VIDEO NEWS

PICTURES ON TAPE

by C. G. Dixon.

Basically, any picture which can be reproduced by electrical means is capable of being recorded on magnetic tape. If one wants to record 25 pictures per second, each containing a large amount of fine detail then one is faced with the problem of recording frequencies up to 3,000,000 cycles/sec. Television recorders, or video tape machines, are therefore very complicated and expensive. In the early days of television the BBC broadcast rather crude 30 line pictures which were received by a handful of enthusiasts who made their own receivers with whirling Nipkow discs. To assist these early TV amateurs some records were produced on which pictures were recorded with a maximum frequency of 10,000 cycles/sec.

A third type of picture transmission is that which is used for sending newspaper photographs from one part of the world to another by radio; this is called 'facsimile' and it involves the transmission of single photographs in great detail. Each picture takes several minutes to transmit and is reproduced on a piece of photographic paper wrapped round a drum. This type of picture transmission was also broadcast by the BBC in the 1930's but the idea never caught on and broadcasting finally ceased.

Intermediate between true television and facsimile we have a system which has been called " slow scan television " in which the rate of scanning is such that a picture is built up on a cathode ray tube in a time of 1 to 10 seconds and is continuously being renewed. The type of cathode ray tube used for radar display is eminently suitable for this purpose as it has a persistent phosphor which retains the light and shade imprinted on it for several seconds. It is impossible, of course, to portray movement and this system is thus limited to still pictures; nevertheless pictures can be sent in quick succession one after the other, and this is undoubtedly the technique used by the Ranger VII rocket which sent back pictures from the moon. The first successful slow scan pictures were produced by Copthorne Macdonald in the USA, although members of the British Amateur Television Club had already been experimenting along similar lines. 'Cop' Macdonald's system involved a line frequency of 20 cycles/sec. and a picture read-out time of 6 seconds thus giving a 120 line picture. The signal was impressed on a 2,000 cycles/sec. carrier which carried positive going synchronising signals in addition to the video signal. J. Plowman, of Yeovil, and I, each built monitors to display tapes received from the USA and these were successfully demonstrated at various radio shows in different parts of the country. In addition, a very remarkable event occurred on November 22nd, 1959 when J. Plowman received transatlantic pictures direct from 'Cop' Macdonald who was transmitting in the 10 metre amateur radio band.

Since then, tests have shown that a frequency modulated system is much to be preferred as this combats the effects of fading, during radio transmission, and varying amplitude of recording due to slight variations in the magnetic coating. The use of an F.M. system, however, implies that each frequency must be reproduced faithfully and " wow " and " flutter " can cause variation in light and shade in the picture, so a good recorder is essential.

When faced with the task of designing a completely new system of image transmission and recording, one is faced with the problem of what standards to choose. The Americans, having a mains frequency of 60 cycle/sec. have chosen for their F.M. system a line frequency of 20 cycle/sec. and a frame time of 8 seconds giving a 160 line picture. As most radar tubes have round screens it was felt that a 1:1 picture ratio would make the best use of the screen area. With these figures we have 160 x 160 picture elements to transmit in 8 seconds which gives 3,200 elements/sec. and requires a maximum frequency of 1,600 cycles/sec. as each $\frac{1}{2}$ cycle of carrier wave can transmit a picture element. The Americans are thinking in terms of radio transmission over the crowded amateur radio bands where a band width of 2 or 3 kilocycles is usually all which is available.

On the other hand I am more interested in the tape recording of pictures and have chosen standards which make better use of the response of the average tape recorder which extends to 10, 12 or even 15 kilocycle/sec. As the British mains are at 50 cycle/sec. this was taken as the line frequency and with a frame time of 4 seconds this gives a 200 line picture. By simple arithmetic we get a frequency of 5 kilocycles/sec. and about 10 or 11 Kilocycles/sec. being at the lowest frequency during the sync. pulses and at the highest for peak white. It is interesting to note that if this variable frequency constant amplitude signal is passed through a system whose H.F. response falls off rapidly, there emerges a variable frequency signal with amplitude variation. In this way, Aubrey Black in Abersychan and Henry Chenery in Ringwood, Hants., have both resolved F.M. pictures transmitted by me, using monitors which were originally designed for amplitude modulation. When seen on a proper F.M. monitor, the detail is only slightly better than that obtained with American standards but the system scores heavily in its more rapid vertical scanning for the following reason. As the scanning takes place, a bright line is seen to travel slowly down the screen leaving a picture behind it; the glowing phosphor