

# PS Builds

A picture! All it took was one last twist of the "azimuth" knob.



At last! A workable home TV tape-recorder kit that shatters the

**By Ronald M. Benrey**

**I**T SOUNDED incredible. A TV tape recorder you build from a kit for about \$400? That's exactly what the note from our European Editor said. A small British electronics firm—Wesgrove Ltd.—was offering the kit for sale to experimenters and electronics hobbyists.

Its specifications were brief: The VTR-500 records and plays back black-and-white television when connected to any standard TV set.

But I was still staggered by that \$400 price tag. The cheapest factory-built TV recorders cost several thousand dollars. I know; I've gone shopping. Ever since PS reported the first prototype TV recorder for home use [Oct. '63], I've dreamed about owning my own personal machine.

What would I do with it? In the begin-

ning, I'd record the best TV shows so I could play them back whenever I wanted. I might even collect a tape library of televised plays, concerts, movies, operas, championship athletic events.

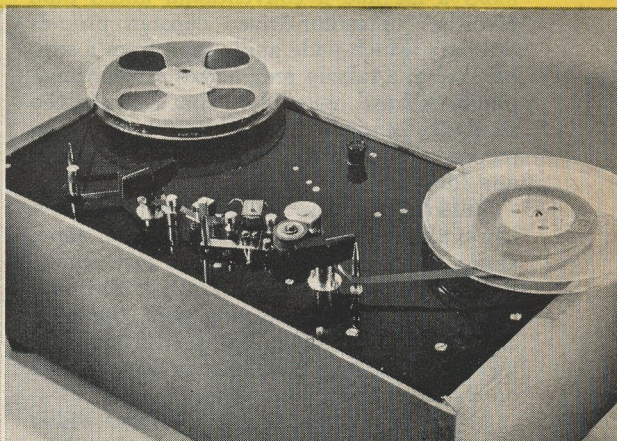
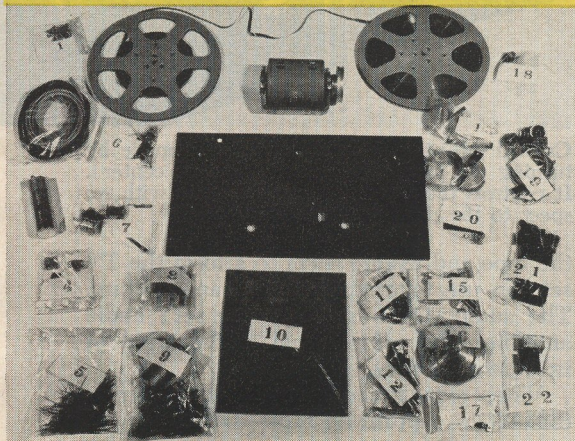
But that's not all. Why couldn't my wife record the Saturday-afternoon ball game? Then I'd be able to watch it in the evening when I came back from the golf course. Someday, I might even add a low-cost closed-circuit TV camera, and make TV "home movies."

True, \$400 buys a lot of lunches, but the VTR-500 was too good to pass up. I figured I could swing it without selling the family buggy.

Our kit had to be shipped to us from England, but if you want a VTR-500, you can order it from the new U.S. distributor: P.A.F. Enterprises, 32 E St., Bayonne, N.J. The price is \$405 FOB Bayonne.

# a TV Tape Recorder

...and so can you



Here's what the mailman brought. The parts were packed in numbered plastic bags keyed to the instruction manual. The kits are now marketed with the tape deck preassembled.

VTR-500 ready to roll: Note the tortuous threading path the tape follows past the heads. This photo shows seven-inch reels on machine; don't use them! Reason? See bottom of next page.

\$500 price barrier. Any electronics buff can build it. Cost: \$405

The chances are that any advanced electronics buff with a lot of patience can assemble the VTR-500. It is definitely not a kit for beginners. It took me 30 hours to bolt and solder things together, 20 more to

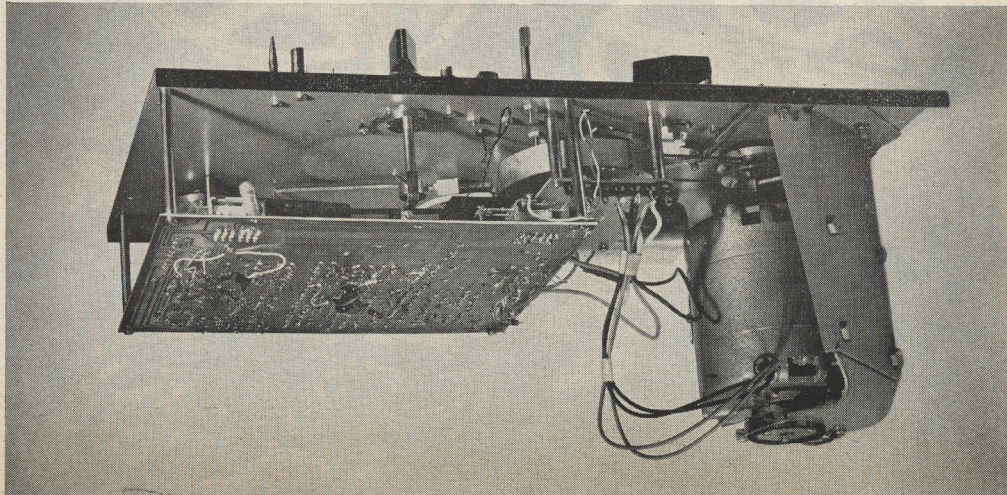
hook it to my TV set, and a final 100 hours to get the controls adjusted.

*150 hours later.* When it's finished, the VTR-500 looks as if it's built from surplus sewing-machine parts. It makes noises like

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Large printed circuit board holds a 23-transistor record-and-playback amplifier. The heavy

flywheel (to left of motor) stabilizes tape speed. The motor's rated at  $\frac{1}{10}$  hp.



a runaway lawn mower, occasionally chews up a reel of tape, and may catapult a half-full reel across the room.

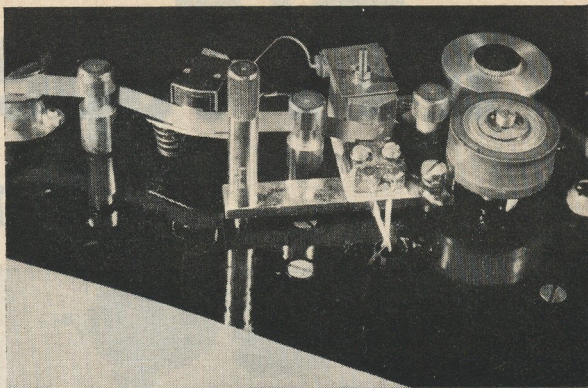
In spite of its shortcomings, the VTR-500 *does* record and play back television through my TV set. It doesn't have a single frill or luxury—not even a tape rewind—just the minimum equipment needed to do its job.

**How it works.** The VTR-500 in action looks a lot like a conventional audio tape recorder. A motor-driven capstan propels ordinary ¼-inch-wide audio tape from a supply reel to a takeup reel, across a recording/playback head assembly. That's where the similarity ends. The VTR-500 has two record/playback heads: one for video and one for audio.

Video signals are recorded on a narrow track along the bottom edge of the tape, audio signals on another track just above. Both tracks take up less than half the tape width. After one recording pass, the tape can be "turned" over, like a hi-fi recorder tape, and run past the heads again to record on its clear edge.

To make a recording, audio and video signals from your TV set are fed to the VTR-500's recording amplifier. The audio signal is taken from across the set's loudspeaker; the video signal, from the set's video circuitry. The recording amplifier "distorts" these signals in a precise way, transforming them into signals that can be recorded easily on magnetic tape.

The recorder's playback electronics undo the damage: They take the signals from



Critical adjustment—head azimuth—is made by turning the knurled-top shaft (left of center). It controls the slant of the video head with respect to the path the tape follows.

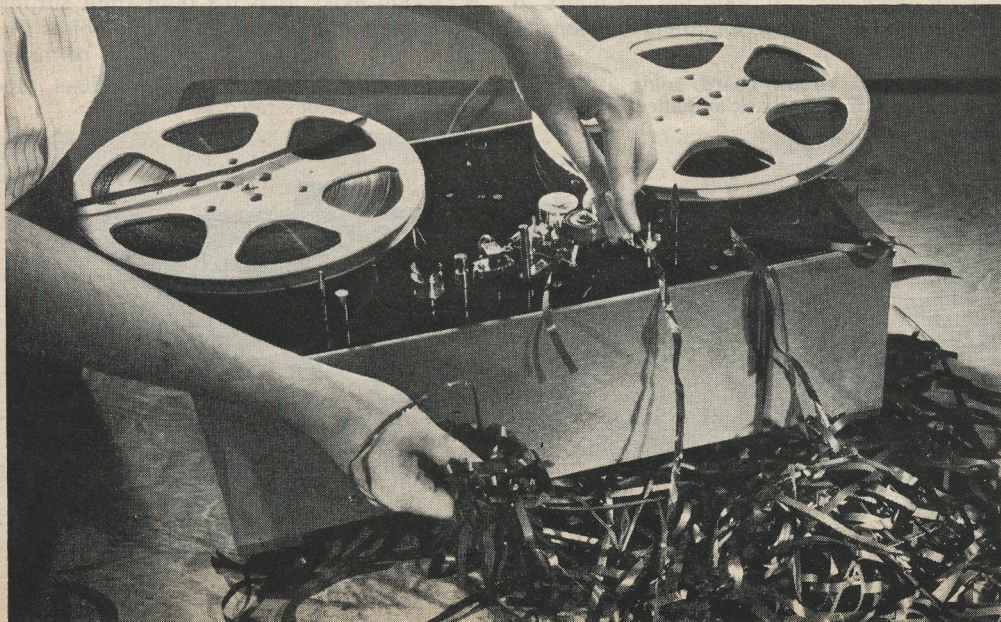
the tape and restore them to a form the TV set can use to produce sound and picture. The audio signal is fed to the set's audio amplifier; the video signal to the input of its video circuitry.

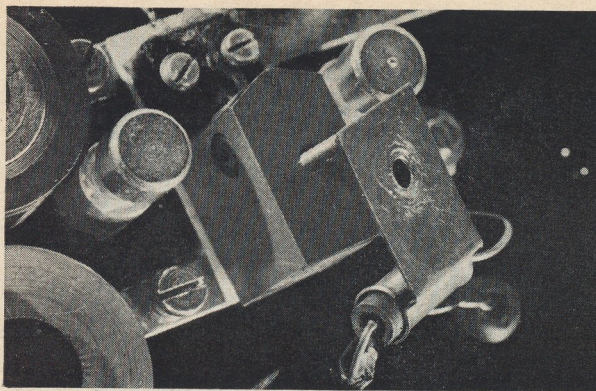
Video signals are wary beasts. They're difficult to capture on tape—that's why TV tape recorders are so expensive. A video signal is a complex blend of high- and low-frequency components that spans a frequency band almost three megacycles wide. Unless the recorder catches most of this band width, picture definition and contrast will deteriorate during playback.

The VTR-500 uses a brute-force method to achieve a wide video-recording band—a very high tape speed. Tape moves at an

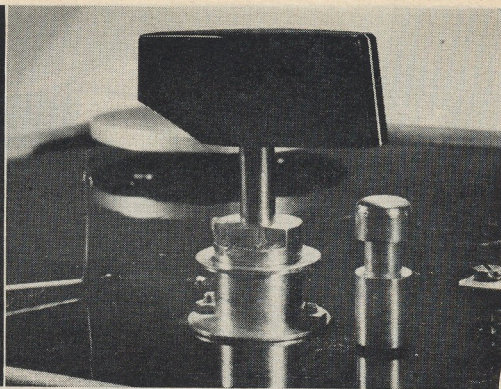
**Trouble:** This happened if: 1) the tape accidentally broke, 2) seven-inch reels were used,

3) the takeup-reel drive clutch slipped, and 4) any of the shaft-locking setscrews loosened.





"Head heater" helps cut down video-head wear. Tape glides smoothly across the heated metal head—its abrasive iron-oxide coating flowing, rather than dragging across the gap.



"Bias" magnet is mounted on control shaft. Tape rides over it, and is partially magnetized prior to recording. In first tests, its edges were too rough; it scraped oxide off the tape.

awe-inspiring 180 inches per second (24 times the speed of hi-fi audio tape).

At full gallop, the VTR-500 has a just-adequate video-recording band width of a little more than two megacycles: The picture is less than perfect—it's fuzzy and a bit jittery on occasion—but it's perfectly watchable.

There's a catch: 180 i.p.s. gobbles up tape at over 10 miles (or about \$50 worth) an hour. An oversize 11¼-inch reel of triple-play half-mil mylar tape lasts about 10 minutes. Run through in both directions, a jumbo reel records only 20 minutes of TV.

**Tricky work.** Moving tape at 180 i.p.s. takes a lot of power. The VTR-500's tape transport uses a ½-hp. motor to spin the tape-drive capstan (audio recorders get along with a fifth the pulling power).

Speed stability is a problem. Unless the tape is pulled past the head at a constant speed, the playback video signals won't synchronize the TV set's picture—it will "roll" and "tear" just as if the set's vertical- and horizontal-hold controls were set incorrectly. What causes speed instability? The worst culprits are dust and dirt on rotating bearing surfaces, uneven tape thickness, and power-line voltage fluctuations.

A heavy, balanced flywheel on the capstan shaft works at keeping the tape speed relatively uniform, and the transport's stiff steel baseplate fights—but rarely eliminates—tape-twisting vibrations that cause additional instability. Unfortunately, as the instruction manual points out, the VTR-500's simple mechanical system just isn't capable of maintaining sufficiently constant tape speed. The recommended solution is a sim-

ple circuit addition to your TV that enables it to lock in on the wavering video signals.

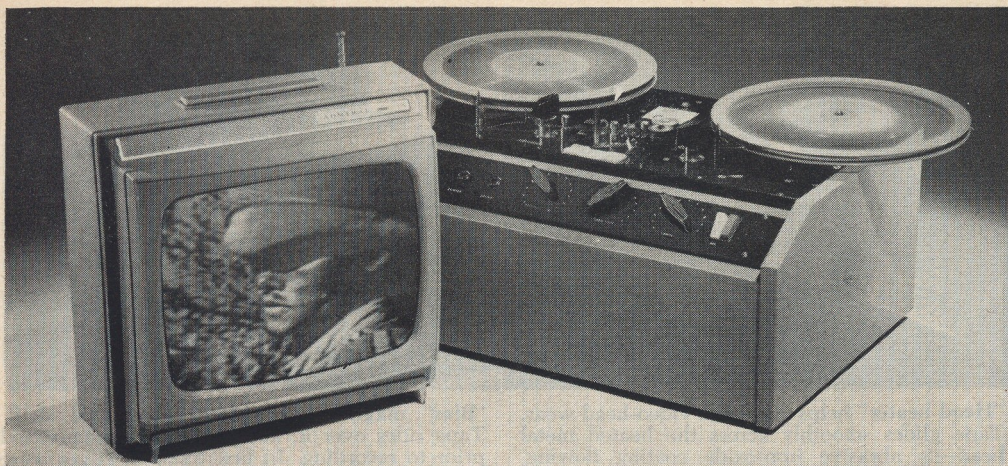
Next to watching playback of a TV show, the most amazing sight from the VTR-500 is the horrendous tangle that develops if the tape goes haywire. If the tape breaks or slips out of its guides, usually 200 or so feet of tape wind up on the capstan before you can cut the power. The only way to get the tape off the capstan is with a razor blade.

**The heat treatment.** Even at low audio-recorder speeds, the tape's iron-oxide coating acts as an abrasive; at 180 i.p.s., wear of the critically proportioned video head becomes a formidable problem. The recorder has a unique solution: Whenever the tape is moving, the head is heated by an energized one-watt power resistor strapped to it with a copper bracket (the head gets warm to the touch).

The tape's oxide coating tends to flow smoothly across the heated head, rather than rub across it. As a result, the video head has a rated life of about 200 hours. A replacement costs under \$10. Audio-quality triple-play tape holds up for about 100 runs; lubricated "instrumentation" tape lasts considerably longer.

**Is it hard to build?** Putting the VTR-500 together was a relatively straightforward job: Mechanical assembly was simple and the electronic components plugged into an easy-to-wire printed circuit board. If you build one, you'll have even less work to do: New kits have a preassembled tape transport.

The most time-consuming tasks are finding the correct settings for two critical



Don't want to pioneer? For the less-adventurous TV taper, there's a prebuilt, pretested

version of VTR-500, the VTR-600. It's more refined, has added controls, costs \$550.

controls: video-head "recording-bias" current level, and video-head "azimuth." The only way to find the ideal points is by trial and error—and it can take weeks of spare-time fiddling.

Recording bias is the DC fed through the video head when it's recording a signal on the tape. Its level is set by a small rheostat. Azimuth is the relative incline of the video head to the path of the moving tape.

Should *you* build one? If you have an uncontrollable urge, as I did, to own the first TV tape recorder on your block—and you have a solid knowledge of TV electronics—go ahead. Otherwise, consider buying the VTR-600, a factory-built version of the 500. It will cost you \$550.

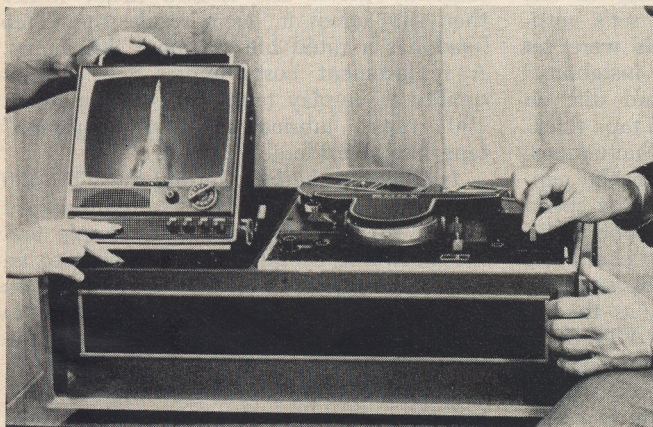
In all fairness: Our kit was a very early model and was loaded with bugs. Most

have been eliminated in newer recorders.

Instructions? The manual I got was the worst I've found in an electronic kit. The newly revised one is better, but still nowhere near as comprehensive as manuals of major U.S. kit makers. Forget the VTR-500 kit if you count on step-by-step, "solder-don't-solder" instructions.

Test equipment? The bare minimum is a multirange volt-ohm-ammeter for adjusting the critical control settings.

My conclusion is that although the VTR-500 has more rough edges than a sack of uncut diamonds, I got my money's worth when I bought it. To me, it's an electronic Model T—a working, bargain-basement TV tape recorder that's crudely designed and temperamental to operate. I hope you have as much fun building it as I did. ■ ■



### Sony Videocorder TV at slow speed

This new home-TV tape recorder has a rotating video head—like that on professional studio machines. The Videocorder uses a special ½-inch-wide tape looped in a half-spiral around a slotted drum containing a spinning video head. As tape is drawn around the drum (at a slow 7½ i.p.s.), the head records the video signal on narrow adjacent bands on the tape. With built-in TV set: \$995. Sony, 580 Fifth Ave., NYC.