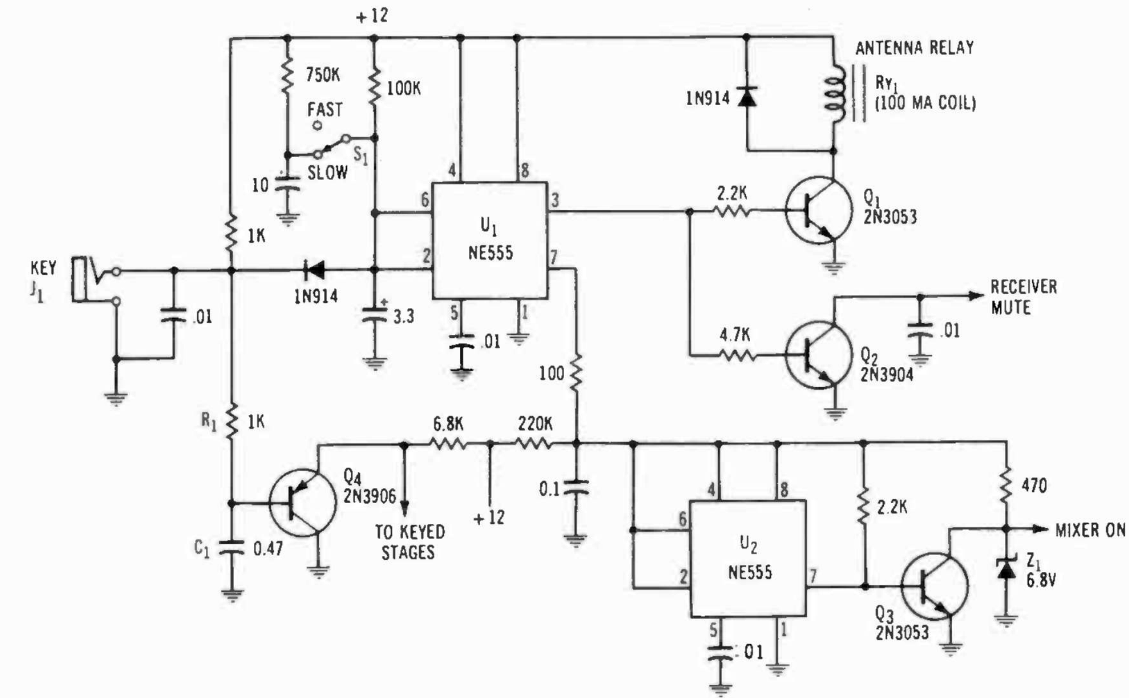

Figure 13

TRANSMITTER CONTROL CIRCUIT

The timer V_1 controls antenna relay and receiver-mute timing. Timer V_2 turns on mixer stage and transistor Q_4 controls keyed stages. Time delay is determined by switch S_1.

lows the antenna relay to operate, U_2 turns on a low-level mixer stage. At the same time these operations take place, the keyed stages of the transmitter are activated by Q_4, an emitter follower. The combination R_1-C_1 provides proper keying characteristics.

In the case of a vacuum-tube amplifier driven by a solid-state device, the circuit of figure 14 may be used. Driver Q_2 is keyed through transistor Q_1 and the amplifier tube V_1 is blockgrid keyed directly through a waveform shaping circuit (R_1-C_1).

18-4 The Electronic Key

The *International Morse Code* used in radio telegraphy is made up of three elements: the *dot,* the *dash,* and the *space* (see Chapter 1, Section 4). Intelligence can be transmitted at high rates of speed by using various combinations of these elements. A standard time relationship exists between the elements and between the space between words. The dot is a unit pulse and one pulse per second is termed one *baud*. The dot has a duty cycle of fifty percent, thus making the space equivalent in length to a unit pulse. The dash has a duty cycle of seventy-five percent, or three unit pulses in length. The space between words is seven unit pulses in length.

These fixed relationships between the code elements make it possible to use digital techniques to generate the timing characteristics used in an automatic electronic keying device, or *keyer*.

The representative keyer is actuated by the operator who keys at approximately correct times, the keyer functioning at precisely correct times determined by the *clock circuit* of the device.

In most keyers either an astable multivibrator or a pulse generator is used as a clock to create precise dots and dashes. The latter are made by filling in the space between two dots. Latching (memory) circuits are used so that an element, or code character, will be completed once it is initiated by the keyer paddle, or lever.

Since the transmitter following the keyer has wave-shaping circuits and possibly relay closure delay, a *weight control* may be

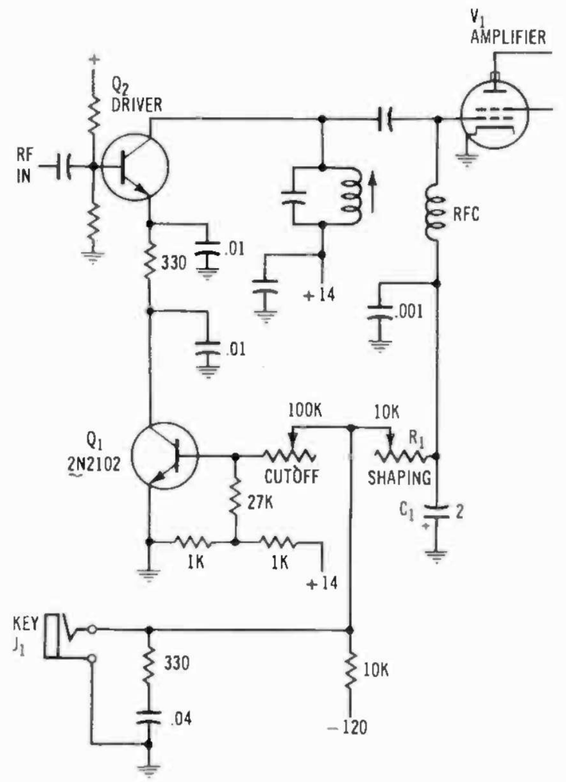

Figure 14

TWO STAGE KEYER CIRCUIT

Blocking bias to amplifier V_1 is keyed via a shaping circuit R_1-C_1. The driver is keyed by transistor Q_1.

incorporated in the keyer to vary the dot-to-space ratio.

Modern electronic keyers make use of solid-state circuitry which is admirably suited to on-off operation. A basic electronic key uses a single or dual key lever, movable in a horizontal plane and having two side contacts, much in the style of the mechanical key, or *bug*. Moving the keying paddle to the right produces a uniform string of dots and moving the paddle to the left produces a uniform string of dashes. A more sophisticated keyer makes use of a dual *squeeze* paddle having double paddles, levers, and contacts, one set for dots and one for dashes. In one version of this *squeeze keyer* (the *iambic* keyer), closing both paddles at once produces a string of sequential dots and dashes. This simplifies the sending of the letters having this sequence, such as C, Q, A, L, X, R, and K. Other versions of the squeeze keyer produce a string of dots or dashes when both paddles are closed. The keyer may be modified to send dots over dashes or dashes over dots when one paddle is closed after another. This action is termed *override*. Automatic dot completion is achieved by incorporating a *memory* circuit in the keyer.

A Basic Keyer The logic functions of a typical keyer are performed by silicon integrated circuts (figure 15). The pulse (dot) generator, or *clock*, is a free running multivibrator made up of two inverters (IC_{1A}, IC_{1B}) with the pulse speed controlled by potentiometer R_1. The free running, astable multivibrator allows pre-

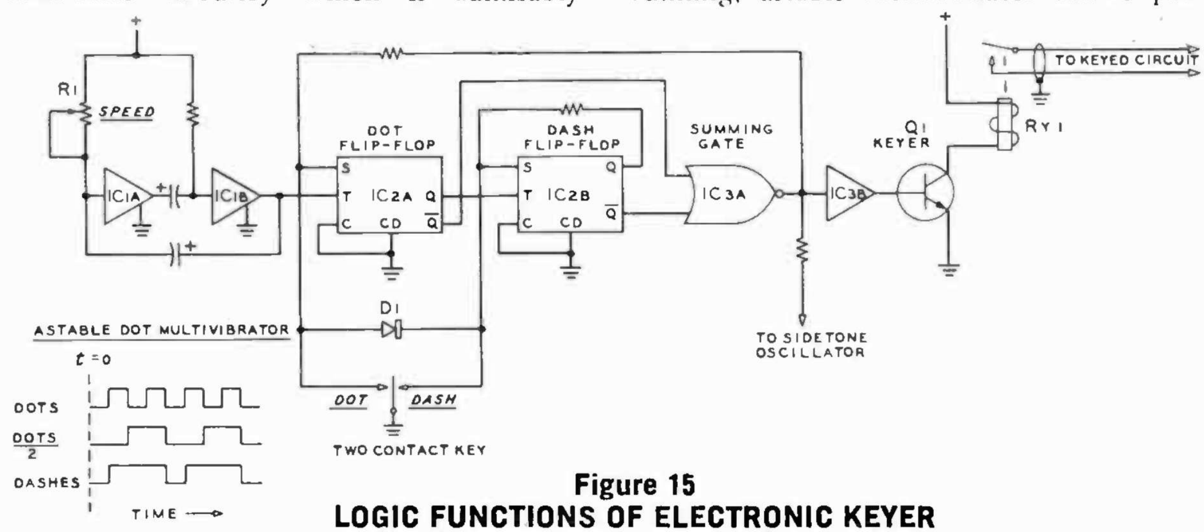

Figure 15

LOGIC FUNCTIONS OF ELECTRONIC KEYER

Astable multivibrator (IC_1) generates string of pulses (dots) with speed controlled by potentiometer R_1. Dot flip-flop sends precise square-wave dots when key contact is closed. Dash flip-flop adds long pulse to dot, forming 3-baud dash at output of summing gate. Amplifier and keying transistor drive a reed relay which controls the transmitter circuit. Dot memory, sidetone monitor, and iambic characteristic may be added to the basic keyer, if desired.

cise spacing between the code elements as the space will always be one dot long, regardless of the sending speed. A dual flip-flop (IC_{2A}, IC_{2B}) is used as a character generator. Grounding the dot contact of the two-contact key triggers the *set* (S) input of the dot flip-flop (IC_{2A}) which then sends precise square-wave dots as long as the dot contact is closed. If the dot contact is opened before the completion of a dot, the element will be completed (dot memory).

Grounding the dash contact of the key triggers the *set* input of the dash flip-flop (IC_{2B}) and also grounds the *set* input of the dot flip-flop through diode D_1. The dot flip-flop starts a dot, the dash flip-flop is triggered, and a second dot is initiated completing the dash element at the end of the second dot. The outputs of the flip-flops are added in a summing gate (IC_3). Once a character has started, it is impossible to alter it with the paddle and characters are self-completing.

The transmitter is actuated by a keying transistor (Q_1) employing a fast-operating relay in the collector circuit. In many instances, a *reed relay* is used. This type of relay has operate and release times of less than one millisecond and can allow good keying up to 100 words per minute. Some keyers eliminate the relay in favor of a keying transistor having a high collector-to-emitter voltage rating and a large collector current rating, thus permitting the transistor to be used to directly key cathode or grid circuits carrying up to several hundred milliamperes with an open-key voltage up to 300.

A *sidetone oscillator* or keying monitor can be driven by the keyer to provide the operator with an audible indication of the keying process.

Variation in the control logic and the use of a double paddle key permits conversion of the basic keyer to iambic keying whereby grounding either the dot or the dash contact and then immediately grounding the other produces alternating dots and dashes. Another version will produce a dot or dash

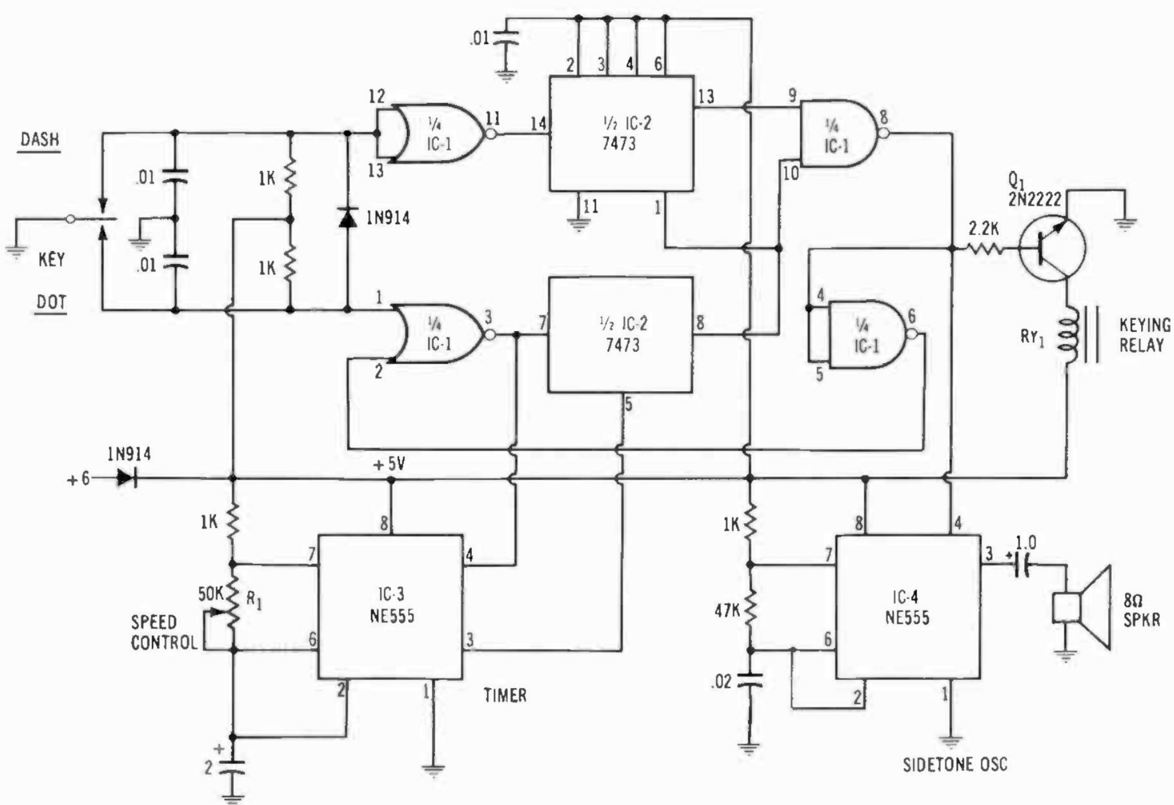

Figure 16

ELECTRONIC KEYER

Device IC-1 is a 7400 Quad, two input NAND gate. RY_1 is a reed relay.

override sequence whereby closing both contacts simultaneously, only dots (or dashes) are generated.

A representative keyer is shown in figure 16. This unit employs a dual flip-flop for dot and dash generation at a three-to-one ratio. The IC-3 (NE-555) serves as a clock generator whose speed is set by control potentiometer R_1. A second timer serves as a sidetone generator. The transmitter is keyed by means of transistor Q_1 and a reed relay which isolates the keyer circuit from the transmitter voltages.

18-5 The COSMOS Keyer—Mark II

This compact and reliable keyer is an up-to-date version of the popular W9TO keyer

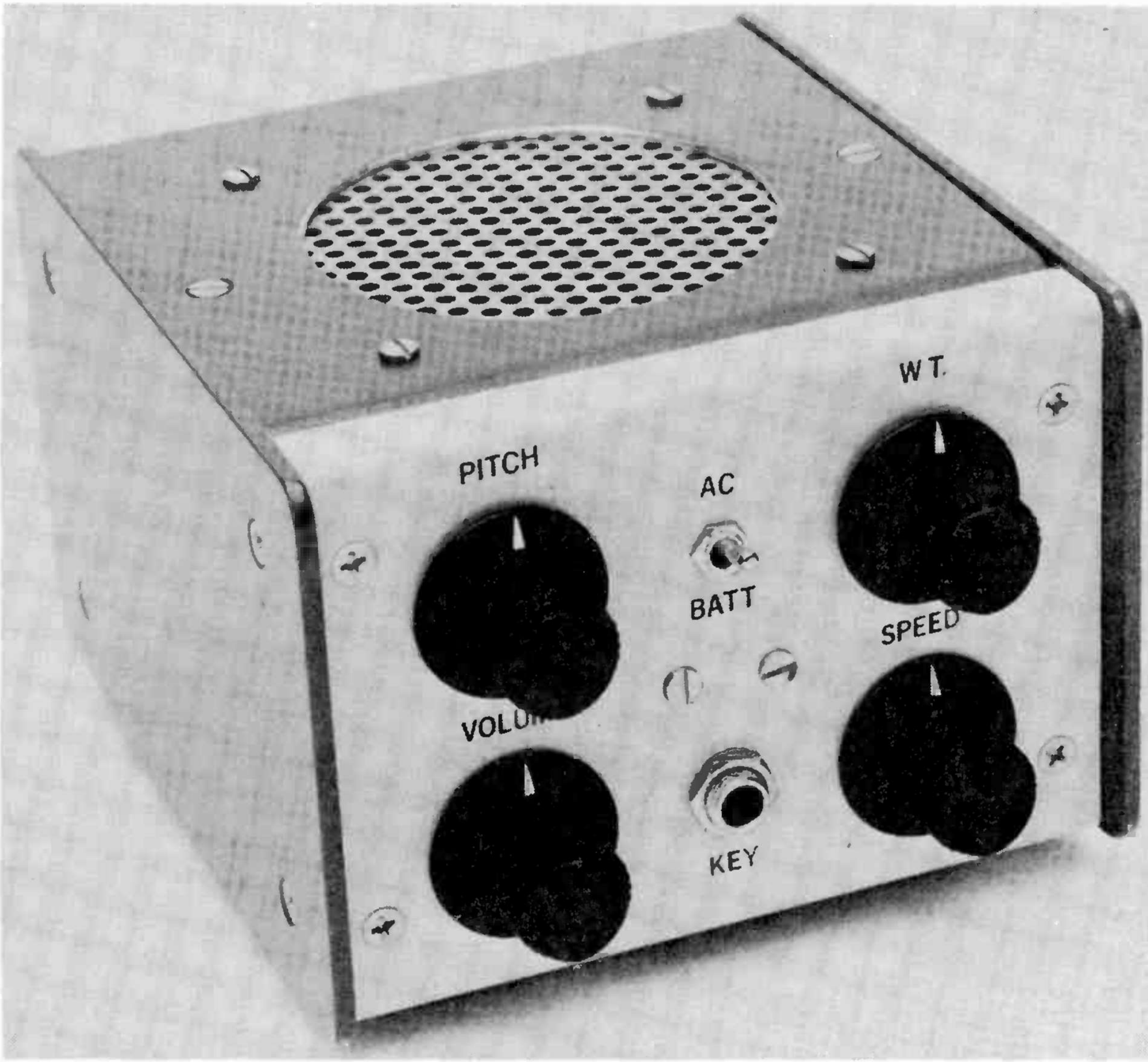

Figure 17
THE COSMOS INTEGRATED-CIRCUIT KEYER—MARK II

The COSMOS keyer uses CMOS logic with a single IC, the Curtis 8044. This device provides dot and dash memory, variable weight, and iambic (squeeze keying) mode. The device works either from an internal 3-volt battery or from 120 volts 60 Hz. The unit is built in a Moduline cabinet measuring 5" wide, 3½" high and 5" deep, exclusive of controls. The small speaker is mounted in the removable lid of the box. Pitch and weight controls are in line across the top, with volume and speed controls across the bottom. Rubber feet are placed at the bottom of the box to prevent scratching the operating table. Box color is gray, with an off-whte panel.