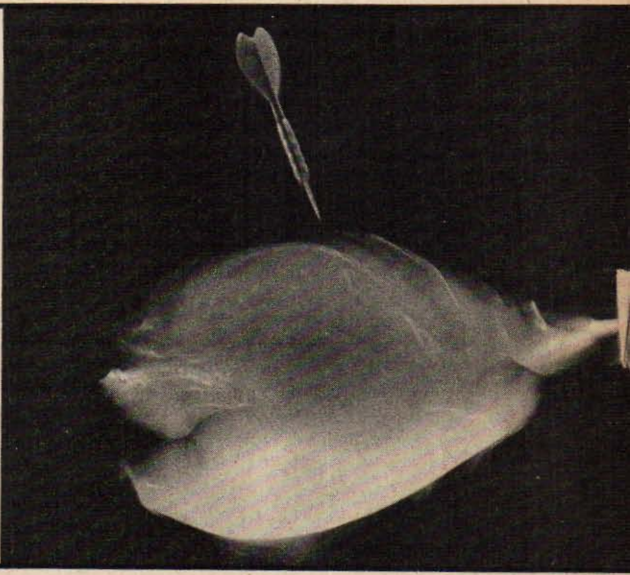


Fig. 4. Layout and wiring of complete trigger unit



Three examples of triggered photoflash photograph

TESTING AND SETTING UP

The unit should now be switched on; the meter should indicate a battery drain of between 0.75mA and 1mA. A sharp whistle a foot or so from the microphone should result in a perceptable increase in supply current. If these tests are satisfactory the meter may be withdrawn and battery connected in the normal manner.

The switched-on photo flash may now be connected to the synchroniser via the extension cord and connector. If the hands are now clapped, or fingers snapped within a few feet of the microphone the flash unit should fire.

Adjustment of the preset control VR1 will produce a wide range of sensitivity and on maximum gain the trigger unit can be set to fire the flash at the drop of a pin. The completed unit can now be suitably housed in a container of the constructor's choice.

A $4\frac{3}{4}$in × 3in × $1\frac{1}{4}$in plastics box as specified in the components list would be quite suitable and easily obtainable. Fig. 4 illustrates the position of the

The sequence of operations is as follows:

1. Set up camera (on "bulb" position) and subject, together with flash gun as for a normal flash exposure.
2. Connect synchroniser to flash gun, switch on synchroniser and then the flash unit.
3. Turn off main lights leaving only the "safe" light on.
4. Open camera shutter, preferably with cable release and hold open.
5. Commence action which will create impact sound. Flash will operate on impact.
6. Close camera shutter.
7. Turn on main lights.

The synchroniser is very sensitive to sound and its gain can be preset to reduce to a minimum false firing by extraneous noise but respond reliably to the impact sound. Sound travels at approximately 1,100 feet per second thus the delay in firing the photo flash can be adjusted by placing the unit one foot away from the subject for every $\frac{1}{1000}$ second delay required.

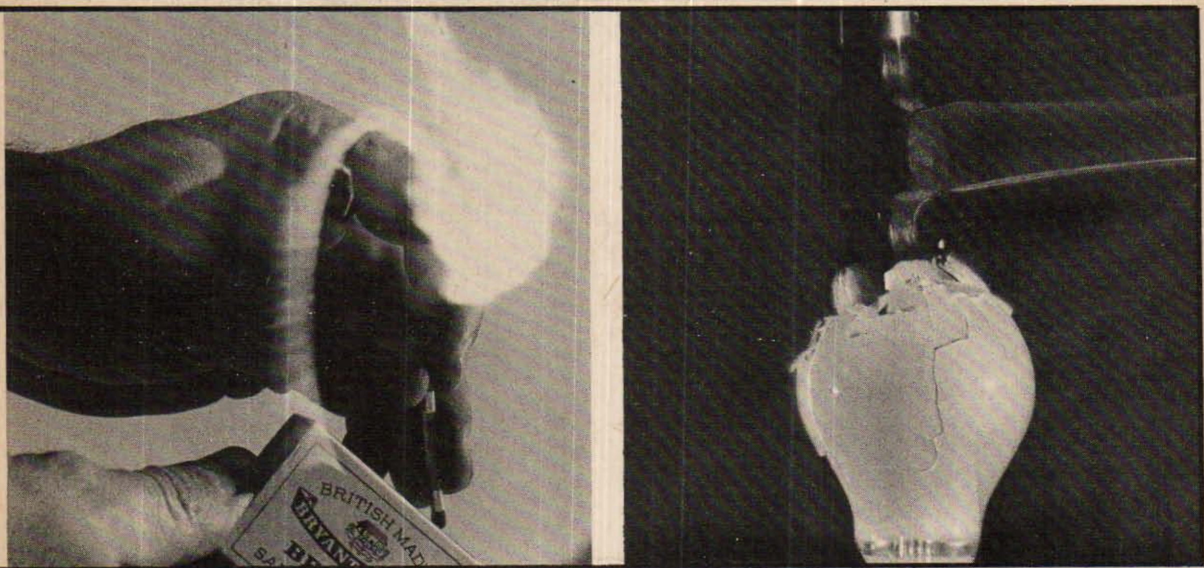
For more ambitious results, two or more flash units can be fired by separate synchronisers placed at predetermined distances from the subject to give a superimposed sequence of events or stroboscopic effect.

SPURIOUS FLASH

If it is desired to avoid spurious flashes when setting up the equipment the following sequence should be followed:

1. Switch on synchroniser unit.
2. Connect to flash gun.
3. Switch on flash gun.

The reason being that the surge current that occurs on switching on the synchroniser is sufficient to fire the thyristor. Also, if the photo flash is switched on before connection to the synchroniser, the depletion capacitance of the thyristor may be sufficient to draw a pulse of current from the trigger circuit large enough to fire the flash. After connection, however, the equipment may be recycled as many times as desired and the flash will only be fired on receipt of sound pick-up of sufficient amplitude.



howing a burst balloon (left), striking match (centre), smashed bulb (right)

VARYING FLASH TIME

The average duration of flash from a modern general purpose electronic flash unit is of the order of $\frac{1}{1000}$ second or a little less, according to the operating voltage used to charge its main electrolytic storage capacitor and power output of the flash unit in joules.

The larger the capacitance of this electrolytic the larger will be the output ($\frac{1}{2}CV^2$) in joules, but at a cost of increased duration of flash. If the same output is maintained by using a lower capacitance operating at a higher voltage, then the duration of flash is reduced.

If a real "freezer" flash is required for "stopping" very high speed phenomena, we can use these principles to modify an existing flash unit. The simplest approach is to replace temporarily the existing main storage capacitor with an ordinary smoothing capacitor of 16μF or 32μF of correct working voltage. This will reduce the flash duration to as little as $\frac{1}{5000}$ second, but at a very much reduced power output.

A revised guide number can easily be obtained for this reduced output, by making a test film and recording a range of apertures and distances. The distance in feet between the flash gun and object, multiplied by the stop setting that produced the best negative, is the new guide number.

It is emphasised that the above modification is only required for exceptional use and the photographs submitted by the author were all taken with an unmodified commercial flash gun.

A typical example of speed of operation is shown in the "striking match" photograph. As soon as the match *starts* to move, the flash gun fires. The continued motion of the flame is registered even though the match appears to be still on the box, because the aperture is still open and light from the match photographed on the film.

The "burst balloon" also shows some movement of the balloon during collapse.

Several other examples of application can be tried with some success. Any form of impact, crash or explosion can be photographed using this technique in dark conditions. ★