

### SINGLE-FLASH PHOTOGRAPHY WITH THE STROBOTAC AND THE STROBOLUX

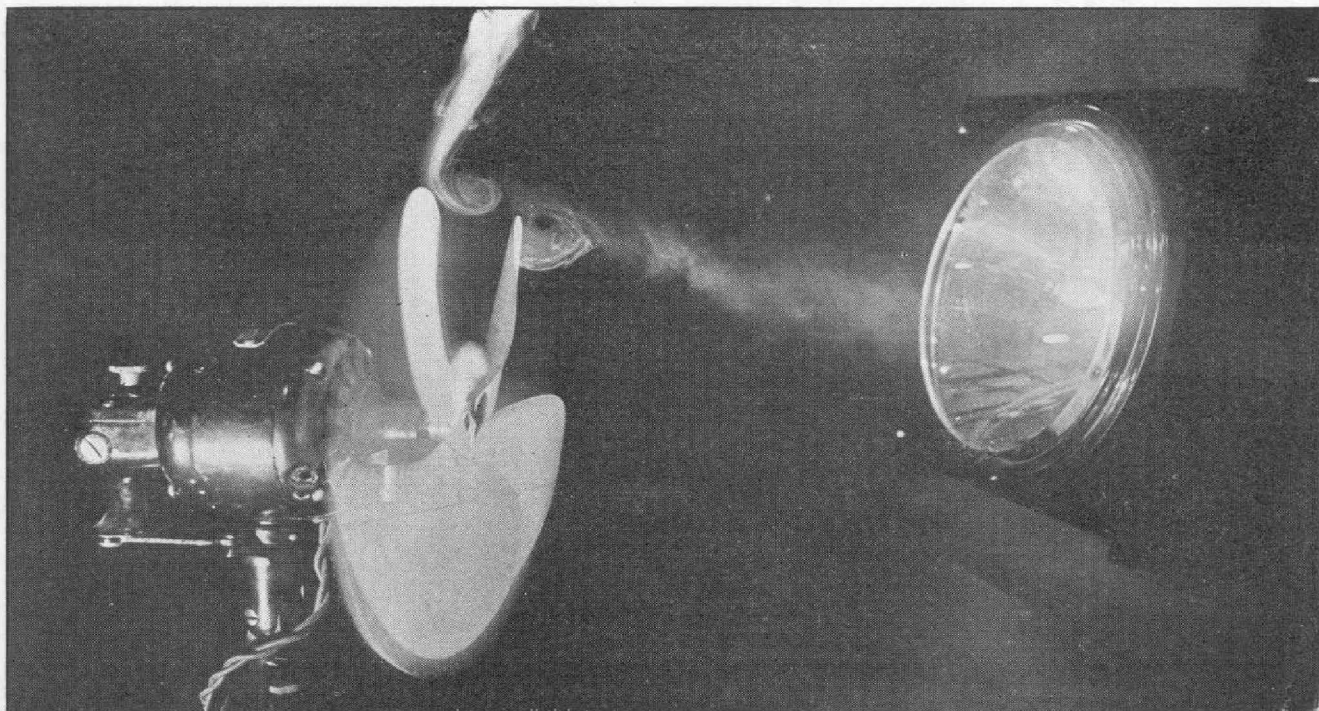
● FOR THE PAST SEVERAL YEARS the effectiveness of single-flash photographs in stopping a multitude of types of motion has been vividly demonstrated in the popular press.<sup>1</sup> Suspended action photographs of dancers, runners, tennis players, golfers and other athletes have been taken by means of the powerful single-flash equipment designed by Messrs. Edgerton, Germeshausen, and Grier of the Massachusetts Institute of Technology,<sup>2</sup> under whose license General Radio Company manufactures the Strobotac and the Strobolux.

While the Strobotac and the Strobolux are intended primarily for visual observation of mechanical phenomena, these instruments can be

<sup>1</sup>See also the collection of striking single-flash photos taken by Edgerton, Germeshausen, and Grier in the new book, *Flash*, published by Hale, Cushman, and Flint.

<sup>2</sup>Eastman Kodak Company have recently placed on the market the Kodatron Speed Lamp which is a powerful single-flash stroboscopic light designed for general photography where extremely large areas are to be illuminated.

FIGURE 1. Smoke pattern around moving fan blades. Hand synchronization: Camera is focused, shutter opened, Strobotac-Strobolux fired by hand, and the camera shutter closed.



used quite successfully for taking single-flash pictures when the area to be illuminated is relatively small. The Strobolux when used for single-flash work supplies about ten times as much light as it does when flashed continuously from the Strobotac. The duration of a single flash, however, is about 1/30,000th second.

When single-flash pictures are to be taken over an area not exceeding approximately two feet square, and when the motion to be photographed can be stopped in not over 1/30,000th second, the Strobotac and the Strobolux can be used quite satisfactorily.

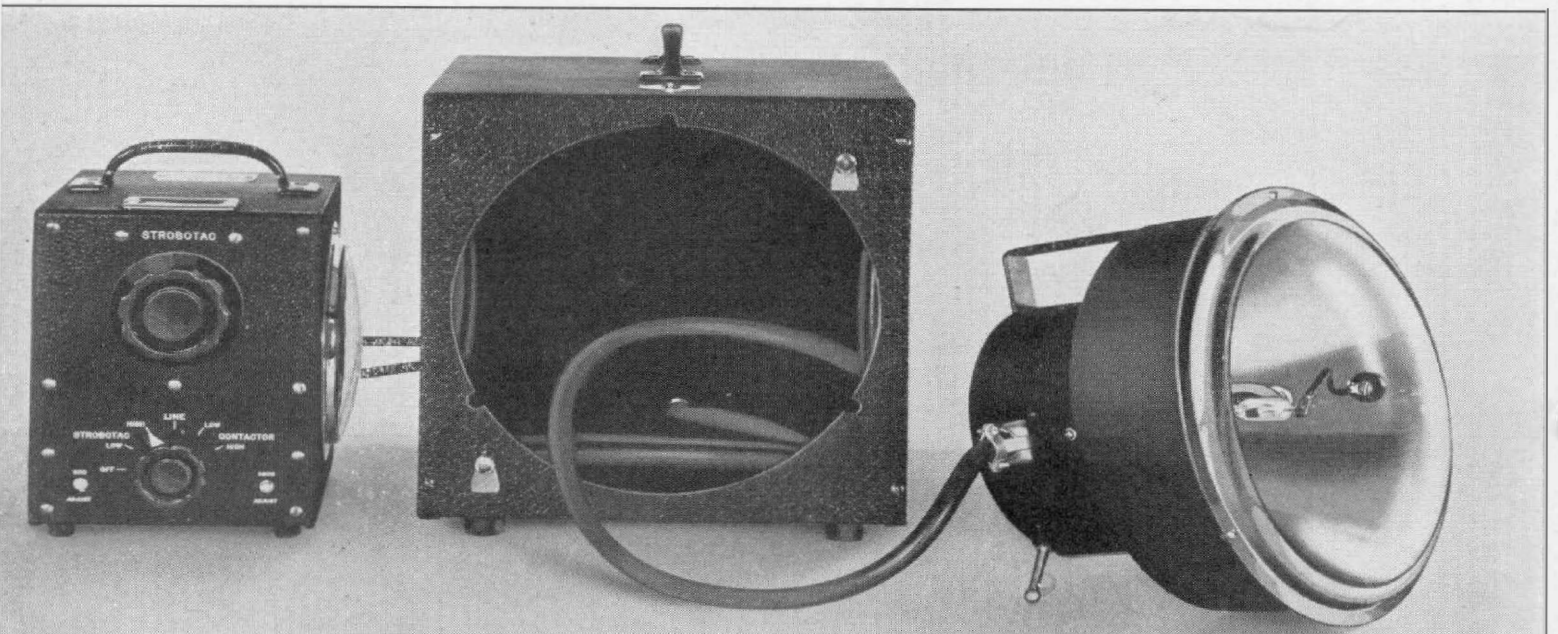
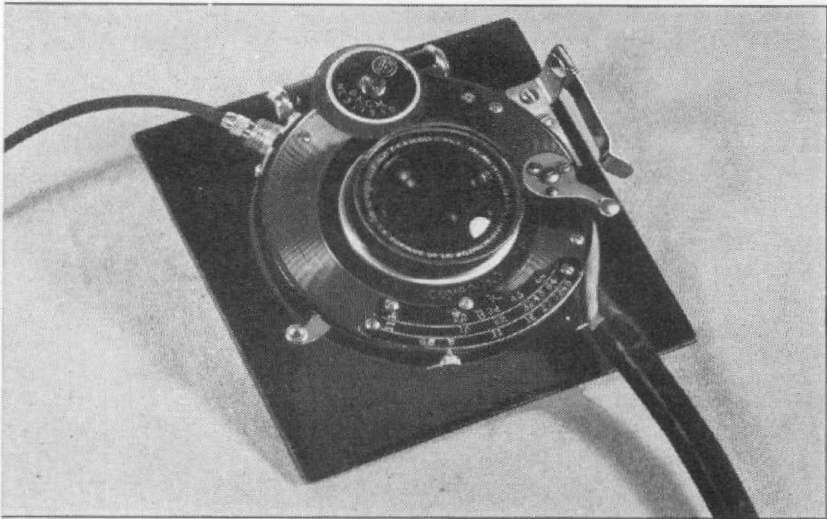
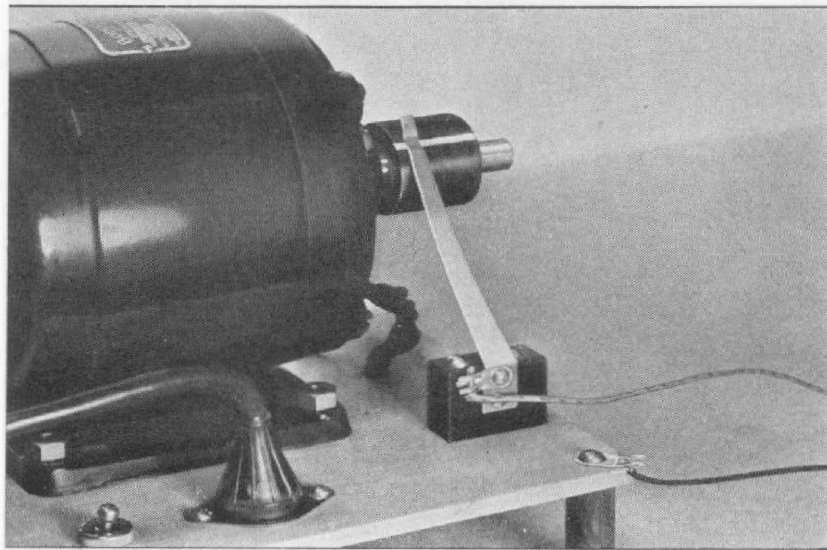
The principal problem in using the Strobotac-Strobolux for single-flash pictures is the synchronization of the flash with the opening and closing of the camera shutter. It is the purpose of this article to describe a number of synchronizing methods which have been used successfully by many persons.

The indulgence of the camera-addict reader is asked for the elementary photographic statements, since many persons with *no* photographic experience may desire to take single-flash photographs.

FIGURE 3 (left). Simple spring mechanism which fires Strobolux when shutter cocking lever is in mid-position.

FIGURE 2 (above). Make and break commutator. By shifting the position of the commutator on the shaft, the Strobolux can be fired in phase with any desired motion of the machine being photographed.

FIGURE 4 (below). TYPE 631-B Strobotac and TYPE 648-A Strobolux. The Strobolux lamp is supplied with a 10-foot extension cable and can be removed easily from its case.





## CAMERA AND LENS EQUIPMENT

The field of illumination supplied by the Strobolux is limited; accordingly, it is usually necessary to work quite close to the subject being photographed. It is also necessary to use the lens at moderately wide openings to secure sufficient exposure. For these reasons the depth of field is one of the important factors in selecting the size of camera for single-flash pictures. In general it will be advisable to use as large a film size as is compatible with the allowable depth of field in order that enlargements will not be needed to secure sufficient detail in the finished print. If the overall diffusion sometimes found in enlargements from miniature negatives is not objectionable, a small size negative (even as small as the 35 mm. motion picture size) may be used with correspondingly increased depth of field. If contact-sized prints are to be used, the upper limit in practical film size is normally about 4 x 5 inches.

With the films suggested below and with the Strobolux placed as close to the subject as possible, lens apertures

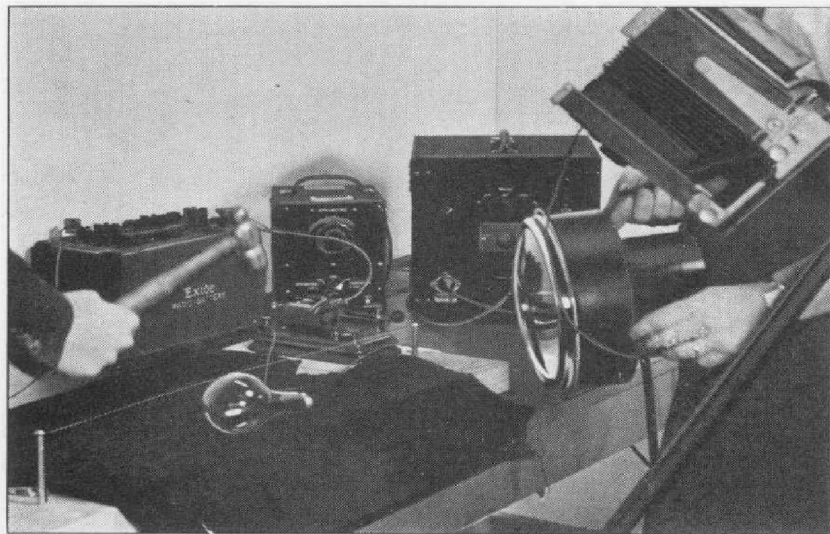


FIGURE 5 (above). Set-up for taking photograph by mechanical impact — breaking wire. The photograph is taken in semi-darkness; the hammer breaks the wire and the bulb, and fires the Strobolux.

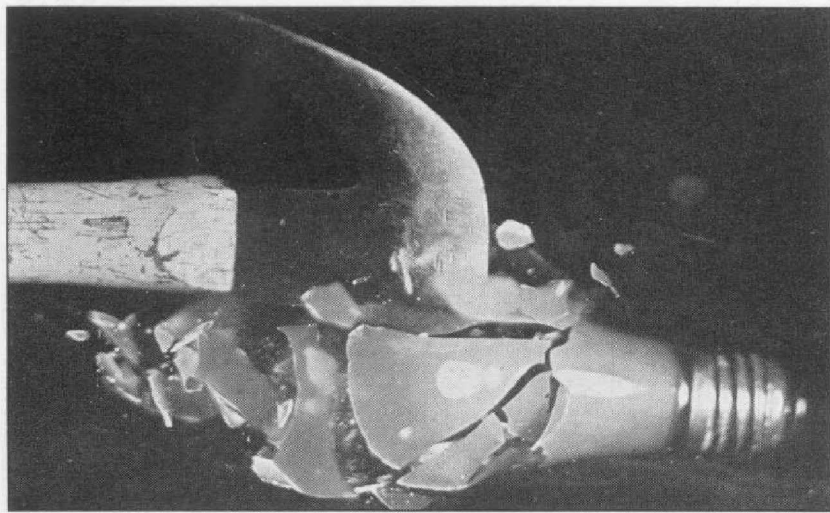
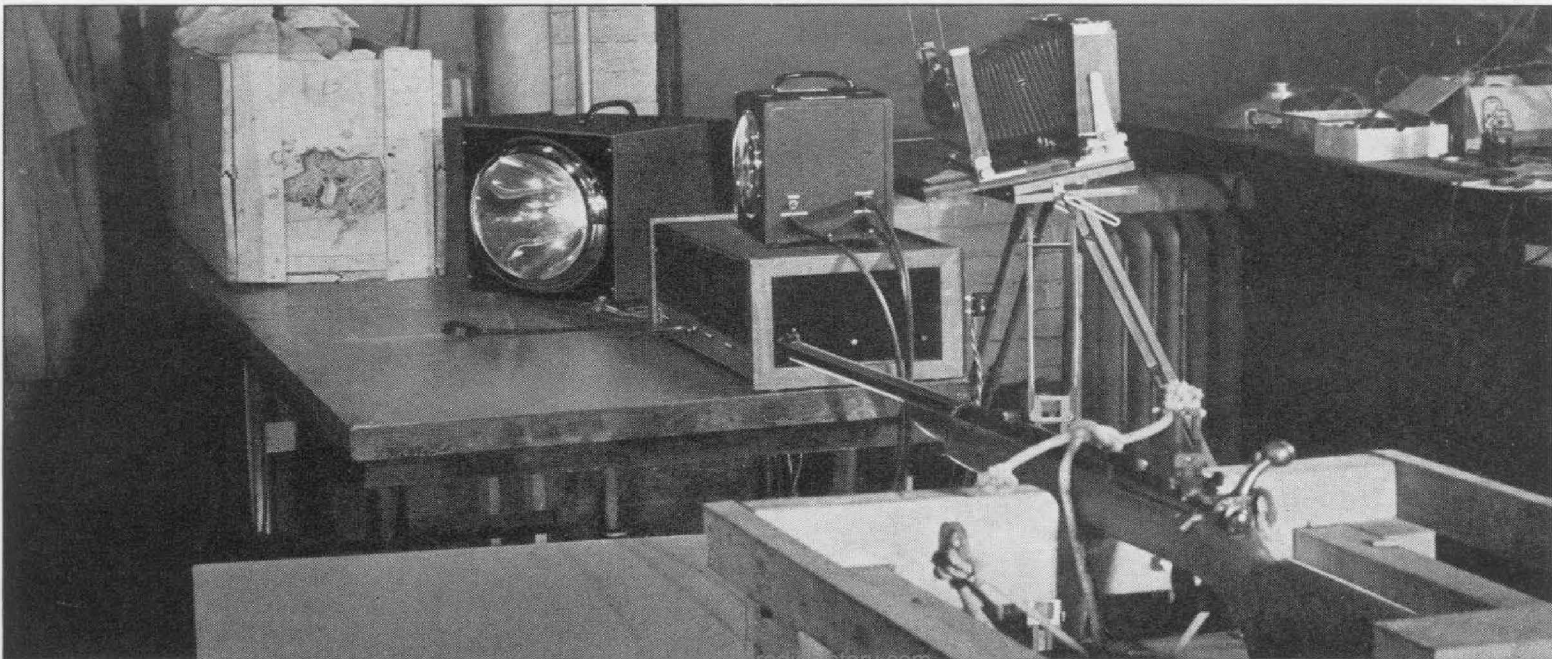


FIGURE 6 (above). Exploding electric light bulb taken with set-up shown in Figure 5.

FIGURE 7 (below). Set-up for photographing bullet breaking light bulb. The microphone on the table picks up the explosion which causes the Strobotac and Strobolux to flash. Exact timing is secured by moving the microphone.



vary between  $f/4.5$  and  $f/11$ . Any modern anastigmatic lens having this range of diaphragm openings should be satisfactory. The focal length of the lens should be normal for the film to be covered; that is, it should equal, approximately, the diagonal of the film.

### FILM

Normally only the fastest type of film should be used. The new Eastman Kodatron Panchromatic film is especially designed for use with stroboscopic light. This film is more sensitive to stroboscopic light than are Eastman Tri-X and Agfa Triple-S and it should be used when maximum sensitivity is needed. However, Tri-X, Super XX, and Agfa Superpan Press and Triple-S are satisfactory for most work. The Superpan Press should be used when the maximum contrast is desired. The Triple-S film has almost the same effective speed and is to be preferred when the subject contrast is high since this film furnishes negatives of average contrast. If the camera is equipped with cut-film holders, cut film has some advantages over roll film or film packs.

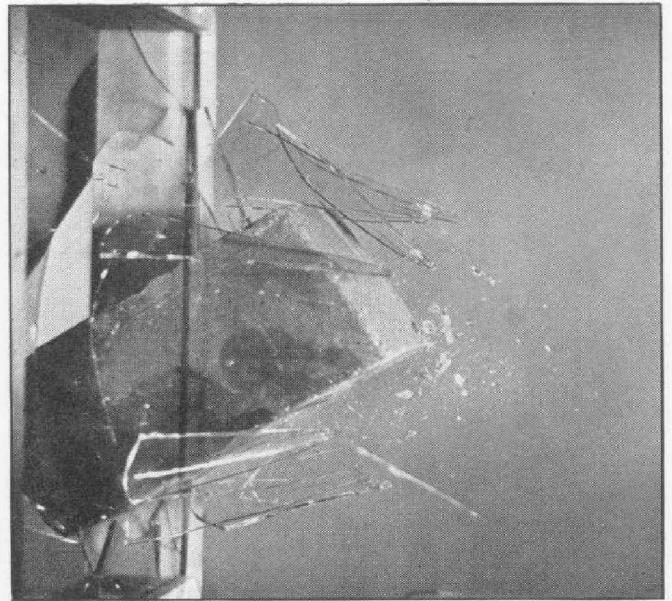


FIGURE 8. Brick breaking pane of glass. TYPE 759-A Sound-Level Meter, placed twenty-five feet away from the plate of glass, fed a TYPE 714-A Amplifier which in turn caused the Strobotac and Strobolux to flash.

### LIGHTING

For the type of small-area photography discussed in this article, usually a single Strobolux supplies sufficient light. When necessary to relieve the shadow side of a Strobolux photograph, a white cardboard reflector can be used.

### HOW TO "FIRE" THE STROBOSCOPE

Appropriate terminals and connecting cords are supplied with the Strobotac and the Strobolux so that they may be operated at single flashes. The two instruments are connected by these cords

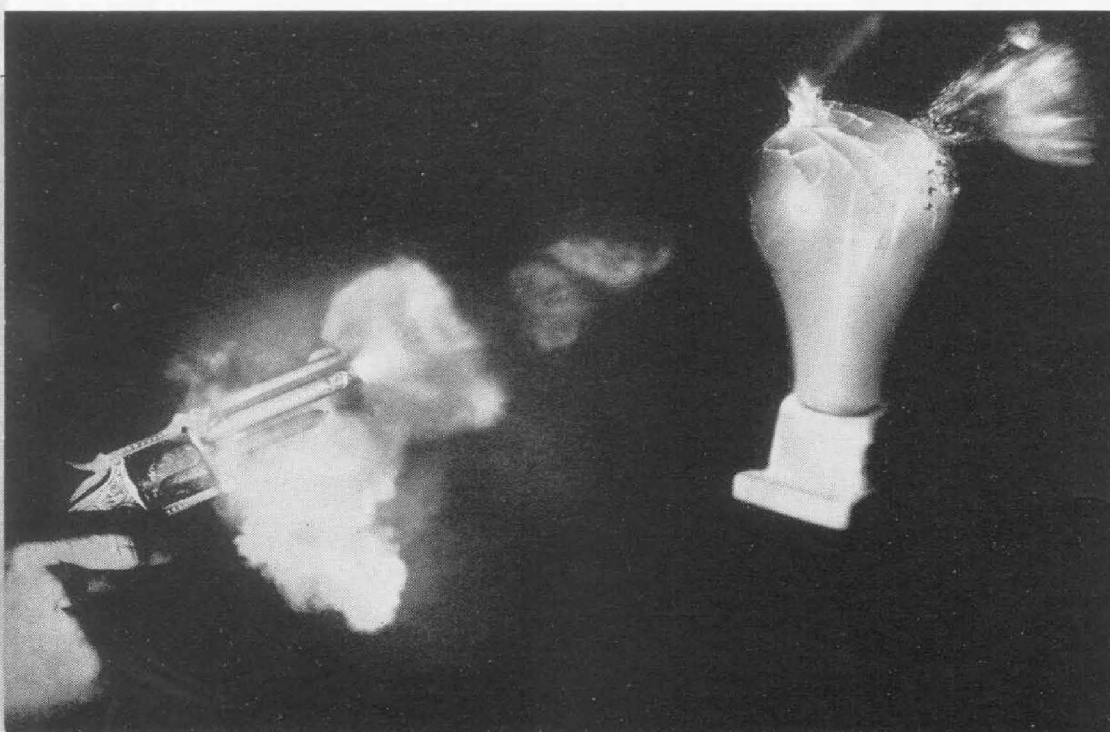


FIGURE 9. Composite photograph from two single-flash shots taken with set-up shown in Figure 7. The bullet is still inside the light bulb which has not had time to "explode."



and the plug is inserted in the CONTACTOR jack of the Strobotac. When the wires attached to the plug are short circuited, the Strobotac and the Strobolux produce a single flash. The voltages and currents present are so low that no precautions need be taken in handling the exposed ends of the wires.

The SPEEDS switch on the back of the Strobolux should be set at "slow" to secure maximum illumination at single flashes.

The exact manner in which the electrical contact, for producing the single flash, is synchronized with the opening and closing of the camera shutter will depend upon the particular problem and the ingenuity of the user. The following suggested methods of synchronism have been employed and will be adequate for many applications.

#### HAND SYNCHRONIZATION

Many mechanical applications in which the motion is cyclic can be photographed by synchronizing the flash and the exposure by hand. The subject is focused and composed on the ground glass or view finder of the camera, the camera shutter is opened, the two wires

FIGURE 11. Shuttle just emerging from shed of loom shown in Figure 10. This shuttle is thrown horizontally through the shed, for a distance of approximately five feet, 180 times a minute. The exact shape of the loop of thread from the shuttle is of considerable significance.

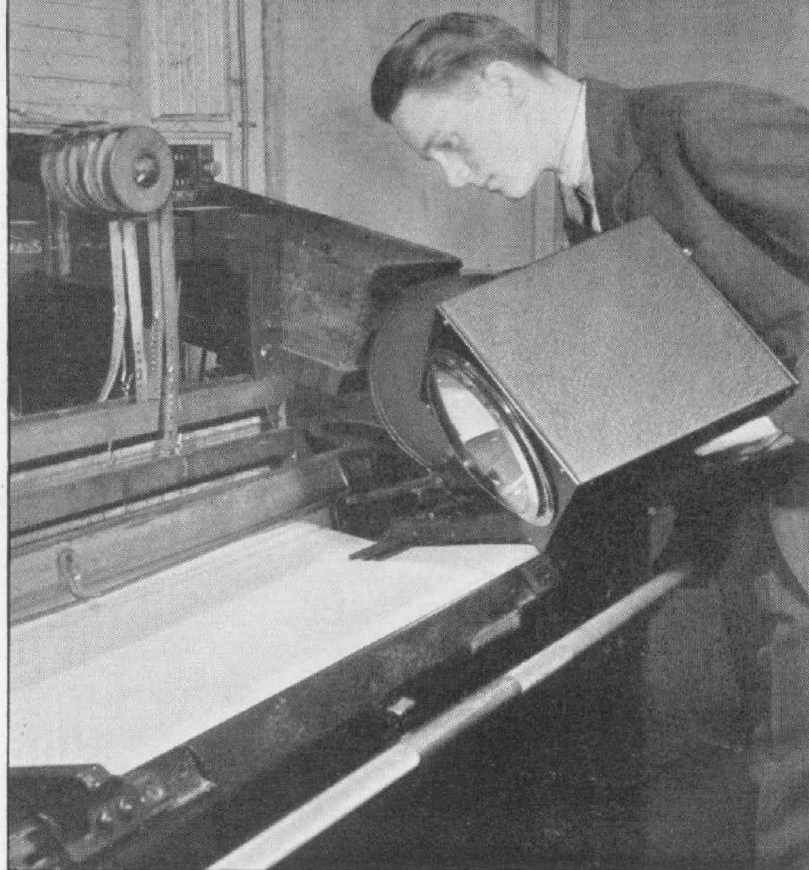
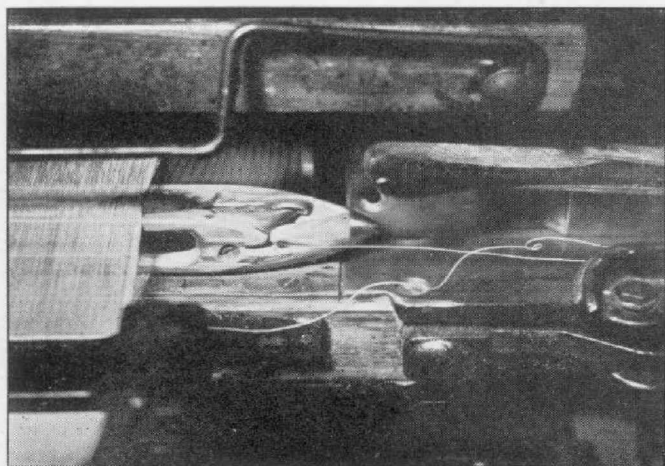


FIGURE 10. Photo courtesy Hoosac Mills, New Bedford, Mass. Experimental loom operating at 180 picks per minute. Long rod in foreground was geared to a make-break contactor so that the exact phase of flash could be set by hand.

from the Strobotac CONTACTOR plug are momentarily connected, and a single flash is obtained; the camera shutter is then closed. Operation in this fashion presupposes two conditions; first, that the exact phasing of the motion is of no importance and, secondly, that the photograph can be taken in subdued light. Since the shutter of the camera probably will be open for a considerable time, and since the film used is very fast, it is difficult to avoid fogging of the film from any outside light which may be present. This type of synchronization is satisfactory in a large number of instances when the exact timing of the flash is not important.

#### ELECTRICALLY SYNCHRONIZED SHUTTER

It is quite easy to arrange a mechanical synchronizer on any type of Compur shutter so that the Strobolux flashes

only when the shutter release is operated. A simple spring arrangement is attached to the lens board so that when the shutter cocking lever passes its approximate mid-position, electrical contact between the spring and the lever will be made while the shutter is open. Connection is made to the spring and to the metallic case of the shutter itself. The shutter should be set for some speed between 1/100th and 1/300th of a second.

To synchronize the shutter with the flash it is merely necessary to remove the ground glass and to look through the lens when the camera is pointed toward the Strobolux and release the shutter. If light is seen through the entire lens, synchronization is correct. Any light which reaches the ground glass should be the full flash. If the contacts are not synchronized, rotate the shutter in the mount until the contactor fires the Strobolux at the proper time.

With this type of synchronization the equipment can be operated in any room light that is not sufficiently strong to be photographically objectionable for any ordinary exposure at shutter speeds from 1/100th to 1/300th of a second.

## MECHANICAL CONTACTOR ON MOVING SHAFT OR PART

Many applications require exact synchronization between a sequence in a mechanical operation and the exposure. Usually it is possible to fit a simple make-break contactor on a rotating shaft or moving part. By adjusting the position of the contactor the exact moment of flash can be phased accurately with the desired motion. To avoid more than one exposure it is necessary to place a quick acting switch in the single-flash contactor circuit so that this circuit can be opened by hand as soon as one flash has been obtained, unless the subject to be photographed has repetitive motion that will permit a series of flashes as often as the motion repeats itself.

In taking photographs with this type of contactor it is, of course, necessary that the equipment be operated in subdued light since the camera shutter must be operated by hand and is open materially longer than is required for the flash exposure alone.

## MECHANICAL IMPACT — DIRECT ELECTRICAL CONTACT

A number of trick photographs, such as the shattering of a glass container full of liquid, can be taken by causing the impact between the falling object and two metallic plates upon which it falls to make the electrical contact

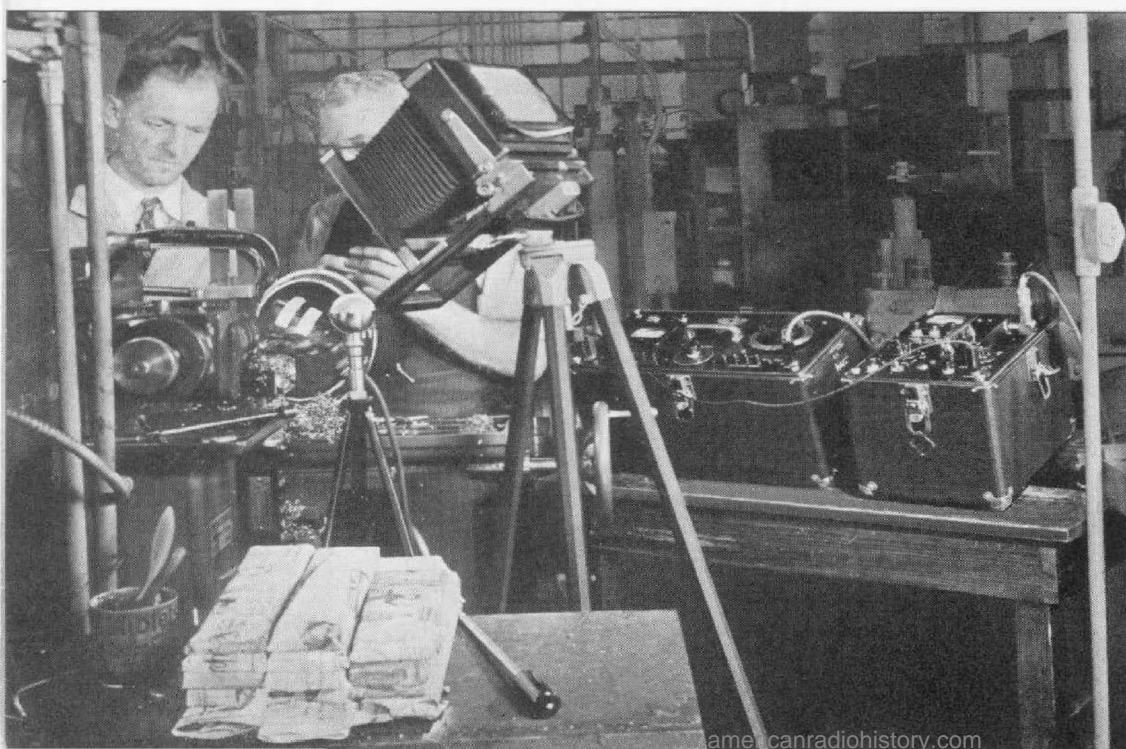


FIGURE 12. Set-up for taking photographs with TYPE 759-A Sound-Level Meter, TYPE 760-A Sound Analyzer, TYPE 631-B Strobotac, and TYPE 648-A Strobolux. The camera shutter is opened and closed by hand; the Strobolux is flashed at any particular frequency of sound selected by the Sound Analyzer.

for the single flash. More practical applications of this simple system are apparent in specific problems.

Two metallic plates are separated by means of crumpled pieces of paper between their corners. A wire is lead from each plate to the CONTACTOR terminals of the Strobotac, and the falling object causes the two plates to make electrical contact and flash the Strobolux. The camera shutter, of course, is opened before the object falls and is closed immediately after the flash. By varying the thickness and size of the paper separating the plates, the phasing of the synchronization can be changed to time the flash to almost any moment desired.

It is usually advisable to cover the plates with a piece of cloth or paper of a color contrasting strongly with the color of the object being photographed.

#### MECHANICAL IMPACT — BREAKING WIRE

In many cases synchronization can be obtained by stretching a very fine wire across the path of the moving body that is to be photographed. A simple open-circuited telegraph relay is connected to the wire through a battery. When the wire is broken the contacts on the relay close. The CONTACTOR wires from the Strobotac are connected to the contacts on the telegraph relay. The sequence is: the camera shutter is opened by hand; the moving object breaks the fine wire, which interrupts the battery voltage on the telegraph relay; the con-

tacts on the relay close; the Strobolux flashes, and the camera shutter is closed by hand. The proper timing can be obtained experimentally in several ways. The physical position of the wire along the path of the moving object can be changed; the tension on the wire can be adjusted so that the wire will break at different times; the pull on the armature of the electromagnet on the telegraph relay can be adjusted over a considerable range; and the total throw of the armature and its contacts can be lengthened or shortened.

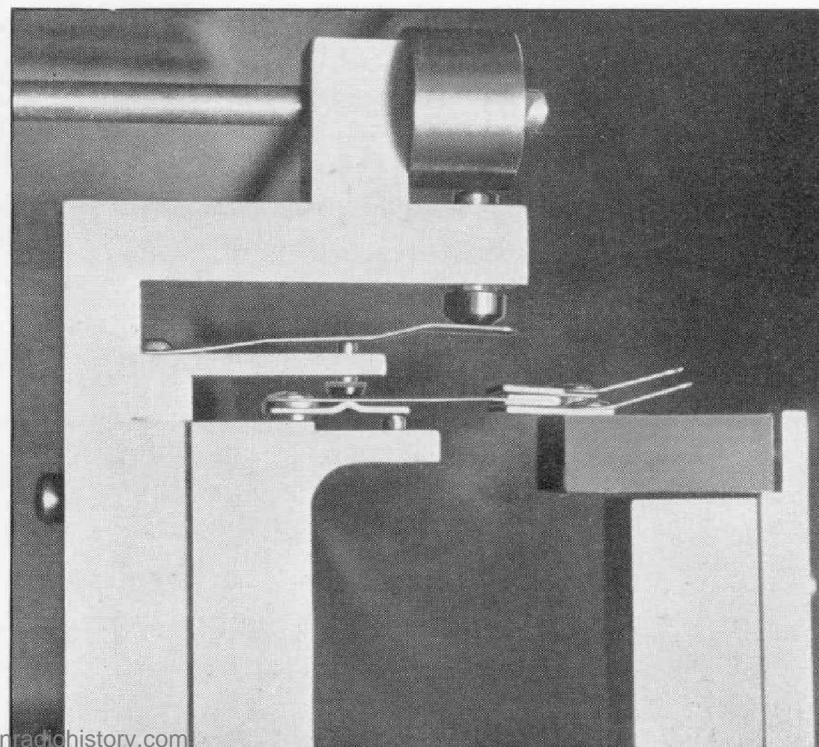
#### ELECTRICAL SYNCHRONIZATION — MICROPHONE

If the mechanical phenomenon to be photographed is accompanied by sound, it is possible to fire the Strobolux in a number of ways with a microphone and an amplifier. Several combinations of microphone pickup and associated equipment are possible; their selection will depend upon the particular application.

#### MICROPHONE AND AMPLIFIER

Since the output of most microphones is not great enough to trip the Strobo-

FIGURE 13. Photo courtesy Mu Switch Corporation, Canton, Mass. Another example of the hundreds of practical mechanical applications of single-flash photography. This set-up photograph was used by the Mu Switch Corporation to determine that their switches, once tripped, traversed the distance between contacts; that there were no intermediate positions of equilibrium. A motor-driven cam (at top of photograph) operated the switch and flashed the Strobolux.





tac directly, it is necessary to connect an amplifier between the microphone and the Strobotac. In many applications the General Radio TYPE 714-A Amplifier has been used successfully.

Through a long flexible cord, the microphone is connected to the input terminals of the amplifier, the output of which is connected to the CONTACTOR terminals on the Strobotac. Whenever a sufficiently strong sound wave strikes the microphone, the Strobolux flashes. Synchronization between the mechanism creating the sound and the flash is obtained by shifting the relative position of the microphone and the subject. Considerable delay between the sound and the single flash can be obtained in this manner.

When sequence photographs of repetitive operations are desired, the sequence can be obtained generally by shifting the position of the microphone between each exposure (and flash) on either a single film or on a series of films.

#### **MICROPHONE AND SOUND-LEVEL METER**

Use of the General Radio TYPE 759-B Sound-Level Meter and TYPE 760-A Sound Analyzer permits unusually effective single-flash photography when the subject to be photographed generates a sound wave of complex form. The sound is picked up by the Sound-Level Meter and the appropriate frequency component is selected by the Sound Analyzer which then fires the Strobolux only when sound of this particular frequency is present. Many applications

of this type are obvious. This method is the only one possible for obtaining single-flash photographs of certain types of machine operations which produce a sound wave of complex form.

#### **PHOTOELECTRIC CELL**

If the subject to be photographed can be made to interrupt the beam of light between a photoelectric cell and an amplifier, these instruments can be used successfully to take single-flash pictures. Synchronization between the moving subject and the single flash is obtained by varying the distance between the subject and its position when it interrupts the beam. As the output from photoelectric cells is quite small, an amplifier is required to build up a sufficient voltage to operate the Strobotac.

#### **DARKROOM MANIPULATIONS**

The darkroom procedure in handling single-flash pictures differs only slightly from the normal photographic practice. As the illumination from the Strobolux is generally quite low and as most users employ only a single unit with correspondingly low light contrasts on the subject, the developing formula used for films should be of the maximum contrast type. Developers ordinarily used for positive motion picture film build up contrast quite satisfactorily. An increase of 50% to 100% in development time is also recommended for increasing the contrast.

Correspondingly, in a number of cases the contact or enlarging paper from which prints are made should be of maximum contrast grade.

— JOHN M. CLAYTON

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