VIDEO TALK

FROM THE MAKERS OF "SCOTCH" BRAND MAGNETIC TAPE

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Producing Visible Patterns on Magnetic Recording Tape

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The art of producing simple visible patterns for illustrating the location of magnetic fields ranges from the age old method of sprinkling iron filings on paper to the use of solutions containing finely divided ferromagnetic particles for editing television tape. This bulletin will describe some of the basic principles which are instrumental in producing visible patterns on magnetic tape and will relate these principles specifically to the subject of making the video control track visible for editing purposes.

A magnetized substance of magnetic material may be thought of as containing an almost unlimited number of individually magnetized microscopic parts, each with its own north and south pole. If the degree of magnetization in each of these nearly infinitesimal magnets is equal and if their poles are oriented in the same direction for any appreciable distance along the surface of the material, the substance has very little attraction for other ferromagnetic substances located at a small but finite distance away.

This is because the average distance from any point outside of the substance to any one or more of the microscopic south poles is essentially the same as the distance to any one or more of the microscopic

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north poles. Accordingly, their effects cancel each other, and little or no net attraction occurs. This is essentially true whether the magnet in question is heavily charged (microscopic poles laying end to end) or demagnetized (microscopic poles with random orientation). Since the length of the microscopic pole is very short, the two conditions referred to result in little or no net attraction to substances located a respectable distance away.

By way of illustration, one might consider a long but conventional bar magnet. The degree of attraction to a soft iron nail held at or near the magnetically uniform center of such a magnet is negligible as compared with that at or near either end, where the magnetic flux density is undergoing rather violent changes per unit of distance.

A magnetized media such as recording tape, therefore, will most readily attract finite magnetizable externally located particles at points along its surface where the rate of change in magnetic strength is maximum rather than where the sheer flux density is maximum.

Figure 1 describes the foregoing principles as they might be applied for interpreting visible patterns corresponding to the control track signal on television recording tape. For sake of illustration, the input recording current has been taken as sinusoidal. (Graphic illustrations are not to scale.)

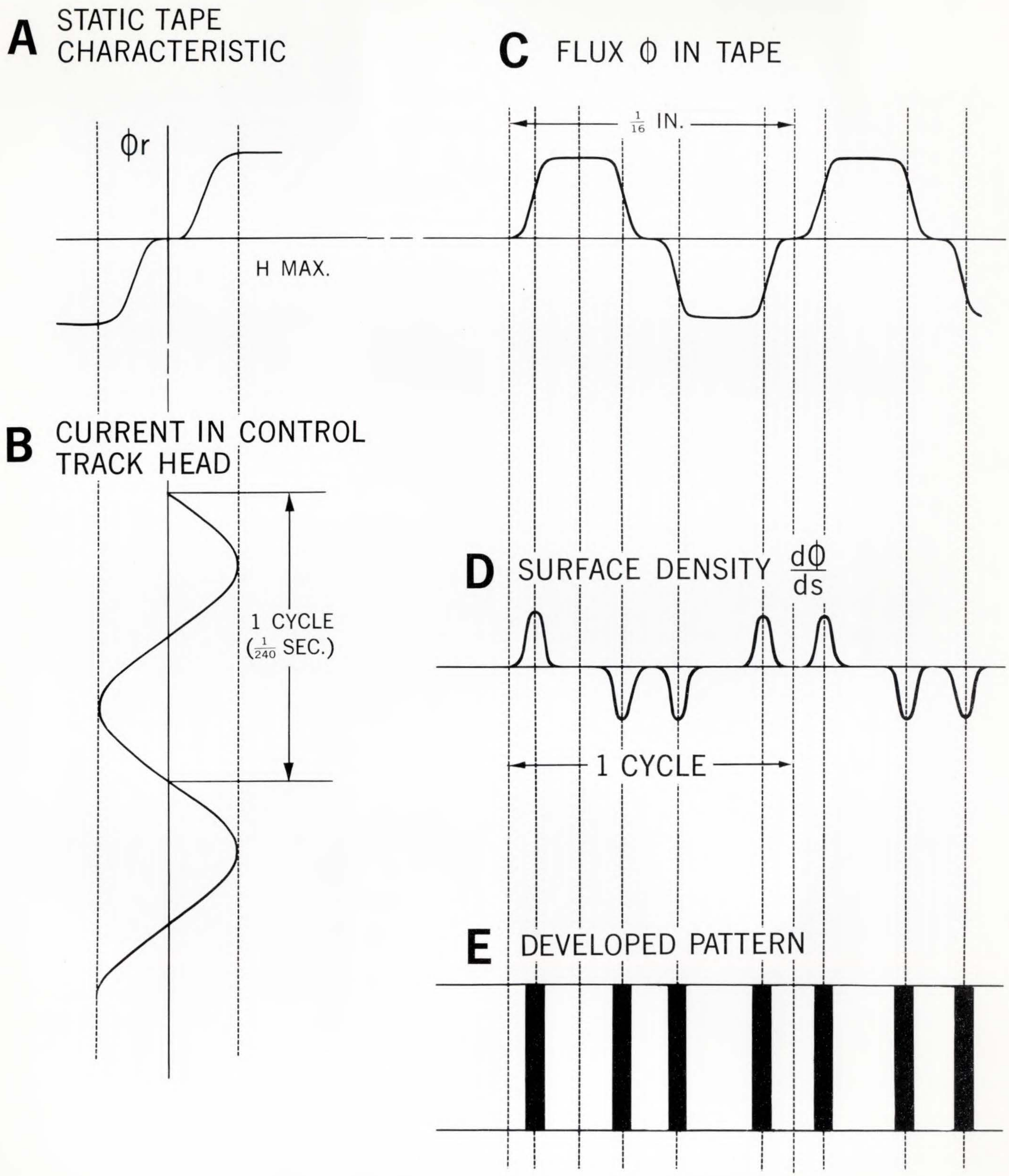
Where there is a change in magnetic strength along a magnetic material, the cancellation effects previously referred to diminish markedly and there is a net attraction for any nearby magnetizable object or substance, such as carbonyl iron powder.

Normally one would expect a sinusoidal recording to have two equally spaced poles per cycle; that is, a north pole alternating with a south pole. As shown by diagram E of Figure 1, this is not the case since four unequally spaced poles appear in each cycle of recorded information. The spacing of the poles suggests that a "gap" is opened up in the middle of each pole of a normally recorded sine wave.

The explanation of this paradox lies in the fact that supersonic bias is not used in the recording channel for the video control track. Consequently, the flux distribution in the tape represents a highly distorted wave shape even though the current in the recording head is sinusoidal.

This distortion can be illustrated by the series of diagrams in Figure 1. The static characteristic of the tape is shown in diagram A. This is a plot of the remanent flux, ϕr, in the tape as a function of the maximum field intensity, H max, to which the tape has been subjected. Note that the

FIG. 1 EXPLANATION OF "GAP" IN VIDEO CONTROL TRACK PATTERNS



curve is very nonlinear in the region of small values of applied field.

If the tape is moved at a uniform velocity through a sinusoidally varying field, represented by the signal in the control track head B, the resultant flux can be determined graphically by projecting points on curve B upwards onto the static characteristic A. The intersection on curve A can then be projected to the right and plotted against new uniform time axis as in C. In a tape moving at uniform velocity, time and distance along the tape are linearly related. The flux C therefore can also represent the longitudinal flux distribution in the tape.

However, the pole strength along the tape surface, which is the determining factor in attracting the developing solution, is not measured by the flux in the tape, but by the flux density *coming out* of (or *going into*) the tape. This surface flux density is shown in curve D. Note that this curve has two peaks in each direction for a total of four per cycle of recorded information. These peaks correspond to the four regions of rapidly changing flux in the tape. Note also that the effect of the nonlinear region in the tape characteristic is to interrupt or cause a gap to open up in each pole of a normally recorded sinusoidal signal. The visible pattern which would be predicted from this graphical analysis is shown theoretically in diagram E of Figure 1. An actual pattern is shown photographically in Figure 2.

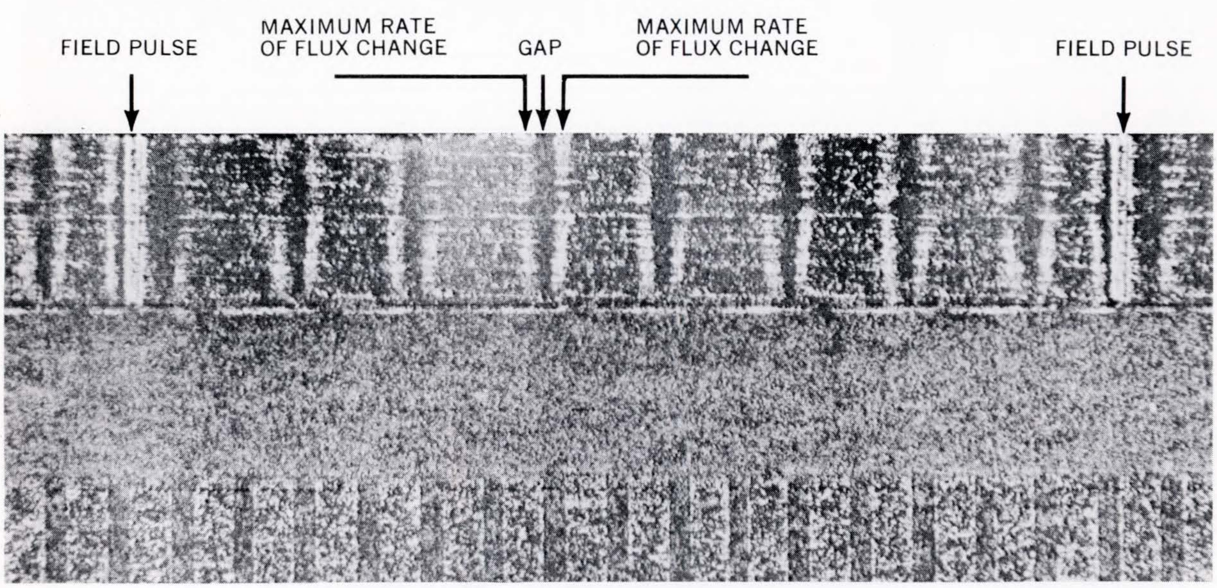


FIG. 2 PHOTOGRAPH SHOWING DEVELOPED CONTROL TRACK PATTERN.