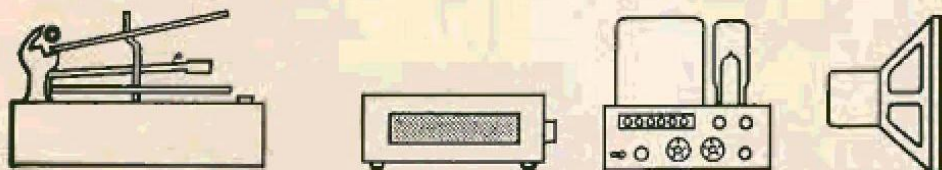


EQUIPMENT



PROFILE

HEATHKIT STEREO TAPE RECORDER, MODEL AD-22

The Heathkit Model AD-22 tape recorder is a 2-track machine designed to record and play 4-track mono and stereo, with record bias and audio output being supplied from the built-in preamp. The AD-22 is supplied in kit form (or preassembled), and is a kit in the old sense of the word—the only parts that are preassembled are the capstan bearing assembly and the main wiring harness. Of course we are all aware of the trend to package and partially assemble kit units, to the extent that some normally complex kits can be assembled in a mere handful of hours. This latter category is really quite ideal for the audiofan who wishes to save a little money and also get a much closer look at the insides of his audio system. On the other hand, the experienced audiofan who wishes to save more will gravitate towards the less elegant package such as this Heathkit unit.

For example we found, on opening the box, that all the small parts were dumped into two moderate-size brown-paper bags. Of course the experienced builder immediately sorts out the parts in some neat array—in fact this procedure is suggested in the manual. On the other hand, it is not diffi-

cult to imagine the reaction of the less experienced builder; the hopeless feeling when confronted with a jumbled mass of parts which are not familiar to him. For the latter reason we would suggest that the less experienced builder would be wise to be prepared emotionally and have sufficient available time before tackling this kit.

Insofar as time is concerned it took us just a hair over 16 hours to get the AD-22 put together and operating correctly. It would have taken us somewhat less but we found the mechanical readjustments rather time consuming. We will go into that aspect later.

On the whole, we found the AD-22 to be a good performer, basically satisfying the need for a moderately priced tape deck. In addition, the AD-22 is a very uncomplicated and relatively rugged machine which should provide a good level of performance for a long time.

Mechanical Circuit

The driving power for the mechanical system is supplied by a single-speed induction motor which is coupled to the capstan by means of a round rubber belt. (Actually the motor drives a rather substantial flywheel which in turn drives the capstan.)

The AD-22 is a 2-speed machine and speed selection is achieved by raising or lowering the shaft just to the rear of the head cover—in the up position the speed is $7\frac{1}{2}$ ips and down it is $3\frac{3}{4}$ ips. The capstan speed is determined by the size ratio between the motor pulley and the capstan flywheel: the motor pulley is two-stepped, the smaller step being for $3\frac{3}{4}$ ips and the larger for $7\frac{1}{2}$ ips. This system of moving the belt from a larger to a smaller diameter ($7\frac{1}{2}$ -to- $3\frac{3}{4}$ ips) requires a belt which does not stretch, a stringent requirement. On the other hand it has the advantage of being unusually simple. Also, the speed that would suffer if the belt stretched is $3\frac{3}{4}$ ips which is not a serious loss in many cases. The method whereby the belt is shifted is also rather simple: the shaft which projects above the deck moves a forked finger that straddles the belt, and the belt moves down or up to follow if the motor is rotating.

In the play or record positions, the tape is clamped to the capstan by the capstan idler thus moving the tape toward the take-up reel. At the same time the takeup reel is driven forward by a belt which runs between it and a pulley mounted below the capstan idler. Thus the motion of the capstan is transmitted to the capstan idler and from there to the takeup reel. Head pressure is achieved by means of a spring-loaded compliance arm between the capstan and the takeup reel and also by a holdback arm whose felt face presses the tape against the tape guide located between the supply reel and the head assembly. There are no pressure pads to grind the tape across the head. Also there are no tape lifters to take the tape away from the head during fast forward or rewind.

Fast forward is accomplished by mechanically shifting the takeup brake drum so that it presses against a rubber surface on the motor pulley. Rewind is accomplished by pressing the supply brake drum against a rubber-faced idler which in turn presses against a smooth surface on the motor pulley.

The forward oblique rewind control may be turned from one position to the other without pausing for the neutral position so that the tape may be "jockeyed" easily to locate a particular passage. The play control however is locked in neutral when the forward oblique rewind control is being operated. This precaution is necessary to prevent the tape from being broken by switching too fast from rewind to play.

In essence then, the mechanical circuit consists of a single-speed induction motor driving the capstan system by means of a belt in order to reduce flutter, while the fast speeds are direct or idler driven to accomplish their mission as quickly as possible. The concept and execution are simple.

Electrical Circuit

The electrical circuit for the playback preamplifier is extremely simple since it is very limited in function; all it has to do is amplify the signal from the playback head, produce the proper NAB playback equalization, and send this signal out to the rest of audio system in proper style. To accomplish these simple purposes, the preamp utilizes three stages of amplification (actually three tube sections V_{1A} , V_{1B} , and V_{1C}) and a cathode follower output stage, V_{2A} . (We will not make mention of tube types since the only type used in the preamp is the 6EU7, a twin triode.) NAB equalization is applied at V_{1A} with the internal resistance of the tube and its plate-load resistor being part of the equalization circuit. It should be noted that special attention is exhibited in the low-level stages in that low-noise resistors are used in the cathode

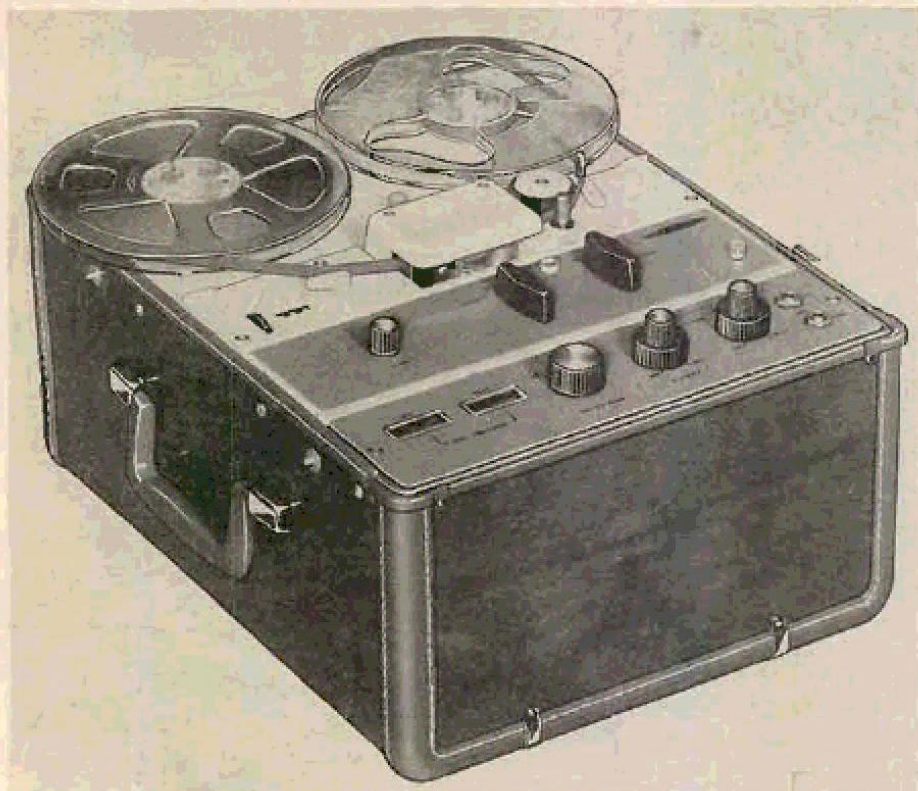


Fig. 1. Heathkit stereo tape recorder, Model AD-22.

and plate circuits of the first two stages in each channel. In addition, in these stages, d.c. heater bias and hum-bucking potentiometers are used to minimize hum.

The record circuit is, in a sense, the reverse of the playback circuit with several necessary embellishments. First of all, the record circuit accepts signals from both a microphone and/or a high-output source such as a tuner. This makes it necessary to have two sets of gain controls as well as entry points at different stages of amplification. Next it has a VU-type motor for monitoring the input signal in each channel before it reaches the record head. Also record bias is necessary to enable the signal to be recorded on the tape with minimum distortion; this requires a bias oscillator. An erase head is provided so that the tape carries no signal by the time it reaches the record head. Finally, the recording curve (on the tape) is the inverse of the playback curve; if the two curves were "added up" the resultant curve would be a straight horizontal line. In addition, record equalization is different for the two speeds at which this machine can record, and thus additional circuitry is necessary.

We will not give a stage-by-stage description of the record circuit because it is rather straightforward and without any especially distinguishing characteristics. We should mention, however, that the bias oscillator tube is a 12AU7 and the oscillation frequency is 75,000 cps.

The power supply utilizes a full-wave voltage doubler followed by a four-section filter network for the B-plus voltage.

Construction

Previously we noted that a certain amount of experience might be helpful in constructing the AD-22. We were referring to the money-saving packaging concept which Heath pioneered. In addition to parts handling experience, a certain amount of mechanical *savoir faire* would be extremely helpful too. Let us hasten to say that this is not a criticism of the kit but rather an awareness of the inevitable mechanical adjustments and the difficulty in performing some of them on a completed unit. It's not just a matter of patience, that's not the type of experience we were referring to, but more a matter of being able to visualize how parts interrelate.

For example, we experienced some difficulty getting the rewind functioning properly. First we consulted the manual in that special section devoted to difficult problems. Unfortunately all the advice and analysis offered failed to locate the difficulty. Then we just propped the machine up so that the recalcitrant area was clearly in view and proceeded to operate the rewind control. Then the cause of the difficulty became clear: the arm which is supposed to move the rewind brake drum in contact with the idler was not moving far enough. It was then a matter of locating the point where the arm had become snagged. This turned out to be not as easy as we expected; the arm had gotten off its track in a rather hard-to-see way. Anyhow, the point of all this is that mechanical adjustments can be more complex than appears on the surface and being able to visualize operation is helpful.

In spite of the previous discussion, the AD-22 is really rather simple to build, both mechanically and electrically. The mechanical assembly was not in any way complicated by "tight corners" or difficult-to-understand directions. To the contrary we find the instructions concise and unambiguous.

Electrically, the AD-22 went together with extreme ease. Contributing largely to this is the printed circuit board which

mounts most of the preamplifier circuitry. Another major time and temper saver is the prefabricated harness for the power supply and oscillator chassis; the wires are all neatly loosed in position with break-outs at the proper locations to make wiring simple. A rather neat innovation in the manual is the combination of pictorial and procedure in assembling the components to the circuit board; the step-by-step procedure surrounds the pictorial of the board with arrows leading from the assembly step to the component location on the board.

The use of illustrations in the manual is almost lavish when compared with the type and number found in manuals a few years ago. On the other side of the ledger, we found some of them inconveniently placed.

As mentioned previously, it took us 16 hours to assemble the AD-22 with a certain amount of the time consumed by readjustments. We feel that is not likely that the mechanical adjustments will be completely correct until the entire unit is assembled (we are not referring to the difficulty we described before). In reality the possibility of checking mechanical operation is not suggested until after the electrical assembly has been completed and installed. We would suggest that the motor plug be installed and plugged into a power source, the knobs installed and the unit checked prior to starting the electrical assembly. For one thing, the mechanical "picture" will be fresh in mind, and second it will be easier to get at the mechanism.

Performance

The most significant characteristics for a tape recorder and playback machine are accurate speed, low distortion, high signal-

to-noise ratio, wide frequency response, and good separation between channels. In addition, an important characteristic is the way the machine handles tape.

In all these areas the Heathkit AD-22 performed well, easily meeting the published specifications. (We would like to point out that we have never tested a piece of Heath equipment which didn't meet all its published specifications easily—and the specifications are invariably well defined and valid.) In the area of speed accuracy we found it to be within 1 per cent at 7½ ips, and at that speed wow and flutter was 0.18 per cent. The harmonic distortion was specified with a 400-cps signal using NAB procedure, and with these conditions the distortion was 0.84 per cent. At the same recording level used in the distortion test, signal-to-noise ratio was 47 db and channel separation was 40 db. Frequency response at 7½ ips was within 3 db from 40 to 15,000 cps as specified although over most of the range it was within 1 db. The playback equalization was within NAB limits.

There are no published specifications for tape handling capability, but from our experience we would classify the AD-22 as a machine which handles tape well. That is, it had positive control of the tape under all running conditions, and it handled the tape gently. It should be pointed out again that this machine does not use pressure pads at the head and thus should have less head wear than machines that do.

In sum, we would rate the Heathkit very well for its performance characteristics in its category, suitable for the kit builder with some experience. It could also be appropriate for the less experienced builder with good mechanical ability. In either case, at its price it is an excellent buy.

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