IX. MULTIPATH TRANSMISSION

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A. NARROW-BAND LIMITING

Technical Report No. 252, covering this work, has been prepared and is scheduled for publication.

Further experimental work is being continued.

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B. FM TRANSIENT RESPONSE OF A BANDPASS FILTER

The FM transient response of an ideal rectangular filter has been investigated theoretically and the response of a practical filter has been studied oscillographically. The theoretical study did not reveal any new ideas.

In the experimental investigation the FM transients resulting from a frequency step within the passband of a 7-pole Butterworth filter were studied on a cathode-ray oscilloscope. The filter, which was the i-f section of one of the laboratory receivers used in the recent transatlantic FM tests, had a bandwidth of 32 kc/sec down to the 3-db points, with a ripple of 2 percent over a 26 kc/sec band. It was followed by a quick-acting limiter-discriminator section. The limiter and discriminator each had a bandwidth of 1 Mc/sec. Signals having frequency steps of varying magnitude and position within the filter passband were fed into the i-f section, and the detected instantaneous frequency variations were displayed on the oscilloscope. Photographs of typical observed patterns appear in Figs. IX-1 and IX-2.

In Fig. IX-1, the frequency steps were centered about the center of the filter passband, and the magnitude of the step was varied progressively, as indicated at the right-hand side of the photograph. Notice that as the magnitude of the step was increased, the rise time of the resulting frequency transient became greater. Another interesting phenomenon is the appearance of an inflection in the leading edge of the transient waveform. This inflection is apparently caused by the sudden change in either amplitude or phase (the two are interrelated) as the jumps approach and pass the 3-db points of the i-f strip.

Figure IX-2 shows a photograph of 5 kc/sec jumps decentered as marked at the edge of the picture. A general observation can again be made about inflections as the jump approaches one of the 3-db points. Portions of these curves look similar to those obtained by Hatton (1) for a single-tuned circuit.

One general observation that can be drawn from the photographs is that FM transient response is inferior to double sideband AM transient response. If the i-f characteristic used above is considered to be a rectangle 32 kc/sec wide, with linear phase, the AM

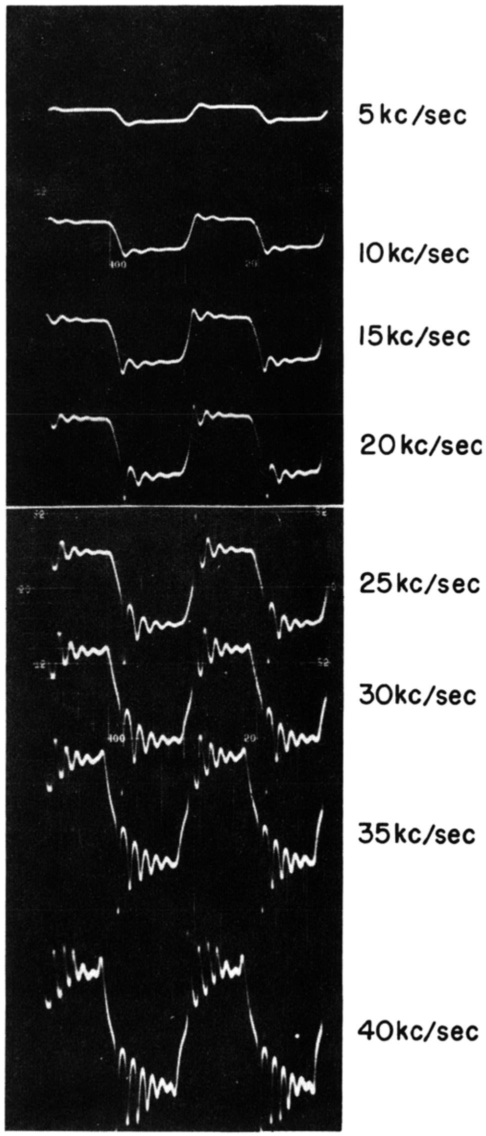

Fig. IX-1

Photographs of FM transient response; 7-pole Butterworth filter, 32 kc/sec between 3-db points; square-wave frequency, 1.5 kc/sec. All jumps are centered on band. Magnitude of jumps is noted at edge of figure.

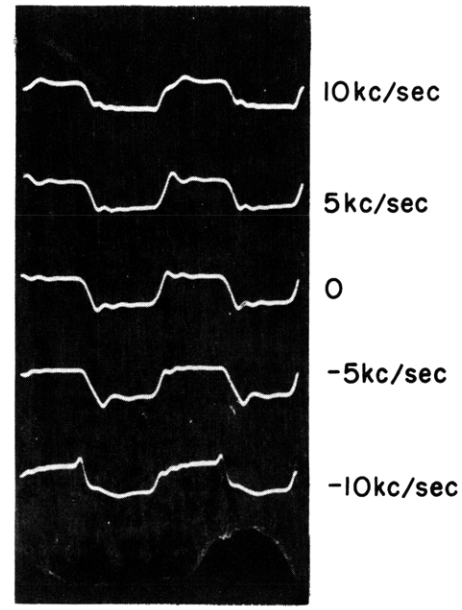

Fig. IX-2

Photographs of FM transient response; same filter characteristics as in Fig. IX-1. All jumps are 5 kc/sec, decentered as noted.

transient waveform would have a rise time of less than 60 μsec and an overshoot of 18 percent for all sizes of steps. The photographs show a minimum rise time of 65 μsec and a minimum overshoot of 20 percent for frequency modulation. The FM transient response becomes poorer as the size of step is increased.

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References

1. W. L. Hatton, Technical Report No. 196, Research Laboratory of Electronics, M.I.T., April 23, 1951.