Capture spectacular action shots with this

Sound triggered photo flash

How would you like to be able to take photographs like those spectacular shots of breaking light bulbs and splashing liquids? You can take them with almost any normal camera and electronic flash unit, by using this low cost trigger unit. It's easy to build and offers facilities not found on any other design that we've seen.

by IAN POGSON

To take spectacular action shots of things like glass breaking and water splashing, you need to take the shot at just the right instant and to use a very short exposure time. This isn't as easy as it might sound, because in many cases the timing of the shot has to be accurate within a few milliseconds (thousandths of a second).

The secret is to use an electronic flash, and trigger it from the sound made by the event you're trying to photograph. The flash provides a suitably short exposure time, and the timing is right because it's automatic.

The sound trigger unit described here is designed especially for the job. It takes the signal from a standard medium-impedance microphone, and uses it to produce a trigger signal capable of operating any normal electronic flash unit. And to give increased flexibility, it lets you introduce an adjustable electronic delay into the system, so that you can carefully alter the timing of your shots.

Actually this isn't the first sound trigger unit we've described. We published an earlier design in April 1972, but that was a fairly simple unit with few refinements. And of course it's now a little dated, electronics having progressed rather rapidly in the last seven years.

The new unit doesn't just use newer circuitry — it also offers improved facilities. While retaining basic simplicity, we have been able to produce a unit which has a constantly variable sensitivity over a wide range, together with a constantly variable time delay over a range from about 1ms to about 120ms. We have also provided an "inhibit" switch which prevents the unit from firing prematurely while a final setup is being arranged.

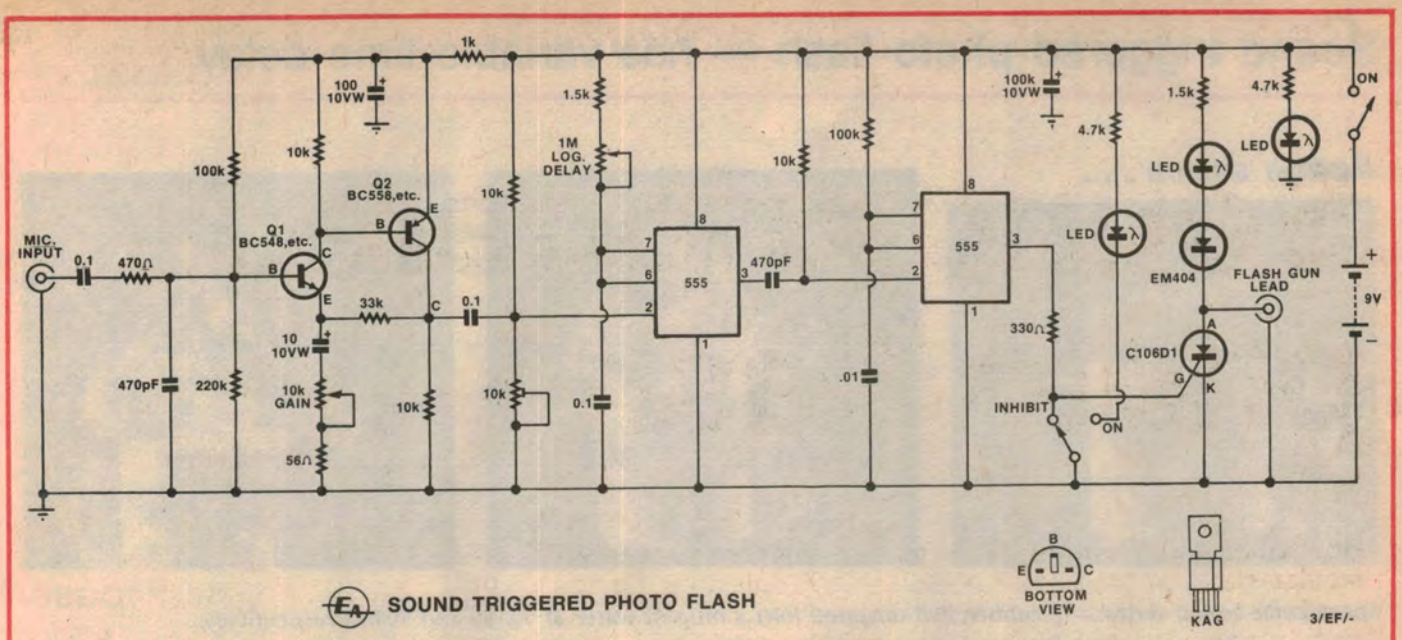
In addition to the above features we have also provided components which prevent the unit from firing again after the initial and wanted flash firing. During development, we found that where a flash unit was capable of firing in quick succession and where an action was accompanied by a succession of sounds, more than one flash occurred with consequent multiple exposures on the one frame. There may be cases where this is an advantage, but more often a good shot could be spoiled.

To avoid this problem, we have added a bleed circuit in series with the triggering SCR, such that when the SCR fired, a "holding" current is established to prevent any possibility of the SCR beging triggered again. The unit can be reset simply by turning off the power switch and turning it on again. We are not aware of this feature being included in any other sound-operated photo flash unit, despite its importance. More will be said about it later on.

After the successful development of the flash unit, we spent an interesting time in our photographic studios taking a number of action shots. Some of the pictures which we attempted include:

(a) a ball dropped onto the trigger of a rat trap, using different time delays,

The prototype provides variable time delays from 1ms to about 120ms. The centre LED comes on to indicate that the unit has fired.



SOUND TRIGGERED PHOTO FLASH

A simple microphone preamplifier, two 555 timer ICs, and an SCR form the basis of this economical circuit.

(b) dropping an electric light globe onto a hard surface,
(c) smashing an electric light globe with a hammer,
(d) dropping an egg onto a plate,
(e) dropping a ball into a cup of water, with various time delays.

Some of the resulting pictures are reproduced in these pages. Apart from a few comments, perhaps they can be left to speak for themselves!

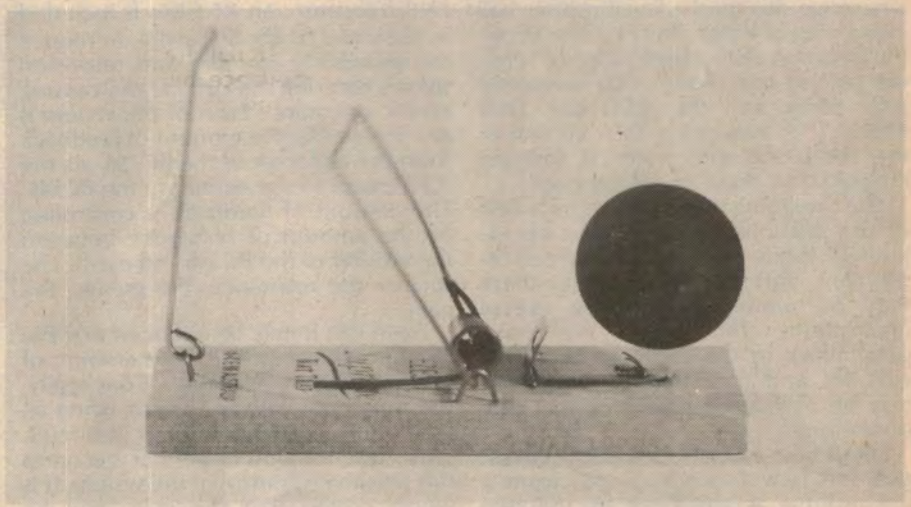
Triggering a rat trap proved to be an interesting subject. The final result depended on where the ball was made to strike the trigger, as well as the time delay used. The picture shown was taken with a time delay of 20ms and the trigger was struck near the end away from its pivot. Other shots of the same subject using a delay of 10ms and striking the trigger a little futher back showed the arm of the trap in a position where it had not travelled as far.

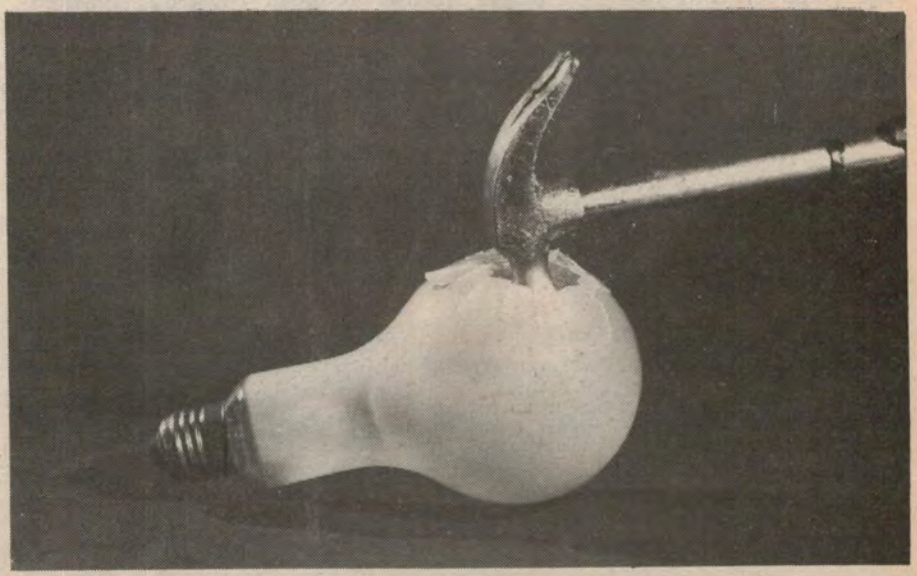
Smashing electric light globes is always an interesting subject. The first time we dropped one onto a table, it bounced! The second effort was successful and the picture on page 55 shows the glass actually disintegrating.

A second globe was struck with a hammer. This produced the impressive shot shown on this page, with the hammer caught just as it entered the bulb. As you can see, the bulb is still intact at this stage, apart from a hole surrounded by small radiating cracks. However, just after the shot was taken, the bulb completely shattered.

Just in case you're wondering, this shot was taken with a delay of about 15ms.

Our next effort was to drop an egg onto a plate and observe its state after a time delay of 10ms. The picture shows this quite clearly.





View at top shows a rat trap caught in mid action after being triggered by a rubber ball. Above shows an electric light bulb 15ms after impact with a hammer.

Sound triggered photo flash — has variable time delay

Action series . . .

Spectacular action series — a rubber ball dropped into a mug of water at 10, 50 and 100ms respectively.

Another quite spectacular series is where we dropped a small rubber ball into a mug of water. The first one shows the situation after a time delay of 10ms, the second one shows what happened after 50ms, and the third one after 100ms. It is interesting to note that in the third one, the water is forming droplets and they are falling back.

The foregoing examples are but a few of the possibilities which may be exploited. While many of them are of little value apart from their novelty, there may be many other more useful applications. The trigger may have possibilities in the study of nocturnal wild life, and also in industry, where it may be of value in analysing machine operation.

Let us take a closer look at the circuit and see how it works. Input from a microphone is amplified by the two stage amplifier consisting of a BC548 NPN transistor, followed by a BC558 PNP transistor. An RF filter is included in the input to the first stage, to reduce the possibility of radio and television signals entering the circuits and causing erratic operation. Gain of the system is determined by the amount of feedback from the collector of the BC558, via the 33k resistor to the emitter of the BC548. The amount of feedback is controlled by the amount of resistance between the emitter of the BC548 and earth. The smaller the resistance, the greater the gain.

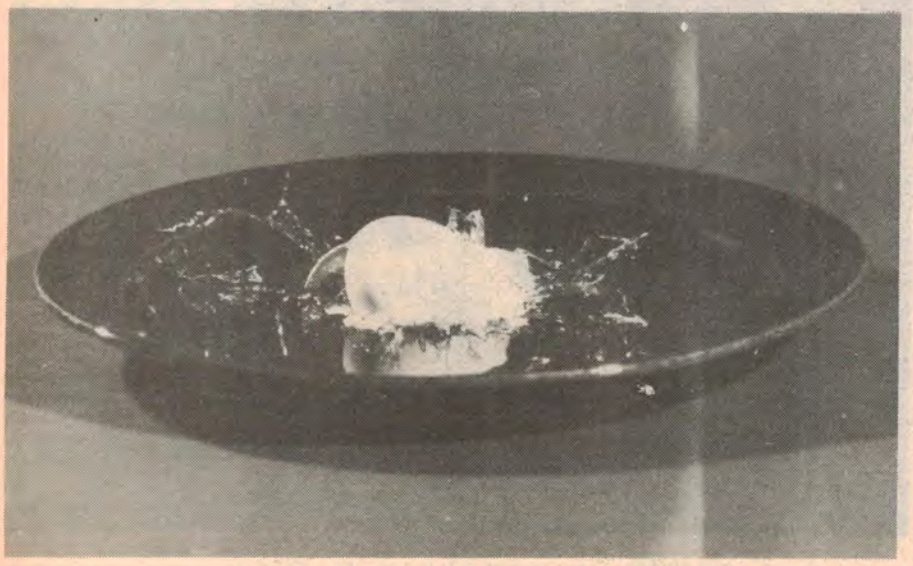
From this it may be deduced that the 56 ohm resistor governs the amount of maximum gain available. Conversely, the minimum gain will occur when all of the 10k potentiometer is in circuit. Thus, the 10k potentiometer becomes the sensitivity control of the system. It is worth noting that the gain may be further reduced by using a potentiometer of about 50k. However, this was not found to be necessary. In fact, the range of control was reduced so that a smoother control could be achieved over a range found to be most practical.

Following the audio amplifier are two type 555 IC timers. These are wired as monostables. Bias to pin 2 of the first 555 is adjustable by means of the 10k trimpot and which is normally set so that the voltage at pin 2 is just above one third of the supply voltage. The 1.5k resistor, 1M log potentiometer and the 0.1uF capacitor form a variable time constant applied to pins 6 and 7 of the first 555.

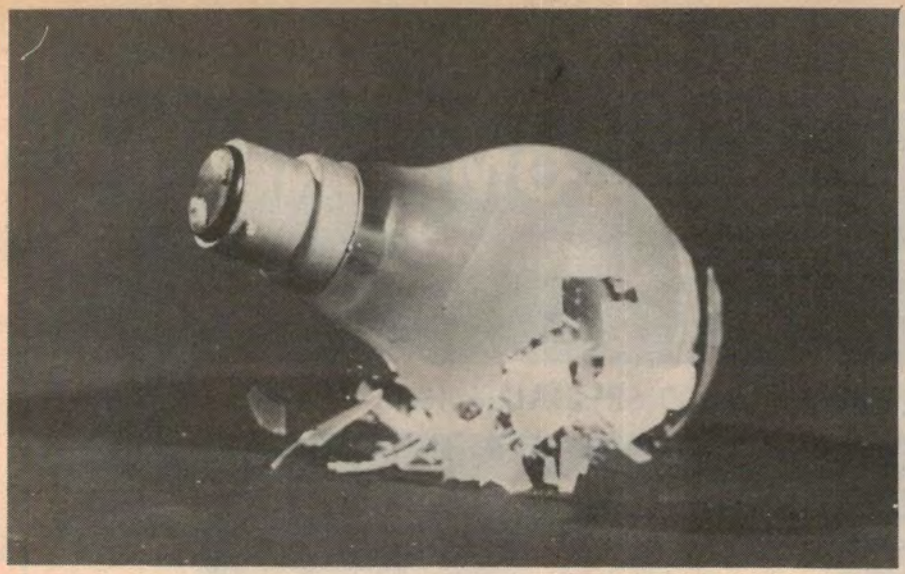
When sufficient level of signal is delivered by the audio amplifier to the first 555, a pulse appears at the output pin 3, with an effective delay determined by the time constant. This pulse in turn triggers the second 555 and a positive going pulse appears at its output pin 3. Provided the "inhibit" switch is open, this pulse will trigger the SCR into conduction. This in turn fires the flash gun.

The idea of the inhibit switch is to inhibit firing while final arrangements are being made in a particular setup. This is particularly useful where near maximum sensitivity is required and where any small sound may be likely to trigger and fire the flash prematurely. The switching incorporates a LED to indicate the state of this function.

The 1.5k resistor, 400V diode and LED between the positive rail and the anode of the SCR are to provide the "holding current" mentioned earlier. When the SCR fires, the current which flows through these components ensures that it remains in conduction to prevent further triggering. The LED indicates that latching has occurred, so that you are prompted to turn the unit off briefly to reset it before attempting the next shot.



A time delay of 10ms was used to capture this action shot.



An electric light bulb disintegrates on impact with a table-top.

Thanks to this facility, you won't get multiple exposures even if your electronic flash recycles extremely fast and you are trying to photograph something which makes a prolonged sound or a series of sounds.

From a constructional point of view, the trigger unit should be simple and straightforward. The components used are readily available, and most are wired on a printed circuit board (PCB) which measures 92 x 51mm. The board is coded 79SF9, and its pattern is reproduced here actual size for those who may wish to etch their own board. Patterns have also been sent to board manufacturers, so that ready-made boards should be available shortly.

As may be seen from the pictures, the unit is housed in one of the now popular "jiffy" boxes. Although we have only provided a small 9V battery, there is room in the box to accommodate a larger battery should this be desired.

Start by assembling the printed board first. Due care should be taken with the whole assembly process, making sure that the job is done in a neat workmanlike manner. All component leads should be kept to a minimum and due regard should be given to all polarities. This applies to all diodes, including LEDs, transistors, electrolytic capacitors, the SCR and the two ICs. Use a small soldering iron, kept clean at all times. Be sure not to overheat components but at the same time, make good soldered joints.

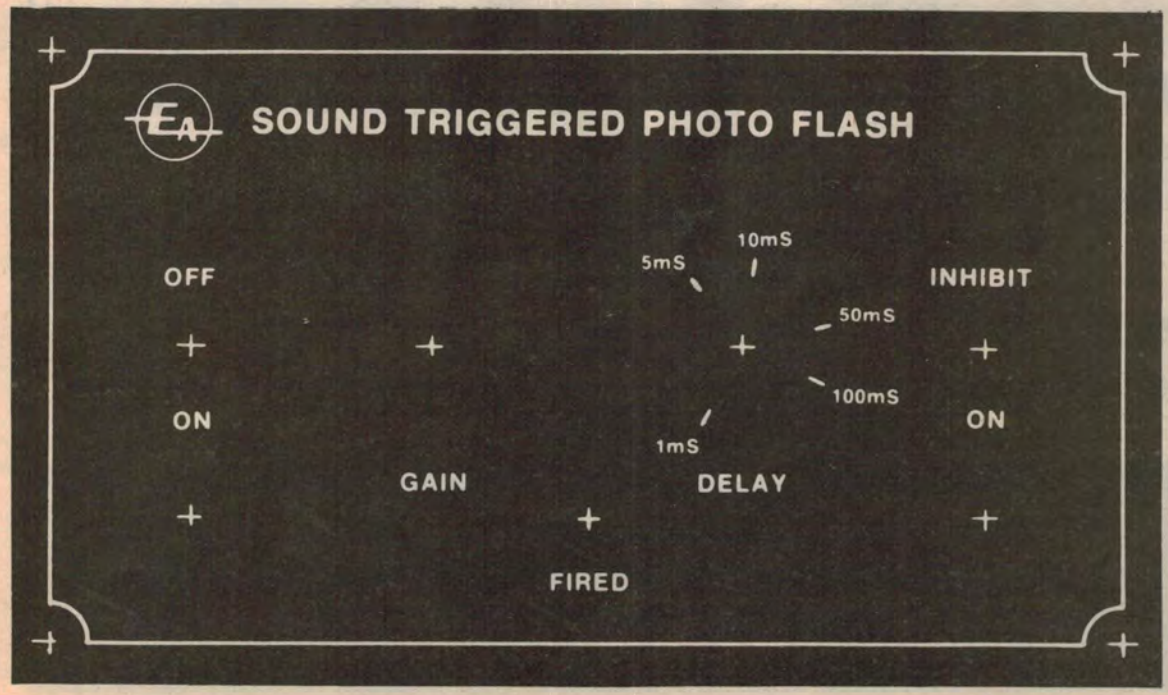
It is always a good idea when assembling printed circuit boards, to start with the small components, such as resistors and diodes and gradually move towards the larger components. The ICs should only be fitted to the sockets when the rest of the assembly has been completed.

When the printed circuit board is finished, it should be checked to make sure that all components are in the right places, that all polarities are correct and there are no bad soldered joints or solder bridges across adjacent points or conductors.

The front panel may be now assembled. Layout is not critical but readers may wish to follow our layout as shown in the pictures. We have produced an artwork for this panel and it is reproduced full size so that readers may use it in one way or another in the preparation of individual panels. Fix the potentiometers, switches and LEDs to the panel. A 5-tag miniature tagstrip is soldered to the back of the time delay potentiometer as may be seen in the picture. The tagstrip is used to mount the 1.5k resistor and the EM404 diode and for interwiring between the strip and other parts of the circuit.

Before doing the final assembly, a number of external leads have to be soldered to the printed circuit board. These include two for the microphone socket; two for the gain control; two for the time delay control; one for the inhibit LED; one for the on/off switch; one for the corresponding LED; one to the earth point on the inhibit switch; one from the SCR gate to the inhibit switch; one to the EM404 diode and one for the negative pole of the battery.

Just where you fix the printed board, the battery and the microphone socket into the box is not really important. However, unless you have reasons for



Actual size reproduction of the front panel artwork.

Sound triggered photo flash — uses two 555 timer ICs

doing otherwise, we suggest that you place them as we have, as may be seen from the picture.

We fixed the board with four ⅛in Whitworth x ½in RH screws, with the heads under the box. Two nuts were run onto each screw to act as spacers and when the board was placed in position, it was then held with four more nuts. The battery is held in place with an L-shaped bracket which we fashioned from a piece of tinplate. One hole was drilled in the bracket to screw it in place. The socket is an item which should be selected to match the microphone which you intend to use.

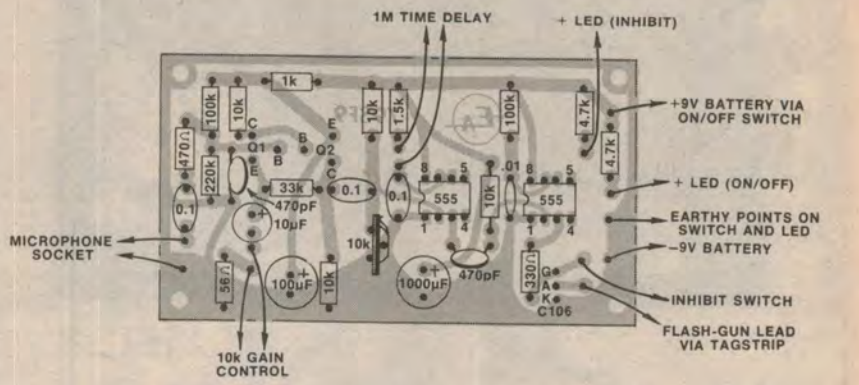
The output lead is actually an extension lead for flash guns and obtainable from photographic stores. The female socket which mates with the lead of your flash gun should be retained. The plug at the other end is cut off and the lead terminated on the tagstrip, taking the outer braid to the centre earthy lug and the centre conductor to the cathode of the EM404 diode. Our lead was two metres long.

On the subject of microphones, a few comments may be helpful. There are many microphones in use in various types of equipment which may be used quite successfully. These could include microphones supplied with tape recorders, amateur and CB gear, etc. Most of these microphones are of the dynamic type, usually of fairly low impedance, about 500 ohms. This is the type which we used. The high impedance type of dynamic microphone (usually about 50k) should also be OK for the job. Although they are less popular now, a crystal microphone could probably also be used.

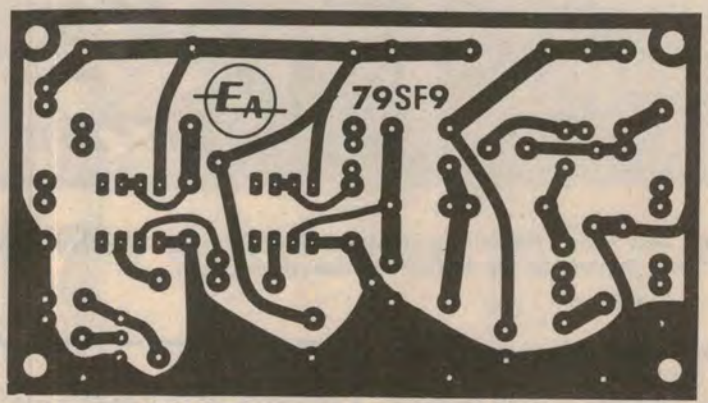
There is only one basic adjustment which has to be made to the unit itself. The 10k trimpot on the board should initially be set to its mid position. It may then be adjusted carefully to give the maximum sensitivity of triggering to sound. It should be noted that if the rotor is turned too far in either direction, triggering will cease.

Instead of the lead of the flash gun being plugged directly into the appropriate socket on the camera, the lead from the flash gun is connected to the output lead from the sound triggered unit. The microphone is plugged into the input of the sound triggered unit. A typical setup would be where the camera is on a tripod and focused on the subject (or the position where the subject will be at the time). The microphone is strategically placed close to the source of sound.

When the scene is ready, lighting is subdued, the sound triggered unit is switched on and its power LED will light. Then before the action is to take



The PCB layout for the sound triggered photo flash. Follow it carefully in conjunction with the circuit diagram.



Here is an actual size reproduction of the PC pattern.

place, the inhibit switch is switched on and its LED will also light. The camera shutter is then opened, action follows and the shutter closed immediately after the flash. When the flash has fired, the third LED lights, indicating the fact. The inhibit switch is switched off and unless the unit is wanted again very soon, the battery should be switched off also. Incidentally, battery current is a little over 20mA so that battery life should be considered.

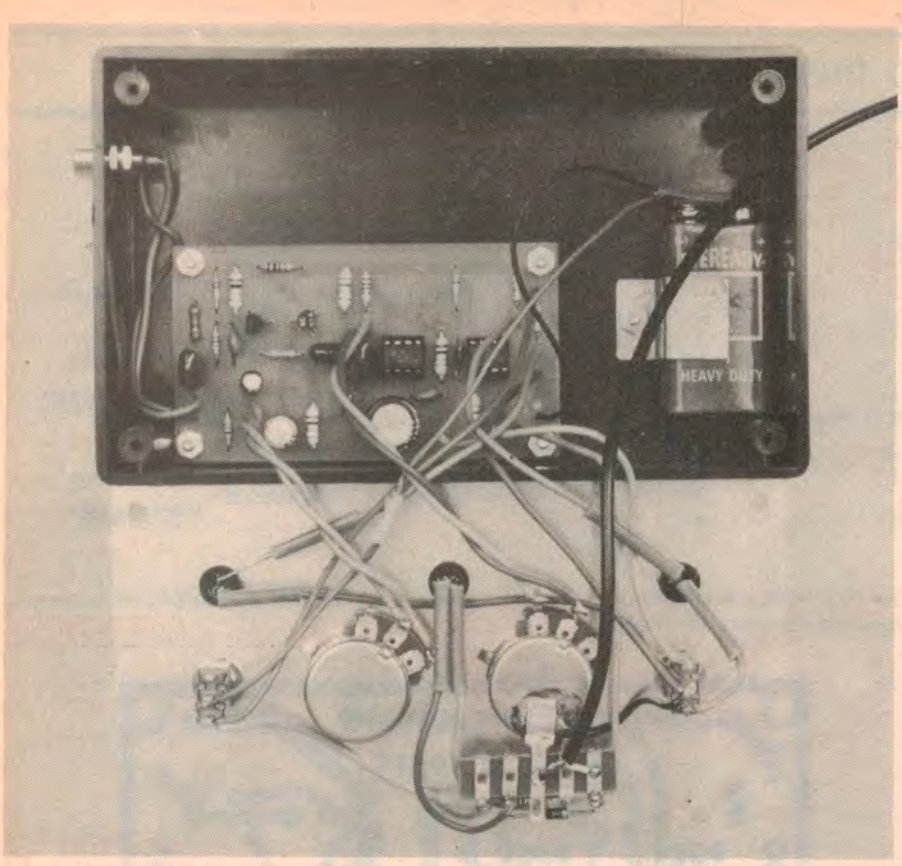
Fairly obviously, some of the movements will need to be rehearsed in order to make adjustments on the sensitivity to be used for the microphone. Also, the time delay and exposure must be determined. How these are to be done, will depend on the circumstances of the particular exercise.

One very important point and one which we have not touched on so far is the matter of flash duration, which obviously ties in with exposure. However, the flash duration is important where high speed action is involved and the duration of the flash must be considered in this light. No pun intended!

It is with some trepidation that I quote figures but they should act as a guide and give a good idea of what we are about. Some years ago, when high voltage electronic flash units were in use, the duration of the flash was of the order of 1/5000th of a second. More recently, low voltage flashes have taken over and the flash duration is somewhere between 1/800th and 1/1000th of a second.

Quite rapid action can be stopped with longer duration flashes of between 1/800th and 1/1000th of a second, but higher speed action requires shorter flash times. Fortunately, shorter flash times can be achieved with all but the simplest flash guns on the market today. A facility is included on most modern flash guns whereby the flash duration can be shortened in response to the amount of flight being reflected from the subject, and this can be exploited where we need to take shots of fast action.

Just how this can be achieved will depend somewhat on the particular flash gun being used. However, there is one "trick" which may be worth considering in setting up a gun to a particular flash duration. Instead of relying



This internal view shows the wiring layout of the prototype. The flashgun lead is soldered to the tagstrip at the bottom of the photograph.

PARTS LIST

1 Utility box 159mm x 96mm x 50mm
1 Printed circuit board 92mm x 51mm, code 79SF9
1 BC548 transistor, or similar
1 BC558 transistor, or similar
2 555 ICs, 8-pin DIL
2 IC sockets, 8-pin DIL
1 C106D1 SCR
1 EM404 diode, or similar
1 10k miniature trimpot
1 10k linear potentiometer
1 1M log potentiometer
2 SPDT miniature toggle switches
3 Red LEDs with bezels
1 Microphone socket to suit (see text)
1 Rubber grommet
1 Miniature tagstrip, 5 tags
1 9V battery, with clip lead
1 Clamp for battery
1 Flashgun extension lead

Resistors (½ watt)

1 56 ohms	*2 4.7k*
1 330 ohms	*4 10k*
1 470 ohms	*1 33k*
1 1k	*1 100k*
2 1.5k	*1 220k*

Capacitors
2 470pF ceramic
1 .01uF greencap
3 0.1uF greencap
1 10uF 10VW electrolytic
1 100uF 10VW electrolytic
1 1000uF 10VW electrolytic

Miscellaneous
Hookup wire, solder, screws, nuts.
Note: Resistor wattage ratings and capacitor voltage ratings are those used on the prototype. Components with higher ratings may generally be used providing they are physically compatible. Components with lower ratings may also be used in some cases, provided the ratings are not exceeded.

We estimate that the current cost of parts for this project is approximately

$22

This includes sales tax.

on the light reflected from the subject to control the flash duration, which will have many variables, a fixed reflector can be added to the body of the flash gun.

The reflector may be fashioned from a piece of scrap aluminium, or even a piece of cardboard. The idea is to shape the piece so that part of its surface will catch some of the light from the gun and reflect it back into the sensing device on the gun. The distances involved will probably be of the order of 5 to 10cm, between the reflector and the gun lens and the sensing device. Care should be taken to ensure that the reflecting material does not obscure light which is intended for the subject.

The idea of this exercise is to persuade the sensing device that there is more light being reflected from the subject than is actually the case. This results in a shorter flash duration, which is what we are looking for. The amount of light being artificially reflected back into the sensor may be controlled to a large extent by varying the colour of the reflector. All of this is subject to experiment. Incidentally, the reflector may be fixed to the body of the gun with rubber bands or adhesive tape.

By resorting to this or other methods of flash time reduction, we can effectively obtain speeds of 1/2000th of a second; even speeds up to the order of 1/50,000th of a second may well be possible. Some of these figures have been taken from a Sunpak Owner's Manual. With the reduced amount of light from the shortened flash, of course the lens aperture will have to be increased accordingly.

With some of the higher order of flash speeds obtainable, quite high speed action may be successfully photographed. In many cases, the action may appear to be completely "stopped" — so much so that it may even appear to be "faked".

For readers who have been wondering how we took the pictures which we have reproduced on these pages, here are the relevant details. The camera was loaded with Ilford Pan F film ASA50, with the camera aperture set at f5.6. A Sunpak Autozoom 2000 flash gun was set up at the front to one side, and 90cm from the subject. The light output was set to 1/16 of available output, which would give a flash duration of the order of 1/50,000 of a second. A similar and second flash gun was set up for back lighting, to the back and to one side and fired by a photo-detector "slave" unit.

The use of two flash guns is not essential, but does give more satisfying moulding of the subject and fewer shadows. The easiest way of operating the second flash gun is to use a "slave" trigger, and we hope to describe a simple unit of this type shortly to help you in this regard.

However in the meantime, why not try your hand at basic sound-triggered photography using a single gun? The scope is limited only by your imagination, and the results can be very satisfying.