Sound or light operated flash trigger has many features

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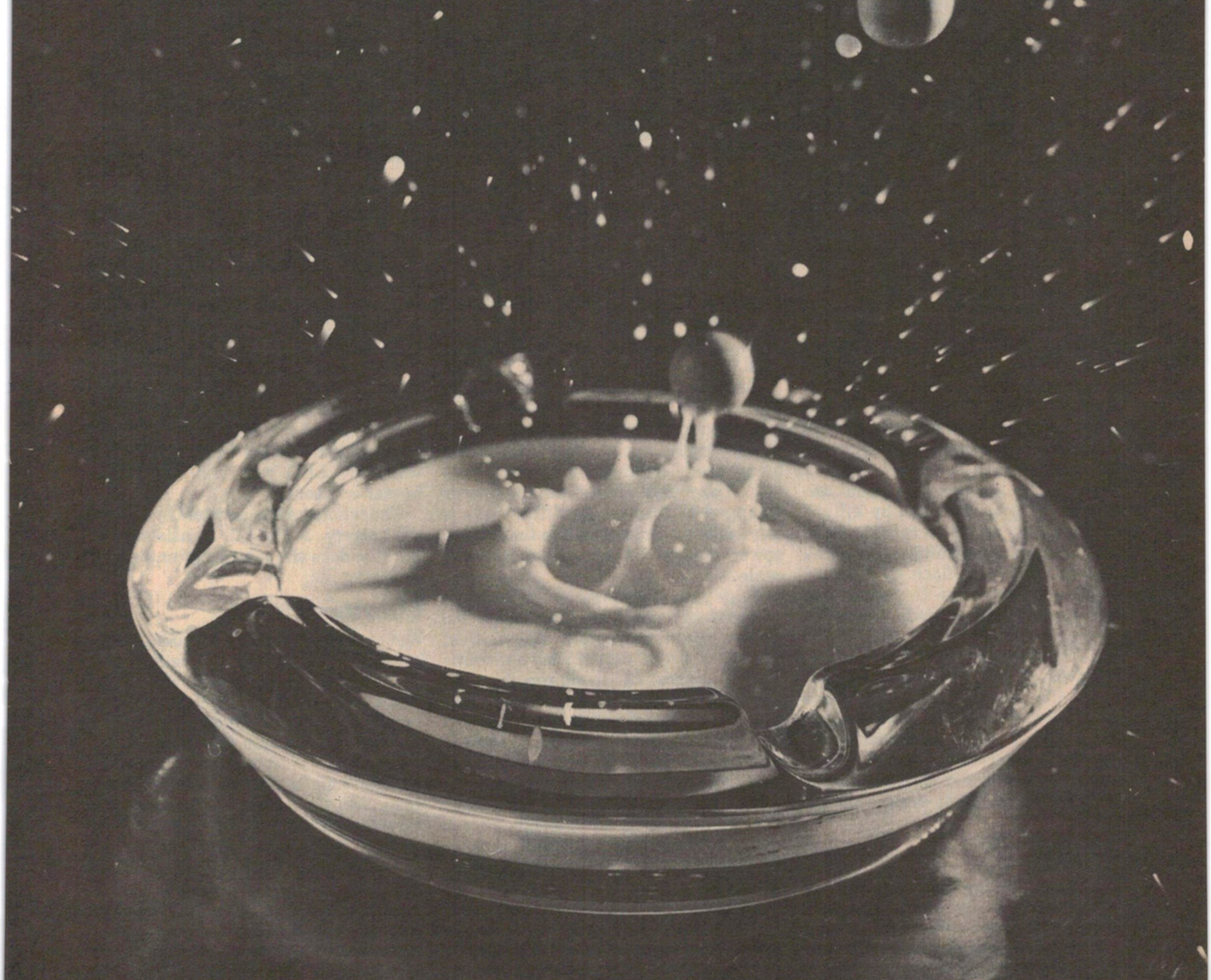
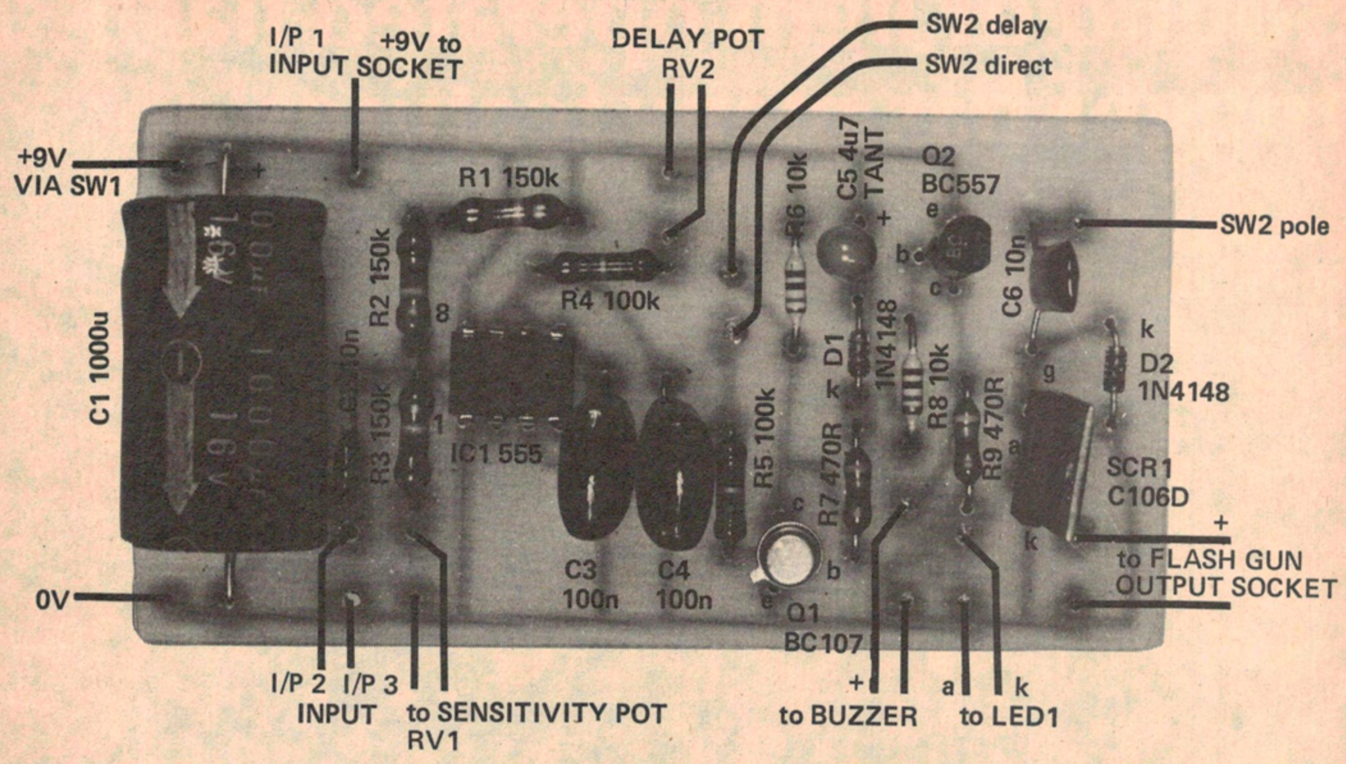
You too can take spectacular action shots just like those shown in these pages. This project is simple to build, suits any flash unit and can be triggered in a number of ways.





NOTE: Printed circuit board artwork is on page 113.

PHOTOGRAPHICALLY 'freezing' an action while it is in progress is an extraordinarily difficult task unless you can accurately time the flash to 'fire' at a particular instant during the event. This project does exactly that. You can trigger your flash from a sound, such as that produced by a bouncing ball, or by light — by having an object break a beam of light for example. You can arrange to trigger the flash by a light source turning on, or turning off. In addition, this unit permits you to *delay* the triggering of the flash by a preset amount, allowing you to 'catch' the action at differing periods after the triggering event.

The attraction of this unit is that you need no fancy equipment to take good pictures like those you see on these pages. You don't have to have a fancy SLR camera — just a simple model on which the shutter can be locked open. We haven't tried it, but with a powerful flash gun even a pinhole camera should work!

The circuit

A 555 timer IC (surprise, surprise!) is employed to provide a trigger pulse from a suitable input sensor. This can be an inexpensive crystal microphone or a phototransistor connected to trigger the 555 from a light source turning on or a light source turning off. Obviously, the unit can be used as a slave flash trigger also.

The 555 is operated in the *monostable* mode. That is, when triggered by the input signal detector it provides a single pulse output, the width of this pulse being predetermined by a preset control. The pulse output of the 555 is arranged to turn on an SCR which is connected in series with the flash gun's power supply via an interconnecting cable.

To provide a variable delay, the SCR is triggered from the *trailing* edge of the pulse output from the 555. The width of the pulse can be varied with a potentiometer control. A minimum delay of about 10 milliseconds and a maximum delay in excess of 200 milliseconds can be obtained. If you require a shorter delay, the value of R4 may be reduced, but do not use a value less than 1k.

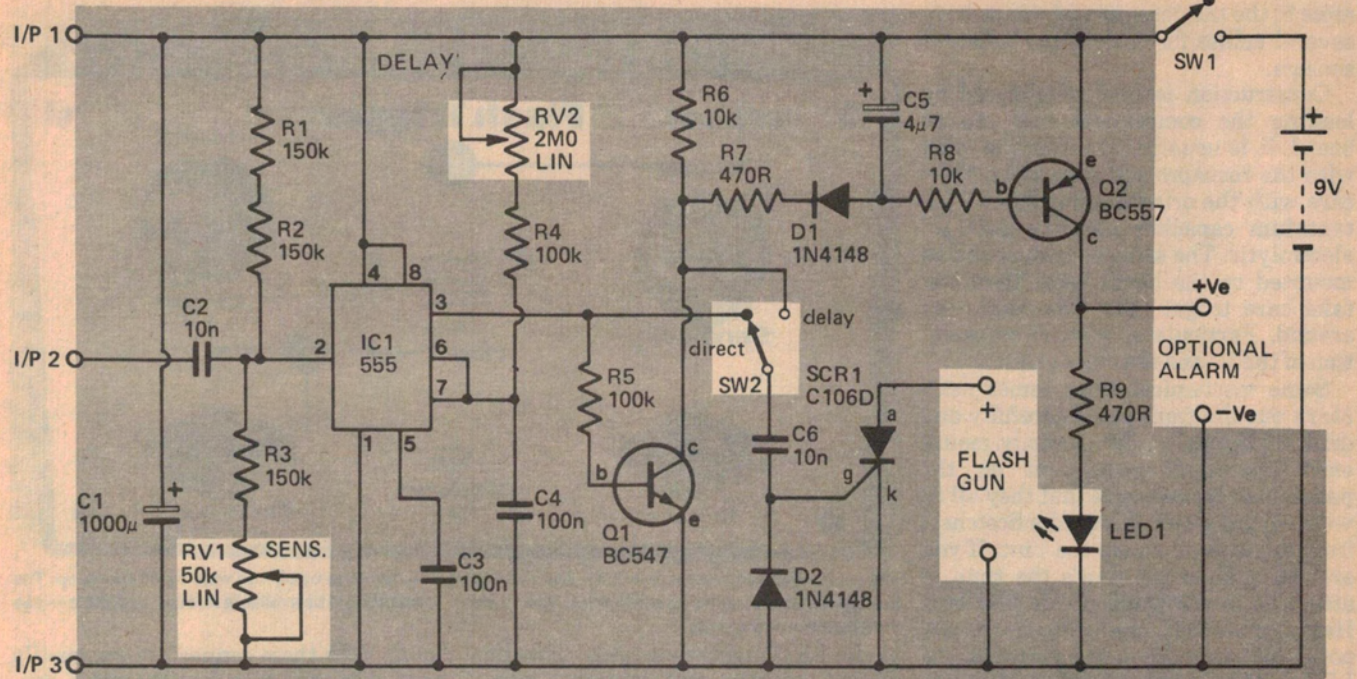
When setting up a shot, one needs some indication that the trigger unit is being correctly fired by the action, without having the flash gun 'popping' numerous times. For this reason we have included a LED on the front panel and a piezo buzzer to provide both a visual and an audible indication. The piezo buzzer is optional, but we found it handy as you can't always be involved in the action and watch the LED at the same time.

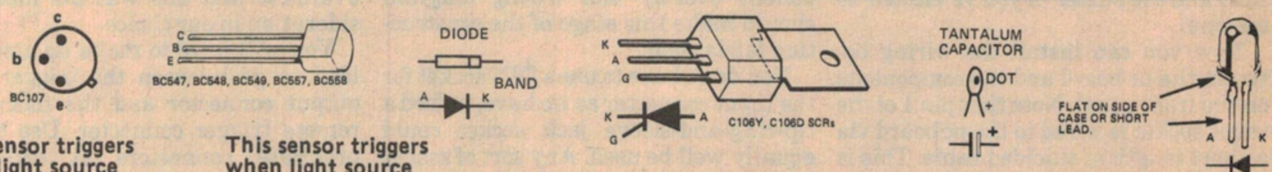
For 'rehearsals', the flash gun cable is disconnected. With everything set to go the sensitivity control on the trigger unit is set at some arbitrarily chosen level and the action initiated. If all is well, the LED will light and/or the buzzer will sound.

The whole unit is powered by a single 9V battery. A No. 216 transistor radio battery does the job nicely and should give long life.

Construction

We constructed our unit using a pc board to mount all the minor components. We recommend you use the pc board as it simplifies construction and avoids the more common wiring errors. The whole unit was assembled into a convenient 'jiffy' box measuring 160 mm long by 95 mm wide by 50 mm deep. All the major components were mounted on the aluminium front panel and wired to the pc board with hookup wire. We used a five-pin standard DIN socket for the input connector and a two-pin socket, usually used as a speaker connector, as a connector for the flash gun cable. The sensors generally need to be placed in a convenient position re- ▶

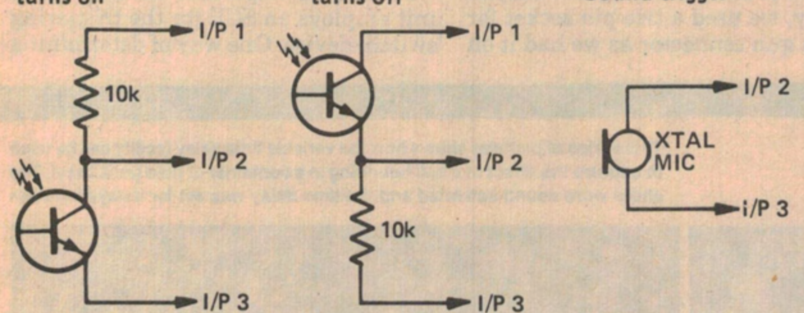




This sensor triggers when light source turns on

This sensor triggers when light source turns off

Sound trigger



Use phototransistors, type FPT100 or TIL78 or similar

HOW IT WORKS — ETI 568

IC1 is a 555 timer connected in the monostable mode. The timing period is determined by RV2, R4, C4 and is adjustable between 11ms and 230ms with the values shown. The trigger input of the chip is held just above its firing potential of one third supply voltage by adjustment of RV1 which acts as a sensitivity control. A negative-going signal is coupled to the input by capacitor C2. Note that the values of R1, 2, 3, RV1 provide a medium input impedance and screened cable may be required when the sensor must be separated from the unit.

When IC1 is 'fired', its output (pin 3) goes high for the monostable period. With SW1 switched to 'direct', this positive going pulse will fire the SCR and discharge the flash enabling the unit to be used as a slave flash. There will be a finite delay owing to rise time of phototransistor response, propagation delay within IC1 and rise time of its output. However, this will be measurable in microseconds and should be negligible.

When used in the 'delay' mode, the output pulse is inverted by Q1 causing the flash to fire on the trailing edge of the monostable pulse. To avoid repeated use of the flash when setting up the unit, indicator LED1 is provided. Each negative excursion of Q1 collector causes C5 to charge via R7, D1 effectively stretching the monostable pulse and providing a clearly visible flash.

An optional alarm, for example a solid-state buzzer, can be connected into the circuit providing audible indication of triggering.

Capacitor C1 provides overall decoupling. Supply current is about 10 mA.

PARTS LIST — ETI 568

Resistors all ¼W, 5%

R1,2,3	150k
R4,5	100k
R6,8	10k
R7,9	470R

Potentiometers

RV1	50k lin
RV2	2M lin

Capacitors

C1	1000u electrolytic
C2,6	10n polyester
C3,4	100n polyester
C5	4u7 tantalum

Semiconductors

IC1	555
Q1	BC547, BC107 etc
Q2	BC557, BC177 etc
SCR1	C106D or similar
D1,2	1N4148 or 1N914
LED1	any LED

Miscellaneous

SW	SP DT toggle switch
SW2	SP DT toggle switch

ETI-568 pc board; flash gun connector, crystal microphone with plug and socket (if used); 9V battery and battery clip; box to suit; buzzer (if required).

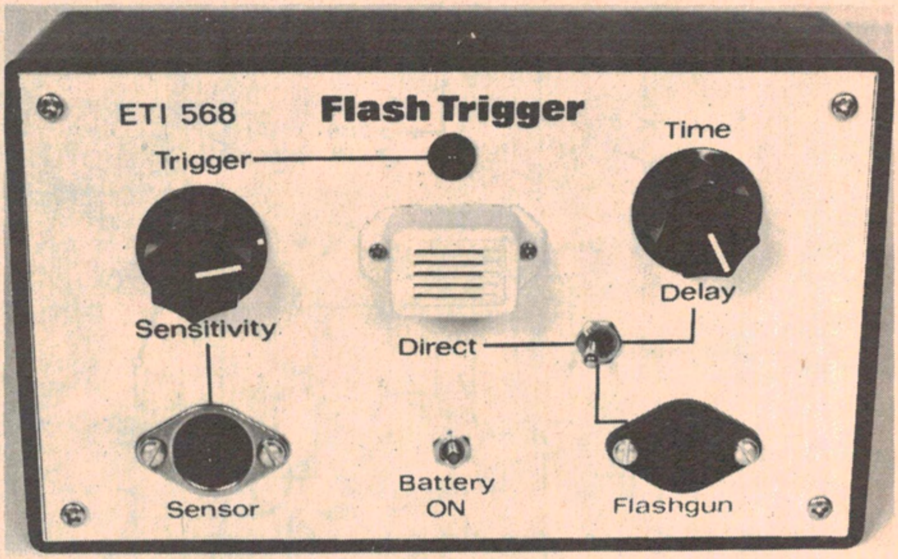
Additional Components for Light Operation:
Phototransistor FPT 100, TIL78 etc.
10k resistor.

mote to the trigger unit and we made up several cables for each of the different sensors.

Construction is best commenced by loading the components into the pc board. It is usually convenient to start with the resistors and capacitors. Take care with the orientation of the 4.7 μF tantalum capacitor and the 1000 μF electrolytic. The semiconductors can be mounted on the board next. Here too, take care to get them the right way around. Particularly watch the orientation of the IC and the two diodes.

Some mechanical work comes next. Mark out the front panel carefully and drill all the holes. Temporarily mount each individual component on the panel, just to make sure that they all fit without problems. We used a Scotchcal front panel to dress up the unit. If you are doing likewise, now's the time to attach it to the panel of the jiffy box. Having done that, finally mount the two pots, the two sockets, the switches, the LED and the buzzer (if you've elected to use one).

Now you can install the wiring between the pc board and the components on the front panel. Note that pin 1 of the input socket is wired to the pc board via a short length of shielded cable. This is to avoid pickup of stray signals, such as hum, which may cause triggering difficulties. Be careful with the connections to the LED and the two pots. The component overlay and wiring diagram should make this stage of the construction fairly clear.

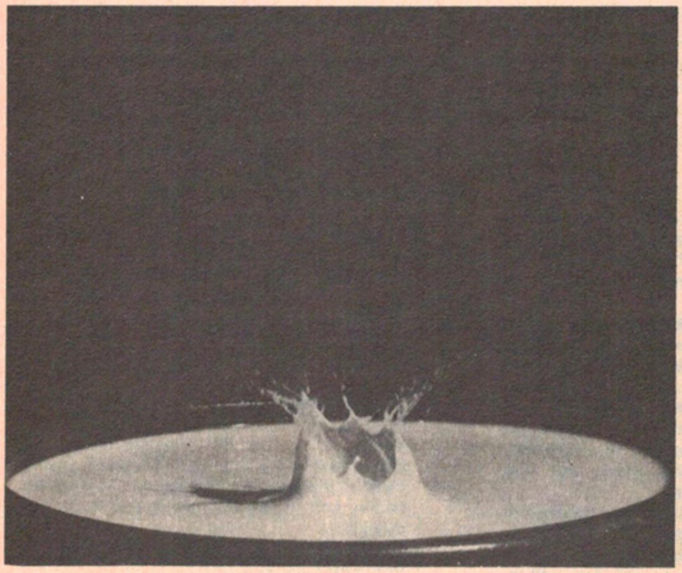


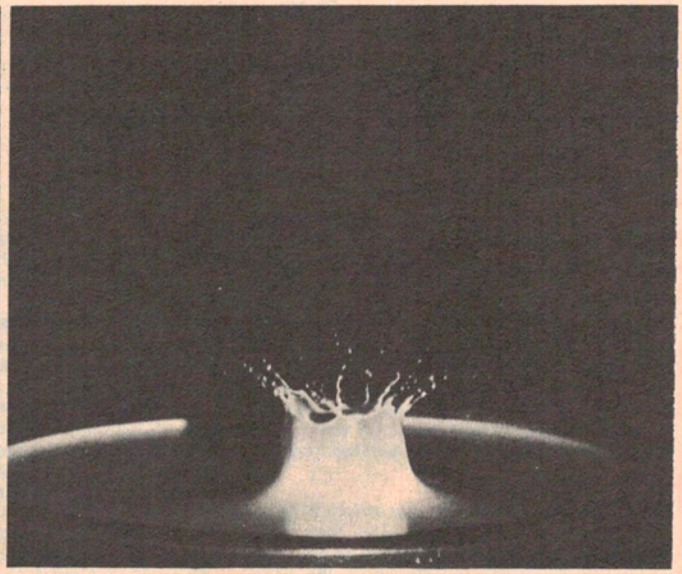
The prototype was housed in a 'jiffy' box measuring 160 mm long by 95 mm wide by 50 mm deep. The front panel was dressed up with a Scotchcal transfer. These should be available through suppliers — see Shoparound on page 65.

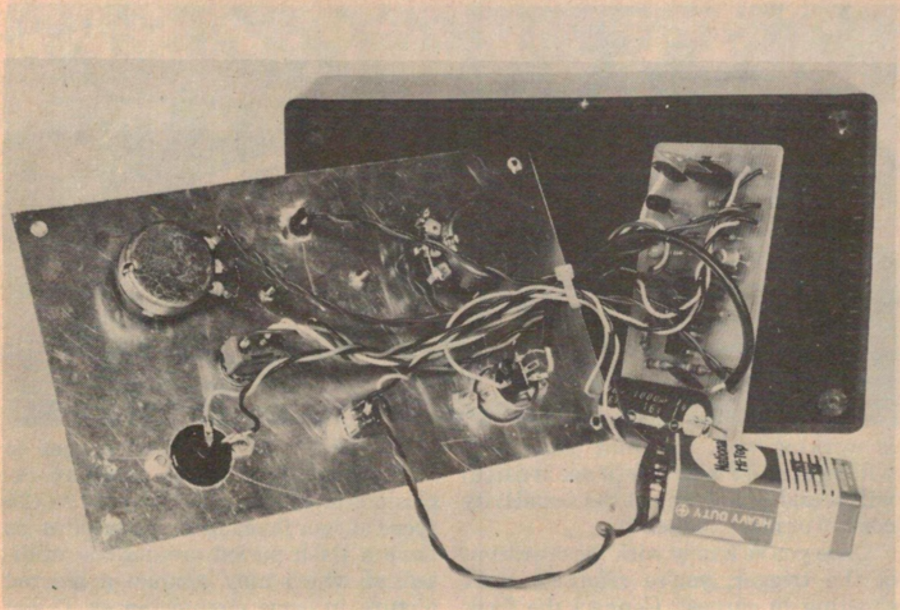
You don't have to use a DIN socket for the input connector as we have, indeed a tip-ring-and-sleeve jack socket could equally well be used. Any sort of socket having three connections will do the job. Similarly, we used a two-pin socket for the flash gun connector as we had it on hand. Both these connectors are readily available and this was the main consideration in our choice.

You will have to make up a suitable lead to go between the trigger unit's output connector and the flash gun's remote trigger connector. Use the appropriate connectors at each end. Polarity is important as the trigger unit employs an SCR for the triggering 'switch' device. One way of determining

This series of pictures shows how the variable time delay facility can be used to capture the effect of a ball bouncing in a container of fluid (milk here). The shots were sound-activated and the time delay was set for delays between







Internal view of the completed prototype. Note that wiring between I/P2 and the panel-mounted input socket is via shielded cable. Sensors should be wired with shielded leads also.

the polarity of the flash gun is to measure the voltage present at its trigger socket with a multimeter.

Sensors

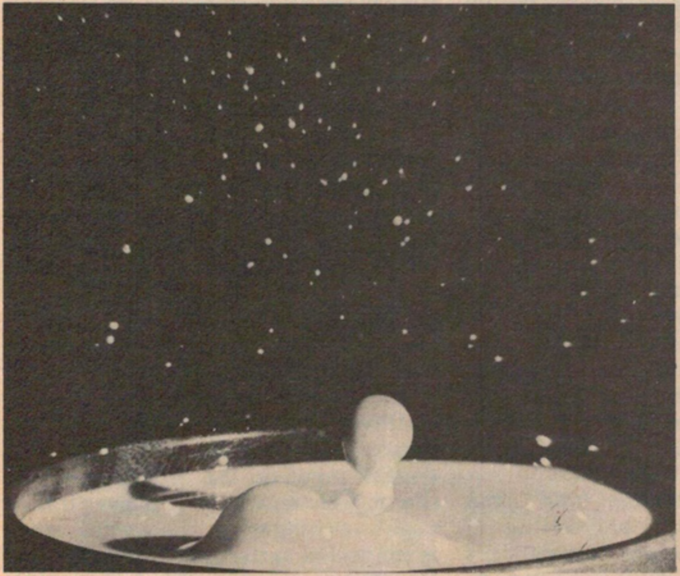
Before you can try out the unit, you will need to assemble some suitable sensors. The simplest is just a crystal microphone. We used an inexpensive 'lapel' mic and obtained excellent results. A crystal mic is recommended as it has quite a high output level. You can give the unit a 'dry run' at this stage. Set the Direct/Delay switch to Direct and the Sensitivity control to mid range and turn on. Clap your hands once and, if all is well, the LED will light and the buzzer will sound for a brief period. Set the unit to Delay and the Time control fully clockwise. Clap once more and again the LED will light following a brief delay. Experiment a little with the sensitivity control so that you get some idea of how it affects the operation.

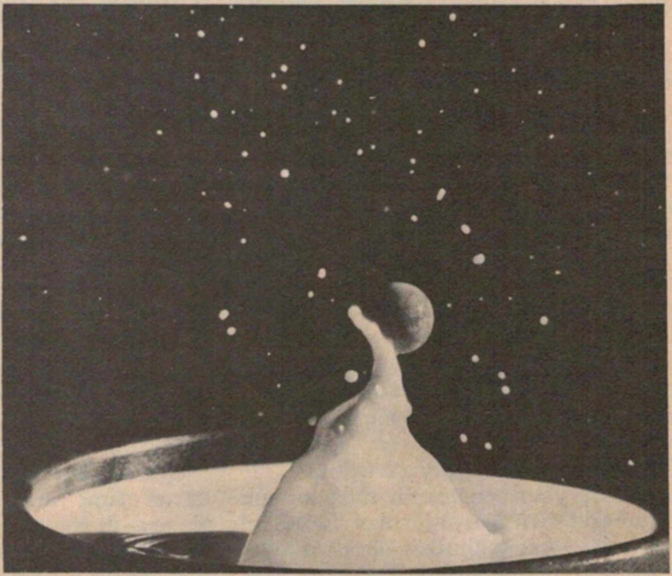
There are two ways the unit can be triggered from a light source, as we said before — by a light source turning on, or a light source turning off. The different sensor circuit configurations are given in the accompanying circuits. An inexpensive, readily available phototransistor is employed — either a Fairchild FPT100 or a TIL78 from Texas Instruments. There are many similar devices available and no difficulty should be experienced here.

The phototransistor can simply be 'hung' from the leads at the end of a cable, the other end being terminated in the input plug (which suits the input socket used). The 10k resistor may be mounted in the input plug housing. There is plenty of room in a DIN plug. If you want something a little more salubrious, the phototransistor could be inserted in a small diameter plastic tube (say, 12 mm dia.) with the 'business' end of the device flush with the end of the tube. The tube can then be filled with epoxy resin. It's advisable to have the phototransistor attached to the cable before you do this!

Microphones usually come in their own housing, so there's no need to go to any trouble with them. The lapel mics come with a handy clip, so they can be attached to any convenient support. ▶

50 milliseconds and 200 milliseconds. Similar shots could be light activated by arranging the ball to break a beam of light.





Another sensor to try out is a silicon solar cell. To use one as a sensor with this unit, you will need to obtain one of those small 'transistor radio audio transformers' — the type having a "1000 ohm" primary and an "8 ohm" secondary, or similar. It is used 'back to front' in this application. Connect the solar cell directly across the transformer's low impedance winding and connect the high impedance winding between I/P2 and I/P3. It's simple, but it's sensitive. Suitable solar cells, or solar cell pieces, are obtainable from David Reid Electronics stores, Dick Smith Electronics stores, Ellistronics, Electronic Agencies, Radio Despatch Service (all advertisers in ETI) or Amtex Electronics of P.O. Box 285, Chatswood NSW 2067.

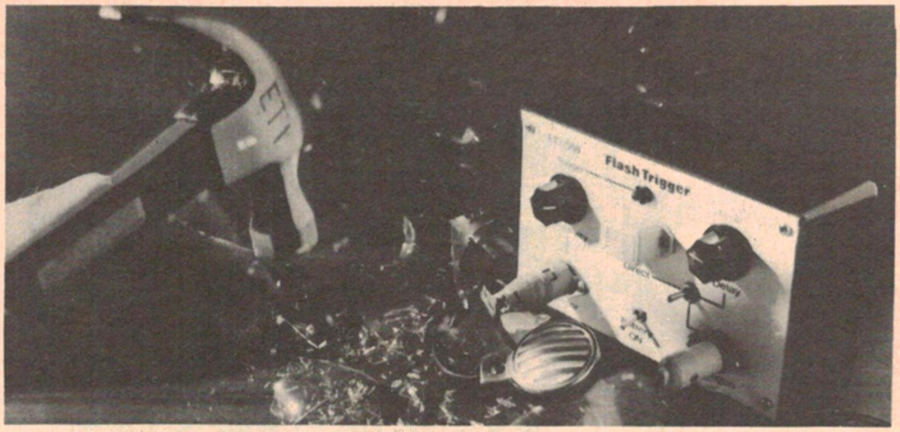
Above, a ball on the bounce. Top right, breaking a light bulb.

Using the trigger

You'll probably need a fair bit of practice before you get properly used to working with our flash trigger, but persevere — the results will be well worth it.

First of all, position the microphone or light sensor near the object to be photographed, taking care to keep it out of the camera's field of view. The sensitivity of the trigger is quite high, so it should be possible to place the sensor quite remote from the action. For scenes involving explosions or splashing liquids this is certainly advisable!

Set up your camera for the shot you want and then do a dry run of the action with the camera shutter closed and the flash gun disconnected. The purpose of this is to make sure that the trigger is being reliably fired by the action. If all



is working well, the front panel LED will light and the buzzer (if one is fitted) will sound. If not, adjust the sensitivity control or move the sensor.

Once you're happy with the operation of the trigger, you're ready to start shooting in earnest. Connect the flash gun to the trigger unit and set your camera aperture according to the exposure guide table supplied with the flash gun. Remember that the aperture setting given in the guide relates to the distance from the object being photographed to the *flash gun*, not to the camera. Take another look through the viewfinder, just to check that all the action will be in frame and neither the flash gun nor the sensor is visible.

The camera shutter cannot be triggered by the flash, so it must be set to the 'time exposure' or 'B' position. Before you open the camera shutter, make sure the room is in TOTAL darkness. Try not to trip over any of the equipment in the dark!

Open the camera shutter and set off the action, releasing the shutter button when the flash has fired. You may find a cable shutter release very useful if you don't have a friend helping you to set up the shots.

You should now have a picture, but at this stage you won't know whether or not you've captured the exact instant of the action you wanted. So set the trigger unit to give a different delay and shoot again. If your trigger is sound operated, you can get very fine control over the delay by taking advantage of the relatively slow speed of sound. Sound waves move at about 330 metres per second, so for every metre change in the object-to-microphone distance there's a 3 millisecond change in the triggering delay.

By this time you'll have spent quite a lot of time and trouble (and some money) in constructing and setting up your flash trigger, so don't be mean with film. Shoot a whole roll if necessary, to make sure of getting the one or two shots that you really want.

The ability of the flash trigger to freeze very fast action such as explosions or collisions will depend on the speed of your flash. Most camera flashes have a flash period around one millisecond which may produce a blurred picture in some circumstances. If you find your picture is blurred you will have to use a faster flash or strobe unit.

Calibrating the delay

If you wish you can use an oscilloscope to calibrate your delay control.

If you have a dual-trace oscilloscope, connect one vertical input to the sensor output and the other to the gate of the SCR. Set the oscilloscope to trigger from a positive going edge on the sensor output and the time base to 10mS per division. Switch the flash trigger to the delay mode and activate the sensor. Looking at the CRO you should see a delay between the first negative edge of the sensor output and the gate pulse. You should be able to vary the gate pulse, by rotating the delay control, from about 10 ms to 200 ms. As the trace will only sweep once for each trigger pulse, it may be difficult to see. Retriggering the sensor quickly with a flashing light will improve the visibility of the trace. Alternatively the sensor can be replaced with a low frequency pulse generator, but be careful not to have a pulse period shorter than the delay you are trying to measure. Measure the delay for each 20 degrees or so of the delay potentiometer and calibrate your scale. Our unit measured close to 11 ms minimum delay to a little over 200 ms at maximum.

The procedure for using a single trace oscilloscope is similar, except that the sensor output is fed to the external trigger input on the oscilloscope, and the trigger control set to trigger from a negative going edge. The vertical input is connected to the gate of the SCR and the sensor activated. The delay is then measured from the left hand edge of the trace to the gate pulse. ●