Television reception with the superheterodyne

By R. William Tanner

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 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.

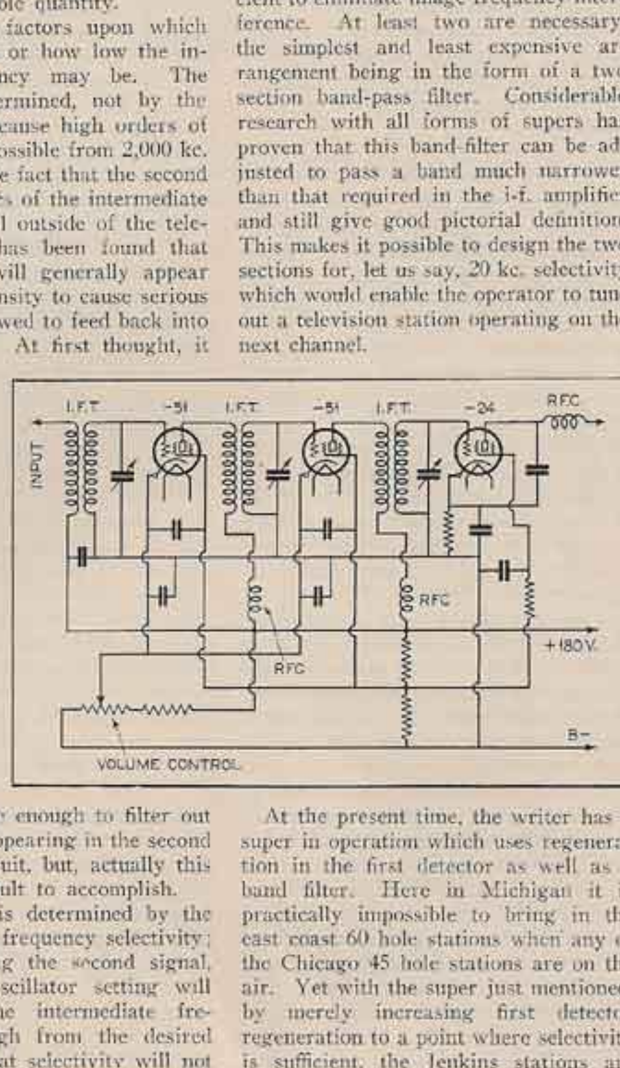

Fig. 1. Intermediate-frequency amplifier.

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

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

Television LighBeam Modulation

Television, transmitted experimentally on a beam of light, utilizing a wavelength of but a billionth of a meter, was successfully demonstrated here in the radio consulting laboratory of the General Electric Company, Dr. E. F. W. Alexanderson announced. This use of the ultra short waves, Dr. Alexanderson believes, opens the way to a new and valuable era in the art and promises to result in more distinct television pictures.

In the laboratory tests, the pickup device was of the conventional type such as used by Dr. Alexanderson in his previous television experiments. Instead of the electrical impulses being fed into a radio transmitter as heretofore, they were modulated into extremely high frequencies on a light beam from a high intensity arc. This beam was projected the length of the laboratory into a single photoelectric tube, which transposed the modulated light waves back into electrical waves. The electrical impulses reproduced the image by means of an ordinary television receiver.

"The work thus far is highly experimental, yet some day we may see television broadcast from a powerful arc light, mounted atop a single tower high above the city," Dr. Alexanderson said. "These modulated light waves will be picked up in the homes by individual photoelectric tubes or electric eye, instead of the present type wire antennae.

"Light broadcasting may have the same relation to radio broadcasting as the local newspaper has to the national newspapers. These light waves can be received at relative short distances only, perhaps ten miles. Each community could then have its light broadcasting system."

The greatest difficulty in television today, Dr. Alexanderson believes, is in the method of transmission. Radio waves usually follow several paths in travelling from the transmitter to the receiving station. Each day following a different path produces a different image so that a composite image is apt to be blurred. For this reason television has been tending toward shorter waves.

"The logical progress of this development," said Dr. Alexanderson, "is that in the future we shall explore still shorter waves, until we finally arrive at the light waves which we know travel in straight lines and which can be accurately controlled by such optical means as mirrors and lenses.

"When it was decided to take up experimentation on this subject Dr. Irving Langmuir of the research laboratory was consulted about the probabilities of being able to modulate to a source of light. Dr. Langmuir, who has done much research work with arcs, believed that this could be accomplished by using a high intensity arc. It was concluded that a most desirable light would be a high-intensity arc of the type where the light comes from the arc rather than from the crater. In the 10-ampere arc lamp used for the first test, most of the light comes from the crater, and comparatively little light is in the arc.

The lamp was used in such a way that the light from the crater was eliminated, and the arc used was therefore quite a weak source of light. The current from the standard television pick-up was superimposed upon this arc, and the light from the arc intercepted by a photoelectric tube at a distance of 130 feet. The photoelectric tube was then used to control our regular television projector. The television image transmitted in this way had the same sharpness of detail as the one ordinarily obtained without the interposition of the light beam.

In 1927 a picture three inches square on the screen was achieved by Dr. Alexanderson; in 1928 the first radio-television drama was broadcast from Schenectady; in the fall of 1929 a picture 14 inches square, not simply black and white like a silhouette but with all the gray shades for depth and detail, was produced; in 1930 Dr. Alexanderson sent television signals to Australia and back, and after traveling 20,000 miles, a rectangle still had four corners; and in the same year television first appeared as part of a regular performance at a theater in Schenectady with an image on a screen seven feet square.

Modulated light has also been used in many previous experiments by the General Electric Company. For instance, there is the talking beam of light that has been used at meetings and convention demonstrations, and the ship-to-shore communication of last summer with a talking light beam.

Radio World, January 9 1932