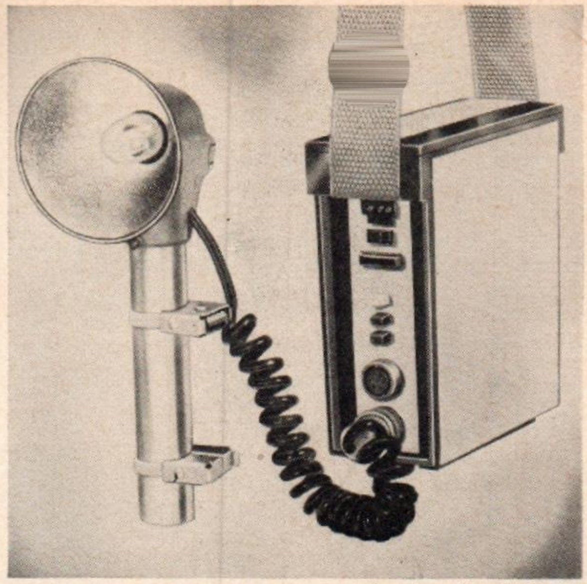
E. Leitz, Inc.
The Braun Hobby Automatic EF-3.



American Speedlight Co.
The Ascorlight A423.

INSIDE THE ELECTRONIC PHOTOFLASH

Photoflash repairs can be business builders. Don't pass up work on these simple electronic circuits.

By C. L. HENRY

THE electronic service technician who limits his servicing to TV and radio sets is passing up a substantial amount of business. Electronics is invading new fields rapidly, and more equipment requires servicing than ever before. A good example of this is in the field of amateur and professional photography.

More than one-fifth of the amateurs and almost all professional photographers have electronic photoflash equipment. The latest photography directory lists 31 manufacturers of such equipment, each having from 2 to 16 models. All photoflash units contain at least one large electrolytic energy-storage capacitor, batteries, several resistors, a flash tube, switches, several cords and connectors. Many units are more elaborate, using dc-to-dc converters consisting of transistor oscillators, silicon rectifiers, power monitoring circuits, battery recharging and thyratron triggering circuits. As you can see, this is a fertile field for electronic servicing. Though modern photoflash units are complex, the circuitry is usually easy to understand. Fig. 1 shows the basic circuit used in all photoflash units. C1 is charged to its rated voltage through R1. The time it takes to charge C1 to 63% of capacity is $T = RC$, the old familiar time constant formula. This is what photographers refer to when they speak of recycle time, although a slightly longer interval is usually allowed to permit the capacitor to charge to more than 80% of its rated voltage. Most photoflash units recycle in 5 to 20 seconds, depending on their power supplies.

One formula that may be unfamiliar to you is E (energy) equals ½C (microfarads) times V (kilovolts) squared ($E = \frac{1}{2}CV^2$). This tells us that the energy in the capacitor depends on the capacitance and the square of the voltage. For instance, in Fig. 1, with 450 volts applied to a 1,000-μf capacitor

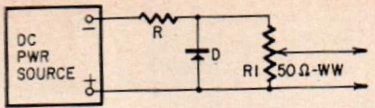


Fig. 3—Voltage drop across a silicon diode rectifier makes a good regulated power supply for the transmitter. Adjust R for 100-ma through the diode.

diode (such as the Sarkes Tarzian M500 or International Rectifier SD-94) is approximately 0.6 volt. If a battery charger is used, a filter capacitor may be required across the diode or charger output to reduce the ripple. A suitable circuit for the silicon-diode regulated power supply is shown in Fig. 3.

Adjustment and operation

Connect a few feet of wire to the antenna terminal and place this lead near the receiver. Tune the receiver to the crystal frequency and advance the potentiometer until you hear the signal beat with the receiver bfo. Just as oscillation starts, or (as the potentiometer is advanced) ceases, the note will be ragged and rough. Between these two points it will be clean and pleasant-sounding and remarkably free from chirp. If the solar cell is used to power the oscillator, a slight change in frequency will be noted as the strength of the sunlight varies, but this effect is not objectionable. Of course, if the sun goes behind a cloud (or is otherwise obscured), oscillation may cease. At these times the potentiometer may have to be readjusted.

Excessive current through the tunnel diode may ruin it and readers are warned against connecting the transmitter to a higher voltage source than that recommended unless a silicon rectifier is used to hold the voltage constant. Always turn the potentiometer to the voltage-off position before applying power to the diode. Then, depress the key and advance the potentiometer slowly until the oscillator starts. (The key is inserted in the line between C1 and the arm of R1.)

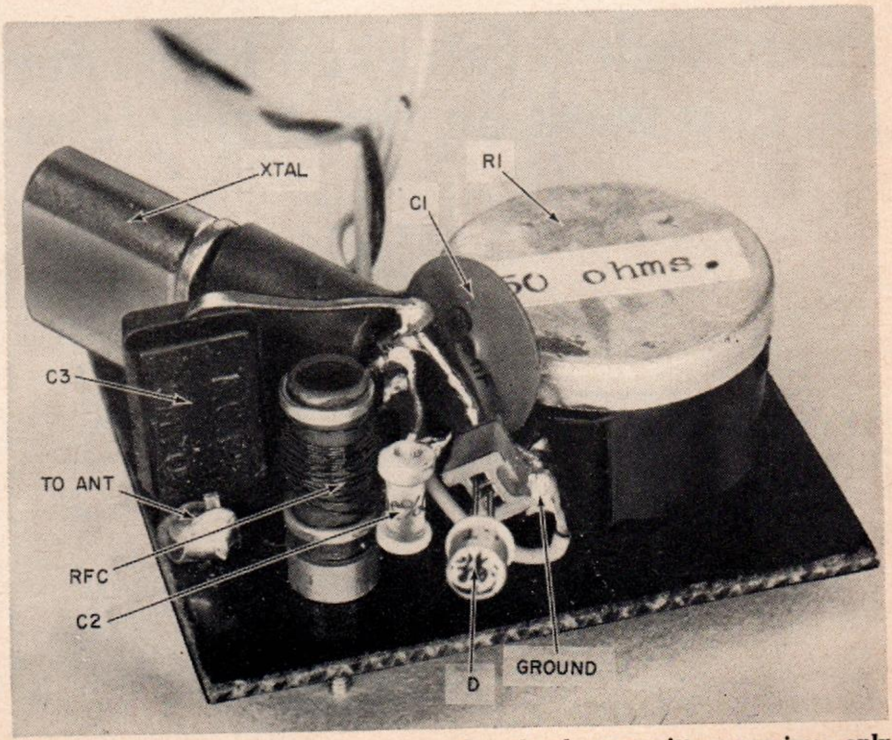
It is an excellent idea to check diode current with a 0-to-10 ma meter connected between the arm of the potentiometer and the .005-μf capacitor (C1). As the potentiometer is turned up you will see the meter pop up to a reading of less than 1 ma. If the potentiometer is increased further, the meter will jump another step. If the voltage is increased beyond this point, the diode may be damaged! If the potentiometer is reduced, the meter will suddenly drop to the intermediate point and then to the starting current. **The middle step is the correct operating point for the diode.** By observing the meter and listening to the receiver, you should have no trouble getting the transmitter to work.

It was interesting to note that, with only a 3-foot length of wire connected to the antenna terminal, the oscillator was heard on a communications receiver more than 300 yards away. The strength of the signal indicated that much greater distances were possible.

To see if the tunnel diode was actually a useful communication device, rather than a laboratory curiosity, I arranged to have a fellow New Zealand ham (ZL1AOF, some 160 airline miles distant) listen for the signals. Initial tests were very discouraging—not a peep could be heard. Next the transmitter was used to drive a 6BQ5 amplifier. Amateur radio ZL1AOF discovered he had been listening on the wrong frequency as soon as he picked up the "high-power" CW transmitter excited by the tunnel diode oscillator. Once again the tunnel diode transmitter was connected directly to the antenna. This time the signals were received with amazing clarity. A tape recording of Jack's reception, along with a card confirming the contact, attest to the performance of the transmitter.

If actual contacts are desired, rather than experiments, an 80-meter antenna must be connected to the tunnel diode, as shown in Fig. 1. A good earth ground is also absolutely essential to duplicate the author's successful contact. [Apparently ZL1AAX has never tried a good counterpoise?—*Editor*] Some antennas may pull the diode out of oscillation and, if this happens, the value of C3 (nominally 500 $\mu\mu$f) should be reduced until oscillation starts. For best results adjust the potentiometer with the antenna connected to the transmitter. END

Fig. 4—Original QSL confirming 160-mile contact using tunnel-diode transmitter.



Completed transmitter requires only antenna, ground and power source.

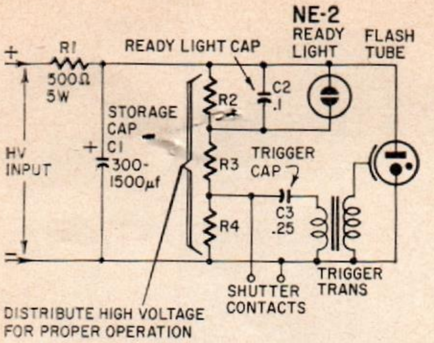


Fig. 1—Basic electronic flash circuit.

(C1), a total of 100 watt-seconds will be available when the capacitor is discharged. If this discharge takes place in .001 second through the gas tube, the circuit, in that instant, is carrying 100,000 watts. Incidentally, 100,000 watts developed in your screwdriver blade will probably melt it and will surely ruin the electrolytic capacitor. Always discharge these large capacitors through a resistor of 500 to 1,000 ohms.

Capacitor C1 is a special electrolytic, not only because of its high capacitance, but also because of its very low leakage current. Typical leakage resistance on a good capacitor will average 10 megohms. This type capacitor must be carefully re-formed after any idle period of 2 months or more. The voltage applied should be raised slowly over a period of minutes until the rated voltage is reached. It must never be exceeded. These capacitors are also expensive ($13.50 is typical) so be careful.

The balance of the circuit is composed of three parts: the flash tube, the ready light and the triggering circuit.

Flash tube

This is a xenon-filled tube made of either fused quartz or high-grade Pyrex. It presents a dynamic resistance, when triggered, of from 0.1 to 5 ohms depending on the type tube, and may draw an instantaneous current of 1,000 amperes. The circuit of the flash tube should be of very low resistance to prevent limiting this current. This means that all connectors must be clean and tight, and the wiring must be adequate. The spectra of these flash tubes approaches daylight, with much infrared and ultraviolet included.

The triggering circuit is composed of a trigger transformer which fires the tube by developing about 10,000 volts on its secondary, which is applied to the flash-tube trigger electrode. It should be as close to the flash tube as possible, preferably inside the envelope. C3 supplies the power for this triggering circuit by being charged to 200 volts and discharging through the primary of the trigger transformer when the shutter contacts on the camera close. An oscilloscope with a triggered sweep is very useful in checking the various instantaneous currents and voltages developed in these circuits.

Ready light

The last part of the typical flash unit is the ready light. This is an indicator that tells the photographer when the capacitor is charged to at least 80% and ready to fire. After the flash tube is fired, the neon lamp will glow steadily until the capacitor is recharged. Then it will start blinking at a rate determined by R3 and C2.

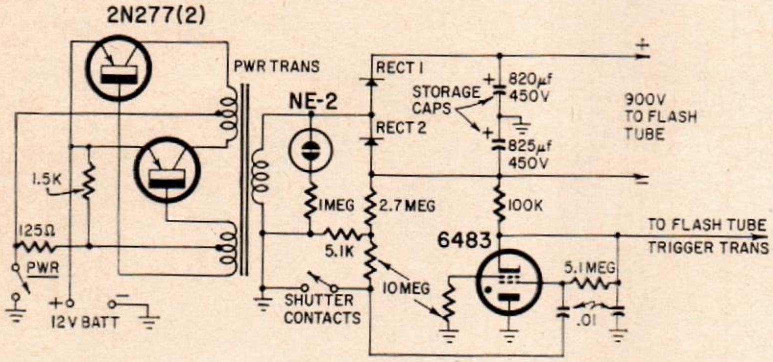


Fig. 2—Two-transistor one-tube circuit of the Ascorlight.

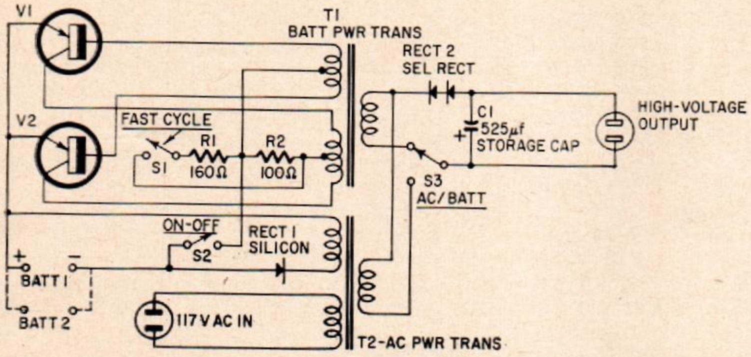


Fig. 3—Circuit of the Synctron Sixty.

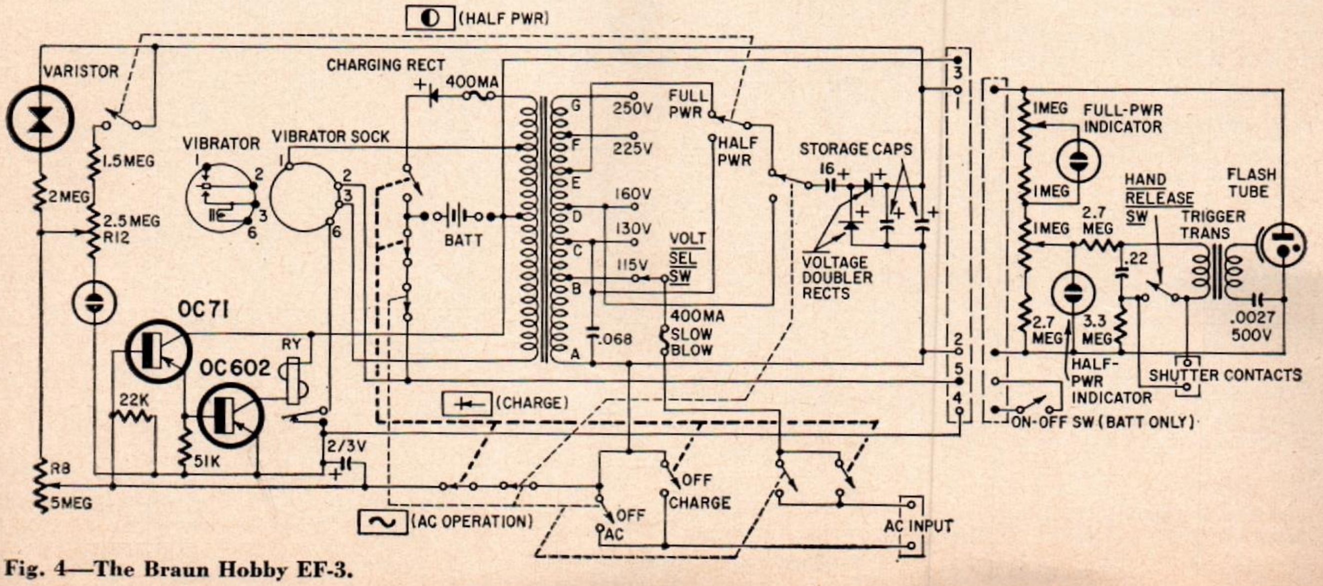


Fig. 4—The Braun Hobby EF-3.

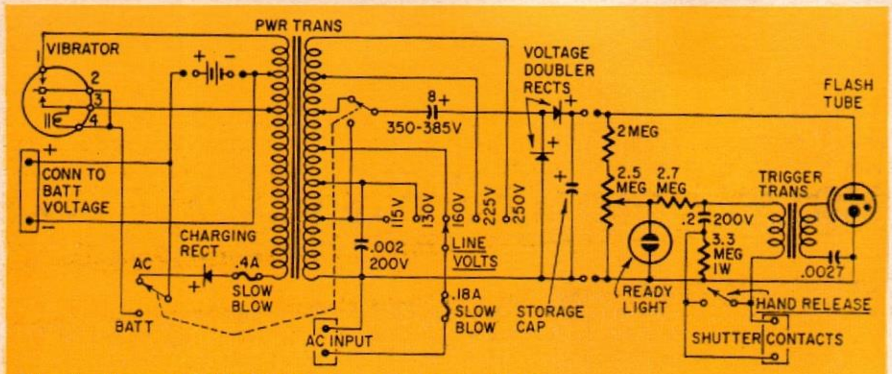


Fig. 5—Braun Hobby EF-1 electronic flash circuit.


Multiblitz, Inc.
The Multiblitz Color CL.

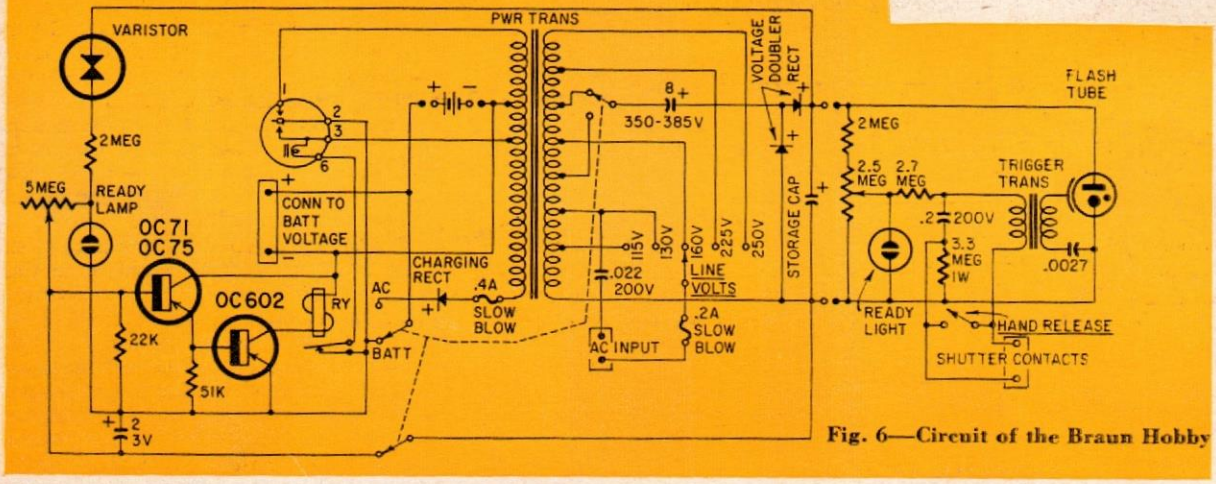


Fig. 6—Circuit of the Braun Hobby EF-2.

There are many variations of this basic circuit. Fig. 2 is the circuit of a professional photoflash unit, the Ascorlight A423, made by American Speedlight Co. A 200-watt-second unit, it will recycle in 7 seconds and has a power-conserving circuit for its nickel–cadmium battery. Drain on the battery during charging is 5 amperes, and drops to 350 ma when idling. The transistor oscillator, using two type 2N277 transistors, operates at 1,500 cycles. Waveforms from collector to collector and base to base are square, with little or no overshoot.

The transformer output is doubled by the rectifiers and supplied to the flash-tube balanced to ground, to prevent insulation troubles. The flash tube is triggered by the thyratron, a 6483. Firing the flash tube in this manner prevents excessive shutter-contact current.

Photoflash circuits

Fig. 3 is another transistor photoflash unit—the Synctron Sixty, made by Dormitzer Electric Co. Notice that ac operation is provided by T2 and RECT 2. This circuit also recharges the built-in battery through RECT 1. S1 provides a fast recycle in cases where this is desirable. As you can see, this switch raises the biasing voltage on the bases of V1 and V2, increasing the output of the circuit and also increasing the battery drain. Recycling takes 12 seconds normally and 6 seconds with S1 closed.

Figs. 4, 5 and 6 illustrate three flash units made by E. Leitz, Inc. Fig. 4 is the Braun Hobby Automatic EF-3; Fig. 5, the EF-1, and Fig. 6, the EF-2. These flash units are transistorized (transistor power-monitor circuit) and have vibrator power supplies powered by built-in nickel–cadmium batteries. A self-charger is included in each unit. The EF-3 flash head has an adjustable reflector, to vary the beam width.

The EF-3 (see photo) has three pushbutton type multi-circuit spst and spdt switches as function selectors. When all are up, the unit operates from batteries and is controlled by a switch on the gun. The button on the left (marked with a sine wave) is the ac on–off switch; the center button (marked with a half-shaded circle as on the diagram) is pressed for half-power operation on batteries or ac. The button marked with the rectifier symbol is pressed to charge the battery from the power line.

The transistorized power monitor cuts off the vibrator when the storage capacitors are charged to 510 volts ±10 volts on full power or 350 volts ±10 on half power. R8 and R12 set the

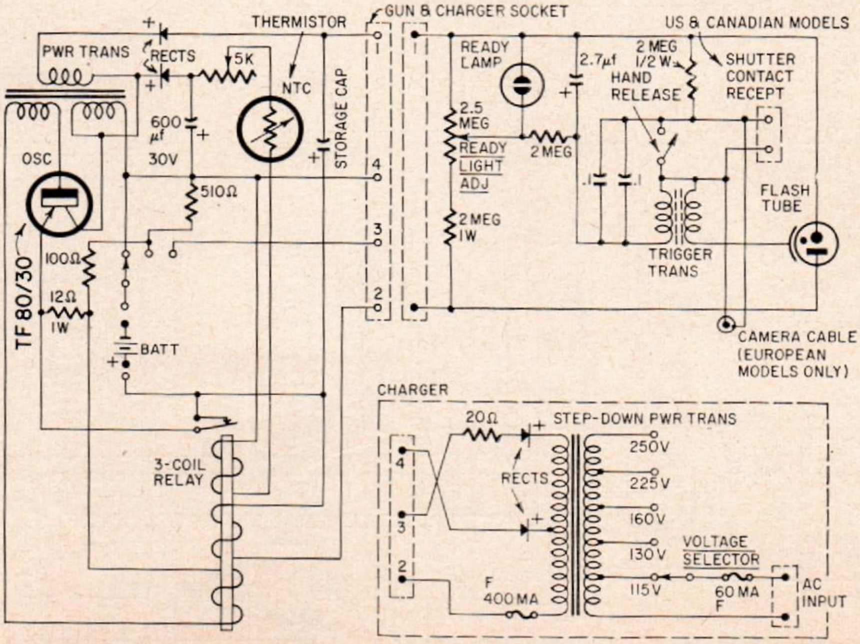
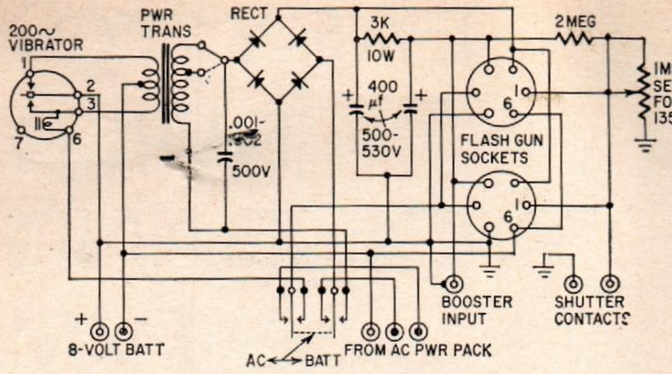
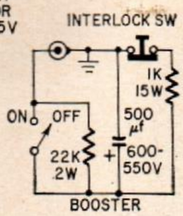


Fig. 7—F-60 power supply for the Braun flash units.





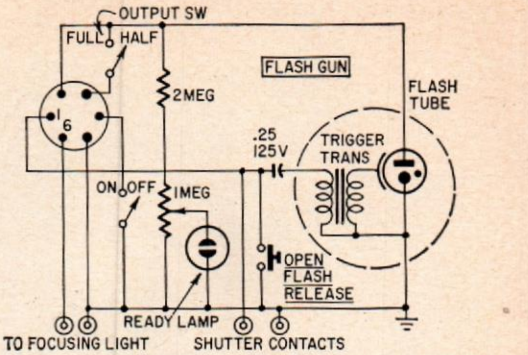
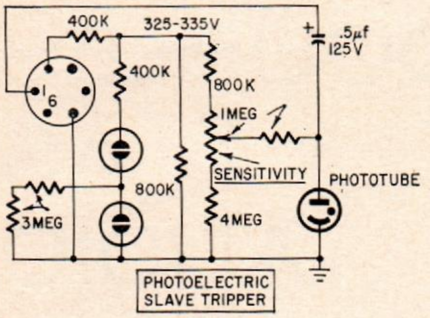
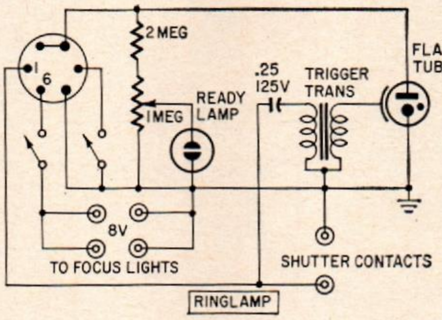


Fig. 8—Circuit of Multiblitz Press.





turnoff points for full power and half power, respectively. The vibrator comes on when the output voltage drops 10 to 30 on full power or 10 to 40 on half power.

E. Leitz advises me that they supply parts only to authorized Braun Hobby repair stations. Fig. 7 is the power supply made by E. Leitz for various flash heads, and is similar to the three just described.

The Ultrablitz Press in Fig. 8 is a versatile professional type electronic flash. It operates from an internal 8-volt storage battery, a combination ac power pack and charger or flashlight batteries. Accessories include a photoelectric slave tripper, focusing lamps, an extension flash head that can be used simultaneously with the standard head on the camera, a booster (plug-in 600-µf capacitor) to double light output and a circular or ringlight for shadowless lighting when making closeups of small objects.

Fig. 9 is another Multiblitz flash, the Color SL. A vibrator converter is also used in this unit, together with a unique transistor power-monitor circuit that allows the battery to idle between flashes. This lengthens the usable battery life before recharging is necessary.

Many electronic photoflash manufacturers discourage local service of their flash units, even though photographers may be caused considerable inconvenience (and loss to professionals) in sending the equipment to an authorized service station in the next state, or even back to the manufacturer, for service. However, a reputable service shop should be able to obtain parts if necessary from the manufacturer, or even obtain the local service franchise! A pleasant letter here will help! In many cases substitution may be possible, even if exact replacement parts are not available. Kemlite Laboratories supply many different types of flash tubes, Sprague supplies several types of photoflash capacitors, and alternate transistors, transformers, rectifiers and vibrators are also available. All current manufacturers of photoflash units are listed in the *Popular Photography Directory*, 1960 issue.

After repairing a flash unit, test it by shooting a roll of film, following the manufacturer's guide number.

Troubleshooting

An electronic flash is easier to service than an ac–dc radio. A vom is the only piece of test equipment you must have. A scope is an additional aid.

The best place to begin is at the flash tube. Measure the voltage here. If it is normal and the flash does not fire, the trouble is in the triggering circuit. If a thyratron is used to fire the flash tube, check to see that it is biased properly. The firing bias should appear on the firing or trigger grid when the sync contacts are shorted. Also be sure to check the voltage on the keep-alive grid. Since cold-cathode tubes are almost always used in this application, this voltage is vital to the operation. Low voltage here or a bad tube can cause the flash tube to fire too late, although this defect will be noticed only on the faster shutter speeds of the camera.

After the tube part of the trigger circuit is eliminated, check the trigger coil for proper operation. If an oscilloscope with triggered sweep is not available, replace the trigger transformer if you suspect it. A triggered scope will tell you whether the trigger transformer is functioning properly. A milliammeter in series with the trigger coil will kick slightly when the trigger capacitor is discharged through it, but experience is necessary here to judge whether the components are good.

In the event of low or no high voltage, trace the circuit further toward the battery. Also, don't forget the necessary low leakage factor of the electrolytic flash capacitor. If the capacitor's leakage current increases, a long recycle time will result. If this current is too high, the power supply may not be able to charge the capacitor to its rated voltage. The capacitor can be disconnected temporarily **(Be careful!)** and the output of the rectifier measured unloaded. In the event of high-voltage battery operation, this is, of course, unnecessary. If with the capacitor disconnected, the voltage is still low, check the rectifiers, transistors or vibrator. Remember that normal voltage with the capacitor disconnected will be only 0.7 times the voltage with it in circuit.

Some units use a power monitoring circuit. It is supposed to cut down the activity of the vibrator or transistor oscillator when the flash capacitor reaches full charge. A wrong bias here will cause the input circuits to idle all the time and will cut down the output voltage. It is best to disconnect this circuit if there is any doubt of its operation. Then if the output voltage assumes its normal value, you know where to find the trouble. END

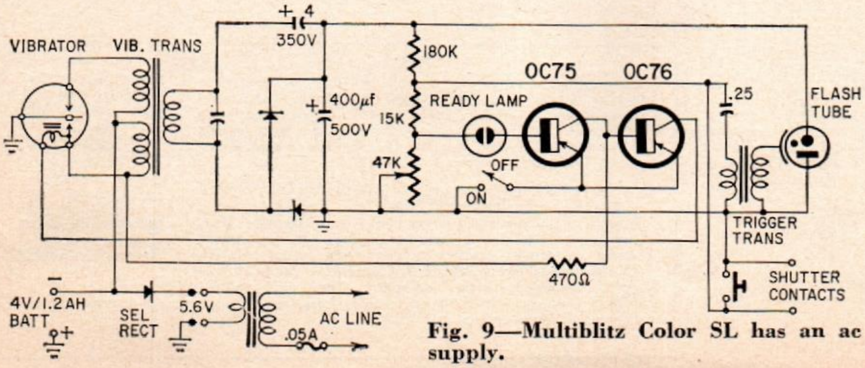


Fig. 9—Multiblitz Color SL has an ac supply.