The—
COMMERCIAL RADIO MAGAZINE

CQ

June 1933

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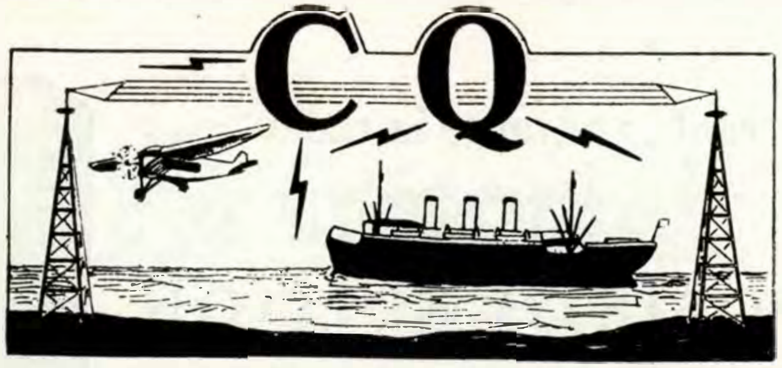

THE COMMERCIAL RADIO MAGAZINE

The ONLY Magazine in America Devoted Entirely to the Commercial Radio Man.

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JAMES J. DELANEY, Editor L. D. McGEADY, Bus. Mgr.

VOL. II JUNE, 1933 NO. 10

CONTENTS:

Editorial

JUST A SUGGESTION

It would appear not out of place for the Federal Radio Commission in the exercise of its congressionally granted powers to emphasize a little more on personnel. Equipment is without a doubt important, but the finest equipment with the poorest of handling is practically worthless.

It is a time of individual encouragement. Many vast improvements with minor equipment are possible. Figure assets are being tossed to the winds, as they are crumbling rapidly. Better and better personnel is being made available due to the times. Unemployment is the chief problem, and with just a little bit of encouragement this unemployment can be turned to employment of the most constructive sort. Capital can and must be subjugated to the more pressing problems of the individual, at least for the time being, as one is so entirely dependent on the other as to make this advisable.

Men everywhere are finding new outlets for normally suppressed activities, necessity as always is showing the possibility of invention and this happens right now to be the invention of ways and means of a livelihood, which should be encouraged.

THINGS TO WATCH

New and powerful forces are at work. Experience of the past should be our guide for the future. Otherwise we will be guilty of making the same blunders over again. It has often been said, and seldom denied, that if all material things were evenly divided today, they would within a short time be back to their original holders. The why of this is obvious. Some of our leading industrialists are busily engaged in a process and an honest one of disintegration. Others with not so honest a purpose are engaged in one of solidification.

In times like this ordinarily considered a purging or purification period, it is hard to discern the good from the bad, but it is doubly necessary for those in whose hands the fostering or discouragement remains to be ever watchful that their works of today, be not the curse of tomorrow.

IMPROVEMENT EVERYWHERE

Reports from all directions indicate a steady improvement in commercial radio. The ship business indicates the usual summer activity due to opening of routes not active during winter months. The summer cruise business is a helpful factor.

Thanks to the department of commerce, the radio activity in the airways is steadily advancing. The Federal Radio Commission while not exercising as strong an influence on this field as in some others, is encouraging by this more or less passive attitude advance strides which would not otherwise be possible. Summer business for the airways as well as the active encouragement of the post office department is making available revenue for constant improvements.

The broadcast field already suffering the loss of revenue of curtailed advertising accounts is rapidly becoming accustomed to the new conditions. Already in many ways this is improving, and the immediate future appears bright.

Development in every branch is a prime factor, and while it is now a fact that in many other industries this development factor is practically nil, it is anything but that in the commercial radio field. About the only branch of radio that has been badly affected by the times, and undoubtedly set back in the matter of time, is what never did get past in the experimental stage—television.

All in all, we can well say the worst appears to be a matter of the past, and we can look forward with increasing confidence.

VIEW OF THE PRESS

The article below needs very little introduction. It is reproduced from the San Francisco Examiner. Such little incidents of years passed of Mr. Dolar pacing the deck and threatening to put his boats under British register have come to our ears, and of two radio operators now doing the work of three at present, but this is pretty bad.

UNPATRIOTIC ACT

The employment of a Chinese crew for an American boat dependent on American Government subsidy is a most amazingly asinine thing for the directors of the Dollar Line to have permitted.

Granting that the Dollar Line did not itself hire the Chinese crew, nevertheless the Dollar Line leased one of its own boats under conditions which allowed the hiring of the Chinese crew and furthermore the Dollar Line could not have been ignorant of the fact that the conditions of the lease permitted the hiring of an Oriental crew, because the Dollar Line had previously leased the same boat, the President Johnson, to the same lessee, the Boring company, and the Boring company had previously employed a Chinese crew in the same manner that it is now employing one.

The Dollar Line cannot therefore divest itself of responsibility for this not only unpatriotic, but utterly idiotic act.

Nor can the Boring company escape due odium and opprobrium by declaring that, "If there is any evasion of the law," the company will "get a crew elsewhere."

The question is not merely a matter of law evasion. It is a question of disloyally repudiating the obligation to the nation to give employment to Americans when twelve million Americans are out of work.

It is a question, too, of utter failure to show some sort of patriotic appreciation of the fostering care of the United States Government and the liberal patronage of the American people.

And if these obligations make no appeal to the officials of the Dollar Line and the Boring Tourist Agency, there is still the question of ordinary rudimentary intelligence, which ought to prevent any sane person from flouting the feelings of the American people upon whose generosity the existence of this line and this tourist agency depend.

If the Dollar Line has no broader outlook than it has exhibited in this instance—if it has not even the sense of gratitude which is cynically described as "a lively sense of favors to come," it should change its name to the Plugged Nickel Line and be appropriately designated.

The Hearst papers are incensed because these papers are trying to help build the American merchant marine and the task is made difficult by such heartless and brainless exhibitions of callous indifference and ingratitude on the part of the beneficiaries of American favor.

Congratulations are due Mr. Andrew Furuseth, admirable defender of the rights of the American working man, and Representative William Sirovich, alert congressional guardian of the public interest, for exposing and promptly moving to correct this rightly termed "outrageous" situation.

The Hearst papers will continue their campaign for an American merchant marine confident that no thoughtless act of certain short-sighted individuals can discredit so great a cause or permanently prevent the development of so worthy and so necessary a policy.

Yes, It's True, That:

Mr. Owen D. Young was recently reported as having made the claim in an address that we (the United States) were entirely to blame for a great part of the present world-wide economic conditions by insisting that European countries pay interest on their debts to America in cash. This somewhat startled many of Mr. Young's friends as it seemed either a premature announcement, or a lack of "minds running in the same direction" on the part of the President of the United States.

Within a surprisingly short time after the announcement of the appointment of Col. Henry L. Roosevelt, former Radio Corporation of America European representative to the position of Assistant Secretary of Navy by President Roosevelt, came the announcement that Mr. Newton D. Baker, Secretary of War under President Wilson, had been elected to the Board of Directors of the Corporation to fill the place made vacant by resignation of Owen D. Young. Mr. Baker is himself a lawyer, as was Mr. Young in his early days.

Announcement was recently made that Charles Francis Adams, Secretary of Navy under President Hoover, was elected to the Board of Directors of the General Electric Company.

It was "nosed around" not so very long ago that in view of the outspoken plan of the present administration to be a little soft on the anti-trust laws that certain high officials of both General Electric and Westinghouse would try to keep their posts with R.C.A. This did not seem to go over so big, and shortly after the resignation from R.C.A. posts by the officials in question was publicly known.

E. T. Cunningham has been appointed President of RCA Victor Co. Inc. and retains his older position as President of RCA Radiotron Co., Inc. The announced plan is to consolidate the two subsidiary units of the Radio Corporation. It has been interesting to watch Mr. Cunningham advance first from the presidency of E. T. Cunningham. Inc. to the tube company and then to the manufacturing unit. Significant also is Mr. E. K. Throckmorton's following him in step as vice president of each of the three units.

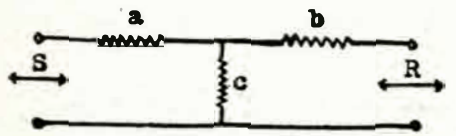
It must have been with a sigh of sympathy that Mr. Young heard Mr. Gerard Swope would be called to testify in the Federal case against banker Mitchel. It will be recalled that Mr. Young did some of that himself in the Insul Utility "bust" investigation, and it could hardly have helped when his name was announced on the "preferred" list of utility offers by bankers Morgan & Co.

The courts have decided that it was a little too high handed for the Radio-Keith-Orpheum organization to name their theatre in Rockefeller Center, New York the RKO Roxy Theater, when another theater in the same city had for many years spent many, many dollars in publicly advertising their large and well known Roxy Theater. It is too bad that owners of already defaulted securities on the Roxy Theater had to spend good money to protect their rights in this name "piracy," but the decision against the bankrupt theatrical chain should partly compensate.

Methods for the Calculation of the Resistance of Pure Resistance Artificial Lines

By LOUIS W. BARNETT
Studio Engineer WKBF. Asso. I.R.E.

The following gives a method for computing the values of the resistance elements of "T" type pure resistance artificial lines (sometimes called resistance pads), and is accurate for the design of any such artificial line which is to have a required loss —L (db) and is to operate between circuits having impedances S and R of pure resistance.



In the above figure the resistance elements may be found as follows:

$$a = \frac{S(m^2S + R - 2Rm)}{m^2S - R} \qquad b = \frac{R(m^2S + R - 2Sm)}{m^2S - R}$$

$$c = \frac{2mRS}{m^2S - R}$$

Where m = the number whose logarithm is

$$\left(\frac{L}{20} - 0.5 \log \frac{S}{R}\right)$$

or $m = \log^{-1}\left(\frac{L}{20} - 0.5 \log \frac{S}{R}\right)$ (All logarithms are to the base 10)

The value of L is to be used as a positive numeric in the above formula. For ease of solution the larger of the two circuit impedances should be chosen for the "S" end of the pad.

Example—Suppose an artificial line is to be designed for a loss of 15 db when inserted between a 500 ohm pure resistance circuit and a 200 ohm pure resistance circuit.

Then let S = 500 and R = 200

$$\text{The value of } m = \log^{-1}\left(\frac{15}{20} - 0.5 \log \frac{500}{200}\right)$$

$m = \log^{-1}(0.75 - 0.5 \times 0.39794) = \log^{-1}(0.55103)$.
$m = 3.5566$

Then—

$$a = \frac{500(12.649 \times 500 + 200 - 2 \times 200 \times 3.5566)}{12.649 \times 500 - 200}$$

$= 416.5$

$$b = \frac{200(12.649 \times 500 + 200 - 2 \times 500 \times 3.5566)}{12.649 \times 500 - 200}$$

$= 96.92$

$$c = \frac{2 \times 3.5566 \times 200 \times 500}{12.649 \times 500 - 200} = 116.14$$

If the artificial line is to be of the balanced "T" or "H" type, half of the resistance of the series elements a and b, as computed above, should be used in each side of the network. Thus for the above example, the corresponding "H" type line would be as shown in the following figure.

$\frac{1}{2}a = \frac{1}{2} \times 416.5 = 208.25$ $\quad \frac{1}{2}b = \frac{1}{2} \times 96.92 = 48.46$ $\quad$ c — remains the same.

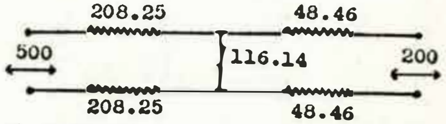


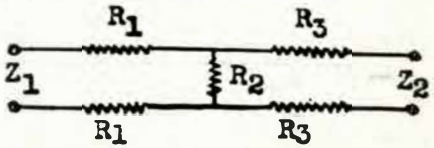
Table for the minimum loss possible for a "T" type pad with a given ratio S/R.

Ratio S/R.	Minimum loss in DB
1/1	0.
1/1.5	5.77
1/2	7.65
1/3	9.96
1/4	11.44
1/5	12.55
1/10	15 79
1/100	26.00

Minimum loss equals $\rightarrow 10 \log_{10} S/R \left(1+\sqrt{\frac{S-R}{S}}\right)^2$

$\rightarrow 10 \log_{10} r\left(1 + \sqrt{\frac{r-1}{r}}\right)^2$ where r equals S/R.

Here we have another method for calculating the resistance legs of pads by using the known constants shown below:



Z_1 represents the input impedance.
Z_2 represents the output impedance.
R_1 is the series resistor at the input end.
R_3 is the series resistor at the output end.
R_2 is the shunt resistor.

The input impedance and the output impedance of a desired pad is known. The DB loss is also known. The formula for finding the shunt resistance is given below:

$R_2 = 2K_1\sqrt{Z_1 \times Z_2}$

The value of K depends upon the DB loss

required and is given in the following table, shown below the formulae for the series legs.

$R_1 = K_2Z_1 - K_1\sqrt{Z_1 \times Z_2}$

$R_3 = K_2Z_2 - K_1\sqrt{Z_1 \times Z_2}$

DB Loss desired	K_1	K_2
1	4.34	4.34
2	2.15	2.21
3	1.43	1.51
4	1.05	1.16
5	.820	.965
6	.670	.835
7	.525	.725
8	.476	.690
9	.406	.645
10	.352	.610
12	.269	.565
14	.208	.540
15	.184	.532
16	.163	.525
18	.128	.515
20	.101	.510
25	.056	.502
30	.0318	.500
35	.0178	.500
40	.0100	.500
45	.00565	.500
50	.0032	.500

Example—Suppose an artificial line is to be designed for a loss of 10 db when inserted between a 500 ohm pure resistance circuit and a 200 ohm pure resistance circuit. Reference must be made to the above shown chart for substitution constants:

Z_1 500 ohms
Z_2 200 ohms

$R_2 = 2 \times .352\sqrt{500 \times 200}$

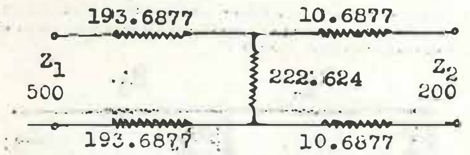
$R_2 = .704 \times 316.228 = R_2 = 222.624$

$R_1 = .610 \times 500 - .352\sqrt{500 \times 200}$

$R_1 = 305 - 111.312 = R_1 = 193.6877$

$R_3 = .610 \times 200 - .352\sqrt{500 \times 200}$

$R_3 = 122 - 111.312 = R_3 = 10.6877$



Since low impedance circuits are not rigidly critical as to impedance matching, a slight percentage of error is permissible in the building of pads. Therefore commercial resistors which are not very accurately measured may be used. Their percentage of error may sometimes be as high as 3%.

When the values of the calculated resistors turns out negative in value, the pad combination is impossible. Two pads may be found, however, which will give the desired loss and also match the two impedances.

The following table has been compiled for ease in selecting the correct resistance elements to be used in pads of 600 to 600 ohm circuits. For pads having characteristics other than 600 ohms, the resistance values required may be determined by obtaining the product of the characteristic resistance and the constants shown below. The values of the resistance elements shown below are to be used in "T" type pads but may be adapted for "H" type pads by using half the value of B in each of the four series arms.

Let $K = \frac{I_1}{I_2}$ and R_0 equal the characteristic impedance of the pad.

Then $B = R_0 \times \frac{K-1}{K+1}$ and $C = R_0 \times \frac{2K}{K^2-1}$

Pad Loss in DB	Current Ratio K	$\frac{K-1}{K+1}$	$R_0 \times \frac{K-1}{K+1}$ (B ohms)	$\frac{2K}{K^2-1}$	$R_0 \times \frac{2K}{K^2-1}$ (C ohms)
1	1.132	.0574	34.5	8.65	5190
2	1.259	.1147	68.8	4.303	2582
3	1.413	.1712	103.0	2.840	1704
4	1.585	.2264	136.0	2.098	1259
5	1.778	.2802	168.0	1.645	987
6	1.995	.3322	199.0	1.340	803
7	2.239	.3825	230.0	1.116	678
8	2.512	.4305	258.0	.9465	568
9	2.818	.4760	286.0	.8410	505
10	3.162	.5195	312.0	.7030	422
11	3.548	.5600	336.0	.6123	367
12	3.981	.5934	359.0	.5364	322
13	4.458	.6340	380.0	.4710	283
14	5.012	.6675	400.0	.4156	249
15	5.623	.6980	419.0	.3670	220
16	6.310	.7262	436.0	.3253	195
17	7.080	.7521	451.0	.2881	173
18	7.943	.7766	466.0	.2558	153
19	8.912	.7982	479.0	.2273	136
20	10.00	.8180	491.0	.2020	121
21	11.22	.8360	502.0	.1797	108
22	12.59	.8520	512.0	.1600	96.0
23	14.13	.8670	521.0	.1423	85.3
24	15.85	.8810	529.0	.1267	76.0
25	17.78	.8930	536.0	.1129	67.7
26	19.95	.9040	543.0	.1005	60.3
27	22.39	.9140	549.0	.0895	53.7
28	25.12	.9230	554.0	.0797	47.8
29	28.18	.9310	559.0	.0711	42.7
30	31.60	.9380	563.0	.0632	37.9

I wish to express my sincere thanks to Mr. J. G. Harden, Indiana Bell Telephone Company, and Mr. N. D. Apple, A. T. & T. Co., for their kind help in the compilation of the above shown article. Mr. Harden originally derived the first method shown. B. Sachs of C. B. S. is responsible for the second formula and table. I sincerely hope that the article may be of some use to a great number of broadcast engineers.

ENGINEERING THE COMMERCIAL SHORT WAVE RECEIVER

THE SUPERHETERODYNE

By JAMES MILLEN*

It was demonstrated in our preceding article that simplicity of control is fully as desirable in a commercial short wave receiver as in a broadcast set designed for entertainment reception. The accelerated influence of LC variations on high radio frequencies is such as to slow down the operation of individual tuned circuits in addition to contributing similar and augmented effects through interaction. The solution to these closely interrelated problems is a truly single control receiver—a receiver in which there are an adequate number of tuning and amplifying stages, without trimmers of any apology or order, combined with volume and oscillation controls, the variation of which do not effect the resonance of the tuned circuits. Trimmers, unless calibrated make accurate logging impossible, and, even when dialed, complicate and retard the operation of the receiver.

This ideal is approximately achieved in the National Communications Type 58C tuned-radio-frequency receiver described in "CQ" last month. It can be attained, without reservation, in a superheterodyne, such as the National AGS.

It will be immediately appreciated that the solution of the associated problems presents an engineering feat of no mean magnitude. Obviously the very factors which indicate the desirability of a single control receiver contribute to difficulties of design. It is relatively easy to make a good single control broadcast superheterodyne (even discounting the liberal tolerance of a receiver designed for none-commercial operation)—and several companies are doing so. However, the difficulties encountered in making the short-wave super increase exponentially, and once more are readily demonstrated by inspection and differentiation of the fundamental equation for resonant frequency—

$$F = \frac{1}{2\pi\sqrt{LC}}$$

Consider the preselector and first detector circuits in a conventional broadcast superheterodyne. Both circuits are tuned to the signal frequency of 1000 kc. The preselector circuit

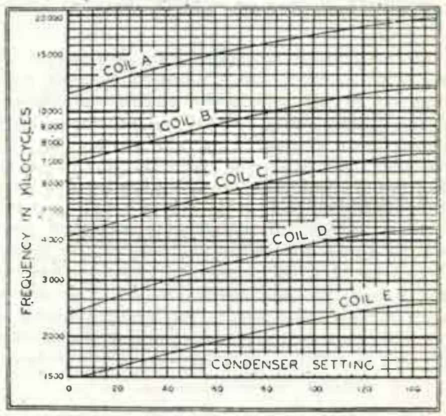


Figure 1—Tuning curves of the standard sets of AGS coils. Band-spread coils are available for any of the commercial short-wave spectra.

has an inductive value of 240 microhenries and a capacity, contributed for the greater part by the tuning condenser, of 105.5 micro-micro-farads. Assume that the inductance of the detector circuit is slightly out, having an effective inductance of 242 microhenries. It will be necessary to compensate this by turning back on the trimmer, and adjusting the circuit capacity to 104.7 mmf. The two circuits are now in perfect alignment at 300 meters.

*The National Co., Malden, Mass.

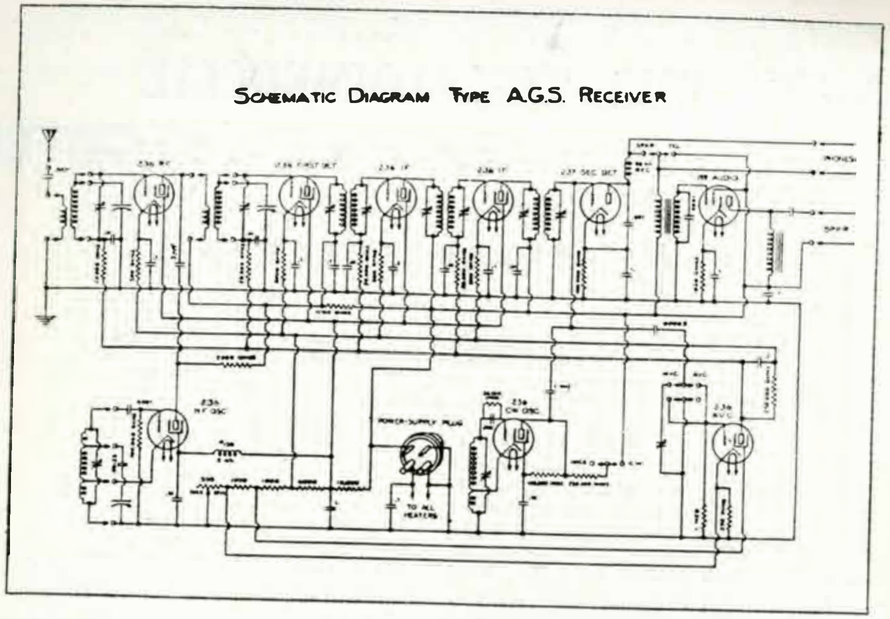


Figure 2—Wiring diagram of the National AGS short-wave super. Designed for complete a-c operation, it may be slightly modified for use with batteries.

Let us tune in a longer wave station by adding approximately one hundred percent to the capacity of the preselector circuit—i.e. 100 mmf. If the condensers are at all reliable, the detector circuit will receive a similar capacitative increment, and we now have the following conditions: 240 microhenries and 205.5 mmf. in the first circuit and 242 microhenries and 204.7 mmf. in the second circuit. The preselector circuit will be tuned to 716,650 cycles, and the detector circuit to 714,900 cycles. In other words they will be out of tune about 1.75 kc. This discrepancy is negligible due to the small amount, and the fact that in tuning a compromise is always effected between off resonance attenuation in the i-f and r-f circuits.

However, conditions are aggravated on the short waves, while the probability of the absolute amount of error in capacity or inductance remains almost the same! Take two circuits, the first having an inductive value of 10 microhenries, and 10 mmf. and the second circuit an inductance of 9.259 microhenries tuned by 10.8 micro-microfarads. Both circuits resonate at 15,915,550 cycles. If the capacity of both circuits is increased by 10 mmf. (approximately 100 percent) the first circuit will tune to 11,257,470 cycles and the second to 11,468,700 cycles—a truly serious discrepancy of over 200 kc!

The solution to the problem is as obvious as it is difficult of attainment. For true alignment, the inductance and capacity of each circuit tuning to the same frequency must be identical at all times. In a short wave superheterodyne employing a preselector, this entails a multitude of individually checked adjustments. The condensers must have identical tuning curves. The circuit distributed capacities must be the same. The inductance of the wiring in each tuned circuit must be checked for similar identity. The inductance of every coil must check within tolerances far more rigid than could be ascertained by the usual production methods. Finally the distributed capacity of each coil in a given set must be identical!

In the AGS, the tuning curves of the three condensers are first checked, and corrected if slight discrepancies exist. If other than minor adjustments are required, the condensers are discarded. The distributed capacity of each circuit is adjusted to a predetermined minimum by means of padding capacitors, checking against laboratory coils of standard capacitative and inductive values. Using the same coils, the inductance of the wiring is set to a similarly predetermined value, by moving the tap on the inductive slide-wires in each condenser compartment. These wires are soldered when the correct inductance is obtained.

Equally painstaking procedure is employed in

(Continued on Page 24)

PIONEER RADIO OPERATORS

By DR. LEE DE FOREST

The Great Lakes were calling me. Those enterprising boys in Chicago, Ocker and Odell, by no means satisfied with the laurels they had won in the history-making wireless tests on the Chicago and Alton Flyer, had sought new fields to conquer. This time on the Lake.

As early as May that year, 1905, we had put on trial installations on the steamer "Indianapolis" for her first run of the season to Michigan City. W. H. Greenbaum was the operator, and on that first trip nearly won a glass arm sending back to Chicago some 60 messages from 40 incredulous press representatives on board—"All the way into Michigan City." Incredible! But now, whether the germ idea originated in the fertile brain of Ocker or with Harry Perry, Bud White, and "Social" Smith, well known gamblers—the old steamer, "City of Traverse," had been covertly turned into a floating poolroom de luxe, with bookie stalls, bar fixtures, and all the paraphernalia to attract lovers of horse flesh—and a few fishing poles for appearances' sake. Up in the wheel-house was a complete wireless station in charge of new operators skilled in pool room abbreviations. Thus manned and thus equipped, resplendent in a new coat of white paint, the City of Traverse sailed boldly out to defy the powers of the city of Chicago—out beyond the three-mile limit and to a watery spot where theoretically the three states of Illinois, Indiana, and Michigan mingled in one non-juridicial coalescence.

For several days this piratical craft sailed out laden [illegible] to her gunwales with bookies and racing touts. The sudden pe[illegible] [illegible]larity of these brief "Voyages to Nowhere," the [illegible] [illegible]d bling swarms of "fishermen" who disappeared an hour after the distant race tracks closed for the day, aroused the suspicions of Chicago's Assistant Chief of Police, Schuettler.

Detectives disguised as applicants for operator's jobs, and coincidently a Chicago University instructor in physics, visited Mgr. Ocker at the Railway Exchange Wireless Office—inquired earnestly regarding the mysteries of Wireless, listened intently while Ocker flashed messages to nowhere, asked casually regarding the long wire leading up to the top of the corner flag pole—and departed.

Next morning's papers read: "Police Raid Wireless Office; Cut off Floating Pool Room Race Results."

"3:00 P. M. It's all off. The Coppers are here. No more results today." That was the last message flashed to the good ship "City of Traverse," latest device of the pool room men, from the general offices of the DeForest Wireless Company yesterday afternoon. Immediately thereafter Chief Schuettler's men took charge of the office and the betting far out on the Lake ceased.

Wm. Ocker, local manager, with Edward Brandon and E. O'Brien, operators, were arrested; the expensive instruments torn out and taken to the Central Police Station.

Out on the Lake 300 gamblers had received the results of three races at Sheepshead Bay and the speculation of the fourth, as well as races at Latonia and Highland Park was brisk. The favorites had been doing fair business all the afternoon, and the crowd was bitterly disappointed when returns ceased. Later on enough information trickled in from another wireless station (the 20 K.W. on the West Side, where Chas. E. Fischer was right onto his job!) to enable the books to pay off on the races played, but the sport was killed and if the word of Herman Schuettler goes for anything it will remain killed."

But the Chief figured too fast. He little knew the resourcefulness of Wireless and of Wireless men! Ocker and Oddell at once retained Col. J. Hamilton Lewis, now U. S. Senator from Illinois, to make a test case of the right of the Company to furnish wireless news of any character. "It is my present intentions," said Col. Lewis, "to proceed to the Federal Courts to test the rights of the Wireless Company to transmit any news, not vulgar or obscene, to any place or person, leaving the punishment for the improper use of such information such as gambling, to those who actually gamble."

"The difference in the position of the Western Union and the Wireless is this: The Western Union put machines into certain rooms and assumed to furnish news from their general offices; pool sheets were made in the same rooms. This was held in violation of the ordinance because the rooms became pool rooms. The instruments in the general offices could not have been seized because they transmitted all kinds of news. My clients are not responsible for what transpires at other places as a result of the news which they transmit."

Whereas the Chief expressed himself [illegible]fectly satisfied with the result of his [illegible] "Let them go ahead and make a test [illegible] [illegible] future Senator di[illegible] [illegible] case [illegible] it." And the [illegible] application for an injunction restraining the authorities from interfering with the wireless as a common carrier was promptly made by Ocker.

"Those bulls simply couldn't hear it," said [illegible] O'Brien to a reporter of the News. [illegible] clicks of the incoming messages are so faint that an operator cannot hear them unless he wears a telephone receiver. How did those slick hawkshaws rubber in on our messages when they were outside the office? Then besides," as he became more confidential with the reporter, "the messages are never addressed. They are not addressed to the 'City of Traverse' or Harry Perry, or anyone connected with the gambling boat. How did the smart detectives know we were sending race results to that boat? They were sent out in all directions and anyone with a wireless receiver could have interpreted them!" Thus argued our logical culprit, out on bail. He well knew, or thought he did, that there were no cops equipped in those days, no police radio cars, not even a Federal Radio Commission spotter down the alley.

TWO NEW OSCILLATORS FOR THE RADIO FREQUENCY RANGE

By C. T. GRANT

Members of Technical Staff Bell Telephone Laboratories

Telephone Apparatus Development

In recent years rapid strides have been made in the use of ever increasing frequencies for the transmission of speech, both over wire lines and through space. Frequencies as high as 35 kilocycles are used for carrier telephone circuits operating over telephone lines, and frequencies up to 150 kilocycles for power line carrier systems. For radio broadcasting purposes, frequencies from 500 to 1,500 kilocycles are employed, and above this range come various short-wave channels such as those for ship-to-shore and point-to-point communication. Thus, speech can now be transmitted at frequencies as high as about 2,000,000 kilocycles.

To carry on experiments and tests in the lower part of this range it became necessary to develop means for generating currents at different frequencies. Accordingly, the design was undertaken of a high frequency oscillator which would cover at least a substantial part of the above range. Fifty and three-thousand kilocycles were set as satisfactory lower and upper limits.

The circuit as developed employs a push-pull oscillating stage directly coupled to a balanced two-stage amplifier. An aircore transformer couples the tuned plate circuit of the oscillator to the grids, which are in turn directly connected to the grids of the first amplifier stage. The purpose of the first amplifier stage, which is coupled to the second by retardation coils and condensers, is solely to act as a buffer between the output stage and the oscillator, so that any change in load will not reflect back and change the frequency of the oscillator. A balanced circuit throughout was selected as the most ready means for controlling the impedances between high potential points.

Plate supply to the first amplifier stage is connected to the mid-point of an input transformer which is used as a retardation coil and tuned to offer a high frequency. The second amplifier stage has its impedance at the operating plate supply connected to the mid-point of the output transformer which steps down the impedance of the vacuum tubes to one hundred ohms. The output is then controlled by a balanced H type resistance network, which may be varied over a 40 db range in steps of 2 db.

This new radio frequency oscillator, known as the W-10414, has a frequency range from forty to four thousand kilocycles, and will deliver an output current of approximately sixty milliamperes into a resistance load of one hundred ohms. Its harmonic content is held to less than three per cent by use of the balanced circuit. The output frequency is calibrated to an accuracy of two-tenths of one per cent and this accuracy will be maintained with normal variations in filament current and plate supply voltages, and with changes of tubes.

One special feature of primary importance encountered in the design of this oscillator was the development of suitable decade condenser switches. Since the inductance of the oscillating circuit, which includes the wiring to the condensers, must not change as the capacitance is varied, a special decade switch had to be designed. This is of the "ferris wheel" type and is designed so that when one condenser is removed from the circuit another is put in its place. In laying out the assembly of the oscillator, these decade switches, of which several are employed, are placed around the oscillating coil so that the wiring from each switch is of approximately the same length.

With the completion of the design of this oscillator, development work was immediately started on a similar oscillator but with a frequency range from 3,000 to 30,000 kilocycles. This second oscillator, known as the W-10465, differs from the lower frequency one chiefly in certain precautions taken to decrease high-fre-

(Continued on Page 32)

ELECTRON CONDUCTION IN THERMIONIC VALVES*

By W. E. BENHAM

The present paper is concerned with the physical nature of the medium constituted by the cloud of electrons passing between cathode and anode of a Thermionic Valve. Attention is directed primarily to the simple case of a high vacuum two electrode valve of plane geometry.

In the theory of conduction in solids, liquids, and gases, it is of paramount importance to derive the conductivity and the dielectric constant or specific inductive capacity of the conducting medium. In solids, the carriers of electricity are believed to be "free" electrons. There are, however, electrons which do not play any part in conduction. These electrons are those which are capable only of restricted motion, being more or less "bound" to the parent atoms of the molecules. The "free" and "bound" electrons correspond to the mechanisms of conduction and of inductive capacity, respectively.

When we come to the case of conduction by a cloud of electrons, each electron being far outside the sphere of influence of atoms of any kind, there is nothing to correspond with the "bound" electrons, and at first sight it would appear that the dielectric constant of the electron cloud must be unity. This, however, is found to be true only as an approximation in the case of highly attenuated clouds.

In case of electron clouds commonly obtained in practice, the electrons—all of which are conduction electrons—are sufficiently numerous to endow the electron cloud with a dielectric constant different from unity. This does not alter the fact that the ether between the electrons is of dielectric constant unity, so that the value of the "electric intensity," except in the minute proportion of volume occupied by actual electrons, is also the value of the dielectric displacement This state of affairs is brought about rather by distortion of the electric field due to the electronic charges than by any property analogous to inductive capacity, such as is possessed, for example, by ionised gases, in which the conduction electrons are to some extent "bound" to the relatively inert gaseous ions. An analogy to the case of "bound" electrons which at first sight may appear far-fetched may be traced by considering the electrons of an electron atmosphere as "bound" to one another in a negative sense; the mutual repulsions of the electrons certainly constitute a factor of vital importance. It is probably a matter of the point of view taken, but the distortion of field in the case under consideration is brought about entirely by the presence of electrons in sufficient quantities for mutual repulsion to be effective. In the case where the electron atmosphere is imprisoned not between parallel planes but between spheres or cylinders, the field is non-uniform apart from the distortion arising from the electrons. Even in this more complicated case, however, there is nothing to suggest that the dielectric property may not be attributed to mutual repulsions occurring under different conditions of field distribution.

In a recent paper the dielectric constant and conductance of an electron atmosphere between the parallel electrodes of a Langmuir diode were evaluated as functions of pT, where p is the angular frequency of a small impressed alternating e.m.f. and T is the mean transit time of the electrons between the electrodes.

Figure 1 shows that the dielectric constant ϵ has a value less than unity for frequencies lying between 0 and $\frac{9}{2 \pi T}$. Taking 10^{-9} seconds as a typical value for T, we see at once that the frequency range for which $\epsilon < 1$ embraces nearly all the frequencies so far obtained using thermionic valves (an angular frequency of nearly 10^{10} may be obtained under favourable conditions). Figure 1 may also be read as the value of ϵ for different values of T, p being held constant. Read in this way it will be seen that as pT increases from zero up to about 1 or 2, the value of ϵ remains sensibly constant at the value 0.6 which means that in this case the value of ϵ is constant over the space included between the cathode (T=O) to the anode ($T=T^d$). This surprising result that (for a range of frequencies of practical interest) the dielectric constant of all points in the interelectrode space is $\frac{3}{5}$ must constitute the first known case of a "dielectric" which is distinctly non-homogeneous in constitution and yet homogeneous in respect of dielectric constant. Although on the above considerations ϵ is constant, the displacement current nevertheless varies from point to point. The space variations of displacement current and of potential combine to effect complete neutralisation of the space variation of dielectric constant in a Langmuir diode.

Experiments were carried out by the author to verify that $\epsilon < 1$ in the case of a Langmuier diode. Independent experimental evidence of a confirmatory nature is to be found in a paper by Bergmann & During.

Figure 2 shows the relative change in conductance for values of pT between 0

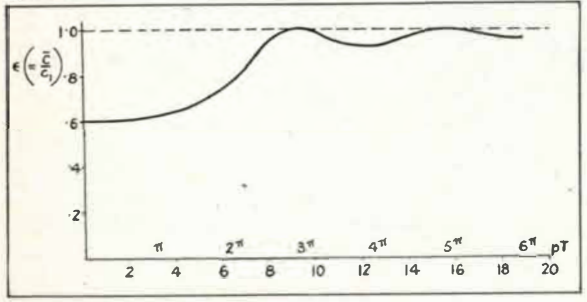


Figure 1

*Reproduced from and by courtesy of Electrical Communication. (April, 1933)

and 22. Fig. 2 also represents the conductivity c
of the atmosphere of electrons at values of pT
the atmosphere of electrons at values of pT
between 0 and 22. Just as in the case of the dielectric constant, Figure 2 may be read as the variation of conductivity over the space. It is seen that the conductivity for exceedingly high frequencies is alternately positive and negative at a number of regions between the plates. If the anode plate lies in any one of these regions, the diode as a whole exhibits negative conductance. Regarded another way, for any given anode voltage (fixing T^d), there are ranges of frequency for which the diode exhibits negative conductance. Mathematically, the number of such frequency ranges is infinite. Experimental difficulties are likely to limit the number obtainable in practice. Potapenko, in a recent publication of his investigations in the field of the ultra short electro-magnetic waves obtained in a single valve five types of waves the frequencies of which stood in the ratios indicated by $\lambda b/\lambda$ in Table 1. The wave of lowest frequency is called "normal" by Potapenko, who calls the higher frequency waves the dwarf waves of the 1st, 2nd, ...order. The fair constancy of the last column shows that Potapenko's waves have frequencies whose relation to one another is not very different from the ratios determined by taking the minima of Figure 2. (The minima beyond the range of Figure 2 occur very nearly at intervals of 2π—rough estimates therefore give pT 26.6 and pT 32.9.) It does not always follow that the frequencies observed coincide exactly with the minima of conductance (i.e., the maxima of negative conductance) owing to frequency variation of the conductance of the circuit associated with the valve. In Table 1, λb is the wave length calculated from Barkhausen's formula; by taking the ratio $\frac{\lambda b}{\lambda}$ the variable factor of grid voltage is effectively eliminated.

TABLE I

Potapenko's Waves			Minima of Fig. 2	Exp./Theor.
Type of Wave	range of λ (oms)	$\frac{\lambda b}{\lambda}$ (average)	pT	$\frac{1}{pT} \cdot \frac{\lambda b}{\lambda}$
Normal	74 —54.2	1.145	7.6	1.505
1 dwarf	43.7—35.6	1.965	13.85	1.420
2 dwarf	20.7—12.65	2.996	20.3	1.475
3 dwarf	18.8—12.55	3.975	(26.6)	1.495
4 dwarf	12.4— 9.4	5.035	(32.9)	1.532
				Mean 1.485

It will be seen that some of the wave ranges overlap. In general, it was necessary to use higher grid voltages to obtain shorter waves, but the possible ranges of grid voltages overlap in many cases. The mean value of 1.485 differs by 4.5% from the value of 1.420 for the 1st order dwarf wave, the discrepancy being 3% for the 4th order dwarf wave, 1.3% for the normal wave and less than 1% for the other two dwarf waves. In no case would Potapenko's waves lie outside the regions of negative conductance predicted by the theory which thus provides the clue to the mechanism of ultra-short waves. A significant feature of the theory, in contrast to previous conceptions, is that the generation of oscillations in an external circuit can take place with amplitudes of electron motion so small that if the motion in transit of the electrons under the influence of steady potentials could be followed with the eye, the super-imposed oscillatory motion would escape notice altogether.

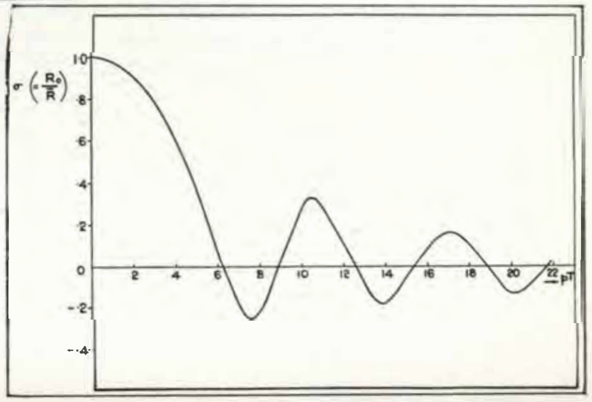


Figure 2

TWO WIRELESS CABINS FOR FRENCH SHIPS

Following the destruction of the French liner "Atlantique" by fire which involved the wireless room within a few minutes of its outbreak, the French Minister of Merchant Marine has issued new and far more stringent regulations to be observed in the protection of ships against fire.

Among these regulations is one totally forbidding the use of wood in the construction of certain parts of ships, including the bridge and wireless cabin, both of which must be entirely of metal. In addition, the bridge and wireless cabin are to be designed in such a way as to resist fire to the utmost possible extent and must be capable of efficient ventilation in case of smoke. Ships of more than 10,000 tons must carry two wireless cabins, each in a different part of the ship. These regulations have been issued by the Minister of Marine after consultation with experts and the directors of the leading French shipping companies.

Article II of the Decree, which is dated January 21st, 1933, states that Safety Certificates, as provided by the Convention of London, 1929, will be granted only to those passenger vessels satisfying the provisions of this decree.

The "President Doumer," a sister ship of the "Georges Philippar," which was launched on January 22nd, will apparently be the first French ship to embody these regulations.

TRANSOCEANIC RADIO COMMUNICATION*

Some 40 Nations Are Linked to U. S. by R.C.A. Communications, Inc.

By H. H. BEVERAGE H. O. PETERSON C. W. HANSELL

With major terminals at New York and San Francisco, and supplementary centers in Havana, Honolulu, and Manila, the R.C.A. Communications, Inc., operates a radio network interlinking the United States with about 40 other countries. When transoceanic services were opened in 1920 only 6 circuits were in use, whereas early in 1932 this total had grown to 54. This system in conjunction with branch radio circuits and wire networks in the countries served reaches practically the whole civilized world.

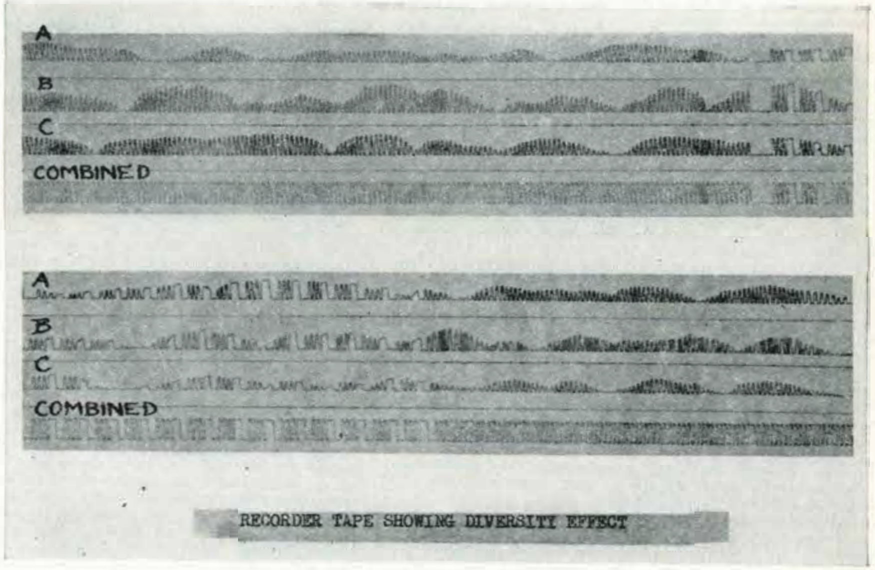
All 10 circuits in use by the close of 1924 were operated at the relatively low frequency of from 15 to 30 kc produced directly by means of Alexanderson alternators. Since 1924, high frequencies have been used increasingly until now they carry nearly all long distance traffic although low frequencies still are used across the North Atlantic to supplement the regular high frequency service when the latter is disturbed by occasional magnetic storms. Since 1927 the number of circuits has doubled, the rapid increase being made possible by the introduction of high frequency vacuum-tube transmitters, the first cost of which is relatively low. These transmitters are used exclusively for high frequency radiation.

Equipment now in service on the Atlantic Coast includes some 8 low frequency and 35 high frequency transmitters, all controlled from New York City, and some 16 low frequency and 40 high frequency receivers to handle incoming New York traffic. On the Pacific Coast are 12 high frequency transmitters controlled from San Francisco and some 20 high frequency and a few low frequency receivers to handle incoming San Francisco traffic. Transmitting and receiving stations are separated from each other and usually are some distance from the centralized traffic offices in the associated terminal cities.

Central Office Equipment

All traffic operations are centralized in traffic offices conveniently located in terminal cities and connected by wire lines with the transmitting and receiving stations. Messages to be sent are transferred to paper tapes by means of perforators having keyboards similar to ordinary typewriters. The perforated tape then is fed through automatic transmitters which impress the dots and dashes of the Continental Morse code upon the control lines to the transmitting stations. The speed of transmission ranges from 5 to 200 words per minute, depending upon circuit conditions and traffic load. On busy circuits a speed of 100 to 125 words per minute usually is maintained.

Signals from the receiving station arrive at the central offices in the form of keyed tones. These are amplified, rectified, and then plugged through to any desired receiving table to operate an automatic recorder. The recorder has a



RECORDER TAPE SHOWING DIVERSITY EFFECT

*Essentially full text of a paper (No. 32-115) presented at the A. I. E. E. Pacific Coast convention, Vancouver, B. C., Aug. 30-Sept. 2, 1932.

light movable coil suspended in a strong magnetic field. Signal currents through this coil cause it to move a light lever carrying a small silver tube through which ink is impressed upon a moving paper tape. The signals appear as undulations in ink line upon the tape.

Tape bearing the signals is drawn at a convenient speed across a guide on the operator's typewriter from which the operator reads the messages and types them on message blanks. If the circuit operates faster than 50 or 60 words per minute, 2 or more operators may divide the tape between them. In this way the messages on all circuits are kept transcribed and there is no delay.

The typed messages are carried on a belt conveyor to a central point where they are timed, numbered, routed according to destination, enveloped, and dropped through a chute to the messenger room for immediate delivery.

Transmitting Stations

Fundamentally, the purposes of the transmitting stations are to:

1. Convert 60-cycle a-c power into power of radio frequencies.
2. Radiate the radio frequency power.
3. Accurately control the radiation frequency.
4. Modulate or key the radiation for the transmission of intelligible signals.

For low frequency transmission an Alexanderson alternator driven by a 2.2-kv 2-phase wound-rotor induction motor is used to produce energy at from 15 to 30 kc. The alternator is of the inductor type with a toothed rotor running between parallel armatures bearing 64 armature coils. The outputs of the 64 coils are combined into a single circuit by means of a transformer which delivers from 100 to 120 amp at 2 kv to one of several downleads and tuning coils of an Alexanderson multiple tuned antenna.

Each of the 2 multiple tuned antennas at the Rocky Point transmitting station is 1.5 miles long and consists of 12 conductors carried on 150-ft. crossarms, supported on steel towers 410 ft. high, and spaced about 1,250 ft. apart. When a signal is being transmitted, the circulating energy in each of these antennas is ab— 700 amp at 135 kv, or nearly 100,000 kva, a figure that indicates the magnitude of the power required for long distance commercial radio communication. Although each of these antennas constitutes a circuit with an extremely low power factor (for its frequency) its radiation efficiency is only about 10 per cent and its directive effect is practically nil.

In high frequency transmitters, vacuum tubes are used to convert 60-cycle power into direct current and then into power of about 5,000 to 22,000 kc. The tubes that produce the radio frequencies are equivalent to resistances, the value of which may be varied with extreme rapidity by varying the potential upon control electrodes within the tubes.

Nearly all of our high frequency transmitters employ relatively low powered piezoelectric crystal-controlled oscillators to produce initial oscillatory currents at frequencies between about 750 and 3,000 kc. The oscillator output then is passed through a chain of vacuum tube amplifiers and frequency multipliers to obtain the final power and frequency required for transmission. The crystal oscillator provides a practically constant frequency and permits the operation of transmitters with relatively small frequency separation. The Federal Radio Commission limits the frequency variations to less than 0.05 per cent on old equipment and 0.02 per cent on new equipment.

The use of frequency multiplication in the successive stages of amplifier greatly reduces the tendency for high power circuits to feed energy back to lower power circuits in a way to set up uncontrolled self-oscillations in the amplifier system. This is an important feature and is almost a necessity where large power amplification is used. The use of screen grid shielded vacuum tubes and neutralizing circuits for counteracting couplings between tube input and output circuits also are helpful in preventing spurious oscillations. The final power outputs to the antennas range between about 1 and 50 kw depending upon the circuit requirements.

Keying of the transmitters in accordance with telegraph signals is done by varying the electrode potentials on some of the vacuum tubes in the chain of amplifiers. This is done through electromechanical relays or through vacuum tube devices controlled from the central office. Some of the vacuum tube keying equipment is capable of functioning at speeds equivalent to more than 1,000 words per minute, and is used at these high speeds in the transmission of pictures or "photoradiograms."

The use of high frequency radiation, with its shorter electrical wave lengths, has made practical and economical the direction of radiation toward the distant receiving station. Consequently, directive antennas commonly are used with high frequency transmitters. R.C.A. Communications, Inc., has developed and applied successively 4 different types of directive antennas, namely, models A and B, which radiate vertically polarized waves, and models C and D, which radiate horizontally polarized waves. The power gain due to directivity ranges up to 80 to 1, depending upon the type and size of antenna. Because of their relatively low cost and great directivity, these antennas give a high ratio of circuit improvement per dollar of cost.

Directive characteristics of a 2-bay model D antenna give a power gain of about 80 to 1 over a half-wave dipole at the same height as the antenna. When used with a 40-kw transmitter this antenna launches radiation toward the distant receiver equivalent to that which would be obtained with 3,200 kw in a non-directive antenna. This is about 800 times the radiation launched toward the distant receiver from an Alexanderson alternator and low-frequency multiple-tuned antenna.

Fading of high frequency signals is a phenomenon of nature which must be overcome in a commercial radio communications system. Often the received signals vary over a great range in intensities, variations at times so rapid as to constitute an audio modulation. Since observations have shown that the fading of even slightly different frequencies is not simultaneous, the effects of fading can be reduced by transmitting the same signals on more than one frequency. In some commercial transmitters the carrier wave is amplitude- or frequency-modulated at an audio rate, in addition to the keying, to produce side frequencies and so reduce fading by frequency diversity. However, it is preferable to reduce the effects of fading by methods applicable at the receiver.

Receiving Stations

The function of the receiving station is to select the desired signals by virtue of frequency discrimination and amplify and convert them to a form of electrical energy suitable for transmission over circuits extending to the central office. In the fulfillment of this function, several technical conditions must effectively be dealt with.

Signal fading already has been mentioned as one of the problems confronted in the operation of short wave circuits. Aside from the short-period fading mentioned previously there are

(Continued on Page 28)

HOW RADIO FUNCTIONS IN AIRCRAFT "BLIND LANDING"

A radio system for the blind landing of aircraft has reached the stage of development by the Aeronautics Branch of the Department of Commerce which permits its use at a busy terminal airport for service tests in fog and under other conditions of poor visibility. A demonstration of this system was given by the Aeronautics Branch at the Newark Municipal Airport, Newark, N. J., with a pilot in a hooded cockpit.

The flights were made by James L. Kinney, Aeronautics Branch test pilot, who succeeded Marshall S. Boggs as pilot assigned to this research work after the latter had been fatally injured in an accident on the west coast the latter part of January while temporarily assigned to other duties. During the past year and a half over 100 blind landings have been made in connection with the research work on this radio system for blind landing of aircraft which has been developed by the Aeronautics Branch through its research division, organized at the Bureau of Standards. While this system makes possible a completely blind landing, it will seldom be subjected to so stringent a test in actual

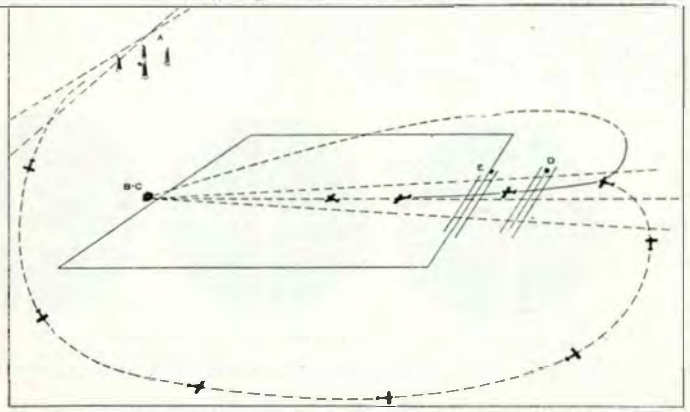


Fig. 1.—Diagram of airplane landing by means of radio system for blind landing. A indicates location of main radio range beacon; B and C, the runway localizing beacon and landing beam; and D and E the marker beacons.

practice, as visibility is not often so poor that the pilot can not see the ground just before landing.

The installation for service tests at the Newark Airport will be available for the use of airplanes equipped with the necessary radio receiving apparatus. The major part of the radio apparatus required aboard the aircraft is the standard equipment used for 2-way communication and for receiving the weather broadcasts and the visual-type radio range beacon signals in flying along the airways. The additional equipment required is quite simple and weighs about 15 pounds.

As now constituted the radio system for blind landing of aircraft gives direction in three dimensions—lateral, longitudinal, and vertical—which is the information that the pilot must have to make a landing. Lateral direction is given by a runway localizing beacon, longitudinal direction by marker beacons, and vertical guidance by a landing beam. (See fig. 1.)

Work on this research project was divided into three stages, the first of which consisted of fundamental experiments and research to develop the basic component parts of the system, including the runway localizing beacon, marker beacons, landing beam, and suitable radio receiving and indicating apparatus for use in the air. The second stage consisted of the practical development of these component parts, fitting them together to form a complete system and finally demonstrating the practicability of the system through the medium of an extensive series of hooded landings, conducted by the Aeronautics Branch at its experimental flying field at College Park, Md. The third stage of the development, which involved the testing of the complete system experimentally under the conditions obtaining at a commercial airport, is at the Newark Municipal Airport where the city of Newark has cooperated in the installation of the system.

The work at the Newark Airport included fog landings as well as hooded landings. The former are, of course, more representative of operating conditions. While the Newark installation is not for service use in air passenger operations, it affords an opportunity for cooperative experimentation with air transport operators. Several of the operators have already indicated their intention to equip one or more test planes for trials of the system. In this way it is hoped that the possibilities of the system will be fully developed.

The Newark Installation

The installation of radio landing aids at Newark Airport includes three elements, a runway localizing beacon, a set of two marker beacons, and a landing beam. The runway localizing beacon, in addition to providing definite means of locating the airport, gives indication of the directional position of the aircraft and permits keeping the craft directed to and over the desired landing runway. The marker beacons give the longitude position of the aircraft when approaching the airport. One marker beacon is located about 2,000 feet from the landing area while the other marks the boundary or edge of the field. The landing beam provides vertical guidance. It employs an ultra-high-frequency radio beam, of the order of 100,000 kilocycles, directed at a small angle above the horizontal, and thereby marks out a convenient gliding path for the landing aircraft, clearing all obstructions.

Transmitting Equipment

The transmitter used for the runway localizing beacon operates on a frequency in the neighborhood of 300 kilocycles and is similar to the visual type transmitters designed for the radio range beacon stations on the Federal airways system. The use of a visual-type transmitter facilities automatic volume control reception on the aircraft. This is quite essential since the pilot, in making a landing, is concerned with so many things that the burden of close manual adjustment of receiving-set sensitivity should be eliminated. Small crossed-loop transmitting antennas are employed in order that the runway beacon may be located near one end of the runway without constituting an obstruction to flying. The loop antennas consist of seven turns of wire on wooden frames 10 feet high by 12 feet in length and are housed in the same building as the transmitting set. A goniometer is provided to the end that the runway localizer course may be swung to take care of different wind directions. At the Newark Airport the wind, under conditions of poor visibility, is usually from the northeasterly quadrant. The runway beacon accordingly is located at the northeast end of the field. Thus by swinging the course over an arc of 40° it is possible to accommodate practically all wind directions pertaining at times when the visibility is low.

The marker beacons are located at the southwest end of the airport. As noted in the foregoing discussion one marker beacon is provided about 2,000 feet from the field while a second marker defines the boundary of the field. The marker beacons are very simple, each consisting of a low-powered transmitting set and a long, low horizontal antenna. These transmitting sets operate directly from the commercial power supply. Each set employs three tubes, a radio-frequency oscillator, an audio-frequency oscillator for modulating the radio-frequency oscillator at the desired audio-frequency, and a rectifier tube for providing plate power supply to the two oscillator tubes. Different modulation frequencies are employed for the two marker beacons to facilitate ready identification of the marker beacon being passed over; the one at the field boundary having a modulation of about 250 cycles per second while the other has a modulation of approximately 1,000 cycles. The transmitting antenna for each marker beacon consists of a horizontal wire a few feet above the ground and extending across the southwesterly approach to the landing area a sufficient distance to intersect the path of the aircraft for all orientations of the runway beacon course.

Experiments at Newark

The experiments at Newark will include the determination of the most suitable radio-frequency (from the viewpoint of an airline operator) on which the marker beacons should operate. A radio-frequency of about 10,000 kilocycles will be used in some of the tests, in which case a simple marker beacon receiving set is required aboard the aircraft.

Tests will also be conducted with the marker beacons operating on the same radio-frequency as the runway beacon, thus permitting their reception on the medium-frequency receiving set normally available on the aircraft. The need for a special marker beacon receiving set is thereby obviated but careful adjustment of marker beacon power output is required to prevent interference with the runway beacon course indications when the airplane is directly over a beacon. The severe requirements imposed upon the system in the experiments at College Park, both by the small dimensions of the field and the obstructions in the approach, did not permit the successful use of this arrangement.

In the third series of tests, the marker beacons will operate on a frequency in the aircraft communication band, 3,000 to 6,000 kilocycles, in order that the high-frequency communication receiving set commonly carried on aircraft may be utilized for receiving the marker beacon indications. Control equipment has been provided to the end that both the communication signals and the marker beacon signals may be received during a landing with minimum effort on the part of the pilot.

The landing-beam equipment is located adjacent to the runway localizing beacon. The transmitter employs a transmitting circuit arrangement specially designed for ultrahigh-frequency operation, 10,000 kilocycles. The transmitting antenna array consists of 12 half-wave horizontal antenna, so grouped as to give the necessary directivity of beam in the vertical plane while spreading the beam out in the horizontal plane to afford service in the 40° sector to be covered. This results in a fan-shaped beam which provides vertical guidance for all orientations of the runway beacon course within the limits specified. The antenna array is 16 feet high, by 10 feet wide, by 2.5 feet deep overall.

The theory of operation of the landing beam is readily understood. Maximum field intensity is produced along the inclined axial plane of the beam. The aircraft does not fly along this plane, however, but on a curved path the curvature of which diminishes as the ground is approached. This path is the line of equal intensity of received signal below the inclined axial plane. The diminution of intensity as the aircraft drops below this plane is compensated for by the increase in intensity due to approaching the beam transmitter. Thus by flying the aircraft along such a path as to keep the received signal intensity constant, as observed on a microammeter on the instrument board, the pilot descends on a curved path suitable for landing. If the aircraft rises above this path, the microammeter deflection increases, while if it drops below the path the deflection decreases.

AIRPLANE TO LEFT OF RUNWAY AND ABOVE THE PROPER LANDING PATH. | AIRPLANE OVER THE RUNWAY AND ON THE PROPER LANDING PATH. | AIRPLANE TO RIGHT OF RUNWAY AND BELOW THE PROPER LANDING PATH

Fig. 2.—The dial of the "combined instrument" with the needle pointers in three different positions

Receiving Equipment

The receiving installation required is a medium-frequency receiving set of the type commonly used by air transport operators for the reception of radio range beacon signals and airways weather broadcasts. This set is augmented by a reed converter and automatic volume-control unit for use with the signals from the runway localizing beacon. Visual course indica-

(Continued on Page 30)

Ship News

Roger P. Soucasse is on the MS Sunoil, and says Sun Oil is one fine outfit to work for.

H. B. Erpenstein is on the Union Oil SS Deroche.

Robert Gamber is still with Petroleum Navigation SS Papoose.

Lester L. Jordan is putting in good time with Standard Shipping.

J. Wesley Geweken is Senior Operator on the SS Fairfax, of the Merchants and Miners.

Victor A. Meinhardt is also operating with the Merchants and Miners.

Z. R. Brown is Mackay operating out of San Francisco.

B. W. R. Hagen is radiomarining at Walteria, Cal.

L. G. De Merritt is on the SS Mericos H. Whittier, out of San Francisco.

John R. McMurray is busy on the SS Delaware Sun.

N. O. Gunderson is working out of San Francisco with Mackay.

W. B. Wilson is an old timer. Many would like to know that he is on the Lighthouse Tender FERN, at Ketchikan, Alaska.

F. T. MacGillivray is in the Marine Dept. of Standard Oil at San Francisco, to his friends.

William Werner is on the SS Betty of the Bull Lines.

Leonard Pratt is sailing with the SS Cities Service Empire.

Richard L. Lindell is with the Merchants and Miners on the SS Essex.

B. Burrell is Marine operating with the Marconi Co., of Canada.

Jack Honer is on the SS Albert E. Watts, out of Houston, Tex.

Leslie H. Greer is on the M. S. Ward.

E. K. Anstey is on the MS Calgarolite of Imperial Steamship Co.

B. Faley is working the SS El Segundo on the West Coast.

J. C. Currie is on the MS "Tide Water," and doing fine.

March Canion is holding down the SS Sapinero.

C. Feinman is another MS Western Sun man who likes it.

G. H. Wiley is chief on the MS Santa Catalina.

Charles S. Smith is operating the SS Cities Service Missouri.

A. E. Goodgame is Standard Shipping on the SS Dean Emery.

A. B. Chappelle is on the SS Tacoma, of Tacoma Oriental.

John F. Taylor is Dollar Lining on the President Hoover.

SOME STRAYS

A. J. Handel is at the Marine Barracks, Cavitte, Philippine Islands.

Capt. J. Bachmann is assigned to Shanghai, China.

Fred F. Hall is at Radio Station W9DHJ, Crown Point, Ind.

Larry Burrow is at the Nome, Alaska radio station.

R. G. Loucks is at Station WPI of the Federal Barge Lines and enjoys hearing about his old friends in the Gulf Division.

BROADCAST STATION NEWS

Thomas L. Siglin is doing his best with WPRO, and that good.

Carl A. Johnson is helping to keep KGA at top notch and doing well.

J. A. Cheeks is doing fine at WTAM.

Kenneth Shirk is Chief Op. at KOIL, where he has been for the last six years. He still holds on to his commission as Ensign in Naval Reserve.

Warren P. Williamson is President and Technical advisor of WKBN.

Everett Whitmyre is manager of WIBX.

M. E. Eisenberg is in charge of television development at WDAY. Well, it may mean something at a later date.

Dan Jones is Chief Engineer of WAAT. He's a Ham too—call W3CZF.

Serge DeSomov is with NBC in New York. The "gang" expects their new quarters at Rockefeller Center will be ready this fall.

Arthur Rydberg has been with KOIL five years. W9AED is his at home call.

Roy Rydberg (brother of Arthur above) is also with KOIL, and has been with the station three years.

Bernard T. Wilkens is Chief Engineer of WKBN. Good stuff, B. T.; and thanx.

Gordon I. Henry has put in four years with KOIL, and is ready for another forty. Just think boys, a Captain in the R.O.T.C., no less. O. K. Gordon, we're with the Navy next time.

Carl Lindberg is Assistant Chief at WKBN. Has W8PH as well as Portable W8ZZA to worry over outside the station. Would like to go to sea but is afraid of losing his YL. What say boys, tell him all about it.

Gordon Anderson hopes to step up at KOIL as soon as things are a little better.

Ray M. Flood is doing nicely at W1FPS.

Neil B. Coil enjoys working at WRHM, and expects to continue.

M. T. Beale is at WJSV, and thinks it is a "great station."

* * *

Station Personalities

Warren P. Williamson is president of WKBN Broadcasting Corporation. Most of the old timers will probably recognize him as Ex SKT of the oft spoken of "Good Old Days," when anything that sounded like a rock crusher and threw a fat spark was the Acme of wireless. Oh, yes, and frequency was a word unheard of by most of us then. What wavelength you were

(Continued on Page 31)

CORRESPONDENCE SECTION

RADIO AT HOME—(And That's That!)

I've never written in to any broadcasting station voicing either like or dislike as regards radio artists, programs, ideas, or stunts. While without doubt, genuine outside fan mail or constructive criticism is invaluable and even necessary to establish a happy medium of applause and appreciation between entertainer, entertained, and sponsor, still, like the rest of the thousands like me, this part of public expression has thus far been left to the voluble exponents of more leisure or more willingness to sit down and write personally, their views and opinions concerning various radio enthusiasms or non-enthusiasms. However, I have noted with interest, the different re-actions in many home circles, to radio influence—either as a source for news, diversified aid, or plain amusement value. Not to mention my own humble preference and opinion as one of the obscure millions, who, as prospective consumers, achieve importance to the real bosses of the present day radio world—the men who put up the cast with cash profit in view—the advertising (ugh!) sponsors.

And I may as well begin with advertising. First of all, while a fair business sense fully warrants some profitable return to the sponsor for his financing which makes the program possible, and while the excessive use of his name, the name of his product, the wonderful reputations of both, and a flood of collossal, awe-inspiring adjectives regarding same, may be sweeter music to his ear than the hired band the entire use of advertising, unless presented in a modest, original, or pleasing style, is just a plain, aggravating, boring nuisance to the millions of dial-twirlers who regard these necessary interruptions with grimly resigned annoyance. However, the average listeners are fair enough to realize that the radio advertising may be crammed in their unwilling ears, and the virtues of many and every product be forced, willy-nilly, down upon them, it is after all, merely the sponsor's just due, provided it is not abused in excess, and provided the program itself is pleasingly worthy. But worthy or not, there is a limit to advertising interruptions and when it is crudely taken advantage of, it defeats its own purpose by arousing the listening prospective purchaser's ire, or ridicule against the poor, stressed over-and-over again product. And when a program ruins itself by employing this crude bally-hoo incessantly, we outsiders just simply and easily avoid it, to the loss of that sponsor and the gain of somebody else.

Like pretty nearly every type of business or pleasure, the public must be catered to for any commercial or artistic success, notwithstanding Art for Art's Sake—unless, of course, private funds take up the stand. I, for one, think that the public as a whole, can be easily pleased in everything, including the radio field. To my layman's observation, it seems merely a matter of dividing up the various classes of people everywhere, into definite, general groups, and arranging programs to suit these separate little worlds according to which class is more desirable or profitable to reach. If quantity in numbers is the main objective, then the masses must be considered by striking a happy medium in a general average of intelligence and preferences, however ordinary. To my purely outside knowledge, no broadcasting station, large or small, has up to the present gone to the trouble and expense of employing a return-postage, card circular system, so simply and cleverly contrived, that a small check sign, and a casual drop in a nearby letter box, could give an exact survey of the necessary public's opinions and preferences—an initial expense well justified, eventually.

As far as radio entertainment is concerned, most families like "folksy," human, real-life sketches; other families prefer current events and politics; some prefer romance, some want adventure, and others crave colorful fantasy and mystery; not to omit those who thrill to stage, screen, cosmopolitan, or rustic atmosphere; and the tired business men (and women!) who desire even more statistics and surveys over the ether. There indeed are many, many types of entertainment to suit many, many types of listeners—but the great and one and only equalizer in entertainment, is, and always will be, music. A good rule to follow, in my opinion as regards radio music, is—jazz for the feet; light classical and smooth popular for the heart; opera and heavy intricacy for the knowing music lover. In spite of the assumed air of modern poise, sophistication, and unemotional surface, the great majority of people today, remain, as their mothers and fathers before them at heart, sentimental, warm, and susceptible as regards any thing appealing to their inner selves. I have seen prosaic, business men slowly assume expressions of unaccustomed softness, when the pleasing, stirring strains of some clever, musical program of long ago, drifts out from their handsome radios; I have seen thin, discontented, drab women-faces go dreamy and sweet at the sound of soft, soothing melody in voice or instrument, from their humble little sets; I have seen young, virile, men and women, caught by the depression, forget their troubles in absorption, thru a magic voice or band, Hawaiian, Cuban, Novelty, or American; and so many, many old folks, (and young folks, too) re-living happy memories in old-time, once popular tunes! Jangling jazz is terrible to listen to—grand to dance to—and novelty numbers, unless originally unique and amusing, are really for the children. So many, many times, in so many homes, and outside, have I heard the remark, "Just listen to that radio! Isn't that music lovely—what a charming program!"—that I have come to the conclusion that light classical and smooth music, modern or old, for listening purposes, is certainly neglected over the radio in comparison

(Continued on Page 29)

INTERNATIONAL FEDERATION OF RADIOTELEGRAPHISTS

BULLETIN NO. 23

Agreements.

Germany.

All the agreements between shipowners and seafarers may be denounced by giving one month's notice, for the first time to terminate on the 31st of March, 1933.

Holland.

The collective agreements in the shipping industry expire on the 31st of March, 1933; no new agreement has yet been concluded.

Denmark.

By the end of December, 1932, the shipowners gave notice to terminate all the collective agreements, including the agreement between the Danish Radio Company, which is owned by the shipowners, and the Radiotelegrafistforeningen of 1917, our affiliated association in Denmark. Due to the threatening of a general Lock-out in the whole of the Danish industrial world, the government introduced a bill in Parliament prohibiting all Lock-outs and Strikes until the 1st of February, 1934. One of the consequences of this Bill which was adopted on the 31st of January, is that the salaries and working conditions of our Danish Colleagues remain unchanged until the 31st of March, 1934, on which date their agreement can be terminated by notice given before the 1st of January, 1934.

Sweden

It appears that the navigating officers of Sweden have agreed to certain wage reductions of from 2-11 per cent. whilst the rest of seafarers including the "Sveriges Radiotelegraphist Forening" are holding out for having the present salary scale introduced in the new agreements. Negotiations are being carried out under the chairmanship of a representative of the Government.

THE SAFETY OF LIFE AT SEA CONVENTION

This convention, entered into on the 31st of May, 1929, has now been ratified by a number of countries, and its general regulations are being put in force gradually upon the ships being inspected when calling at home ports. It is the intention that ALL the regulations shall become compulsory for ALL ships coming under the convention as from the 1st of January, 1934. In view of the fact that several of the clauses in the convention are subject to certain interpretations, we shall give a short resume of the National regulations issued in England, Germany, Denmark, and Finland, and we hope to be able to publish similar details from other countries.

A W/T installation is compulsory on all passenger ships and on all cargo ships of 1600 G.R.T. and upwards, as from the 1st of January 1933. Ships are classified as follows:—

Class I.	Passenger ships of 3000 G.R.T. or upwards and cargo ships of over 5500 G. R. T.
Class II.	Passenger ships of under 3000 G.R.T. and cargo ships of 3000-5500 G.R.T.
Class III.	Cargo ships of 1600-3000 G.R.T.

Watches.

Class I.	Ships must keep continuous watch.
Class II.	Ships must keep 8 hours watch per day.
Class III.	Ships must keep 6 hours watch per day.

If the ship is provided with an automatic alarm device watch must be kept by an Operator for 4 periods of one half hour each, viz.: 0800—0830, 1200—1230, 1600—1630, 2000—2030 in zone A, etc. At all other times the automatic alarm device must be in operation.

Germany.

A W/T installation is compulsory on all passenger ships, except ships which do not go farther from the coast than 20 miles or a distance of less than 200 miles between two consecutive ports, and on all cargo ships of 1600 G.R.T. and upwards. Cargo ships of less than 2000 G.R.T. are exempted from the obligation of having a W/T installation on board until the 31st December 1937, and all cargo ships, which do not go farther than 150 miles from the coast, are totally exempted from this obligation.

Watches.

Passenger ships of less than 3000 G.R.T. 8 hours per day. Passenger ships of 3000-5500 G.R.T. until 31st December, 1933, 8 hours per day. After 1st January, 1934, continuous watch. Passenger ships of 5500 G.R.T. or upwards continuous watch.

Cargo ships of 1600-3000 G.R.T. at least one hour per day. Cargo ships of 3000-5500 G.R.T. 8 hours per day. Cargo ships of 5500-8000 G.R.T. until 31st December 1933, 8 hours per day, from 1st January, 1934, until 31st December, 1934, 16 hours per day; from 1st January, 1935, continuous watch. Cargo ships of 8000 G.R.T. or upwards continuous watch.

For ships provided with an automatic alarm device there are no regulations concerning a human watch.

Denmark.

A W/T installation is compulsory on all passenger ships trading west of the line Utsire—Texel or east of the line Kalmar—Memel, and every passenger ship trading within these boundaries carrying 500 or more passengers. The same rule applies to all cargo ships of 1600 G.R.T. or upwards employed on international voyages. Cargo ships of less than 2000 G.R.T. are exempted until the 1st January, 1938. The same exemptions as in Germany are allowed for ships which do not go far from the coast.

Watches.

Passenger ships of 3000 G.R.T. or upwards trading west of the line Utsire—Texel continuous watch unless otherwise decided by the Ministry of Shipping.

Passenger ships of less than 3000 G.R.T. 8 hours per day unless otherwise decided by the Ministry of Shipping.

Cargo ships of 5500 G.R.T. or upwards continuous watch unless otherwise decided by the Ministry of Shipping.

Cargo ships of 1600—3000 G.R.T. must maintain such periods of watch as decided by the Master of the ship.

The above periods of watch may be maintained by means of an automatic alarm device. Contrary to the Convention it is not ruled by the Danish Ministry of Shipping that the automatic alarm devices shall be in operation at all times when no human watch is being kept.

Finland.

The Finnish regulations follow the Convention throughout, and for all ships of less than 3000 G.R.T. it is ruled that a human watch of 4

(Continued on Page 33)

American Radio Telegraphists Association News

All communications for The American Radio Telegraphists Association should be addressed to Hoyt S. Haddock, President of the Association, 20 Irving Place, New York City.

Authorized delegates:

Los Angeles, M. L. Schaefer, 514 West 55th Street.

Ashtabula Harbor, Ohio, Arthur Freitag, Box 1056

Coral Gables, Florida, D. W. Scott, 222 Sidonia Avenue.

Beaumont, Texas, Clyde B. Trevey, Radio Station, Magnolia Petroleum Co.

Boston, Charles W. Marsh, 28 Westland Avenue.

Boston, Richard J. Golden, 36 Conwell Avenue, West Somerville, Mass.

Seattle, Wash., W. C. Connell, Pier 1.

Norfolk, Va., Jesse Copeland, 322 Bute Street.

Chicago, Ill., Sumner S. Loomis, 1126 Ainslee Street.

ORGANIZATION vs. CAPABILITY

There seems to be a tendency today to oppose organization because it aids groups rather than the capable individual. This view seems to be rather one sided. If you're honest enough or clever enough to own a mansion but have never managed to, are you unwilling to aid your brother, who is not so clever, to get that little Shanty in the South?

Organization will never prevent good men from advancing. Value will always be recognized in general, and because you were loyal to a group of your fellow men certainly will not keep you down if you are on the road to success.

Quite the opposite can be the reasonable expected result. Gaining prestige and respect for your profession gives the individual a better chance of recognition. A display of spirit in a fight for the rights of operators will only bring the attention of the higherups to the worth of all operators and will undeniably help them to see the conscientious, capable man more quickly than will the silent, but brooding, attitude, "I work my head off but get no more than the operator who DOES NOTHING."

If you are willing to help yourself, you will most certainly be willing and anxious to advance the profession that supports you. On the other hand if you do not intend to cooperate with the men of your profession you will stay in the same rut that you are now following and continue to wonder why you are not advanced above someone whom you think incapable of his position.

Forget that you are one. Think of your profession, of the thousands doing the same work as yourself. Strive to better their condition as a whole, and you will certainly improve your own condition. Lose that selfish attitude that you have been pursuing in the past and strive for the success of your profession, and the happiness of your advancements, and success.

New York Notes

The SS Washington, America's newest liner, sailed from New York last month. The Washington, sister ship of the Manhattan, carries radio installation made by the Mackay Radio Telegraph Co., and when you hear WLEE, you will be listening to the latest thing in Marine Radio Equipment. The operators of WLEE are 1st W. D. Thomas, 2nd John Walter, 3rd Morris Welte.

Herman G. Michaelson interrupted a long stay on the beach for a trip with the Luckenbach line.

Joseph Pearlman has also decided that the Luckenbach line beats being on the beach and has embarked on the Andrea F.

John F. Kennedy has given up his headquarters at the Lynmore for a trip on the SS E. M. Clark of the Standard Shipping Co. We hope that the trip will be extended into several trips.

T. C. Ault left the Lynmore for a week end trip home. The trip has evidently been extended, since T. C. hasn't shown up for a week or so.

Mike De Maritino left the Henry R. Mallory for an assignment on the American Cardinal, which he later turned down, and is now sojourning on the beach.

Rittman has been assigned to the American Cardinal, formerly the Dicto, under the Norwegian flag. We wish you luck with the new convert to the American flag. Martin.

Gulf Notes

Harry Bell after staying on the New York beach for about a year has returned to Port Arthur, where he hopes to obtain an assignment before long.

John P. Hemley made his maiden voyage on the SS Maine and left the ship on her arrival in New York to return to Forth Worth and the Broadcast game. John says the sea is fine, but you can't have your best girl with you, and I'm used to seeing mine every day.

The Port Arthur beach seems to be exceptionally slow at present as Robert Harper is still among the unassigned there.

H. A. Stanford took a trip off the Gulfmaid to regain his health and is now back on the Maid riding the waves.

Veteran Wireless Operators Association News

(Note: All communications to the V. W. O. A. should be addressed to WILLIAM J. McGONIGLE, Office of the Secretary, 112 Willoughby Ave.,Brooklyn, N. Y.

Dinner Smoker

The semi-annual dinner smoker of the Veteran Wireless Operators Association was held at Paul's restaurant, 90 Lafayette Street, New York City, on the evening of May 11th. Needless to say it was a great success.

Fred Muller, our president, acted as master of ceremonies and masterfully too—following each speaker with appropriate remarks or an additional story. Did you say Tall Story Club. Many titles would have changed hands had the judges of the Tall Story Club been present. There sure were some good ones... Charles W. Horn, general engineer of National Broadcasting Company delivered a short talk. Glad to see you with us, C. W. H. .. J. V. L. Hogan well known consulting engineer and television experimenter presented a few remarks concerning the return of radio prosperity. Jack Muller, yes! he is a brother of Fred, and is a N. Y. policeman too, sure had some good stories... As did Seargent Pearce, which tends to show that policemen do not lead a drab existence... Ben Titlow of R.C.A. had a few navy stories which sure hit the spot. They were certainly good entertainment... Henry T. Hayden of Ward Leonard told some anecdotes which were received with little resistance on the part of the listeners... Charlie Guthrie our vice president was not to be outdone by other oldtimers. C.G. can always be depended upon for some interesting remarks ... Fred Klingenschmitt failed to play the piano but made up for it with a group of stories... C. S. Anderson, the V. W. O. A. philosopher, lived up to expectations with his anecdotes .. Bill Fitzpatrick was rather reticent at first but upon sufficient urging responded with a few good ones. .. G. B. Rabbitts who is chief on the Santa Barbara seemed to enjoy the party. O. W. Penney of the WMCA operating staff furnished some real entertainment.

All in all the party was a huge success. We hope to see the same faces at our next affair, in addition to many of their friends.

Paul is to be commended for the excellent meal he served our guests. It sure was enjoyed by all.

Murray told a few to those around his table and from reports they should have been told to the entire assemblage... Steve Kovacs, ARTA vice president, seemed to enjoy the proceedings. We were sure glad to see you Steve. Come again sometime soon... V. H. C. Eberlin, our treasurer, had a few original Yonkers stories—and does he know how to tell 'em!! G. B. Rabbitts who unfortunately has missed every other of our affairs, certainly enjoyed the proceedings. He's Chief on the Santa Barbara, you know... Bill Simons, somehow or other escaped being called upon but from all appearances he inflicted, to their amusement, some quips upon his cohorts at the table.. Frank Orth, now with Amalgamated Broadcasting System, had a few timely remarks. We wish him luck in the new "chain".... Our friend Mitchell, Jr., gave a quality story. He will sell you an Underwood... Friend Dietz of National Broadcasting was sure enjoying the sallies of his partner Brother Gluck. And could Gluck remember them. We were too far distant to hear them but they must have been good judging by the amount of laughter at his end of the table... Steve Wallis had the floor for a few minutes and did nobly... R. Pheysey told 'em too. .. J. W. Swanson, at first reticent, later came out with one of the best of the evening... Tambourino of the Frigidaire Company despite his musical name stated that he was not a musician. He obliged with a quip or two ...

Paul Treitwein came thru with a few concerning young married couples—he should know. H. H. Parker added his remarks to the occasion.

AIRWAY NOTES

F. E. Gray is radio engineer for Eastern Air Transport. Aircraft Radio Corp. of Boonton, N. J., equipment is used. Aircraft Radio it will be remembered is merchandiser for Stromberg-Carlson equipment of aviation design.

F. C. Justice is in the Airway Range Station, at Des Moines, Ia.

Arthur B. Nolan, formerly with American Airways is now on shipping service with the M. V. Magellan, sailing on fishing trips out of San Diego.

Frederick R. Neeley, is Chief Aeronautic Information Division of Department of Commerce, Washington, D. C.

Capt. Fred. L. Smith, Director of Ohio State Bureau of Aeronautics, Columbus, Ohio, recently stated that while there were already 120 flying fields in the State of Ohio, there is good reason for establishing many more.

The Sperry Gyroscope Co., with headquarters at the Sperry Bldg., Brooklyn, N. Y., are doing some experimenting of a combination radio and sound device for bringing planes safely to ground in the densest fog.

The appropriation for airmail service asked by the post office was $19,460,000 which was $15,130,000 more than the amount appropriated for 1928.

Recent Department of Commerce reports show that total express carried by plane service is up this year about 35% over last year's figures for same month, passengers carried is down about 32%, while total passenger miles flown is down about 10% from last year.

The Guadalupe Pass, Texas Station of the Department of Commerce is 6,459 feet above sea level, and about 125 miles from any town, the nearest being El Paso. A. E. Beakes is radio operator in charge, whose home port is Paterson, N. J. He is assisted by R. C. Cathey and K. W. Feist, both natives of Texas. Beakes is a former Army man, Cathey is a former Navy man, and Feist is a former Marine, but they are all married and settled down now and have to be friends as they are the only ones near their deserted spot in the world.

There are 545 Municipal airports, 626 Commercial airports 348 Department of Commerce Intermediate fields, 52 Army airdromes, and 15 Naval air stations in the United States. In the first group there are many where radio men should be but unfortunately are not.

ENGINEERING THE COMMERCIAL SHORT WAVE RECEIVER

(Continued from Page 10)

adjusting every coil. The distributed capacities are set at the correct values by small padding condensers within each coil. As the coils are wound on grooved R-39 forms, the inductive values of a production run are very close to the required inductance—well within the tolerances allowed in a high grade broadcast receiver. Nevertheless, they are checked against a standard, and adjusted to a still finer exactitude by varying the length of the short lead between the grid end of the coil and the prong.

The inductive and capacitative values of the oscillator and signal circuits necessarily differ, but the same degree of precision is required and the same technique of adjustment and check is employed. The result is a single control receiver in which **an adequate number of circuits** are tuned to the correct frequency at every dial setting without the use of trimmers. The tuning curves, shown in Figure 1, are **accurate**, not approximate, and stations may be logged and retuned with a delicacy and precision not heretofore available. The tuning curves exhibit straight frequency lines over 270 degrees of rotation, and the ranges of the five standard sets of coils are indicated in Figure 1.

The Necessity for Preselection

It may be argued that the design could be considerably simplified by the elimination of the preselector r-f amplifying stage. However, the use of this stage is essential to the order of selectivity and sensitivity demanded in a commercial type receiver. To depend alone upon the high intermediate frequency and the selectivity of the first detector or mixing circuit for image suppression is tantamount to an admission of the difficulties involved in the design of an efficient high frequency preselector, and a confession of engineering inadequacy.

The intermediate frequency refers to the frequency set up by the mixing of the incoming signal with the local oscillator frequency, and is equal to the difference between these two frequencies. Any signal the frequency of which is the oscillator frequency plus or minus the intermediate frequency will set up an i.f. which will be passed through the amplifying circuits. Assuming that the desired signal frequency is the oscillator frequency plus the i-f value, a second signal frequency equal to the oscillator frequency minus the i.f. will set up interference. For instance, on a broadcast receiver, the intermediate frequency is conventionally chosen as 175 kc, and the oscillator functions at this frequency plus (or minus) the signal frequency. If a signal of 1000 kc is tuned in, the oscillator frequency may be 1175 kc. But a station having a frequency of 1350 kc, if it gets through to the first detector, will also produce the correct intermediate frequency, and be evident as QRM—or an "image frequency." The interfering station will of course be detuned 350 kc, but if it is powerful, and no preselection is employed, it will cause a very annoying whistle and cross talk. Similarly, any two stations, separated by 175 kc, will cause interference if their signals get through to the mixing tube. This phenomenon is known as a "pseudo-image," and will occur even when the oscillator is not functioning.

It is obvious that these effects can be decreased by raising the intermediate frequency—as is done in a short wave super—say to 500 kc. An image frequency signal will now be 1000 kc off resonance, and should be considerably rejected. However, it may still be present to a degree intolerable in a large receiver designed for commercial purposes, and pre-selection should be employed in its elimination. Also, the preselector circuit performs other highly useful functions.

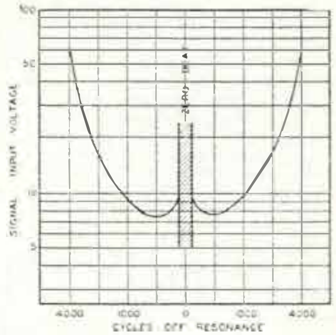


Figure 3—Showing the symmetrical tuning curve obtained when the beat-frequency oscillator is tuned to the i.f.

The preselector used in the National AGS receiver takes the form of a single stage of tuned radio frequency amplification, comprising L1 (Figure 2) and its associated circuit. This arrangement contributes considerably to the overall gain of the receiver, at the same time providing the desired amount of preselection.

The signal to noise ratio—the true criterion of sensitivity—is increased by the AGS preselector circuit, which militates against low frequency back-ground noises which might otherwise reach the intermediate amplifier and be considerably intensified. The oscillator output is also isolated from the antenna circuit, precluding the possibility of radiating through the antenna system.

We return to the circuit diagram for additional insight on the engineering of a short-wave super. Stability of operation is of paramount importance, and this quality is contributed to a great extent by electron coupling the oscillator to the signal frequency circuit.

Electronic Coupling

Electronic coupling is so called because the inner action of the oscillator and load circuits is directly dependent on the electron flow in the oscillator tube, rather than upon inductive or capacitative effects. In Figure 2, both the screen grid and the plate of the oscillator tube function as annodes, with the screen grid, control grid and cathode the elements of a simple triode oscillator. Oscillations cause a periodic or pulsating flow of plate current which is used to set up an oscillating current in the load circuit (plate circuit of the pre-amplifier, in this instance) altogether independent of the primary oscillatory circuit. Thus there is no inductive or capacitative interaction (which might vary with signal and tuning conditions) between the oscillator frequency determining circuit and the rest of the receiver. The frequency of the oscillator is also independent of any reasonable fluctuation in plate or heater voltages, caused by line variations, due to the fact that such changes set up counteracting effects between the two anodes in the oscillating tube.

The general effect is comparable to the increased frequency stability secured by using a buffer stage in a master-oscillator circuit. An idea of the stability attained in an electronic coupled oscillator may be gathered when it is mentioned that such oscillators operating in transmitting circuits at 24 mc, or 12.5 meters, have been declared the equal of crystal controlled systems.

Improved Manual and Automatic Volume Control

The signal, following the mixing stage, is passed to a highly efficient intermediate frequency amplifier employing Litz wire on low-loss forms and tuned, in all primary and secondary circuits, to 500 kc. The biases on both the r-f and i-f tubes are adjusted by the volume control circuit, eliminating the possibility of overload anywhere in the circuit.

Ease of operation and relative freedom from volume control adjustments is of importance in a commercial type receiver, particularly when employed for rebroadcast purposes, and is seldom achieved in conventional automatic and manual control circuits. While a practical degree of AVC may be obtained over a given range of signal input variations, its full possibilities cannot be realized unless it is possible to vary the range of adequate operation. Receivers having an AVC tube biased with a constant potential are definitely limited in respect to range over which satisfactory automatic control may be expected.

In the AGS, provision is made for varying the bias of the AVC tube, thus extending its action,

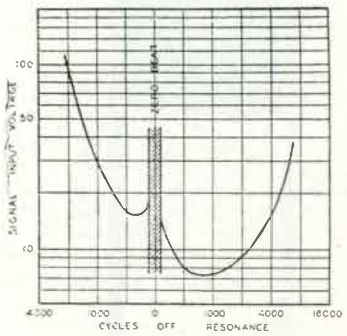


Figure 4—Indicating the additional selectivity achieved by detuning the beat frequency oscillator.

from a genuine boosting effect on very weak signals, to a leveling function on powerful stations. The automatic volume control tube, a type 36, receives its r-f input in parallel with the grid circuit of the second detector through a .00005 blocking condenser. The AVC grid is operated at ground or chassis potential, the cathode at a varying plus potential, depending upon the setting of the manual control knob, the screen grid at 16 volts and the plate at 30 volts.

The same variable 500 ohm resistor is used as a straight manual volume control and for obtaining the optimum operating characteristics of the automatic action—depending on the setting of the MVC-AVC switch. When operated as a manual control, the r-f input is, of course eliminated, and the AVC tube functions as a variable electronic resistor governing the bias to the amplifying tubes—a relay action determined by the setting of the manual control. This action is unusually smooth and noiseless, due to the fact that all microphonic contacts, which results in noise and uneven adjustment, have been eliminated from the actual volume control circuit. The manual control will be used principally on c-w reception, where the r-f output of the beat frequency oscillator necessarily limits the action of the AVC.

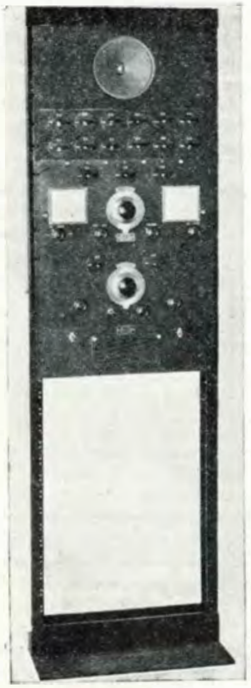


Figure 5—The AGS in a rack-and-panel mounting. The assembly from top to bottom includes a permanent magnet dynamic speaker, coil rack for spare coils, the AGS, a National 5SC Communications type standbi receiver and the dual power supply for both receivers.

When in the AVC position, the manual control still limits the signal intensity in addition to insuring the automatic control action best suited to the average field strength of the signal being received.

Instant selection of manual or automatic control is effected by a convenient switch on the front panel. A similar switch controls the output of the second detector, switching at will from earphones to the input of the pentode power amplifier for loudspeaker operation. The power amplifying tube is of the new type 89—a three purpose, three grid tube—operated as a class A pentode, with a high power sensitivity characteristic.

Beat-Frequency Selectivity

Beat-frequency reception of code signals is effected by means of a second oscillator, electron coupled to the second detector input circuit. The frequency of this oscillator is factory set at the i.f., or 500 kc, but may be readily varied by the accessible adjustment screws which determine the capacities across primary and secondary of the beat-frequency coils. When the frequency is off-set, an assymetrical action results, which provides additional discrimination.

Let us assume that a cw signal of 10,000 kc is being received. If the signal frequency is tuned to perfect resonance, the heterodyne oscillator will function (arbitrarily choosing the higher frequency) at 10,500 kc. The intermediate-frequency circuit resonance will also be perfect, but no signal will be heard due to the fact that the i f. will zero beat with the beat-frequency oscillator. However, as the station tuning control—which, in the AGS, tunes the signal frequency and heterodyne oscillator circuits simultaneously—is adjusted slightly to either side of perfect signal frequency resonance, beat notes of identical intensity will be heard. This is the usual process of tuning, and the losses through detuning—usually a matter of a half kilocycle—are negligible. The curve, characteristic of this condition, is shown in Figure 3, and the symmetry holds approximately for an interfering station causing a beat note from the other side of zero beat axis. For example, let us set up the following conditions. The frequency of the desired signal is 10,000 kc, the oscillator is tuned to 10,502 kc, and the beat frequency oscillator is adjusted to the i-f resonance at 500 kc. The result is a 2000 cycle beat frequency, slightly attenuated due to the fact that the signal frequency circuits will be approximately 2 kc off resonance and the i-f circuits exactly 2 kc off resonance. An interfering signal of 10,004 kc will produce a similar 2000 cycle beat note. As the tuned circuit resonance has been raised approximately 2 kc in the process of tuning the oscillator to 10,502 kc, the interfering signal will be approximately 2 kc off the high-frequency resonance point and exactly 2 kc off the i.f. Conditions being identical with those governing the desired signal, the interfering signal will have equal intensity if the field strength is the same.

Entirely different conditions obtain, however, if the beat frequency oscillator is detuned slightly from the i.f.—say 2 kc by raising the frequency to 502 kc. Once more let us tune in the 10,000 kc signal to perfect resonance. The oscillator will then be heterodyne at 10,500 kc, r-f and i-f resonance will be exact, and a 2000 cycle beat note will be audible—all conditions conducive to the highest possible efficiency. The same beat note will be heard if the oscillator is tuned to 10,504 kc, but now the signal frequency circuit will be detuned approximately 4 kc and the i-f circuits will be exactly 4 kc off resonance—the result being the weakened signal shown graphically in Figure 4.

This assymmetrical characteristic applies to an interfering signal. Assume that the receiver is tuned perfectly to the 10,000 kc signal. An interfering signal of 9,996 kc will produce a similar 2000 cycle beat note, but will be considerably attenuated due to the fact that both the r-f and i-f circuits will be exactly 4 kc off resonance.

Beat-frequency reception is immediately available by a convenient front panel switch.

Selectivity may be still further enhanced by means of a quartz crystal filter in the i-f circuit. This will admit only an extremely narrow band of frequencies—about 100 cycles wide, resulting in a true single signal response. The narrowness of the band in no way affects the audible frequency, as the carrier is mixed with the beat frequency oscillator after the carrier has passed the crystal circuit.

Assembly and Test

The hand made character of the AGS receiver is evident in the painstaking care with which each step in assembly is effected. Mechanical and electrical tests accompany the various stages of construction to insure rigidity, permanence of wiring and adequate bonding of shielded joints. This latter precaution results in the elimination of "creeping" r-f resistance, and contributes its mite in raising the signal-to-noise ratio.

The sequence of precision tests and measurements, which contribute so definitely to the reliable ganging of the tuned circuits, is extended to other portions of the receiver. The intermediate frequency amplifier is peaked at 500 kc, in the conventional manner, by variation of primary and secondary capacitors. Following alignment, the intermediate frequency amplifier is checked for gain, an individual test of definite importance which shows up such subtle faults as power-factor loss in the adjusting condensers, and "maverick" wires in the Litz windings.

The second detector is subjected to a series of tests which determine its overload capacity, and reaction to signals of different percentages of modulation, following which the audio circuits receive routine inspection.

The audible beat-frequency oscillator is adjusted and checked for frequency drift. The output must be precisely regulated so that an optimum amount of energy is applied to the second detector.

Shielding

Triple shielding is employed in the isolation and confinement of radio-frequency currents. Tubes, coils, transformers and tuned circuits are individually shielded in the familiar manner. The plug-in inductors have individual shields, completed by the metal facing to which the handles are attached. Special shielding is employed at various points where experience has discovered the existence of stray currents. It is highly essential that no stray coupling exist between the beat-frequency oscillator and the i-f circuits, which, tuned to practically the same frequency, would amplify such pick-up with resultant overload in the second detector.

Shielding is completed by the overall screening effect of the metal cabinet.

Bypass condenser, resistors, etc., which, beyond the control of the manufacturer, may deteriorate in time and service, are mounted under the sub-base for easy inspection and replacement by the operator.

Mechanical Features

The mechanical features contributing to ease of operation are indicated in the front view photograph, Figure 5. The dial is of a high ratio, **true vernier type**, 270 degrees of rotation being divided into 150 scale divisions. The vernier design permits accurate reading to within 1/10 of one division or slightly less than 11 minutes of arc. Precision of this nature, combined with genuine single control, makes accurate logging possible for the first time. A chart is provided on one side of the tuning dial with room for 100 station loggings, while a chart of the same size, on the other side, frames the tuning curves for ready reference. The four secondary controls, from left to right, are the beat-frequency oscillator switch, with cw and "voice" positions, the MVC-AVC switch, volume control and selector switch for 'phone or speaker operation.

Three coils are shown in position. They are removable, with convenient handles, from the front of the panel, and slide instantly into their places without "fishing" or turning. The coils are completely inclosed in bakelite cases, designed to increase mechanical strength without affecting their electrical characteristics.

It is obvious from the foregoing that the National AGS is truly a laboratory product, without the ballyhoo generally associated with such a claim. It is not sufficient that a small percentage of these receivers be capable of consistent trans-oceanic reception. Rather it is essential that the performance of the finest model be duplicated in every receiver over a long period of usefulness.

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TRANSOCEANIC RADIO COMMUNICATION

(Continued from Page 16)

even greater ranges in intensity changes at a diurnal rate. The diurnal variations are overcome by the use of more than one frequency channel to carry a 24-hr. circuit. For example, the circuit from New York to Buenos Aires, operates on 20,455 kc during daylight hours and on 8,809 kc at night. Some of the circuits from New York to Europe require 3 properly chosen frequencies to insure reliable service.

Short-period fading is overcome by means of automatic volume control and by a "diversity" system of receiving with antennas spaced usually well over 10 wave lengths apart. Automatic volume control is a form of automatic voltage regulation wherein the rectified signal is caused to react upon the overall gain of the receiver in a manner that increases the gain as the signal strength decreases.

This form of gain regulation, together with the utilization of the diversity principle, makes a commercial degree of stability possible on a short wave circuit. In the diversity system, advantage is taken of the fact that fading does not occur simultaneously at points geographically spaced. The extent to which fading at spaced points differs is illustrated in Fig. 1.

To prevent mutual interference between the various receivers each unit is carefully shielded and battery power to each circuit is fed through low-pass filters. All receivers in a station usually are operated from a common battery system continuously charged through filter circuits.

The amount of improvement possible with the space diversity system is dependent upon the range of fading. Thus, if there is no fading, one antenna will do as well as 3 combined. If, however, the signal periodically fades to zero, no amount of gain in a single receiver can give a signal free of drop-outs, while the diversity system might give continuous output. In practice the improvement arising from diversity comes somewhere between these 2 extremes. As a general rule a 3-antenna diversity system will give an improvement of approximately threefold as compared with a single antenna system.

Another quality that becomes apparent in the operation of a diversity system is the matter of reserve apparatus on a given channel. Some of the adjustments of a short wave receiver are so critical that, in making a retune, the signal might be lost momentarily due to error of judgment. With 3 receivers normally carrying the circuit, any 2 will carry the signal fairly satisfactorily while the receiving engineer makes an adjustment of the third. This enables more continuous operation of the circuit—important where high traffic capacity is contemplated.

Directive receiving antennas commonly are used to exclude as much as possible of the undesired radiations such as atmospherics and locally generated disturbances. These antennas are aperiodic, enabling the simultaneous receipt of signals of different frequencies, but their directivity requires the use of separate antenna systems to care for the circuits coming from different directions. At Riverhead, N. Y., for example, there are 39 antennas comprising 13 systems of 3 spaced antennas each.

Directivity in the vertical plane was determined experimentally by an airplane at 3 miles distance where a marked discrimination against radiations originating at ground level may be noted. This property is of decided importance because locally generated disturbances usually emanate from points at substantially ground level.

To reduce the amount of radio frequency voltage induced directly into the transmission lines, a special design is used wherein 4 wires constitute one line, the opposite corners being connected in parallel. The electrical center of the 2 sides of this line are nearly coincident, and consequently the pickup is small.

Passing into the receivers and through the tuned radio frequency amplifiers, the signals are heterodyned to audible frequencies. Most of the selectivity of the receivers is obtained in the audio frequency stages By means of low pass filters, it has been found practical to reduce the band width to 6,000 cycles and with increasing stability of transmitter frequencies, it should be possible eventually to reduce this band width still further.

All signals, both long-wave and short-wave, pass through the tone line control board at Riverhead. All orders from the central office are passed to the supervisor at this control board, who, through the medium of a public address system, issues orders to the engineers at the receivers in both the short-wave and long-wave buildings.

By operating a telephone key the supervisor can listen to any signal and at the same time observe an indicator showing the volume of signal going into the line. Any signal can be monitored also on an ink recorder for checking telegraphic signals, or on a facsimile visual recorder in the case of facsimile signals. The facsimile recorder is used for checking outgoing signals from Rocky Point, as well as incoming facsimile signals from London and Berlin. Because of the very high speed at which facsimile signals key the transmitter, the visual recorder is especially necessary for checking the adjustment of both the receivers and the transmitters.

The principle of diversity reception also has been applied to telephony Because of the higher modulation frequencies involved, the problem of bringing together the outputs of several antennas in such a manner as to be independent of phase is more difficult in the case of telephony than in the case of telegraphy In other words, experience has shown that different frequencies not only fade differently, but that the phase relations between the various frequencies varies as a result of changes in the transmission medium. As might be expected the random changes in phase relations have been found to increase for increasing differences in frequency. Consequently the telephone currents received from one antenna are likely not to have any definite phase relations with respect to the currents received from a similar antenna spaced some distance away, and hence little is to be gained by adding the outputs of 2 or more receivers together during times when the fading is most severe.

In general, however, the antenna with the greatest signal strength at any moment may be expected to deliver the best quality at the output of the receiver. A simple arrangement that

(Continued on Page 33)

CORRESPONDENCE SECTION

(Continued from Page 20)

to its universal appeal, instant appreciation, and regret when time is up.

As for general, occasional speakers—no matter how potent their messages may be, if their voices are flat and toneless, and their well-written sentiments recited without conviction, or expression, only the genuinely interested, or patient listener does not tune them off pronto. And for some reason, this does seem to describe the average run of general speaker—tho once in a while, one does, on his own merit, manage to claim, hold, and inspire full attention to the end.

Concerning comics: I dismiss them with one sentence. If they must use stale gags, they should be made to apologize for them right then and there—ditto for making any personally-prompted, deprecatory remarks concerning another performer—otherwise they serve their purpose in providing laughs in a laugh-needing world.

I cannot see how anyone, in or out of radio circles, can deny the valuable, psychological appeal of appreciative applause, tho not necessarily prolonged. It serves all purposes favorably. To sensitive listeners, it saves a mediocre performance from falling flat with a sickening, silent, thud; to pleasing worthy offerings, it lends and adds an air of glamour and deserving success; to the entertainer himself, even fully aware of the "prop." it gives at least some measure of encouragement. I have myself, noted many times thru my radio, a subtle tone of elation and gladness from many artists when they put across a good piece of work and the subsequent applause denotes it—they then continue their performance with even more pep and enthusiasm, which makes everyone concerned happy—mainly the artist himself, the pleased listener, and of course, the ever important sponsor. Yes, wherever it can be used in radio, the valuable psychology of transmitted applause should certainly be taken advantage of with no fear of risk.

In conclusion, radio is a wonderful means of help, diversified knowledge, and mental and spiritual development and entertainment to all. It is a God-send to the poor and unfortunate—and the many, many people in straightened circumstances at present, (myself included), who can not, for some time yet, afford the expense and newly-regarded luxury of amusement outside the home. Of course, most folks buy radios purely for entertainment purposes—and it has taken such a hold on American life that no home is complete without one, only the great minority being indifferent to its undeniable, present-day influence. Radio has made rapid strides since its infant debut, but remains a most valuable asset, still to be greatly improved upon as a means towards promoting higher education, culture, health, living standards, and true values among the masses, IF some pleasing, and original method can be unearthed (and eventually, it will) to present these important facts in a straightforward, interesting, and popularly impressive, manner.

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HOW RADIO FUNCTIONS IN AIRCRAFT "BLIND FLYING"

(Continued from Page 13)

tion is given the pilot by means of the vertical pointer of a "combined instrument." (See fig. 2)

The vertical pointer of this instrument, which is described later, is pivoted about the lower end and swings left or right depending upon whether the aircraft is to the left or right of the runway course. A reversing switch is provided in order that the deflection of the pointer and the direction of the deviation of the aircraft may correspond whether the aircraft is flying away from or toward the runway beacon.

The marker beacon receiving set required when the marker beacons operate on a radio-frequency of about 10,000 kilocycles employs two tubes, a detector and an audio-frequency amplifying tube. The output signal is aural and is heard through the head phones when passing over the marker beacons. The set is coupled to the same receiving antenna as is used with the medium-frequency receiving set, the coupling arrangement being such that the tuning of each set is independent of the other.

The landing-beam receiving set employs a detector tube, an audio-frequency amplifying tube, a reed filter, and a cuprous-oxide rectifier. The receiving antenna is of the half-wave horizontal type with a reflector and is mounted above the center section. The voltage induced in this antenna by the landing beam is fed to the detector stage of the receiving set by means of a shielded parallel-wire transmission line. After detection and amplification the signal is rectified and the output current fed to the combined instrument, the landing path indications being given by the horizontal pointer of this instrument. During landing, this pointer is maintained in the horizontal position. A rise of the pointer above this position indicates that the aircraft is above the proper landing path, while the reverse is true if the pointer falls below its horizontal position.

Radio Control Panel

The radio control panel contains the usual tuning and volume controls for the medium-frequency receiving set, a switch for operating this set with either automatic or manual volume control, and the reversing switch for the vertical pointer of the combined instrument, the function of which is described in the foregoing. There is also provided an adjustment for altering the steepness of the landing path to suit the particular airplane, a push button for testing the landing beam receiving set, and a "flight-land" switch. In the "flight" position this switch connects the horizontal pointer of the combined instrument to the output of the reed converter, thereby indicating volume of received signal in the output of the medium-frequency receiving set. This indication is for the purpose of informing the pilot that his receiving set and the beacon transmitter are functioning properly, otherwise the vertical pointer, which indicates the beacon course, being of the zero-center type, might read "on course" with the beacon signal off or the receiving set not functioning. In the "land" position this switch turns on the landing beam and marker beacon receiving sets and connects the horizontal pointer of the "combined instrument" to function as the landing path indicator, as described in the foregoing.

In addition to the combined instrument the pilot has a second radio instrument called an approximate-distance indicator. This instrument is operated by the medium-frequency set in conjunction with the automatic volume-control unit, and indicates the approximate distance from the runway localizing beacon.

The combined instrument consists of two separate instrument movements mounted in a single case of standard aircraft dimensions and with the pointers of the two movements crossed at right angles. Two reference lines intersecting at right angles are provided on the face of the instrument, the vertical reference line corresponding to the proper directional course and the horizontal reference line to the proper landing curve. A little consideration will show that the point of intersection of the two pointers indicates the position of the aircraft with respect to the proper spatial landing path. When the two pointers intersect at the central circles as is shown at 1 in Figure 2, the airplane is on the runway localizer course and the landing curve. When the point of intersection is as shown at 2 in Figure 2, the airplane is to the left of the course and below the landing curve. On the other hand, when the point of intersection is as shown at 3 in Figure 2 the airplane is to the right of the course and above the landing curve.

Landings Made With Radio Aids

Landing according to the directions of the radio aids is accomplished in the usual manner with the difference that the pilot, instead of orienting himself by watching the horizon and the ground beneath him, guides his plane by watching the dials on his instrument board, and listening for the signal of the marker beacons through his head phones.

Approaching an airport during a period of no visibility the airman follows the main radio range beacon which may be either the visual or aural type. If he is following a course marked by a visual beacon, the indicator is the vertical needle of the combined instrument. As long as he is on his course, the needle points vertically to the middle of the dial but if he deviates to the right or left the needle swings to the corresponding side of the dial. For following the aural beacon, the pilot listens to dot-dash signals in his head phones.

When the pilot reaches the immediate vicinity of the airport (see fig. 1), and passes directly over the radio range beacon transmitting station, his receiving apparatus indicates this fact. He then retunes his set to the frequency of the runway beacon and makes a wide circle of the field in a counterclockwise direction in order to pick up the signals of the runway beacon. He also throws a switch which places a second receiving set in operation to pick up the signals of the landing beacon.

To follow the signals of the runway beacon, the pilot watches the same needle that he has been using in connection with the main radio range beacon. As before, the needle points vertically to the middle of the dial to show on course, and to the left or right to show deviations from the true course. Upon orienting himself along the runway course—generally 3 to 5 miles from the field—the pilot begins to make use of his second radio receiving set, designed to pick up the signals of the landing beam for vertical guidance. By means of the signals of this beam, received in his second set, the airman gets an indication on a second needle pointer on the same dial with the radio range indicator. This second needle is the horizontal pointer on the combined instrument.

Approach To Field

Continuing toward the airport and flying at about 5 miles per hour faster than normal landing speed, the pilot keeps the needle of the runway beacon at the middle of the dial pointing vertically, and the needle of the landing-beam indicator pointing horizontally. He does this by flying so that the needles cross over the circle in the center of the dial. He is following the center line of the course marked by the runway beacon, but with respect to the landing beam, his indicator directs him along a curved line in the under part of the ellipsoidal beam. If he were to follow the axis of the landing beam in the line of greatest signal intensity, the signals would become increasingly stronger and the needle would rise above the horizontal. If he dropped too far below the beam, the signals recieved would be weak and the needle would fall. The course followed is a curved one underneath the beam's axis where the signal strength remains constant, and which brings him downward in a sweeping glide, flattened at the end, which is correct for a landing. The landing path is so adjusted as to clear all obstructions.

Following this unseen radio path, the airman approaches the field. About 1,000 feet before he reaches the edge of the field, notice is given him by a signal from a marker beacon on the ground below him, reproduced as a buzz in his ear phones. Just at the edge of the field a signal from a second marker beacon reaches him and is reproduced as a different sounding buzz. This gives him warning of the exact moment at which to level off for landing. He thereupon throttles his engine and maneuvers his airplane to follow the landing beam accurately to the point where he is to make contact with the ground.

An important feature of this blind-landing system is that a minimum of equipment is necessary for use on the airplane. The runway beacon signals are received by the regular aircraft receiver which is used along the airway. Reception of the signals from the landing beam and marker beacons require additional receiving equipment as these transmitters operate on high frequencies whereas the runway beacon operates on a medium frequency. For the regular receiving set the ordinary receiving antenna is used, and for the landing-beam receiver, a short horizontal antenna. One power source suffices for all receiving sets.

Further experiments now going forward with the system are directed to the adaption of the equipment for use in varying wind conditions. With runway beacon and landing-beam service in only one direction, of course, landings may be made only when the wind is from that direction, or at not too great an angle from it. However, additional installations may be made for other runways. The landing beam and marker beacon are simple and inexpensive enough so that they may be duplicated. Additional runway beacons, however, would involve considerable expense, and research of the Aeronautics Branch is now being conducted with a view to devising a method for making runway courses in all directions with one runway beacon.

BROADCAST STATION NEWS

(Continued from Page 19)

working on was more a guess than anything else. 8KT boasted the largest and best amateur lay-outs in his district, had a Commercial ticket, and was exceedingly active. Like all good citizens, when the big fracas across the pond involved the U. S. he offered his services and enlisted a "buck" private in the army. Was transferred to Radio Tractor Unit No. 43, Intelligence Dept. U. S. Signal Corps. Climbed up to the Master Signal Electrician when his progress was cut short by end of the story. Spent the period of the war listening to plenty of QRN and occasional messages or signals down on the Mexican border.

Since then he has kept his finger in until it was WKBN. When 3.2% became legal it put him out of work at home too.

TWO NEW OSCILLATORS FOR THE RADIO FREQUENCY RANGE

(Continued from Page 12)

quency losses. Heater type tubes, which had just become available, were used in this oscillator because they had plug type sockets which offer less capacitance from high potential points to ground. To balance the capacitances to ground, all wiring on each side of the balanced circuit was made of equal length and as short as possible.

To cover the wide frequency range, three "plug in" type oscillating transformers are used. These transformers are wound with gold-plated wires on isolantite cylinders to minimize the high-frequency dielectric and resistance losses. The same type of decade condenser is employed, but it is composed of smaller units. A balanced variable air condenser is used to span the range between the steps of the decade condenser. The output transformer steps down the impedance of the plate circuit to one hundred ohms, as with the oscillator for the lower frequency range, since this value of output impedance has been found most satisfactory for radio frequencies. The output transformer is tuned with a variable air condenser, which tends to reduce any harmonics that may be present in the output circuit. This tuning condenser may also be used as a volume control by detuning, and no adjustable resistance network has been used in the output circuit of this oscillator. A transformer is inserted in the midarm of the output stage which permits the output frequency of the oscillator to be modulated with a voice or carrier frequency, thus allowing the oscillator to be used for bridge and transmission measurements with a short-wave receiver as a detector.

A double electrostatic shield is employed, the inner shield being a 1/8-inch aluminum box and the outer a 1/32-inch copper lining for the fumed oak box which houses the oscillator. The purpose of the double shielding is to enable this oscillator to be used in close proximity to other sensitive measuring equipment without danger of coupling between the two circuits. To provide adequate ventilation for the larger tubes used with the W-10465 oscillator, rectangular holes are cut in the inner shield, which are covered with metal screening to maintain the effectiveness of the shielding. Retardation coils and by-pass condensers are inserted in both the filament and plate-circuit supply leads to keep out radio frequencies.

This oscillator delivers an output current of approximately fifty milliamperes into a load resistance of one hundred ohms, and, like the W-10414, has a harmonic content of less than three per cent and a calibration which is maintained to better than two-tenths of one per cent with normal variations in filament and plate voltages and with changes in tubes.

TRANSOCEANIC RADIO COMMUNICATION

(Continued from Page 28)

has been devised to select automatically the receiver having the strongest signal involves the use of 3 spaced antennas associated with 3 separate receivers. The signal outputs from each antenna pass through separate superheterodyne receivers to the grids of individual second detectors. The plate circuits of these second detectors are energized by one battery feeding current through a load resistor common to all. This load resistor is connected between ground and the negative end of the plate supply battery, and with the audio frequency output taken from across the resistor. The voltage drop across this resistor also is applied, through a time-constant circuit, to the control-grid bias of the high frequency amplifier tubes of all sets, thus affecting simultaneously the automatic volume control of all receivers.

The second detectors are operated with the grids biased considerably negative, so that the output is approximately proportional to the square of the input voltage. Consequently, the detector having the greatest input will contribute most of the combined output. Thus, if the signal strength from one antenna is twice that of another, its receiver will contribute 4 times as much to the combined output as will the others. Consequently, as the signal carriers fade up and down in a random manner at the several spaced antennas, the receiver with the strongest carrier reduces the output from the other receivers, and in this manner, an effective switching action is produced. The time-constant circuit may be adjusted to operate at any rate required to handle different classes of fading.

The diversity telephone receiver just described has been used for some time at Riverhead, N. Y.; Point Reyes, Calif.; and Koko Head, Territory of Hawaii, for handling addressed program material for international broadcast purposes. Many of these programs have been put on the coast-to-coast networks of the National Broadcasting Company and the Columbia Broadcasting Company during the past 3 years.

Frequency Measuring

To meet the increasing necessity for channel operation within narrow limits of frequency tolerance, precision apparatus now is in service at Riverhead, Rocky Point, and Point Reyes for accurately measuring the frequency of any given radio signal. Measurements are made by a process of direct comparison with the harmonics of a base frequency of 100 kc generated by a crystal controlled oscillator of high stability. The local standard is known to be accurate to considerably better than one part in one million and the observational errors are made negligibly small.

At Riverhead an average of approximately 6,000 measurements per month are made with 2 operator's positions. Not only have these measurements proved useful in supervising the performance of transmitters, as distant as Manila, but by providing ready and reliable information as to the stations involved, they have been indispensable in resolving such cases of interference as occur on various circuits. This is available not only as of the time the interference is experienced, but also from thousands of routine measurements that are taken regularly and supplied to the R.C.A. central frequency bureau. At the frequency bureau continuous records are maintained of the history and performance of more than 1,000 active high frequency stations throughout the world. Records are kept also of the frequencies on which some 5,000 additional stations are projected or are occasionally measured.

OVER TWELVE MILLION TONS OF IDLE SHIPPING

The United States Department of Commerce estimate that at the beginning of this year the amount of the world's idle shipping was 12,649,-000 tons gross, compared with 14,054,000 tons gross at the middle of 1932. This is stated to be the first decrease since the beginning of 1930, but it is pointed out that the decrease was of a negative character, being due chiefly to dismantling of old tonnage and the curtailment of new construction rather than to the reabsorption of shipping into trade.

The United States had the largest amount of shipping idle at the beginning of this year, with 3,588,000 tons gross laid up, compared with 3,425,000 tons idle on July 1, and 3,031,000 tons on Jan. 1, 1932. Great Britain had the second largest total, with 3,096,000 tons laid up on Jan. 1, 1933, compared with 3,113,000 tons on Jan. 1, 1932.

Germany had a total of 1,103,000 tons on Jan. 1. France and Norway and the Netherlands, in the order named, had the next largest amounts of idle shipping.

INTERNATIONAL FEDERATION OF RADIOTELEGRAPHISTS

(Continued from Page 21)

hours per day must be kept, whilst all ships of more than 3000 G.R.T. must keep 8 hours watch per day, even if the ships are provided with an automatic alarm device.

Affiliated Associations in countries not mentioned above would oblige by sending to the Editor, Cort Adelersgade 8, Copenhagen, Denmark, a resume of the national regulations issued in their country.

J. MADSEN

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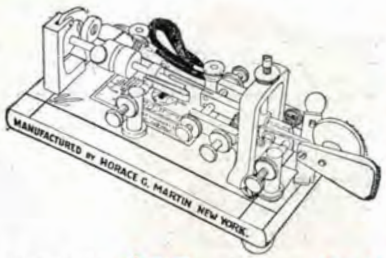

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