RECORDING ON WIRE

By I. QUEEN

RECORDING on magnetic wire or tape is used for voice analysis, business purposes, Signal Corps work and broadcasting. The latter has been especially popular in Europe for a number of years. Wire recording is economical, simple and possesses the unique advantage that it may be used over and over again by simply "erasing" the sound on it. One disadvantage is that the fidelity obtainable is not as good as with other methods.

Magnetic recording was originated in 1898 by Valdemar Poulsen, who used a steel wire which passed through a changing magnetic field and became correspondingly magnetized. When the wire again was passed through a coil (possibly the same one) the varying magnetic field induced an EMF which reproduced the original sound.

The curve of magnetic intensity vs. magnetization is not a straight line at its lower end, so much distortion results from this method. A later system provided for original magnetization of the wire and subsequent demagnetization by the changing magnetic field (due to an impressed sound frequency voltage). Better fidelity is thus possible since the upper end of the magnetization curve is more nearly linear. However, a magnetized wire is very sensitive to external influence and is easily demagnetized by stray fields and shocks introducing noise.

The recording medium may be either a round wire or a flat tape. Wire is easily obtained, but tape allows simplification of apparatus since it cannot twist during travel. Because of the latter characteristic, wire is recorded longitudinally or through the wire (Fig. 1-a), and tape transversely or across the medium (Fig. 1-b).

Wire speed has a marked effect upon fidelity. Fig. 2 shows a typical curve of output vs. frequency for three different speeds. Each characteristic is also a function of the type of medium, its size and the strength of magnetizing force.

A series of inventions relating to magnetic recording and assigned to the Armour Research Foundation of Chicago has recently been disclosed by the inventor, Marvin Camras. These include a complete design for a modern wire recorder, new and improved recording methods, and several accessories of great importance for making better records.

Fig. 3 shows front and side views of a preferred form of recorder. The top panel contains the two reels for holding the wire, which may be of .005-inch diameter high carbon steel. Friction and guide rollers keep the wire in position while passing through the recording and erasing heads. In recording and reproducing, motion is from left to right, after which the wire is rewound back to the left-hand reel. On the bottom panel is the speaker, footage indicator, motor switch and other controls. The neon bulb indicates volume. Below it is the record-playback switch, mounted between two pilot bulb jewels, the green to indicate when recording is taking place, the red for reproducing. Below these are two knobs, one controlling volume, the other a combined tone control-power switch. The motor switch has three positions: forward, stop and reverse.

The amplifier (shown in the side view) is of conventional three-stage pentode design. A high-frequency oscillator is also incorporated, its function being described later. In the output of the amplifier is incorporated an equalizer to improve fidelity. Fig. 4 is a schematic of the recording head and connections. For recording, the amplifier input is connected to a microphone, while the amplifier output is switched to the recording head through an equalizer. At the same time the oscillator is connected to the erasing coil so that any previous magnetization of the wire is erased. When reproducing, the equalizer and oscillator are not needed and are shorted out. The recorder is now used as a reproducer by connecting its output to the amplifier.

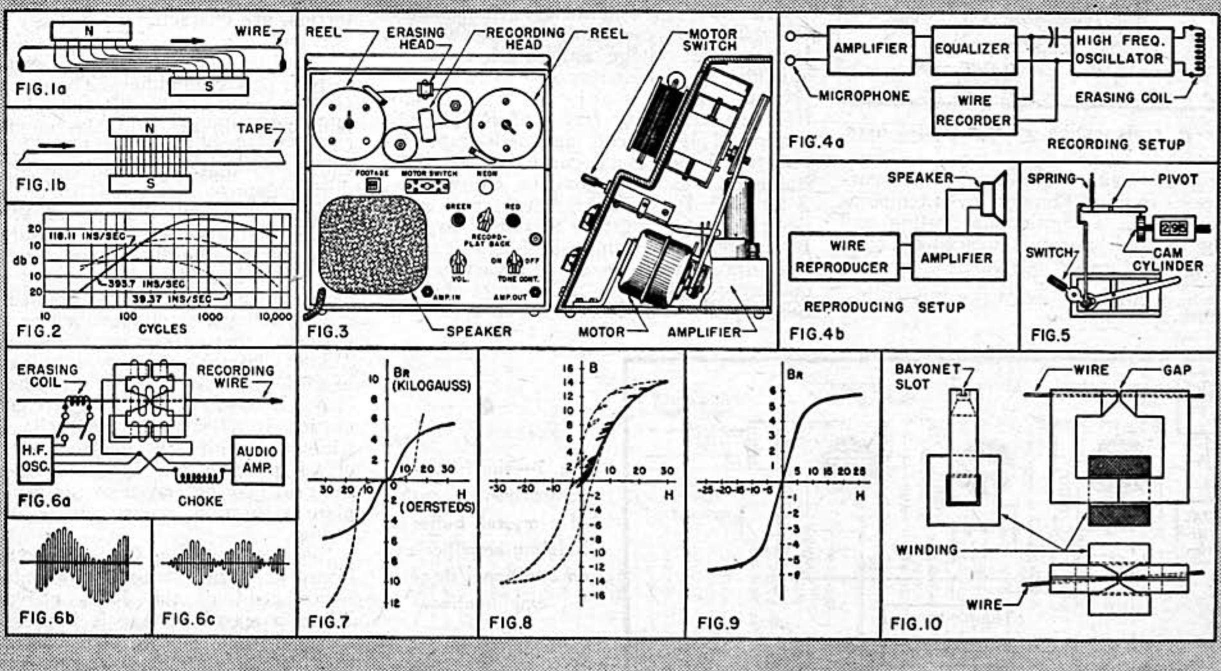
An ingenious method is used to stop the motor as either of the reels approaches complete unwinding (Fig. 5). A cam cylinder on the footage indicator shaft is shaped to have a groove and a raised portion on its circumference. The cylinder rotates only once for a complete winding of wire, and works in cooperation with an armature. As the wire becomes unwound in one direction, the cam follower drops into the groove, lifting the left end of the armature and pushing the switch into neutral. If the wire had been moving in the opposite direction (switch in down position) it would have caused engagement of the cam follower with a raised portion. The left end of the armature would then be pushed down against the abutment and the switch again pushed into neutral.

Connections to the oscillator are given in Fig. 6-a. In this diagram the high frequency and the amplifier output are *superimposed* in the recording head resulting in a wave shape of Fig. 6-b. This is not a modulation (Fig. 6-c).

Excellent fidelity is obtained when the wire is magnetized by means of a superimposed high frequency on the audio frequency.

The erasing coil is positioned so that the wire passes through it before reaching the recording head during a recording. The high frequency field, which may be in the neighborhood of 16 Kc demagnetizes the

(*Continued on page 367*)



RECORDING ON A WIRE

(Continued from page 345)

wire to erase any magnetism which may be present.

The full line curve in Fig. 7 is typical for soft steel and the dotted line is that of high carbon steel, for magnetizing force vs. wire magnetization. Note the non-linearity at the origin. Due to hysteresis, the curve begins at the origin (full line) but thereafter lags behind and forms the closed dotted curve, Fig. 8. Now with the superimposition of a high frequency small closed loops will be formed between the boundaries of the large closed loops and the wire will be magnetized to an average value, because of the rapid reversals of magnetism. (Fig. 9). The curve is now linear within wide limits and high fidelity is possible. It is found that in addition the high frequency component effectively ages the magnetized wire, and greatly increases the dynamic range.

A preferred form of recording head is the construction of Fig. 10. The laminated core is fade up of two pieces for convenience of manufacture and the coil surrounds the break. The pole pieces are tapered laterally on both sides and also on the underside, producing an intense longitudinal magnetic field. The air gap may be .001" to .002" for a wire diameter of .005".

In order that the wire may be replaced or removed without difficulty if necessary, a bayonet slot is built into the pole pieces. The horizontal portions of the slot are wider at the extremities so that the wire may be removed by merely twisting clockwise the protruding ends. At the same time the wire cannot accidentally leave the pole pieces during motion.

WORLD-WIDE STATION LIST

(Continued from page 357)

7.380	HER4	BERN, SWITZERLAND; off at 11 pm.
7.565	KWY	SAN FRANCISCO, CALIFORNIA; N. E. I. Beam, 8:30 am to 12:30 pm.
7.565	WNRI	NEW YORK CITY; European beam, 3:45 to 11 pm; 6:30 to 8 am.
7.575	WLWL2	CINCINNATI, OHIO; North African beam, 3:30 to 7 pm; 7:15 to 11 pm.
7.795	——	LEYTE, PHILIPPINES; U. S. Army—heard at 4 am.
7.805	KRCA	SAN FRANCISCO, CALIFORNIA; Hawaiian beam, 11 pm to 1 am.
7.805	WRUL	BOSTON, MASSACHUSETTS; Mexican beam, 8:30 to 10:15 am.
7.820	WOOW	NEW YORK CITY; European beam, 3:30 pm to midnight.
7.86	SUZ	CAIRO, EGYPT.
8.030	FXE	BEIRUT-LEBANON (SYRIA)
8.035	CNR	RABAT, MOROCCO; heard Sundays, 5 to 6 pm.
8.600	COJK	CAMAGUEY, CUBA.
8.700	COCO	HAVANA, CUBA; heard evenings.
8.830	COCQ	HAVANA, CUBA; 5:30 am to 1:30 am.
8.930	KES2	SAN FRANCISCO, CALIFORNIA; Hawaiian beam, 4:30 am to 1 pm.
8.945	COKG	SANTIAGO, CUBA; 7:30 am to 11 pm.
8.960	APH	ALLIED PRESS HEADQUARTERS IN ITALY.
8.985	COKW	HAVANA, CUBA; evenings.