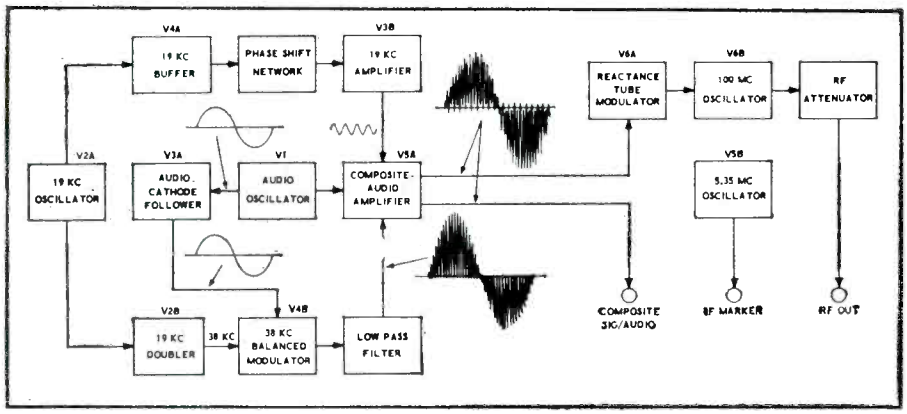

Fig. 2. Block schematic of Heathkit Multiplex Generator.

tions showed as good a signal as one could want. We used it to check the alignment of a tuner that had just had a going over with equipment listing at ten times the cost. The results were the same.

We are not running the usual circuit description (it is given in considerable detail in the construction manual) relying instead on publication of the block diagram, *Fig.* 2. The only comment necessary is that both the 19-kHz and 5.35-mHz oscillators are Pierce crystal-controlled circuits for maximum stability and accuracy at these critical points.

This generator is a tool of considerable merit for its qualities and versatility. If we feel that it could be further improved by the addition of an input for an audio oscillator or music signal and a position that provided *only* 19 kHz (instead of including signal) at the level it is mixed with signal (10 per cent) then we are lint picking. This is a fine instrument; one that does a thoroughly professional job at considerably less than a professional price. For this, even had there been nothing else, Heath is to be congratulated.

Circle 210

REVOX G-36 TAPE RECORDER

Tape recording has come a long way in the last few years. It seems only yesterday that it was an extraordinary machine indeed that could break the 12-kHz barrier. (And, not much earlier, it was a rule of thumb that top frequency response equalled the speed in inches-per-second multiplied by one kHz.)

Now it is commonplace for a recorder to provide 20,000-Hz response at 7½ ips. And, at low distortion. Where standard 0 VU was often specified at a 2- or 3-per-cent point, 0 VU now is expected to be under 1 per cent. And it is often half a per cent or less.

This ReVox G-36 is a prime example of what we mean. Although a recent arrival in this country, the Swiss firm has been on the European scene for a while. The G-36 is identical to the ReVox 736 that has been described in recent British periodicals, with one important difference—the equalization standard in Europe is the CCIR curve, materially different from our NAB curve. The G-36 is, of course, supplied with NAB equalization. The accuracy of that curve reproduced is shown in *Fig.* 4. This is derived from Ampex Test Tape 31321-01. The bass rise shown is, for the most part, the tape and not the ReVox.

At $500, the G-36 is the lowest-priced unit we know that has the capability of handling 10½-inch reels. And, it is admirably qualified to handle these reels, too.

By way of explanation, the G-36 is a three-motor machine. Capstan drive is from an oversized Papst hysteresis-synchronous motor. Each reel hub is an extension of a shaft from a separate Papst motor. Hold-back tension for tape transport is achieved by applying reverse torque to the supply motor. Since the 10½-inch reels have an average circumference (with tape) that is larger than the usual 7-inch reel, greater pull is required for these large reels.

This is achieved by a cleverly arranged knurled ring switch located at the apex of the head cover. In the small-reel position, an arm is extended from the cover and prevents the placement of large reels until a tension change is made by pushing the arm back into the cover.

It is hard to imagine that controls could be placed more logically and practically than they are here. The four knobs shown are actually all coaxials. The two on the left are for the play circuits; the two on the right for record. The coax rings on the two left knobs control power on/off and playback mode respectively. The two on the right are identical. Each selects one of three possible inputs for each channel. This pair also allows sound-on-sound with an extra position each that transfers sound from one stereo channel to the other.

The small knobs are all control pots. On the right, they control respective channel record volume. On the left, one is for play volume through the built-in mono speaker; the other applies bass boost to playback through that speaker.

A pair of standard-ballistic VU meters are provided for record monitoring. They are stilled in playback. Playback, incidentally, is either through a single built-in monitor speaker and six-watt amplifier or, via fixed-output cathode followers (to a stereo amplifier).

Since there are three separate quarter-track heads and separate record and play preamplifiers, off-the-tape record monitoring is possible. This may be done on the machine, affecting only the sound that comes from the internal speaker. Or, it can be achieved on any standard amplifier/control that has a tape monitor facility.

All tape motion is controlled by four of the five piano-type keys. These are electric-keyed to the operation they control. The capstan pinch-roller, assembled on a heavy casting that is part of the over-all head assembly, is solenoid controlled as are the mechanical brakes. These brakes, incidentally, are of fail-safe operation. That is, when power is removed, the brakes are applied. Thus, a plug pulled while in high-speed rewind will safely stop the tape with nary a loose turn. If the tape should run out or break, thus releasing a pressure switch, the brakes will also be applied and the capstan roller released.

The Circuit

The entire electronics section is reached by removing the bottom cover of the unit. Layout is exemplary—all straight line and lovely-to-look-at (and to service if needed). Circuitry is straightforward enough using the common varieties of twin-triode tube. In all, twelve tubes, three silicon diodes, and three selenium rectifiers are used.

Each of the stages is notably single purpose. Relatively unusual in a recorder is the use of completely passive frequency compensation and equalization. Less unusual perhaps, but equally desirable, is the d. c. heating of all early preamp stages. Each record stage has a total of five triode stages. Each pair employs feedback to reduce distortion and noise. Three triode

Fig. 3. View of the Revox G-36 tape recorder.

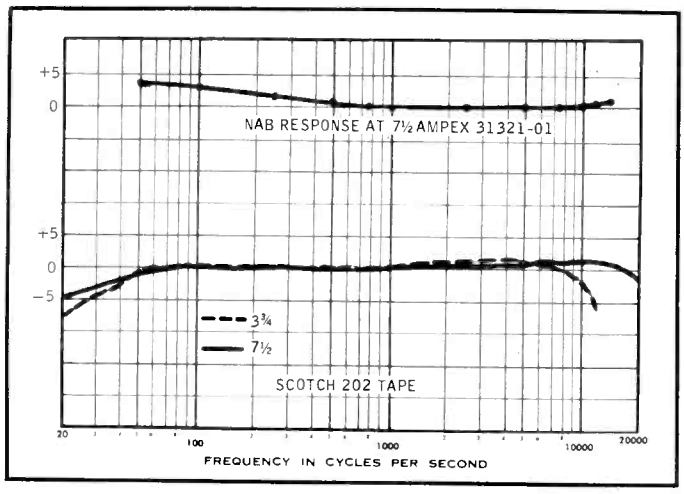

Figure 4. NAB playback and overall record/playback response of the ReVox G-36.

stages, two amplifiers, and a cathode-follower output form the play circuits. These stages just quoted do not count the push-pull oscillator (70 kHz) or the cathode-follower isolators between the record amplifiers and the VU meters.

The built-in mono power amplifier is of a completely standard three-stage push-pull design. It will deliver a legitimate 6 watts into an 8-ohm load.

Test Results

Figure 4 shows the over-all frequency response measured on Scotch 202 tape. Levels were run at 10 dB below indicated 0 VU. Between 18 and 20 kHz we detected some audible beat tones between the input signal and the bias. However, it should be noted that the normal energy content of music at these frequencies is well below the 10-dB mark, so this will never be an audible problem in recording.

0 VU as indicated on the meters was within one dB of standard 0 VU. In fact each channel was within one dB of its mate at all times so our graph has only one channel shown.

Input dynamic range capacity is enormous. In the microphone input, sensitivity is 1.2 mV for 0 VU. Strange, however, was the fact that distinctly non-standard back-panel RCA-type phono jacks were provided.

Tuner input sensitivity is 0.018 volts. Aux (labeled with the British radio term-*Diode*) has a 2.7 mV sensitivity. There are a pair of input attentuators in this function that reduce voltage before the first stage so that the volume control can be used at a convenient middle position. Otherwise, it would be hardly needed. With that 2.7 mV input sensitivity it takes 0.8 *volt* before overload distortion sets in.

Signal-to-noise measurements were arrived at by erasing a 0-VU signal from the tape and measuring the residue. It was a respectable -45 dB left and -43 dB right channel. These are unweighted figures.

That big drive motor and careful attention to tape-handling details resulted in exceptionally low flutter and wow. At the 7½-inch speed our meter needle just hung a bit over the zero mark. This is *below* 0.05 per cent total flutter and wow; extraordinary performance! At 3¾ ips we could, at least, reliably measure flutter. Total combined wow and flutter was 0.12 per cent; still better than we have measured on some units at 7½!

Finally, if you are in a hurry to rewind a tape, the ReVox will zip 1200 feet through in 45 seconds. With a tight, smooth wind.

We can't close without stating something about the plastic cover that comes with the recorder. It is of flexible Tenite-like plastic. Granted it is strong enough to support my 190-odd pounds without so much as a shudder, but its appearance isn't up to the rest of the machine.

So you see, nothing is perfect. (Oh, would that *everything* was so *im*perfect.) Some where along the line we trust that you have reached the conclusion that we are enamored of this machine. Because we are.

Circle 211

HARTLEY 220MS HOLTON SR. SPEAKER SYSTEM

Recently arrived is the latest in a series of 220 speaker systems from Hartley Products. These share the commonness of being full-range single ten-inch drivers. The Holton Sr. designation is indicative of the type of enclosure provided—a floor standing unit of modest but larger than "bookshelf" size.

The MS designation stands for Magnetic Suspension, a device consisting of a ferrous ring beyond the voice coil that acts as a movement damper on the cone. The result is a crisp clarity indicative of excellent transient response capabilities.

This latest version has removed the "whizzer" dome that graces earlier 220-MS's. In its place is a separate coaxial cone connected to the main cone only by a flexible surround. The manufacturer states that separate voice coils drive each section; this cannot be seen by visual inspection.

This, then is a coaxial system employing a ten-inch, long-throw woofer and, at its apex, a small tweeter sub-assembly. The mechanism is sold separately (no cabinet) for $135. In the cabinet, which is fully loaded with a roll of kimsul-type insulation, it is $245. From which price a quality product should be deduced. And, that is indeed what this is.

This is a *full*-range system. If you want to hear what 20 Hz sounds like, listen to this system. It is capable of bass response that needs take a back seat to nothing.

Actually, it is a lack of bass that is most impressive at first hearing. There is no doubling at any normal levels. The solid transients reveal a driver that will not make bass when the music has none.

But one cannot eat of bass alone. This unit will do equal justice to the rest of the model, this 220MS delivers a mid-range that is both easy to listen to and full and rich.

Highs in appropriate abundance are here, too. Response extends smoothly up to the limits of audibility. Microphone checks indicate that those limits are beyond the average range of human hearing.

So it is a safe bet to deduce that musical balance is secure with this speaker. And so it is. Still, extensive listening tests do reveal a characteristic color. This is not a neutral speaker. (What speaker is?) The best adjective is "warmth." Or, to juxtapose, there is no sterile coldness to the sound of this system. Warmth must not be interpreted to mean muddiness. That is certainly not the case. The bass transient capability already alluded to extends over the entire spectrum of sound. Instrumental separation is good. (Don't confuse *instrumental* separation with stereo separation. We mean the ability of the speaker to separate the voices of the orchestra or chorus.)

Human voice is served well by these qualities. There is only a handful of speakers that share this ability to make a male voice *not* sound as if it comes from a barrel.

All of these qualities are bought, apparently, at the cost of efficiency. While this is not the lowest-efficiency system around by any means, it is one that will do best with a moderate to high-powered amplifier. Certainly, 20 watts per channel is a minimum needed.

This system will not prove to be everyone's cup of tea. Perhaps no speaker is or will ever be. But if you want a speaker to complement top-grade components, one that sounds musically valid and has more than adequate dispersion so that highs do not hit you between the eyes, then by all means audition this Hartley.

Circle 212

Figure 5. The Hartley Holton Sr. speaker system.