Super Power on Long Waves

This concludes Lieutenant Wenstrom's presentation of his case for long-wave broadcasting. He has pointed out the advantages which such a system would offer and also the problems involved—with some suggested solutions

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PART THREE

LET us assume that the next stage of long-wave broadcasting will begin with the gradual extension of long-wave stations, which should be put in operation at intervals until the national long-wave chain is complete. When the last transmitter is finished practically everyone in the United States should have available a 200 kc. signal of 1 millivolt per meter or better—a signal at least ten times as strong as most rural listeners have been accustomed to in the past. The ordinary listener should here enter a field which has previously attracted mainly the experimenter. The demand for custom-built adapters and tuners should show a marked rise—so marked, in fact, that custom builders may not be able to keep up with it. At this stage mass production of tuners and adapters might enter the scene. A demand should arise for custom built combination receivers, tuning to both the 200 kc. band and the present band.

The design of such combination receivers presents few difficulties. To cover the present broadcast band, having limits of frequency ratio about three-to-one, variable condensers are required which can tune through a capacity ratio of about nine-to-one. As even a very wide band between 1000 and 2000 meters entails a frequency ratio of only two-to-one, standard condensers will tune easily through any long-wave band that is likely to be used. The corresponding long-wave inductances must be about sixteen times as large (four times as many turns) as those used at present. For two band coverage, therefore, the logical design is two sets of inductances, as shown in Figure 1, with anti-capacity switches throwing either set across the tuning condensers and the remainder of the circuit. This arrangement would be particularly convenient in the superheterodyne where a common intermediate frequency can be used for both long and short-wave signals, but it would be applicable to tuned radio frequency sets as well. Aside from such arrangements, it is possible to build two tuners, controlled from a common dial or separate ones, into the same cabinet with common amplifier and speaker.

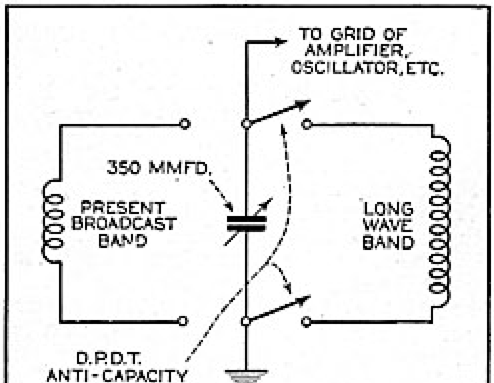

Figure 1. Band changing arrangement for use in a receiver designed to cover both the present wave-band and the proposed long-wave band

As the national long-wave system approached completion, receiver development would naturally tend towards complexity of design along with simplicity of operation. So many variables enter into possible selectivity and sensitivity requirements of the long-wave tuners that it is difficult even to guess at them. Will each long-wave station operate in a separate channel, or will the national chain be partly or wholly synchronized? How close to the new broadcasting channels will code transmitters of other services operate? No one can answer these questions at the present time. In general, selectivity requirements determine the number of tuned circuits a receiver must have, be they in coupling transformers, band pass filters, or whatnot. The greater the need for selectivity, the more tuned circuits in some form. The present broadcasting structure calls for at least four tuned circuits, but the long-wave system should be less exacting. It is possible that three or even two tuned circuits will be found sufficient.

As shown in Figure 2, long-wave broadcasting offers a distinct technical advantage in the matter of selectivity. In the long-wave case the carrier frequency is lower in relation to audio frequencies. This means that for a receiver of given selectivity there is less cutting of sidebands. Or putting it the other way around, for a given standard of quality (harmonic transmission) the long-wave receiver is more selective. This effect, which has been pointed out by Professor N. I. Adams of Yale University, is still another technical argument for the long-wave system.

As for long-wave requirements in the matter of sensitivity or overall radio frequency gain, they should also be less rigorous than present design standards. Today we consider that a broadcast receiver should show gain in the neighborhood of 70 db., which is actually represented by about three efficiently coupled screen-grid amplifiers. The probability is that, due to the high power recommended and consequent high signal levels, less gain will be ample for long-wave tuners. At any rate, long wave radio amplification will be comparatively easy. Aperiodic transformers will be more efficient, and even resistance-coupled radio frequency amplification may have some possibilities.

Completion of the Long-Wave Broadcasting Plan

When all transmitters have increased their power to the required values for universal true service broadcasting, receiver design should reach an even level. Combination receivers should be the order of the day, with or without electric phonographs, home recording, or other desirable variations. Mass production will probably limit the custom builder and the experimenter once more to their present confines. Outside the large cities and their suburbs the present spectrum may suffer somewhat in listener interest when compared with a newer and better service. But if the changes are wisely made, they should be a source of continued stimulation and profit to the radio industry, rather than the danger they might appear to be at first sight. Some dangers there naturally be, for all progress involves dangers of some sort. Man did not learn to use fire without burning his fingers.

Counting the Costs

Some maintain that the idea of a few super-transmitters operating on long waves is economically unsound. Granted that national coverage is desirable, the long wave method is not only sound, but economically superior to other methods. On present wavelengths something like eighty 50 kw stations, evenly spaced across the country, would be required to cover thoroughly the entire country. They would cost perhaps twenty-four million dollars to install.

The installation cost of the seven odd 200 kc. 1000 kw. transmitters would be far less. A pair of 800 foot towers would cost around $200,000, the transmitter up to the final stage around $250,000, and the tubes and circuits of the final stage perhaps $50,000. This latter amount assumes twenty 200 kw. tubes costing around $2,500 each. This brings the installation cost of each station to around $500,000, or $3,500,000 for the entire system. Thus long-wave super-broadcasting should accomplish the desired end at one-sixth of present wave cost.

The running expense of each long-wave super-station would be divided principally into tube expense and electric power expense. Assuming an average of four tube replacements a year, the annual tube bill would come to around $200,000. The electric bill for eighteen-hour-a-day operation at maximum power would be approximately $500,000 per station, but as we pointed out in a preceding article, it would be possible to save a large percentage of this by decreasing power under good transmission conditions.

There are, of course, many assumptions in the foregoing figures, but they are nearer maximum limits than minimum ones. They are at least sufficient to show that, judged by the results it may accomplish, long wave broadcasting is economical rather than extravagant.

Comprehensive Organization Essential

Naturally a system such as we have suggested is beyond the means of small organizations. The logical builder would perhaps be one of the two present broadcasting companies, one of the great electrical or radio companies, or some new organization of similar size and resources. The national long-wave network cannot be built and operated piecemeal, by conflicting local or sectional interests, with efficiency. Immediately on such an intimation there is likely to arise a prolonged and agonized yell of "monopoly"—anathema to many Americans.

Call it by whatever name you like, but widespread organization is necessary in many human affairs, particularly where technology is to be applied on a large scale. The intimate service of a family physician meets small competition from hospitals or clinics. The individual attention of an independent grocer is missed in chain store trading. But no one would think of building a parallel railroad to compete with the New York Central, or stringing telephone wires through the streets to compete with the Bell System. Likewise national long-wave super-broadcasting. Public service on so vast a scale must be performed by large and well qualified organizations. This does not mean government ownership, or monopoly in its narrow and profit-forcing sense. The corporation undertaking such a service can be limited by law to a reasonable maximum profit. As an ultimate development two transmitters, or perhaps more, would be desirable at each station, giving the listener choice of true-service programs. This would open the way for two competing companies, who could strive diligently in public service much as the National and Columbia systems do at present.

Which?

Coverage With Present Waves

80 50 KW. Stations, Costing

$24,000,000

OR

Equal Coverage With Long Waves

7 1000 KW. Stations Costing

$4,000,000

Radio Moves Forward

The scheme which we have suggested must stand or fall on its own merits. All we ask is that it be thoroughly and experimentally investigated. Whatever the means finally adopted, national true service broadcasting coverage, bringing radio to those who now most need it and to those parts of our country where future developments must find their greatest field, is the ideal that should govern American broadcasting progress. Other nations have begun to move in this direction. Throughout Canada there is general dissatisfaction with the present broadcasting situation, and the Canadian Radio League, including some of the most prominent men in the Dominion, has drawn up a plan for building a national system of six powerful transmitters so located as to reach every section of Canada. Soviet Russia has begun the construction of a vast national broadcasting system outspreading from a 500 kw. key station at Moscow. At the present time the United States leads the world in the field of radio—at least so far as quantity is concerned. If this leadership is to be maintained, we cannot afford to neglect new ideas, however radical they may seem at first. A technology so widespread and powerful as ours should be attuned to constant improvement.

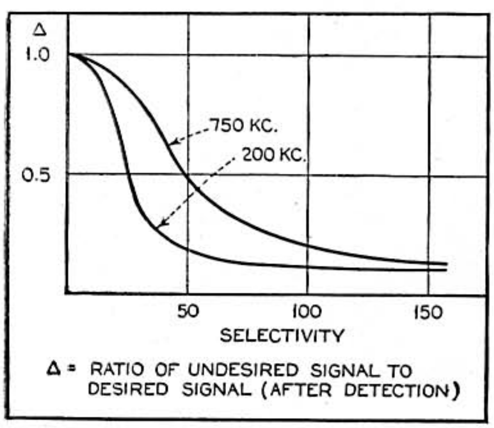

Figure 2. Relative tuning at 750 kc. and 200 kc. (after Adams), assuming receivers tuned to desired signals and separated from undesired signals by 10 kc. High values of selectivity mar quality

Looking Ahead

A few extracts from the Editor's schedule for the October Issue:

Quasi-Optical Wave Transmission and Reception (complete data)
Saxl

Audio Design Charts
Clough

Noise Measurements
Free

RADIO NEWS Prize-Winning Transmitter

A Deluxe Set Tester
Borst

Custom-Built Remote Control
Stevens

Receiving Television Pictures in New York
Replogle

Home Talking Moving Pictures

An Automatic A.C.-D.C. Broadcast Receiver
Cisin