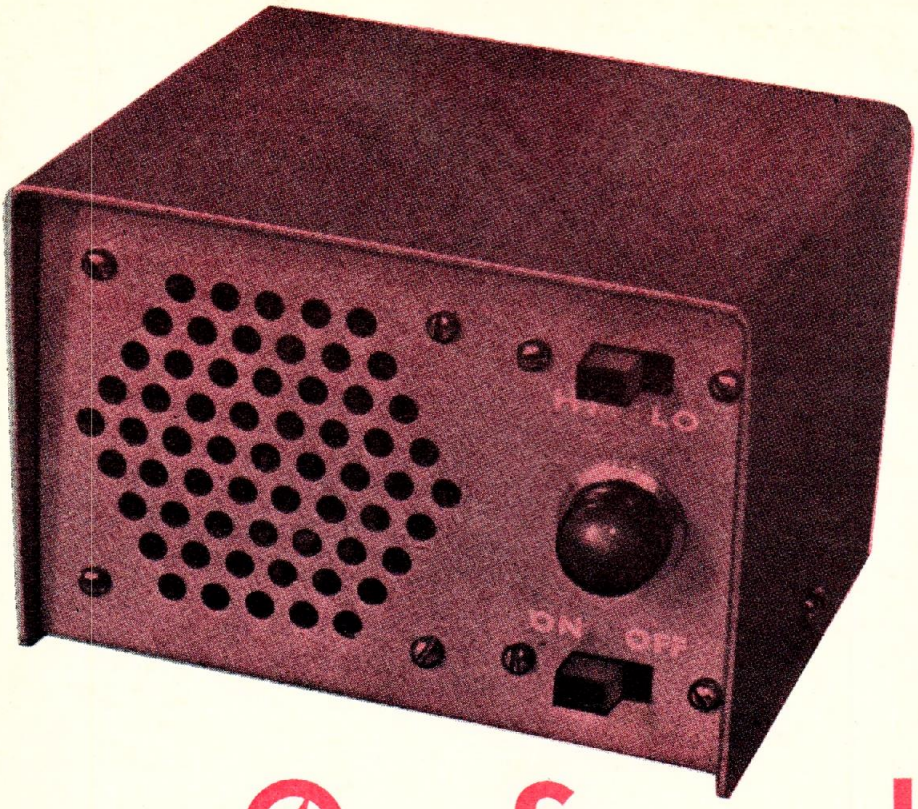

One Second METRONOME TIMER

VISUAL AND AUDIBLE INDICATIONS FOR YOUR DARKROOM

BY A. A. MANGIERI

ONE THOUSAND AND ONE . . . one thousand and two . . . one thousand and three . . . that's the familiar method of counting off the seconds for camera and enlarger exposures when a mechanical or electrical timer is not available. This method is not very accurate. For example, if you are in a big hurry, your count may speed up; or if you are tired, it may slow down. What you really need is a timer that is insensitive to emotions and fatigue.

The photographer's visual/audio One-Second Metronome Timer fills the bill. It paces your second count so that your film and paper exposures can be uniform. To accomplish this, the timer provides an audible "click" and a simultaneous flash of light every second. All you do is count the number of clicks and/or flashes.

How It Works. Transistor *Q1*, in Fig. 1, is a General Electric Type D13T1 "programmable" unijunction transistor, a special type of SCR. The anode gate (AG) of *Q1* is at a voltage determined by voltage divider resistors *R4* and *R5*. When *S1* is closed, *Q1* is initially in the non-conducting state.

Voltage at anode A begins to build up as timing capacitor *C1* charges up

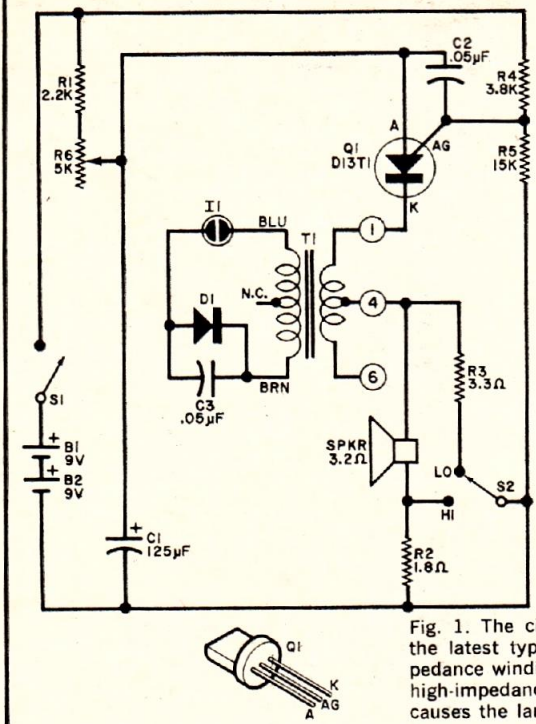

Fig. 1. The circuit is essentially a relaxation oscillator using the latest type of UJT. The turns ratio between the low-impedance winding (connected to the UJT cathode lead) and the high-impedance winding (connected to the neon lamp) of T1 causes the lamp to flash with each audible "tick" of speaker.

PARTS LIST

B1,B2—9-volt battery
C1—125-μF, 35-volt electrolytic capacitor
C2,C3—0.05-μF disc capacitor
D1—1-ampere, 200-volt silicon diode (Motorola HEP-156 or similar)
I1—NE-51H high-intensity neon lamp
*Q1—D13T1 programmable unijunction transistor**
R1—2200-ohm
R2—1.8-ohm
R3—3.3-ohm
R4—3800-ohm
R5—15,000-ohm
All resistors ½-watt
R6—5000-ohm potentiometer (Clarostat Type U39, or similar)
S1—S.p.s.t. slide or toggle switch
S2—S.p.d.t. slide or toggle switch
SPKR—3.2-ohm, 2½"-square speaker
T1—8-watt universal speaker transformer; do not substitute (Allied Radio No. 54C2021)
Misc.—Dialco No. 95-9110 lamp socket with red dome, less resistor for I1; 4½" x 3¼" x 3" aluminum chassis box; perforated phenolic board and push-in solder terminals; rubber feet; hardware; hookup wire; solder; etc.
**Available for 87¢ from Allied Radio Corp., 100 N. Western Ave., Chicago, Ill. 60680. Specify No. 49F3-D13T1-GE.*

through timing resistors *R1* and *R6*. When the voltage at the anode builds up to slightly more than the voltage at AG, *Q1* goes suddenly into conduction and allows *C1* to discharge rapidly through *T1* and the speaker's voice coil.

The sudden discharge of *C1* through *T1* generates a high-voltage spike across the secondary of the transformer, briefly lighting *I1*. Diode *D1* and capacitor *C3* enhance the brightness of the lamp's glow and the duration of the flash. The speaker produces an audible click simultaneously with the flash of *I1*.

As each click and flash occur, the voltage across *C1* drops to a low level and *Q1* ceases to conduct. The cycle then repeats itself as long as *S1* is closed.

Resistors *R4* and *R5* set the *Q1* standoff ratio and valley current for high circuit efficiency. Capacitor *C2* is an r.f. or noise bypass to prevent premature turnon of *Q1* by nearby electrical interference. Switch *S2* provides HI and LO level audio selection.

Construction. It is imperative that a metal case be used to house the timer circuit to shield it thoroughly from electrical noise pickup. A 4½" × 3¼" × 3" aluminum chassis box easily accommodates all parts.

First perforate the front of the box with a ¼" drill (or cut out a 2¼" opening and use a screen grille) for the speaker. Then determine how and where you plan to mount each part and assembly, and machine the box accordingly. A suggested layout is shown in Figs. 2 and 3.

Start assembly by mounting *T1* and the battery clamp on the rear wall of the box. Then mount the components on a 2½" × 2¼" piece of perforated phenolic board with push-in terminals, and bolt the board in place.

Mount the lamp socket, switches, and speaker in their respective locations on the front of the box. Wire together all components, referring to Fig. 1. Make sure that the leads of *C3* and *D1* in the high-voltage secondary side of *T1* do not touch other wires or components. Lengths of plastic tubing slipped over

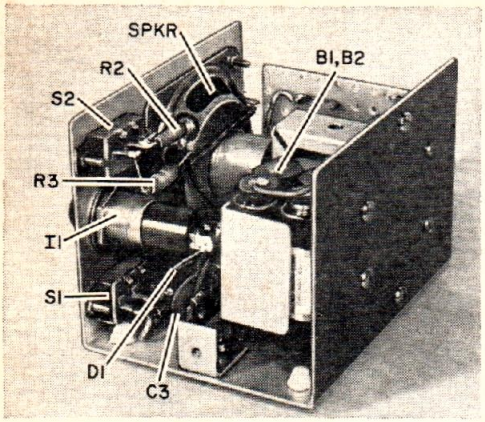

Fig. 2. If you arrange the components properly, they will easily fit within small metal chassis. Metal is used to prevent external noise from false triggering of the UJT, causing timing errors.

these leads will prevent accidental short circuits.

When the circuit is completely assembled, set *R6* for about mid-range. Set *S1* to ON and listen for the click and observe the brightness of the flashes, with *S2* set in the LO position. If the click is too loud or the flash level is too bright, you can omit battery *B2* and operate the circuit on only one 9-volt battery. In either position of *S2*, if the flash level is not bright enough, try reversing the diode. Use the connection that provides the brightest flash. Also, if you prefer an audio-off position, omit *R2*.

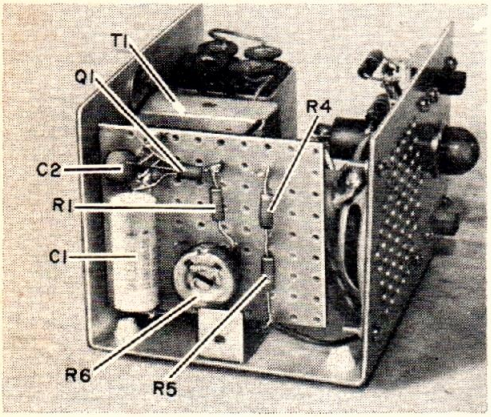

Fig. 3. Most of small electronic components can be directly mounted on piece of perforated board.

Calibration and Use. With the circuit operating, use an electric clock with a sweep second hand to adjust *R6* until you hear ten clicks and see ten flashes in exactly ten seconds. This is all there is to calibration, and you can now assemble the metal box.

Use the timer to pace your count for both timed camera and enlarger exposures. With a few practice runs, you will quickly acquire the knack of operating the camera cable release or enlarger switch at exactly the right moment.

If you incorporated the audio-off feature and have the timer set in this position when working in your darkroom, pace your count by lamp flashes, and rely on that pace because you might miss a lamp flash between eye blinks.

You can expect considerable battery life due to the low drain circuit of the metronome timer. As a rule of thumb, replace the batteries when either the audio or light output drops below your preferences; the count rate is affected very little by battery ageing. Also, recheck the count rate occasionally and adjust *R6* if needed to compensate for any long-term change in *C1*. —30—