>>> RANGERTONE

hi-fidelity
magnetic tape
recording equipment

Rangertone, Inc.
Electric-Music
73 WINTHROP STREET, NEWARK 4, N. J.
HUMBOLDT 2-0125
NEW PHONE NO.
HUMBOLDT 5-2550

July 1, 1948

Condensed Specifications for Rangertone Magnetic Tape Recorder

Frequency Response
$7\frac{1}{2}$"/sec - 65 to 7,000 cps ± 2 db
15"/sec - 50 to 12,000 cps ± 2 db
30"/sec - 40 to 16,000 cps ± 2 db

Dynamic Range
55 DB at all tape speeds.

Distortion
Less than 2% harmonic at all tape speeds - constant current recording employed.

Maximum Playing Time
$7\frac{1}{2}$"/sec - 3 hours
15"/sec - $1\frac{1}{2}$ hours
30"/sec - $\frac{3}{4}$ hours
A veeder type indicator graduated in minutes and seconds indicates playing time at all speeds.

Flutter
Less than 0.2%

Timing
Accuracy of playback timing is within plus or minus 0.3% - instant start at full tape speed.

Monitoring
Built in monitoring facilities - VU indiction of input and output levels, Bias and erase currents - Input and Output attenuators provide a continuously varible loss from zero to infinity.

Editing
Edit and rewind controls permit tape movement and editing in either direction at any speed.

Braking
Dynamic (electric) braking is utilized through out.

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NEW PHONE NO.
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Frequency Response
$7\frac{1}{2}$"/sec - 65 to 7,000 cps ± 2 db
15"/sec - 50 to 12,000 cps ± 2 db
30"/sec - 40 to 16,000 cps ± 2 db

Dynamic Range
55 DB at all tape speeds.

Distortion
Less than 2% total harmonic at all tape speeds - constant current recording employed.

Maximum Playing Time
$7\frac{1}{2}$"/sec - 3 hours
15"/sec - $1\frac{1}{2}$ hours
30"/sec - $\frac{3}{4}$ hours
A veeder type indicator graduated in minutes and seconds indicates playing time at all speeds.

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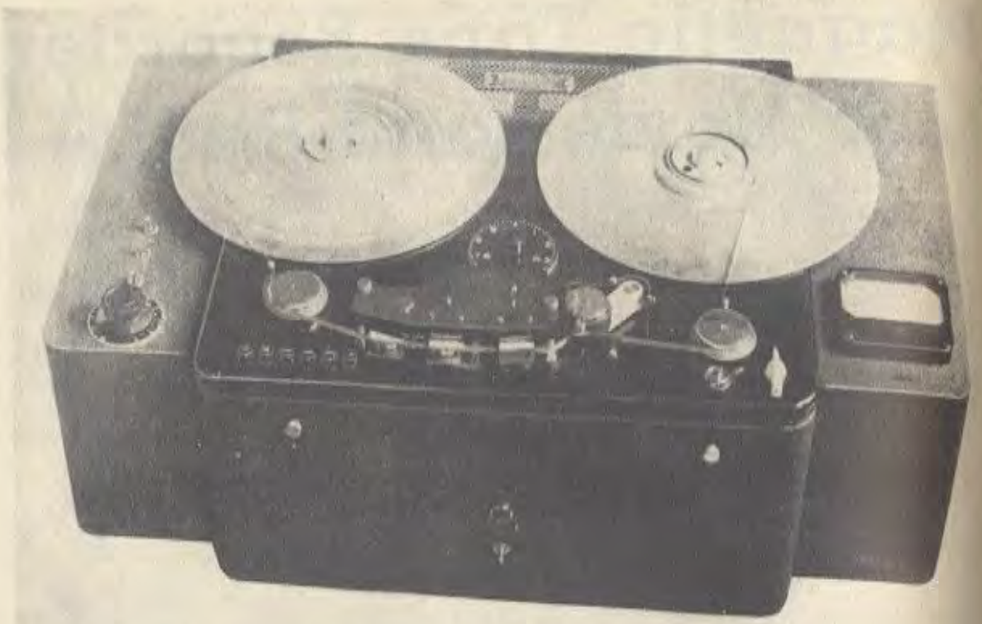


Initial production model of the magnetic tape recorder. Tape runs from left to right. The recording, erasing, and playback heads front and center

Magnetic Tape Recorder for Movies and Radio

New equipment using improved tape driven by three motors at a speed of thirty inches a second has an overall response flat within 4 db from 32 to 9,600 cycles. Overall design considerations and circuits for the recorder-reproducer are shown and a word spotter for editing is described

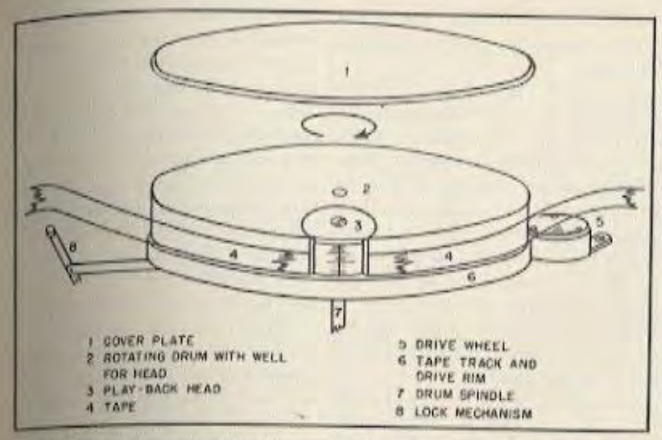
By RICHARD H. RANGER

President, Rangertone, Inc., Newark, N. J.

THE BASIC FACTORS underlying the magnetizing of ferrous wires as a means of recording, storing, and later reproducing intelligence have been known since the turn of the century, and more recently the expansion of the technique to include ferrous oxides on paper or plastic tapes has been well developed[1].

In Germany, magnetic tape recordings were used by broadcast stations and the military during the war. The technique was probably developed to its highest point in the so-called K-7 Magnetophone manufactured by Allgemeine Elektrische Gesellschaft. The recordings consist essentially of iron rust supported on a synthetic tape of great inherent physical strength. The tapes pass rapidly and uniformly by erase, record, and pickup heads.

A method of using a frequency in the order of 100 kilocycles as a means of erasing and preparing tape for recording audio currents has been worked out to give a quality of reproduction not heretofore approached. Using an early model Magnetophone and what information has become available in this nation has become available in the United States through reports of Army Intelligence missions[2], pro-



Artist's sketch of the word-spotter that can be plugged in replacing the triple head. A still newer device will operate in two different ways: with the play-back head stationary and the tape moving normally by, or with the head revolving past the stationary tape

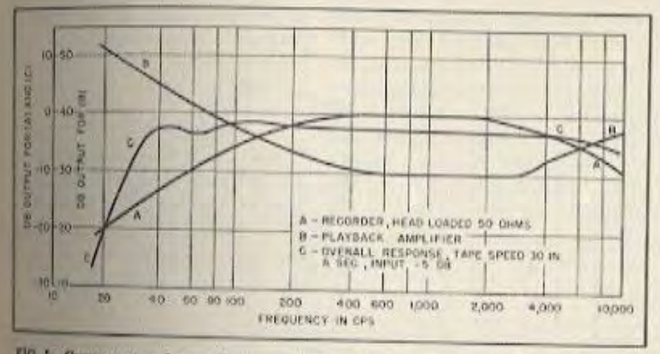


FIG. 5—Component and overall response curves for the magnetic tape unit. Curve A shows the recorder alone with no input equalization. The amplifier response is superimposed in curve B (note the different vertical coordinates); while the combined response is given in C

ror in this alignment will easily result in a variation equivalent to the width of the gap across the quarter-inch tape. This alignment can be achieved through the use of a microscope set up with sturdy longitudinal and vertical movement controls. Actual alignment adjustment is made by screw adjustments on the top of the head assembly, and can be accomplished in the field with the tape in motion. For this purpose, a standard tape recorded at 6,000 cycles with 50 percent modulation is furnished. Adjustment can then be made by observing maximum response, and setting the adjustment screws to this position. With the pickup head adjusted it is then possible to align the record head. For this second check purpose, a blank tape is used, and recorded with a 6,000-cycle signal put on the recording head. The pickup head is not readjusted during this operation, but its maximum response is noted as the record head screw is adjusted.

Gap Spacings

The recording head has a normally wider gap than that of the pickup head. There seems to be an improvement in using a slightly larger gap than that in the playback. In recording, the signal laid down on the tape seems to be primarily a function of what is happening at the pole piece edge where the tape leaves the recording gap. This edge should be as straight as possible. The magnetism that will remain in the tape may be considered as a statistical average of the effects the tape has undergone, caused by both the audio recording and the high frequency bias as it passes through the gap fields. This statistical average is finally influenced more by the flux immediately on the edge of the gap where the tape last passes than it is at any other point.

This phenomenon has two beneficial results; it increases the free magnetomotive force ready to go up into the tape at the trailing edge, and it makes the resultant lines of force appear to pass up more vertically into the tape and thus increase the definition.

The alignment of the erasing head is not at all critical; it is 20 mils wide. In much the same manner as demagnetizing a watch, the purpose of the erase head is to create a rapidly alternating magnetic field that increases and decreases as the tape passes through it. In consequence the tape is left neutral magnetically. Noise on the tape is entirely a function of the statistical averaging of the so-called domains of magnetization, and where there is as thoroughly a random condition as possible, noise will be at a minimum. It is obvious that the high frequency bias accomplishes this same improvement in quality on recording, by leveling this statistical average to that value required to represent the desired audio response.

Equalization of Amplifiers

The amplifiers for this recording system have gone through considerable progressive evolution. Generally speaking, it appears that for the recording head virtually constant response with respect to frequency change is the optimum. However, there are some who believe that a slight increase for the low and high frequency may be desirable. For the play-back, however, post emphasis may be used to completely realize a straight line frequency response from whatever signal has been put on the tape. The actual response on a tape with no post emphasis, and recorded with a constant current input to

the recording head is shown in Fig. 5A. The response rises to a maximum around 1,000 cycles in a head loaded for 50 ohms. For an unloaded recording head, maximum response will occur at about 4,000 cycles. The play-back amplifier is therefore compensated for these conditions so that its response follows curve B. The final result of the overall recording and reproducing amplifiers is shown in curve C.

Tape Drive

It is essential that constant tape speed be maintained. Three motors are employed to insure constant tension at all points in the tape path. One of these motors is to the left and on normal playing it controls the release of the tape reel. It must oppose this release with a torque fairly constant from start to finish. The second motor is synchronous and holds the tape rigorously to the rotational speed of this motor by means of a sleeve on its shaft which presses against a rubber idler. The third motor is on the right and drives the take-up reel. As the reel builds up in diameter with the successive layers of tape the moment arm increases with the radius; the larger the reel the slower the rotation. These two facts show the necessary relation between rotational torque of the motor and speed. It is necessary for the motor drive on both the tape take-up and release spools to have a curve of torque inversely proportional to the speed of the reel. Although it has not been possible as yet to obtain a straight-line function for this curve, modification of the rotors of normal capacitor start and run motors has resulted in the characteristic indicated in Fig. 6. Whatever the rotational torque of the motor, the pull on the tape will decrease with increasing radius.

Editing Aid

Use of the equipment for broadcast or sound-track dubbing has been greatly enhanced by the recent development of a "word-spotter". Still in the experimental stage, the device has been arranged to plug in, replacing the conventional head assembly, and is driven by the sync motor spindle and rubber idler that customarily pulls the tape. The large driven drum of the spotter has a circumferential groove slightly wider than the tape. A playback head is mounted flush on the edge of the drum, so that if a short length of the tape is held stationary in the groove, musical chords, syllables or short words are repeated over and over. By this means it is easily possible to spot desired portions of a recording with uncanny accuracy.

Experiments now in progress indicate that the machine may prove useful as a memory device for computer systems, since the shelf life of magnetic wires and tapes has so far proved to be indefinitely long. In order to eliminate errors resulting from possible cold flow of the plastic tape used as the base for the magnetic powder, investigations are being made of Fiberglas tape as a support for the recording medium.

THE VALUE OF MAGNETIC TAPE RECORDING

Interest in magnetic tape recorders is particularly high among three groups.

Film makers are eager to explore the possibility of using magnetic tape as a simpler, cheaper means of recording, editing, and dubbing in the eventual sound track of sound movies.

The success in recording one prominent radio show has led to strong pressure by other artists for similar handling of their productions.

F-M broadcasters, dependent in many cases upon recorded music for the bulk of their present programming, have also taken a keen interest in magnetic tape

Table I—Head Characteristics

Head	Turns	Resistance (ohms)	Impedance (ohms)
Erase	100	1	2,000
Record	600	10	11,000 at 70 kc 560 at 1 kc 58 at 100 cycles
Play-back	600	10	560 at 1 kc 58 at 100 cycles

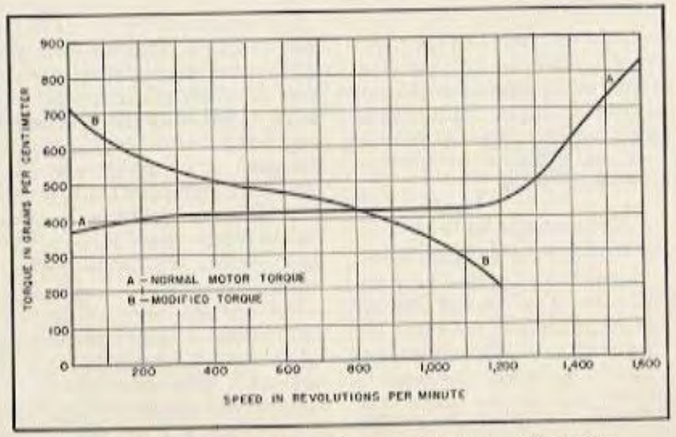


FIG. 6—Modifications in the torque characteristics of motors for recorders

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(2) A Bibliography (a free publication) Reference Service Section, Office of Technical Services, Department of Commerce, Washington 25, D. C.

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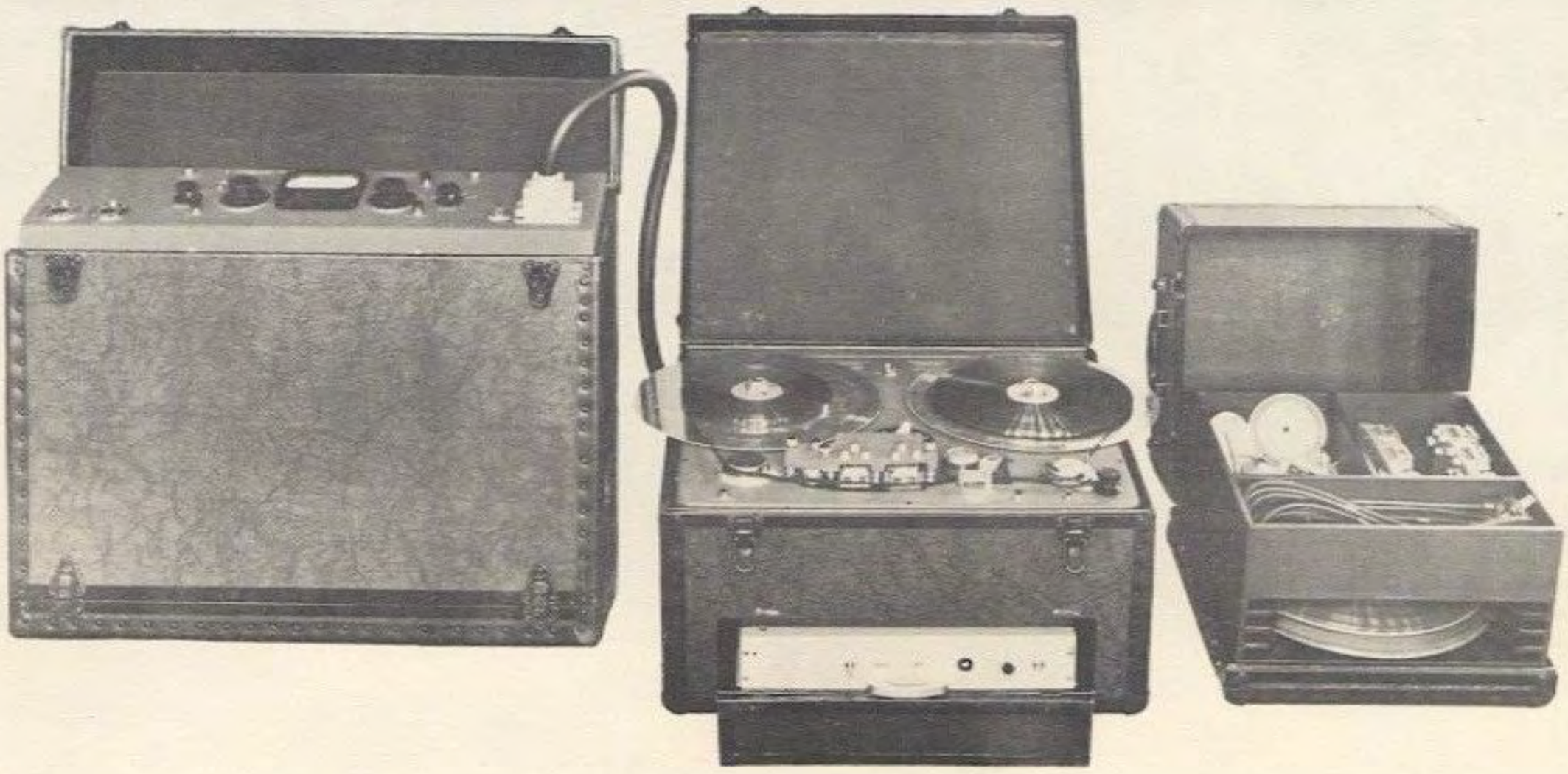
(1) Magnetic Sound for Amateur Movies, ELECTRONICS, p 140, March 1947.
(2) R. H. Ranger, Design of Magnetic Tape Recorders, Tele-Tech, p 36, August 1947.

R-4 TABLE MODEL



R-4P PORTABLE MODEL

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