The MARCH OF RADIO

Will Synchronization Bring a Radio Panacea?

WHENEVER an experiment in the synchronization of broadcast station carriers is announced, articles appear in the press to the effect that, should the experiment be successful, the number of stations operating simultaneously in the broadcast band may be increased greatly. In most instances, this impression is entirely erroneous because only approximate carrier-frequency regulation is attempted. Only when absolute synchronization of both carrier and program signal is the objective is there any hope of increasing the number of transmitters which may operate simultaneously. Absolute synchronization has been accomplished successfully only when the stations are linked by wire lines and both carrier and program signals are supplied from a common originating point, as in the case of WBZ and WBZA.

However, there are definite limitations even to absolute synchronization. It is useful only when the signal received at any one point comes from but one of the two synchronized stations. A receiver, so located that it receives equal signals from both synchronized stations, is subject to serious distortion because the two signals are out of phase due to the differing time required to transmit them by wire and back through the air. Usually, because of fading and field-strength variations in the received signal, this phase difference is emphasized by a swinging effect. Consequently, undistorted reception with absolute synchronization is possible only when the signals of one of the stations predominate over the other at all reception points within their respective service areas.

We are informed of practical experiments conducted in Germany in the field of absolute radio program synchronization, employing wire distribution of both program and carrier. A definite interference pattern, which changed not only from day to day but hour to hour, was found to exist, due to the interaction of the signals received from two points simultaneously but out of phase. Reception, good at one point, would be found to be practically nil at another but a few score yards distant. This experience corresponds to theoretical conceptions of phase difference effects encountered in radio transmission from two different points. Authorities differ on these questions, it is true, but until we have actual demonstration of successful wire-line synchronization under the practical conditions of the present broadcast spectrum, glowing descriptions of this would-be panacea to broadcast allocation ills are rather the expression of a hope than a justified assertion.

In the case of approximate synchronization, attempted by means of independent crystals accurately matched, very serious limitations to its application exist which do not appear to be generally understood. The principal object sought in approximate carrier synchronization is to eliminate carrier whistle on regional channels. This is the most annoying type of interference, now widely experienced on all the crowded regional channels. For example, WCCO and WPCH, now engaging in a synchronization experiment, operate simultaneously only during the day. If their carriers are approximately synchronized, they may also operate simultaneously during such evening hours as the program service areas of the stations do not overlap. If the separation between these stations were reduced by 500 miles, approximate synchronization would still eliminate the carrier whistle, but the distortion due to the simultaneous reception of two programs and the effects of the sub-audible beat note, created by their carrier interaction, would cause disruption of the service of both stations. While a 50- or 60-cycle carrier heterodyne of approximately synchronized stations is not reproduced by the loud speaker, the sub-audible beat occurring interacts with the audio-frequency or program component, affecting musical quality. WPCH serves only a small area, surrounding New York, and, during the early evening hours, WCCO's signal is of such a low field strength that it would not produce an audible effect in WPCH's service area. At the same time, WPCH, being a low-powered station, would have no noticeable effect in WCCO's territory. But, as the later evening hours approach, and good transmission conditions prevail, WCCO may, under certain conditions, deliver sufficient signal in the New York area to affect the quality of WPCH's transmissions. The success of the WPCH-WCCO experiment, therefore, means only that, in certain instances, where a low- and high-powered station, widely separated, are paired on the same channel, their respective service may be somewhat improved at those times that their audio-frequency and carrier signals are of a widely diverse field strength within their service areas. Two or three hours' service in the early part of the evening is a valuable addition to WPCH's opportunity to serve its audience and the experiment of carrier stabilization is thereby justified. But station managements are warned that that is the maximum effectiveness of the experiment. Amateur allocation experts should realize that approximate synchronization will not increase the number of stations which may be assigned in regional channels.

The Federal Radio Commission has issued permission to the Continental Broadcasting Corporation of New York to attempt an experiment in synchronization of two broadcasting stations in Virginia. The frequencies assigned for the purpose are 3257, 3256, and 4795 kc. These high frequencies, when heterodyned, produce a 1539-kc. carrier, the frequency of the two stations in the broadcast band associated in the experiment. The employment of two or three high-frequency transmitters for generating a desired broadcast carrier frequency at several separated broadcasting stations by heterodyning may or may not have advantages over the distribution of a single frequency, which is stepped to the desired broadcast frequency by means of a frequency multiplier or harmonic producer. The latter method requires the use of but one high-frequency channel instead of two or three. The conclusion that a demonstration over short distances will make possible long-range synchronization of chain stations is unwarranted because it still remains to be proved that fading and noise effects do not cause instability in reception of the synchronizing frequencies and that skip-distance effects limit synchronization to very long spans only, so that amplifying such a signal to serve as the carrier for broadcasting is impractical.

Canada's High-Frequency Allocation

AN AGREEMENT has been reached between the State Department and the Canadian Government on continental high-frequency assignments, in accordance with the report of the majority of the American delegation at the recent conference at Ottawa. That report, with which ex-Commissioner O. H. Caldwell of New York dissented, gives the United States a total of 146 of the 228 general communications channels, of which 112 are exclusive and the remaining 34 shared with Canada and Newfoundland. Canada is allocated 38 exclusive channels, to be shared with Newfoundland, and 48 shared with other nations. Newfoundland received 17 channels, shared with the United States, Cuba five exclusive and 15 shared with Canada; Mexico and other nations, eight exclusive and 16 shared with Canada. Of the 65 channels below 3412 kilocycles, the United States holds 34, shared with Canada and Newfoundland; Canada has 48, shared with other nations; Newfoundland 17, shared with the United States; Cuba 15 shared with Canada, and other nations have 16 shared with Canada.

Apparently, the meetings leading to this agreement were not in the nature of a negotiation but rather a presentation of frequencies to Canada. With utter disregard of the future needs of the United States for essential high-frequency communication channels, an extraordinarily liberal award has been made to Canada. Considering that our population and habited area is roughly ten times that of Canada, there is no possible excuse for the present ratio, which gives Canada more than 70 per cent. of the number of frequencies assigned to the United States. Furthermore, the precedent established by this agreement will be pressed by Canada as applicable in the broadcast band. If our broadcast channels were divided in the same ratio, the American allocations would amount to approximately 48, the Canadian 34, and other neighboring countries 14. The same arguments which swayed the State Department into accepting the Canadian proposal for this disproportionately large share of high-frequency channels are certainly applicable to broadcast channels.

It seems to us that the only just basis upon which the 293 high-frequency channels can be divided among Canada, Newfoundland, Cuba, the United States, and the remaining countries in the North American continent is a scientific appraisal of their present communications and future needs. This requires that consideration be given to area, the determining factor in appraising the distances to be linked; population, determining the number of persons to be served, and any special factor which may be necessary to correct inequalities arrived at by this method. In the matter of area, Canada gains an undue advantage because a large part of its area is uninhabited and, therefore, requires little or no communication facilities. Although our population is larger, it is also growing at a rate which would make assignments on the basis of population quite fair. On the basis of area and population alone, Canada rates about one-tenth as many frequency facilities as the United States, although it is entitled to a better ratio than this because many small but important communities cannot be served by any other means of communication than radio. But this consideration does not justify the one-and-a-half-to-one ratio adopted.

Commission Permits Limited Picture Broadcasting

THE Federal Radio Commission has ruled that visual transmissions in the broadcast band will be permitted hereafter between 1 and 6 a.m. Seventeen companies have been granted high-frequency channels for experimentation in the field, including Westinghouse, Radio Corporation, General Electric, Jenkins, WAAM, Inc., Lexington Air Station, Pilot Electric, Chicago Federation of Labor, William Justice Lee, and Aero Products, Inc. Other applicants, while not denied licenses, were ordered to appear at hearings for the purpose of showing why they should be granted television-channel assignments.

This outcome of the visual broadcasting hearing should be encouraging to those interested in its development because it gives them opportunity to demonstrate the possibilities of the art both on high frequencies and in the broadcast band. It is perfectly proper to restrict visual broadcasting to obscure hours until its program value is demonstrated more fully. The present hours, however, should be modified slightly because station personnel is not available at the hours now specified. If the visual broadcasting period were moved forward to midnight instead of 1 a.m., and a morning hour, such as from 8 to 9 a.m., a silent period with most stations, added, much more effective work could be done without, at the same time, affecting entertainment audiences. However, if any progress is made at all, the Commission is likely to consider the merits of the case.

The consensus of those appearing at the hearing was that television and still-picture broadcasting should have opportunity to prove their prospective service value before any attempt is made to determine their future. Representatives of the Radio Corporation of America and allied interests were flatfooted in their statement that there is no place whatever in the broadcast band for television because there is no public interest in the subject. Other authorities, including Dr. Lee deForest, C. Francis Jenkins, and John V. L. Hogan testified that television and still-picture broadcasting may ultimately have real service value in the broadcast band. Broadcasting stations can be relied upon to radiate picture signals only if there are appreciative and responsive audiences. Therefore, there is no wisdom in arbitrarily preventing experimental progress in what may become a useful broadcasting service.

World Peace Via the High Frequencies

IN AN effort to conduct world-wide communication from the Secretariat of the League of Nations, arrangements have been made by that body for a series of high-frequency radio telephone transmissions, utilizing the Dutch station at Kootwijk. A similar attempt in May and June of last year resulted in 92 reports of successful reception in all parts of the world. This year, transmissions to the American continent will be attempted on Tuesday evenings, to Japan on Wednesday and Australasia on Thursdays. For point-to-point communication, this service is likely to meet the needs for diplomatic message exchange with the same reliability that obtains in all short-wave transmissions. If a world-wide broadcasting service is contemplated, however, no single station is likely to be of use. The bulletin, issued by the League's Secretariat, is rather naïve, indicating a somewhat incomplete knowledge of radio transmission phenomena. The only hope for a world-wide broadcasting system lies in the utilization of established broadcasting systems, linked by short-wave transoceanic networks of a nature now being tried by the National Broadcasting Company and the British Broadcasting Corporation. A great deal of time and money could be saved if the League took advantage of the experimental work being done by others.

The occasional rebroadcasting of foreign programs by established systems will undoubtedly do more to promote international understanding than all the lofty declarations of politicians and diplomats. Science is rapidly building the means of promoting peace among nations and, in so doing, is incidentally developing the agencies which will make warfare all the more effective and, therefore, the more destructive.

Municipal Regulation of Man-Made Interference

THE Federal Radio Commission, through its legal staff, has made an investigation of state and municipal regulations applying to radio communications. This body is prepared to give advice and assistance to municipalities and states desiring to formulate ordinances which will not conflict with federal regulation. Only one decision has been made in the courts, demarking the field of federal and state regulation of communication. In that opinion, rendered by the District Court of the Eastern District of Kentucky, Whitehurst V. Grimes, held that an ordinance, attempting to license radio stations, is unconstitutional on the grounds that "radio communications are all interstate."

The Board of Trustees of Boonville, N. Y., adopted an ordinance, providing that no person shall maintain or operate any electrical device or apparatus causing interference with radio receivers within the village of Boonville. No electric sign or other so-called blinking device whereby a make-and-break contact is maintained, shall be operated unless equipped with condensers properly grounded so as to limit interference, nor shall electric pianos or other similar machines be operated. Violet ray or other X-ray machines shall not be used between 6 and 10 p.m. except in emergencies. Anyone violating this ordinance shall be considered a disorderly person and subject to a penalty of a hundred dollars.

We learn from a correspondent of another proposed ordinance being considered by the Brandon City Council of Manitoba, Canada, prohibiting the use of electrical equipment which causes radiations of a type interfering with radio reception. There have been several attempts to pass similar municipal regulation in the United States and, in the few instances that such regulations have actually become ordinances, they have been found to be unenforceable. The attack on electrical interference does not lie in prohibiting the use of equipment of a radiating character. The solution of this problem, which is gradually becoming of greater and greater importance as other causes of interference with radio reception are eliminated, lies in compelling the manufacturers of electrical appliances to equip their devices with filter systems which prevent radiation. Those who cause interference are usually the innocent victims of the manufacturer of the device.

The Press Continues Bungling

THE National Radio Press Association, Inc., of New York City, has been formed for the purpose of supplying spontaneous news and sports reports exclusively for radio stations and, through them, to the radio public. It proposes to build stations in New York, Washington, Chicago, Cleveland, Columbus, Cincinnati, Detroit, Kansas City, St. Louis, New Orleans, Atlanta, Salt Lake City, San Francisco, Los Angeles, Seattle, Philadelphia, Dallas, and Minneapolis. It has made application before the Federal Radio Commission for twenty continental short-wave channels, to be taken from the channels assigned to the American Publishers Committee. There is not the slightest indication of the competence of the organization, but it has been said that Herbert Bayard Swope, former executive editor of the New York *World*, is behind the project.

John Francis Neylan, attorney representing the Hearst newspaper interests, has protested to the Federal Radio Commission about the distribution of the twenty frequencies assigned to newspaper use under the management of Joseph Pierson of the Chicago *Tribune* and president of the American News Traffic Corporation. Under the plan, the Hearst newspapers received three transoceanic channels and three intra-continental, while the United Press and the Scripps-Howard newspapers receive a total of six and a half wavelengths. In a telegram to the Commission, Mr. Neylan states that Mr. Pierson is without authority to represent any newspaper or news association of the Hearst interests and is without authority to speak for ninety per cent. of the press of the United States. The press continues to show marked incompetence in managing its radio affairs.

The Board of Directors of the Associated Press adopted a resolution to the effect that a member newspaper may not establish a chain by which a station in another city than the city of publication may broadcast news of the A. P., unless that member joins with and shares the credit with the originating newspaper. A member may not tie-up the broadcasting of Associated Press news with any advertising program. —E. H. F.

STRAYS FROM THE LABORATORY

Regarding Synchronized Stations

From time to time the public press is assailed by someone who has a newly discovered scheme for doubling up on the ether by transmitting the same audio-frequency program over several stations which are synchronized to the same r.f. carrier. Such a system is offered as a panacea for those who do not want to pick up the same program at more than one point on the dial—as a panacea for those who wish to decrease the number of stations now on the air, and as a panacea for those who want to increase the number of programs now on the air.

Since there is such recurrent interest and speculation on this matter of putting several stations on the same frequency, it seems worth while to review briefly a paper read in March, 1929, before the Wireless Section of the Institution of Electrical Engineers (London) by Captain P. P. Eckersley and A. B. Howe. Until recently Captain Eckersley was chief engineer of the British Broadcasting Company, and he is well known among all serious and well-informed radio engineers.

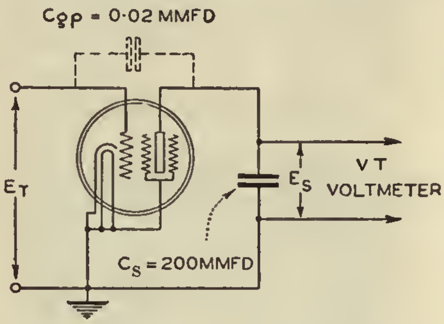
In 1926, 1927, and 1928, four British stations operating on low power and transmitting the same program were synchronized to within 100 to 200 parts in a million.

Consider first the unmodulated carriers of two stations. If the stations were situated close enough so that either carrier could be heard if the other were turned off, an interference pattern would be set up. Under these conditions a listener in a locality where the carriers come to him in phase will receive signals which may be twice as strong as those which could be produced by either station, and a listener in a locality where the carriers are out of phase may receive nothing at all.

Now if the carriers are modulated with the same single audio-frequency tone, listeners near either station will receive the modulation undistorted, but listeners midway between the two stations will receive "mush." In other words, turning on the second of two such stations restricts and reduces the service area of the other.

Now suppose the stations send out the same program consisting of tones situated at various parts of the audio-frequency spectrum. Because these side frequencies may not arrive at a listener's receiver in phase, even though the carriers are in phase, the listener will get distorted signals.

To test these and other possibilities, two stations, G5BG and G5IT, were tuned to 610 kc. and maintained there by transmitting a synchronizing signal of 305 kc. from a third station. This signal was picked up by both stations, doubled, and used to drive the two transmitters. They were supplied with the same program by a 38-mile wire line which connected them. A portable field strength measuring set and a standard receiver were transported to various localities in the field of the two stations.



All types of distortion discussed above were found; in addition it was learned that if one station were five times stronger than the other, the program of the first would be received properly and without distortion. If one station differed by five cycles in carrier frequency from the other, it would be necessary that the first station be ten times stronger than the second at a given locality in order to receive an undistorted signal. If the two stations transmitted different programs but on exactly similar carrier frequencies, the strength of one would have to be from 100 to 200 times stronger than the other in order to receive undistorted programs.

The difficulty in using the same carrier frequency for several programs, or for the same program, comes from the fact that the direct ray from the transmitter is supplemented by the indirect ray reflected from the Heaviside layer. At locations remote from the transmitter the latter is the more important; it causes fading and distortion. It seems wise to use antennas which transmit poorly toward the sky and which confine their radiation more nearly to the ground wave. Such radiators are high vertical antennas.

Captain Eckersley states that for large distances between stations, it is better to use low frequencies; for short distances it is better to use higher carrier frequencies. This is due to the fact that the direct ray falls off more with distance as the wavelength is decreased, while the indirect radiation seems to be more or less independent of the distance. Another interesting result of the author's experiments leads to the statement that when 6 or 7 stations share the same frequency, their service areas are not affected by the addition of other stations.

The problem seems to resolve itself into several phases: (1) to provide accurate synchronism between stations either by transmitting a standard radio-frequency signal from some centrally located station, or by means of land lines; (2) to restrict the radiation as much as possible to the ground wave; and (3) to choose properly the location and power of the stations sharing the common frequency.

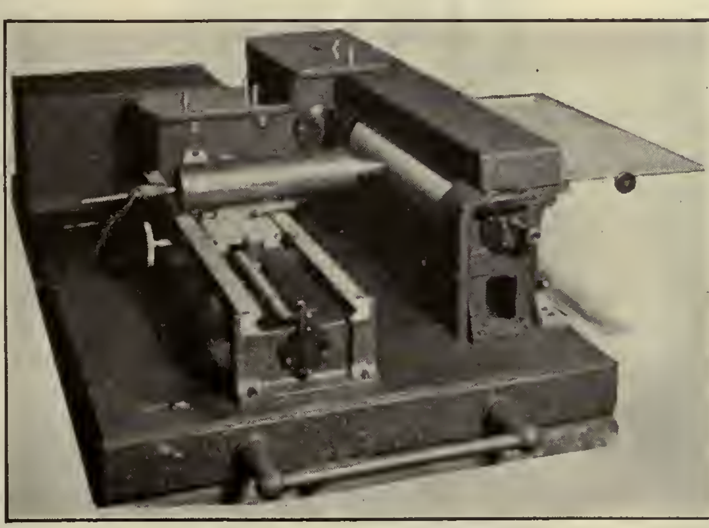
Measuring Screen-Grid Capacity

Measurement of the extremely small capacity existing between plate and grid in a screen-grid tube is a difficult problem. Comparative measurements are not difficult to make by putting the tubes across tuned circuits and measuring the change in frequency, but to get the capacity in exact units involves a standard of the order of 0.02 mfd.

In *Experimental Wireless* (England), June, 1929, the following method is put forth as a way out of the difficulty. It involves putting another and larger condenser in series with the desired capacity, and measuring the voltage across this large capacity when a known voltage is put across the two capacities in series. Thus in Fig. 1 the voltage is shared by the tube capacity and the large known capacity, which is about 10^4 times as great as the grid-plate capacity whose value is desired.

A potential at 1500 kc. of about 600 volts was generated in a tuned circuit. This voltage was measured by means of an electrostatic voltmeter and applied to the two condensers in series. The capacity is found from

$C_{g\text{-}p} = C_s \frac{E_t}{E_s}$ since C_s is about 10^4 times $C_{g\text{-}p}$.



The apparatus pictured above is the new high-speed facsimile receiver developed by R.C.A. for transatlantic service.