Television reception with the superheterodyne

By R. William Tanner

Engineering details of the design of a superheterodyne receiver suitable for television.

HERETOFORE it has been almost impossible to bring in television signals on a superheterodyne with even fair pictorial detail. A number of manufacturers have brought out supers claiming that these receivers will tune in television stations. To be sure, ANY short-wave receiver will do this but the question is: "Will the resulting pictures have good detail?" The answer is: "No, unless the receiver is designed especially for such use." When this is done, it is of little or no value for other services.

The reason for this is easily understood when it is considered that the highest audio-frequency encountered in present-day television practice is slightly higher than 40,000 cycles with 60 line scanning.

It is readily apparent then that a receiver wherein the tuned circuits are capable of passing a band of frequencies 80 kc. wide without sideband clipping, would hardly suffice for broadcast reception considering the fact that broadcast stations are allotted channels 10 kc. apart.

The problems of television superheterodyne design are many and varied. Sensitivity is merely a matter of sufficient number of intermediate-frequency stages. To bring about the condition of 80 kc. selectivity, some drastic work on the tuned circuits is required. Band-pass filters, properly constructed, will, of course, solve this problem, but are not an absolute necessity.

Choice of Intermediate Frequency

The choice of intermediate frequency and the elimination of image frequency interference assume no mean proportions. Also, considerable thought must be expended towards reducing regeneration in the i-f. stages and second detector to a negligible quantity.

There are two factors upon which depends how high or how low the intermediate frequency may be. The high limit is determined, not by the gain per stage, because high orders of amplification are possible from 2,000 kc. on down, but by the fact that the second and third harmonics of the intermediate frequency must fall outside of the television band. It has been found that these harmonics will generally appear with sufficient intensity to cause serious interference if allowed to feed back into the first detector. At first thought, it would seem simple enough to filter out these harmonics appearing in the second detector plate circuit, but, actually this is extremely difficult to accomplish.

The low limit is determined by the problem of image frequency selectivity; that is, of keeping the second signal, which a given oscillator setting will heterodyne to the intermediate frequency, far enough from the desired signal so that great selectivity will not be needed ahead of the first detector.

Image frequency interference, as it it is termed today, is the old familiar repeat spot problem. Obviously, there are two oscillator frequencies which will serve to heterodyne a signal to the intermediate frequency, these being separated by twice the intermediate frequency. Also one oscillator setting will serve to heterodyne two signals to the intermediate frequency. To eliminate this type of interference, it is essential that the selectivity of the tuned circuits preceding the first detector be sufficient to definitely suppress the unwanted signal.

If the intermediate frequency is too low, excessive selectivity of the first detector tuned circuits will be required which would mean greater complication in the construction as well as increased cost of production.

Image Frequency Interference

Even with the highest possible intermediate frequency, one tuned circuit ahead of the first detector is not sufficient to eliminate image frequency interference. At least two are necessary, the simplest and least expensive arrangement being in the form of a two section band-pass filter. Considerable research with all forms of supers has proven that this band-filter can be adjusted to pass a band much narrower than that required in the i-f. amplifier and still give good pictorial definition. This makes it possible to design the two sections for, let us say, 20 kc. selectivity which would enable the operator to tune out a television station operating on the next channel.

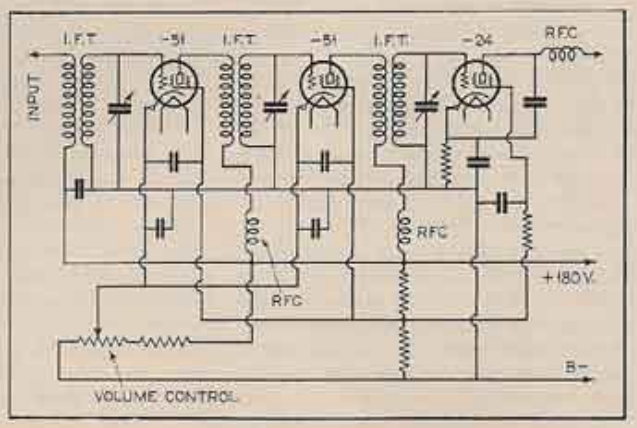

Fig. 1. Intermediate-frequency amplifier.

At the present time, the writer has a super in operation which uses regeneration in the first detector as well as a band filter. Here in Michigan it is practically impossible to bring in the east coast 60 hole stations when any of the Chicago 45 hole stations are on the air. Yet with the super just mentioned, by merely increasing first detector regeneration to a point where selectivity is sufficient, the Jenkins stations are brought in with fine detail and with no interference from Chicago. Increasing the regeneration up to the point of oscillation results in the noticeable decrease in pictorial detail but not to the extent that would be thought.

Considering all of the factors mentioned, together with much research work, it would seem that an intermediate frequency somewhere between 400

Television Not Ready, Says Aylesworth

By M. H. Aylesworth

President, National Broadcasting Company

Various interests already have placed television apparatus on the market. The broadcasting of television programs has been undertaken by others. But from the National Broadcasting System viewpoint, television is not yet ready for the general public.

While the company takes cognizance of the work being done in the receiver field, it does not believe that the time has arrived yet for visual broadcasting on a regular program basis.

And so, during 1931, N. B. C. engineers have continued their studies of television problems as applied to the sending of television signals, conducting numerous tests and investigations that must lead eventually to the inauguration of public television service on a high plane.

The television researches are being conducted by N. B. C. engineers from several points. Television transmitters have been operated at the Times Square Studio, in the R. C. A. Building, and more recently from the lofty top of the Empire State Building. The broadcasts are not intended at this time for the general public or even the television experimenters at large. They possess no entertainment value. Their sole purpose at this time is for the study of television transmission problems, particularly the influence of steel buildings on the propagated waves. The company aims to prepare a solid foundation for the healthy development of practical television in the future.

Every effort is being bent in this direction.

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