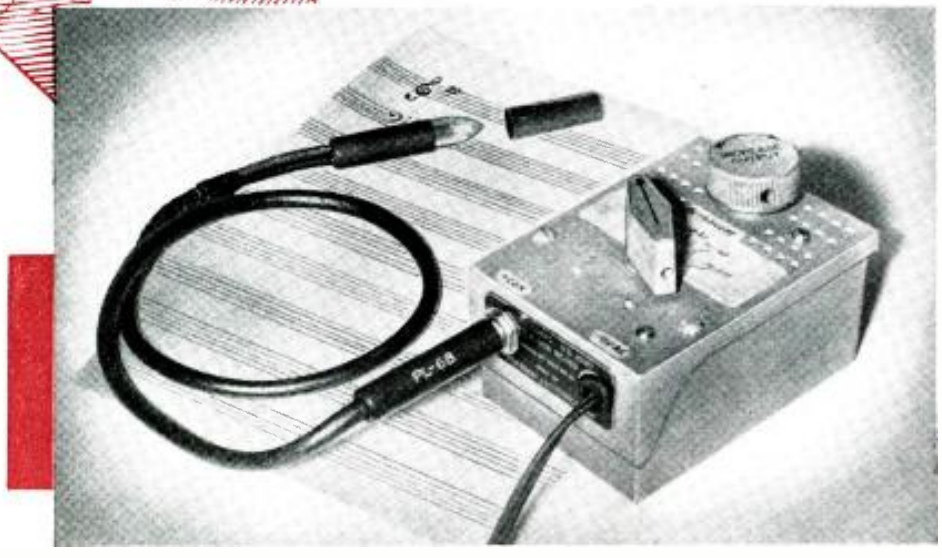
Electronic Metronome Has Neon-Lamp Time Indicator

By O. A. COPPENS



The complete metronome is built in an aircraft radio jack box. The original switch is used.

ARTICLES have appeared in magazines in the past few years on the construction of several types of metronomes, the majority ranging from complicated tube assemblies to special relays and unwieldy capacitors. Following the old pattern of mechanical metronomes, the audible beat seems to be almost a requisite for any device described.

An audible beat interferes with the music, so a metronome of this type is generally used for rehearsal or timing practice only. On the other hand, an inconspicuous *visual* metronome provides a check on timing, may be used at any time, and in no way interferes with the music.

A simple, inexpensive, and fairly accurate visual metronome may be constructed from a selenium-rectifier power supply and a neon-bulb relaxation oscillator. Inconspicuous but usable flashes covering a wide frequency range may be obtained from small standard radio components.

A glance at the schematic (Fig. 1) shows the selenium-rectifier power supply to be conventional. R1 is the rectifier protective resistor; R2 and R3 with the filter capacitors form the filter and voltage-divider network. Approximately 140 volts is applied to the oscillator circuit. The power consumption is small, so heating effects are negligible.

Operation of the neon-bulb relaxation oscillator is as follows: When the device is plugged into a 117-volt supply socket and the switch moved from OFF position, current from the d.c. power supply flows through R4 and R5 to charge gradually any capacitor combination switched across the neon bulb. When the capacitor voltage builds up to a certain definite value (90 volts, approximately), the neon bulb ionizes and conducts. This action discharges the capacitance, and the neon bulb stops conducting. The capacitance then slowly recharges through R4 and R5, and the cycle repeats.

The frequency of the neon flashes is approximately proportional to the supply voltage and inversely proportional to the values of the R-C combinations. Rough frequency control is obtained by switching the various capacitor combinations across the neon bulb. This permits four rough steps of overlapping frequencies with only four small capacitors. The fine control of each step is provided by the high-resistance potentiometer R5 and R4. The high-resistance values of R4 and R5 are also a factor in permitting the use of small capacitors.

A continuous frequency range of approximately 30 to 350 flashes per minute may be obtained. Some alteration in the fixed resistor values may help to obtain

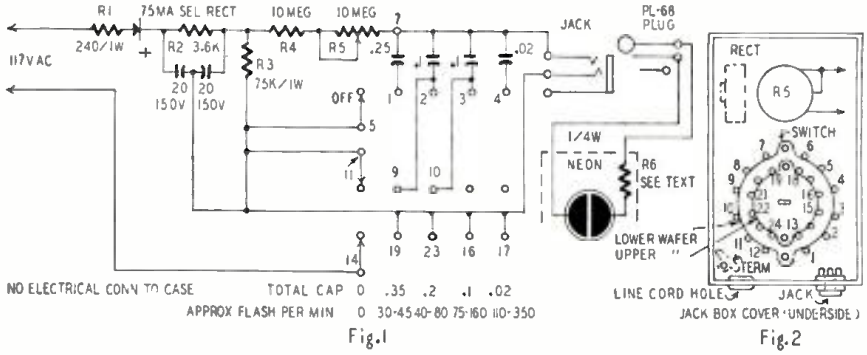


Fig. 1 Fig. 2

Fig. 1—The circuit diagram. Fig. 2—The switch contact numbers refer to those in the diagram.

correct overlapping of ranges. Due to the high resistances used, well-insulated components and good-quality capacitors are of prime importance for stability and proper operation.

Changes in supply voltage will have some effect on frequency. However, this effect is so small that it is not important in a metronome.

Construction

The metronome was constructed around a war surplus BC-366 jack box, available for a few cents. The box provides an excellent case (2¼ × 3¼ × 4½ inches) together with the required switch, 3-circuit jack, and the control knobs.

Photographs show the original jack box, the complete metronome, and the internal assembly of the metronome. All components except the neon extension are mounted and wired on the box cover for ease of construction and inspection. The box is completely isolated from the electrical circuit to avoid possible shock.

Remove the jack box cover and strip all the wiring. Also remove the banana jack and plug assemblies from the cover and base, as they will not be needed. Replace the original potentiometer with

To get into jack box, remove two top screws,

a 10-megohm unit, cutting the shaft to fit the original knob. The single-circuit PHONE jack may next be removed and a rubber grommet inserted in the hole to accommodate the line cord.

Construct a small metal angle bracket for rectifier support, and bolt the rectifier assembly near one corner of the box cover as shown in Fig. 2 and the inside photo. A two-lug terminal strip is also bolted to the cover near the line-cord opening for cord connection and support. A few small holes may be drilled in the cover and base for ventilation.

Remove the rotary switch from the box cover and pry out the spring retention which makes the fifth (CALL) position momentary. This will provide for five switch positions. The switch may then be remounted, using the original knob. The banana-plug insulating strip (not the plug assembly) is remounted in position above the switch, using the original assembly screws, to provide a barrier between switch and capacitors.

After wiring the switch, the fiber banana-plug strip is placed over contacts to insulate them.

A ¼-watt neon bulb is connected to an insulated two-wire extension cord terminating in a three-circuit PL-68 plug. If no plug is available, the neon extension may be connected directly to the metronome circuit by removing the three-circuit MIC jack and inserting a rubber grommet, similar to the line-cord hole. The value of the neon resistor R6 will depend upon the type of neon bulb used. It could be located in the box instead of the extension. A tubular fiber shield with hole, as shown in the photographs, slipped over the neon bulb, will direct and intensify the flashes.

Connect the rectifier power supply, all resistors, and the neon jack according to the schematic. To simplify connections to the switch terminals, an arbitrary numbering system corresponding to numbers shown on the schematic is shown in Fig. 2.

With the power supply on and the neon extension plugged in, temporarily connect various capacitor combinations until the desired ranges and overlaps are obtained by operation of the switch and R5. After the capacitors have been selected, mount and wire them permanently. Ample space is available for 400-volt capacitors. During construction, one 600-volt unit was used merely because it happened to be of correct value, sufficient mounting space being available near the side.

When the metronome is assembled and tested, a paper dial plate may be glued on the cover indicating the OFF position and each frequency range.

MATERIALS FOR METRONOME

Resistors: 1—3,600 ohms, ½ watt; 1—240, 1—75,000 ohms, 1—10 megohms, 1 watt; 1—10 megohm potentiometer.

Capacitors: 2—20 μf, 150 volts, electrolytic; 1—.02, 2—0.1, 1—0.25 μf, 400 volts, paper.

Miscellaneous: 1—75-ma selenium rectifier; 1—3-circuit microphone plug (PL-68); 1—¼-watt neon lamp; 1—BC-366 jack box; necessary hardware.

REGENERATIVE SUPERHETERODYNE RECEIVER

The 6K8 in this receiver converts the incoming broadcast-band signal to the 456-kc i.f. The regenerative triode section of the 6AD7 is the second detector, and the pentode section the audio amplifier.

The tickler coil is added to an ordinary slug-tuned i.f. transformer. Close-wind 15 turns of No. 20 d.c.c. wire 3/16 inch below the transformer secondary. The antenna and oscillator coils are standard commercial broadcast units available at any parts store—*Manolis Samárakis.*