SHORT-WAVE CIRCUITS FOR HIGH-GAIN RESULTS

RADIO WORLD

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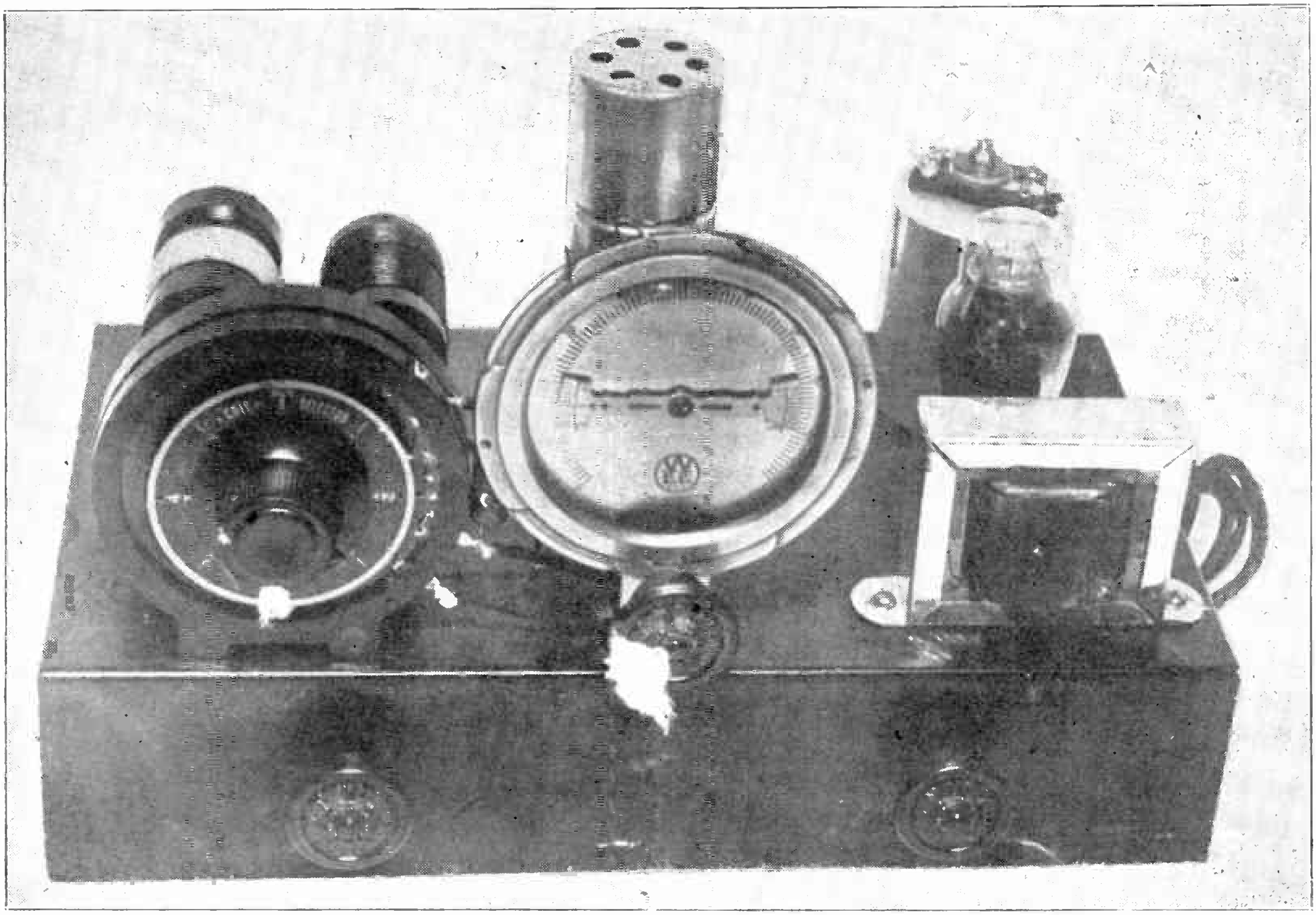
The First National Radio Weekly

656th Consecutive Issue— Thirteenth Year

PUSH-PULL OPERATION ANALYZED

NOISE-REDUCING ANTENNA SYSTEMS

SWITCH-TYPE SHORT-WAVE CONVERTER



The plug-in type short-wave coils are mounted on a rotary frame for band selection by switching, in this short-wave converter. See article on page 18.

TUBES IN AUDIO USES

LINING UP A MULTI-BAND SIGNAL GENERATOR

X, Y and Z CRYSTAL CUTS

OCT. 20 1934

PRICE 15¢ PER COPY

1935 Model ALL-WAVE DIAMOND OF THE AIR!

TABLE MODEL

8 TUBES! 5 BANDS! A. V. C.!

CONSOLE MODEL

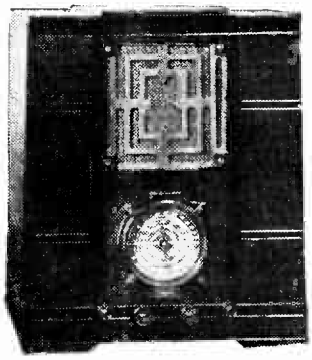


Table Model All-Wave Diamond, using the same 8-tube chassis and tubes as the console model. Wired, complete, with eight tubes. Shipping weight 28 lbs. Order Cat. 1008-T. Net price, F.O.B. Sandusky, O.—$32.05

TO get away from the conventional and ugly cabinets in which table model receivers have been housed in the recent and remote past we have just obtained an entirely new design, 14½ inches wide, 16 inches wide, 9½ inches front to back, to house our 1008 chassis, the finest all-wave 8-tube superheterodyne receiver made. The performance is exactly the same, as between the console model and the table model.

The selection of one model or the other will depend considerably on whether you have some mantel or end table or the like on which you'd prefer to place a physically smaller cabinet (but the same-sized set), or whether you have the room for the large console, 21 inches wide, 36½ inches high, 12 inches front to back. We have gone to great pains to obtain two models that do not differ in performance, and that yield the maximum that radio has to offer to-day, so that space and artistic requirements can be met to the fullest, along with maximum performance.

The table model is Cat. 1008-T, shipping weight, 28 lbs., wired, in cabinet, complete with eight RCA tubes; net price (shipped from Sandusky, Ohio)— **$32.05**

The wired chassis, with speaker and tubes (no cabinet) can be purchased by any who care to use a cabinet they have. See price at right.

WHENEVER a person wants to buy a particularly fine receiver he usually feels he has to pay a particularly high price for it. Ask almost any one what kind of a set he would want and the answer would be: "An all-wave a-c set, of course." He might prefer a console model or a table model, but he would want band selection by switching. The only drawback, perhaps, is that, times not being so prosperous, he hasn't the price of such a fine instrument. But we point to something new and startling in radio merchandising—the production of a de luxe, superb all-wave set, 150 kc. to 22 mgc. (2,000 meters to 13 meters), at the inconceivably low prices of $45.57 net for the console, and $32.05 for the de luxe table model. These two cabinets are illustrated herewith, and the same superheterodyne chassis is used in both.

These prices are absolutely net, and represent complete wired receivers, **equipped with RCA tubes throughout,** and securely packed.

The low prices would not mean a thing unless these receivers were of first quality and excellence, unless they had great sensitivity and selectivity, so that foreign short-wave stations and domestic broadcasts could be tuned in with enjoyable volume and steadiness, and unless the tone was marvelous. These new **DIAMOND OF THE AIR** All-Wave Receivers, in the two models illustrated, are quality products of the highest attainment, enthusiastically indorsed by leading radio engineers, who blink with amazement when told the selling price, in view of the outstanding performance.

As a check on whether care has been taken to make this receiver outstanding, note that the low-frequency band is included. Now, an all-wave set may mean almost anything, but when you are told that the low-frequency extreme is 150 kc., and that the highest frequency tuned in is 22 mgc. (13 meters, mind you!) then you can realize that painstaking craftsmen spent long hours getting the instruments right, so that they would cover frequencies that sweep from one end to the other of program and other bands.

And there is sufficient overlapping between bands, as you turn the gentle band-selector switch, to prevent missout. And moreover, the programs come in with steadiness and clarity, for there is a highly-effective automatic volume control, to correct for fading and to prevent blasting when tuning from station to station.

Exceptional care has been taken in prevention of image interference, and the wisest experts who have given this receiver critical attention admit that the pre-selection is abundant.

Another interesting technical point: This set runs cool. The 6-volt series tubes are used—wise choice indeed—because the elements of these tubes are stronger than those of the 2-volt series, and the power consumption in the heater is considrably less. And yet there was no skimping. The primary power consumption is 80 watts.

Nor does the dial have mere arbitrary numbers on it, 0-100 for instance, as found on what we term "unfinished" sets. This receiver has the very latest illuminated airplane dial, with frequency calibration for each of the five bands, so is direct reading in frequencies, and besides has a double pointer so the benefit of wide spreadout on the scale is derived from both semi-circles. Close vernier tuning is provided.

There is a manual volume control, a tone control and provision for phonograph or earphone connection.

And the speaker? A heavy-duty 8-inch diameter-cone dynamic speaker that is a fitting climax to an expert design and assembly.

The All-Wave Diamond, 150 kc. to 22 mgc. (2,000 to 13 meters), in its distinctive modernistic console cabinet of genuine burl walnut, curly maple front, artistically carved overlays. Extra large baffle and powerful heavy-duty 8-inch dynamic speaker. Wired, equipped with following RCA tubes: one 6A7, two 6D6, one 75, one 76, two 42's, and one 80. Cat. 1008-CON. Weight, complete, 37½ lbs. For 50-60 cycles, 110 volts. Shipping weight, 51½ lbs. Net price, F.O.B. Sandusky, O.—$45.57

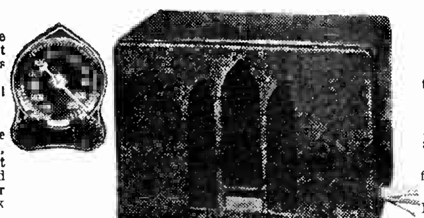
$45.57

The 8-tube, high-gain, all-wave (150 kc. to 22 mgc.) Diamond of the Air wired chassis, 50-60 cycles, 110 volts; with the powerful dynamic speaker and the eight RCA tubes, may be purchased (no cabinet). Order Cat. 1008-CH. Net price, $28.52.

6-TUBE DIAMOND AUTO SET, $23.52

OUR previous model Auto Set was so good that the model was not changed in three years. Now at last it has been improved upon, certain mechanical refinements introduced, and tubes of somewhat higher efficiency included. Some of these tubes were not manufactured until recently. Also the set now has a.v.c.

Our 1009 Auto Radio is a six-tube superheterodyne set, using one 6A7, one 41, one 75, two 78's and one 84, and tunes from 540 kc. to 1,600 kc. It is a one-unit receiver, ruggedly built for long life, and is equipped with a dynamic speaker. It has an illuminated vernier airplane type control. The manual volume control and lock are one combination. The power consumption is 4 amperes.



No B batteries required. There is a B-eliminator built in.

This is one of those fascinating auto sets that has single-hole mounting provision, and therefore is a cinch to install. There are only two connections to make: (1), to the ammeter; (2), to the aerial.

The remote tuner is, of course, supplied with the set. And the spark plug suppressors and commutator condenser are supplied, also.

The size is 8¾ inches wide, 6 inches high, 6¼ inches front to back. Shipping weight is 18 lbs.

Order Cat. 1009, wired, in cabinet, complete with six RCA tubes.

Net price (F.O.B. at Sandusky, O.)—$23.52

ALL OUR DIAMOND SETS EQUIPPED WITH RCA TUBES

We can supply receivers, either in wired-chassis-speaker-tube combinations (less cabinet), or in table or console model cabinets, to meet special voltage requirements. For instance, if you do not have 50-60 cycle, 110-volt a.c. you could not use the standard chassis, No. 1008-CH. So if in doubt, inquire of your lighting company as to the frequency and voltage of your supply. We can furnish the 8-tube all-wave chassis with or without cabinet, for 25 cycles, 110 volts, (add the number 25 after the catalogue number of the standard model) at $1.50 extra, or can supply the 8-tube all-wave model for 220 volts, 50-60 cycles, at 60c above the 110-volt model prices (add number 220 after the catalogue number).

DUAL-BAND SETS

We have a dual-band set for a-c operation, available in wired-chassis-speaker-tube form, and also in a table model Gothic cabinet. The frequencies covered by this receiver are (a) 550 to 1,500 kc; (b), 5.5 to 16 mgc. Coil switch changes bands.

The design is a five-tube superheterodyne, using one 6A7, one 6D6, one 75, one 42 and one 80, a.v.c. is included. The illuminated airplane dial has kilocycle calibration, direct reading, with double pointer. A dynamic speaker is supplied. Primary watts power, 60 watts.

Wired chassis, dynamic speaker, five RCA tubes; for 50-60 cycles, 110 volts; shipping weight, 15.5 lbs. Cat. 1010-CH. .... **Net price—$15.58**

Same as above, but in a Gothic two-tone walnut French cabinet. Shipping weight, 17.5 lbs. Cat. 1010-G. .... **Net price—$17.59**

We can supply the above for 25 cycles at $1.50 extra. Add number 25 to the catalogue number. Or, for 220 volts a.c., 50-60 cycles, add the number 220 to the catalogue number, and increase price 60c net. **($16.18 and $18.19)**

The receivers advertised on this page are expertly designed, engineered and manufactured, and are not to be outclassed by any receivers offered at anywhere near the prices quoted. Thousands of delighted customers attest to the superior excellence of these receivers. Moreover, prompt shipments are made, and the most courteous and fair-minded treatment accorded to customers. The factory is at Sandusky, O., and transportation charges will be on the basis of shipment from that point. You may select any carrier you like, and notify us which way to ship. Otherwise all shipments will be sent by Railway Express Agency. In all instances you pay the transportation.

All prices quoted are on the basis of remittance with order. If C.O.D. shipment is desired, send 25 per cent. with order, and shipment will be made C.O.D. for the difference. The net price on merchandise ordered C.O.D. is 2 per cent. higher than the remittance-with-order prices quoted.

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THIRTEENTH YEAR

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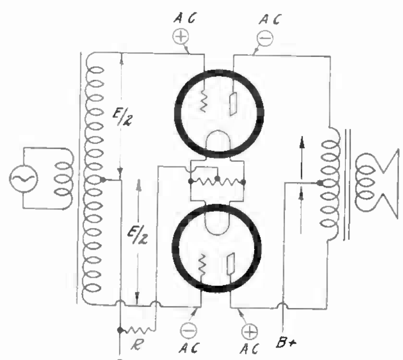
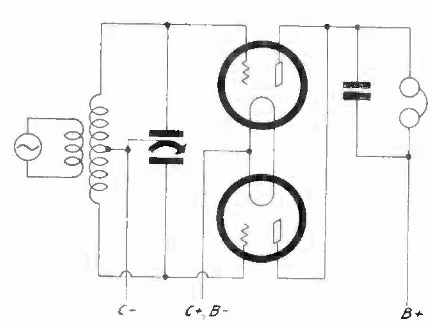
The Case of Push-Pull

Necessity for Operation on Straight Part of Characteristic—Does Circuit Yield Detection? True Balance Nearly Ideal, Seldom Attained

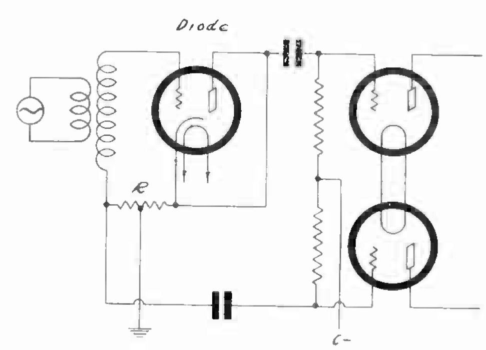
By Martin L. Woods



A push-pull circuit. The signal voltage is put into the primary at left. The total secondary voltage, which would be E, is halved, so that E/2 appears across each half of the winding. The a-c potentials are marked in circles at grids and plates. The center-tap potentials are zero. R is the biasing resistor through which no signal current should flow. The signal current at any instant in a common plate leg should be zero.



A radio-frequency circuit acting as full-wave detector. By using a double condenser the rotor may be grounded. Otherwise the rotor would be at one grid potential. This circuit is not push-pull, because the output is not symmetrical. The input is full-wave and that's all. This is a favorite method of obtaining detection, where one desires to switch from push-pull amplification, in general as shown at left, to full-wave detection. Across the 'phones put 0.000025 mfd.



Here a triode is hooked up to serve as a diode by tying the plate to the cathode. The load resistor R is center tapped. The current through this resistor is d. c. Therefore, counting from the grounded center, the voltage at extremes will be equal in value but opposite in phase, the correct situation for push-pull. Stopping condensers are used so that there will be no awkward difficulties about supplying the negative bias. This same method of diode output utilized for push-pull input may be applied to the 55 and similar tubes.

BY standard definition an amplifier is a device for increasing the amplitude of electric current, voltage or power, through the control of the input power of a larger amount of power supplied by a local source to the output circuit.

The three main classes of amplifiers are Class A, Class B and Class C.

A Class A amplifier is an amplifier wherein the plate current wave form is essentially the same as that of the exciting grid voltage. This is accomplished by operating with such negative grid bias that some plate current flows at all times, and by applying such an alternating voltage to the grid that the dynamic operating characteristics are substantially linear. The grid must usually not go positive on excitation peaks and the plate current must not fall low enough at its minimum to cause distortion due to curvature of the characteristic. The amount of second harmonic present in the output wave that was not present in the input wave is generally taken as a measure of the distortion, the usual limit being 5 per cent. The characteristics of Class A amplifiers are low efficiency and output with a large ratio of power amplification. But their quality is good and their popularity endures.

A Class B amplifier operates in such a manner that the output is proportional to the square of the *grid excitation voltage*. This is accomplished by operating with a negative grid bias that reduces the plate current to a relatively low value with no grid excitation voltage, and by applying excitation such that pulses in the plate current are produced on the positive half cycle of the grid voltage variations. The grid may usually go positive on excitation peaks, the harmonics being removed from the output by suitable means. The characteristics of a Class B amplifier are medium efficiency and output with a relatively low ratio of power amplification.

A Class C amplifier operates in such a manner that the output varies as a the square of the *plate voltage within limits.* This is accomplished by operating with a negative grid bias more than sufficient to reduce the plate current to zero with no grid excitation. An alternating grid excitation voltage is applied such that large amplitudes of plate currents are passed during a fraction of the positive half cycle of the grid excitation voltage variation. The grid voltage usually swings sufficiently positive to allow saturation plate current to flow through the tube. Thus the plate output waves are not free from harmonics, and suitable means usually are provided for removing harmonics from the output. The characteristics of a Class C amplifier are high plate circuit efficiency and output with a relatively low ratio of power amplification.

It can be seen, therefore, that the bias application largely determines the class into which an amplifier falls. Recently there has been some leaning toward amplifiers that are between Class A and Class B, that is, for a given plate voltage, a somewhat higher plate voltage than Class A would require, the negative bias is increased substantially, though not sufficiently to yield performance in the Class B region. This type of compromise circuit is sometimes called Class AB, or "prime" amplification.

Class A the Favorite

The low efficiency of the Class A system is noted. The comparison is made between the amount of d-c power necessary to run the amplifier and the amount of undistorted a-c power output at that level of input which does not produce more than 5 per cent. distortion in the output. Nevertheless, the Class A system is the one principally used, for the inefficincy also relates to the amount of electricity that has to be used to power an amplifier working from the a-c line, compared to the power output, and the price of energy from the line is very low, even if the efficiency is low. Another aspect of this efficiency comparison is the amount of power taken out for the quantity of grid excitation voltage put in, but this is under easy control by proper plate loading, transformation ratios and the like.

It is no sin to have an inefficient amplifier, as attest the fact that most sets have Class Aamplification. There is no relationship between efficiency and fidelity.

At the radio-frequency and intermediate frequency levels, and at preliminary audio-frequency levels, Class A is almost the unexcepted rule. In the output sometimes a Class B amplifier is found, but the point is raised against it that for home use it provides more power output than would be required. If it is said that not all the power output need be used, the answer generally is that the system works best when worked up to or near the hilt, and the tone is not so good on low volume, or low power output, as is found in Class A amplifiers.

Class B in the Home

The comparison of results between Class A and Class B, sometimes demonstrated to radio technicians by tube and amplifier manufacturers, shows that for large power output the Class B system is superior, so the question remains whether such large output is desired or needed for the home. At least it can be said that for such purposes the Class B amplifier has not made much progress. This may be due to the higher cost of parts for such an amplifier, and the special precautions necessary, including special transformers that cause little power loss in the grid circuits through which current flows, and relatively high current, during part of the positive alternation. So, too, the coupling is by step-down transformation, so that the high impedance load may be in the plate circuit, where the d-c resistance of the winding is necessarily large, and could be large without serious effect, while the secondary is of low d-c resistance, so that the loss due to grid current flowing through the secondary is negligible. So, too, a driver stage is necessary. Something has to supply the power to the grids of the output tubes and this something is the driver, meaning an extra tube.

While the definitions given are standard, they do not specifically include the case of the Class B push-pull tubes that operate at zero bias. This type of tube has such a high mu that zero bias becomes practical, there being perhaps only 10 milliamperes or so flowing at no grid excitation, but large current flowing at grid excitation, during the positive half cycle, or part of it. Hence for balance such a circuit is arranged as push-pull, and since the effect is just the same as that of push-pull, the case may be cited as that of true push-pull. It is nothing against a push-pull circuit that grid current should be flowing. If the circuit is symmetrical the grid-current flow is symmetrical and the push-pull condition is true and real.

Equal and Opposite

The symmetry in a push-pull circuit arises from the fact that two tubes are arranged differentially. That is, whatever takes place in one tube takes place equally in the other tube, but in the opposite direction. It is possible to have push-pull with one tube, not meaning two tubes in one envelope either, but such one-tube devices are special and experimental, and so far have not proven popular.

The words "equal and opposite" constantly crop up in discussion of push-pull. Hence, the voltage supplied to the grids of the push-pull tubes is divided, the same way as for input to a full-wave rectifier. This means only half of the original voltage does useful work at the input, at any instant. The total a-c output voltage is twice as great as from a single stage, because the currents are in opposite phase in oppositely-phased windings and thus add up. So each tube has push-pull action during one alternation (half cycle).

Push-pull a not in great gain. In fact, there is greater gain if the two tubes are put in parallel, rather than in push-pull, which is a series formation, because the parallel method doubles the mutual conductance. So once in a while one reads that two tubes were put in parallel and the author of an article on the subject of such parallelling points out that the volume of sound was greater. However, it is not the purpose of push-pull to make the quantity of sound greater, for indeed the gain is nearly always less than from an equivalent single stage, but rather the object is to have the power output capabilities greater. It is generally said that the power output is at least doubled—and that is conservative—while others, still not exaggerating, in the author's opinion, state that push-pull quadruples the available power output.

The Straight Portion

Since first we must have balance, we naturally want to get two tubes that are closely alike. We ought to have several tubes on hand, and test them, under equal conditions of negative grid bias and positive plate bias, to determine whether their static characteristics are about the same. The more nearly they are the same, the better we are off.

Preferably a curve should be run, which may be done by using a fixed bias of the value recommended for the tube at various operating plate voltages below the rated voltage, leaving the negative bias fixed, or, leaving the plate voltage fixed, change the grid bias in both directions. Then we shall find that for part of the curve there is a so-called straight portion, and about in the center of this the operation is most satisfactory for push-pull. Of course comparison of the two curves will be a comparison of the two tubes, so from the group of tube two are picked that have the same or close operating characteristics. In practice this is seldom ever done, but the more fastidious experimenter should try it and determine whether he is convinced it is worth while.

If the bias is either too high or too low, that is, one gets off the straight portion of the characteristic, there will be some rectification, and the condition of true push-pull does not pertain throughout.

Change and No Change

There is a power economy in push-pull, and it has to do with the fact that the action in one tube is opposite to the action in the other tube. We have found that the input voltage is equally divided between the two grids, as by using a center-tapped secondary of a push-pull input transformer. It was not stated expressly that the voltage in one half of the secondary is 180 degrees out of phase from that in the other half of the secondary, taking any equal points on either secondaries, say, the grids. That is so. Therefore when the grids are excited by a fixed voltage, d-c or an a-c voltage that does not change, there is no change in the output, because there is no difference between what is put into the grids.

The a.c. is divided, half being fed to one tube, half to the other, the polarities are opposite, though the two voltages are equal, and so as the plate current rises in the tube that has its grid acted upon by the positive half of the cycle, the plate current falls in the tube that has its grid acted upon at the same instant by the negative half of the cycle. And remember that for any given instant the voltages put into the respective grids are exactly the same, though oppositely polarized, and so if the tubes are identical in performance, and the biases and constants likewise, the operation being on the straight portion of the characteristic, the plate-current changes will be equal and opposite. So the B current through a resistor interposed between plate and B plus would be the steady B current, and it would not change even when the signal was applied. The effect of the signal on the plate current is zero, because the tank fed draws as much less in one leg as it draws more in the other leg.

The Bypass Condenser

This theoretical condition we know does not obtain in practice, for when we put a milliammeter in a common leg we find that the plate current does change somewhat. That perhaps represents the fallibility of human efforts, but it is no reason why we should not strive to reduce that change as much as possible.

Another way of looking at the situation is that there is no signal current through the resistor. And instead of being directly in the plate leg the resistor may be in the cathode leg, which marks really one end of the plate circuit. Then it is used as a self-biasing resistor, and it is well understood that bypass condensers are omitted usually from such a biasing resistor, for the reason stated, that there is no signal voltage drop across the resistor, hence no need for a bypass condenser. Indeed, if symmetry truly obtains, the bypass condenser would do more harm than good by way of some reduction of the power output. Many experimenters have tried putting in a large condenser, and leaving it out, noting no difference. When there is no difference noted, leave the condenser out. If the sensitivity increases and tone seems bet-

(*Continued on next page*)

(Continued from preceding page)

ter with condenser in, either balance the circuit (for the signs of unbalance are obvious) or leave the condenser in as a makeshift.

From the foregoing, it can be seen whence the statement of increased power output is derived, since with a given plate voltage applied we have twice the emission possibilities and can handle twice the output voltage, negative d-c bias on the grids remaining fixed. As we are interested in power, and not in voltage, we can say that the power output is four times as great as with single-sided output.

High Negative Bias

Now we shall consider putting a strong negative bias on the push-pull circuit and see what happens. First, the plate resistance of the tube will be greatly increased, or mutual conductance reduced, so the amplification itself will be reduced. This is in line with the well-known fact concerning vacuum tubes that the amplification is reduced as the negative bias is increased, as attest the manual volume controls that change the bias. So great may be the negative bias in the case discussed that the plate current practically does not flow. And still, despite the rectification, the circuit may be push-pull. It is assumed that the a.c put into the circuit is sufficient to drive the grids to the straight portion of the characteristic. On the linear operating portion push-pull obtained. The tubes no longer follow the wave form of the input, for we have strong odd-order harmonics. There should be no even-order harmonics, for, considering tube A as tending to produce them, the impulse from tube B is always in such phase as to prevent them.

Therefore a test for balance may be made by those who have the equivalent to measure even-order harmonics, particularly the second harmonic. This is by far the strongest offender when harmonics are produced generally, and will be far stronger than the fourth or other even-order harmonics when there are any even-order harmonics. The odd-order harmonics can not be eliminated as a series, because the fundamental is one of them, and it, too, would have to be eliminated.

Push-Pull Detector

It can be seen therefore that for a true push-pull relationship there can be no detection in the real sense, and if a push-pull circuit is to become a listening post, for instance, it has to be changed to a non-symmetrical circuit, as by cutting off the supply to the filament or heater of one tube, or removing the plate voltage from one tube, or by cutting in an extra negative or positive bias to one tube, or by some other method of destroying push-pull action. The question naturally arises: What becomes of the classification of the so-called push-pull detector? We always suspected there never was such a thing. It is of course practical to get a push-pull action out of a detector, but the detector itself is not push-pull. What the detector produces may be taken off in such a manner as to yield push-pull. That is quite different from the detector itself being push-pull.

The so-called push-pull detector (if the phrase means anything) is probably the one that has full-wave type of input, that is, center-tapped secondary feeding the two grids, and the plates paralleled. That isn't push-pull. Balance has been destroyed, as it had to be destroyed to effectuate detection. It is simply a good example of rectification of alternate halves of the cycle. It is a case of full-wave rectification, which is not a case of push-pull. Rectification and push-pull are antithetical.

Ladner and Stone have summarized push-pull facts as follows:

(1)—The push-pull circuit proper is a two-tube circuit with differential input and output circuits, and its action is the same whatever point on the characteristic the tubes are worked, provided there is no assymmetry. The gain is greatest when the tubes are set wholly on the straight part of their characteristic.

(2)—The gain per stage from push-pull for an available signal is no greater than is possible from one tube.

(3)—The gain, tube for tube, is much less than from a system of one-tube-per-stage.

(4)—The increased gain when input is not limited is due only to the increased emission of the two tubes; greater input is required than for parallelled tubes, because the mutual conductance is less.

(5)—Even harmonics are suppressed in a push-pull circuit.

(6)—The push-pull arrangement economizes push plate current.

(7)—Capacity effects to ground are symmetrical in a push-pull circuit.

(8)—One can not rectify with a push-pull circuit.

New Book Gives Insight Into Working of Broadcasts

As a book addressed mainly to authors, and somewhat to actors, so that if these hope to find an outlet for their art in radio the way will not be hampered so much, "Gateway to Radio," by Maj. Ivan Firth and Gladys Shaw Erskine, gives generous chips from the trees of experience that have grown up around these two well-known players.

Even those who have no aim of making a living as radio authors or actors will find the book of considerable interest, so long as radio itself, as to its inside workings, holds forth any attraction to them. A considerable part of the book reveals the ins and outs of programs, from inception to presentation on the air, and where adverse criticism is to be made, the authors have been unflinching. For instance, they point out that sponsors themselves so often trifle with the program according to their whims, and hamstring authors over long periods of indecision, that, though the sponsors pay the bills eventually, they do much to mar artistry on the air. The authors adhere to high ideals of what should be offered to the listening public, and by no means convey the impression that excellence rules the etherway.

Maj. Firth was a prominent official and director of the British Broadcasting Company before coming to the United States, where he became production director of the National Broadcasting Company. To him must be due the delineation of contrast between methods employed here and in Great Britain. For instance, over there as many as five studios are used at once for the same program, and the control engineer picks up the proper sequence from the proper studio, for effects Maj. Firth feels are not gained in this country. For instance, if a jungle scene is to be played, one studio is so equipped that the outdoor echo effects are noticeable, thus adding verisimilitude, whereas the soft-curtained board of directors room for perhaps a following scene would be acted in another studio. Moreover, sound effects are in a separate studio, the noises being produced sometimes continuously, as in a battle scene, to be cut in by the control engineer, whose importance is stressed as to the success of programs both here and abroad.

Since the object of sound effects is to create the proper illusion, the authors find that some improvisations seem more real than the original. A forest fire in a studio —Heaven forbid—would not sound natural to the listeners, they intimate, but the crinkling in the hand of a piece of cellophane, taken from a packet of cigarettes, "will produce the most realistic effect of the crackling of a forest fire." Moreover, an auto exhaust is simulated by operating a small motor, and running a tubing from motor to microphone. The realism is said to be perfect, yet the sound in the studio is so weak that the actors scarcely can hear it. In the loudspeakers throughout the nature the phut-phut will be quite pronounced.

A tribute is paid to American ingenuity in devising sound effects, but nothing is denied to the British that they deserve, as the Major evidently was torn between emotions. The summation of his contrast between the two styles of operating broadcasting may be considered a draw. He finds that in England there are much more pains taken in the preparation and rehearsal of a program, that the absence of advertising lends itself much better to artistic attainment, but that the Americans bring to their own problems great vigor and ingenuity, under the requirement of doing a vaster job with much impromptu material and pacing speed.

Various personalities are appraised by the authors, including especially famous announcers and commentators. For instance, of Lowell Thomas they say: "He can be relied on for authenticity and the truth. The listener is safe to form an opinion on facts that have been given by Lowell Thomas, because he does not attempt to convince you of his own point of view."

The book is published by Macaulay, N. Y. ($2.50).

Shiro and Stannard Start Lasalle Company

Lasalle Radio Products Co., 140 Washington Street, New York City, has just begun business, manufacturing short-wave and all-wave sets and converters. Benjamin Shiro, formerly of RCA Victor Company, and Edwin Stannard, formerly of Supertone Products Corporation, are running the business. The short-wave regenerative sets range in price from $3 to $25 and the all-wave sets, which are superheterodynes, from $25 to $75.

A specialty is an all-wave converter. The problem of covering the low-frequency band to 150 kc has been solved by Mr. Shiro in an original way.

A THOUGHT FOR THE WEEK

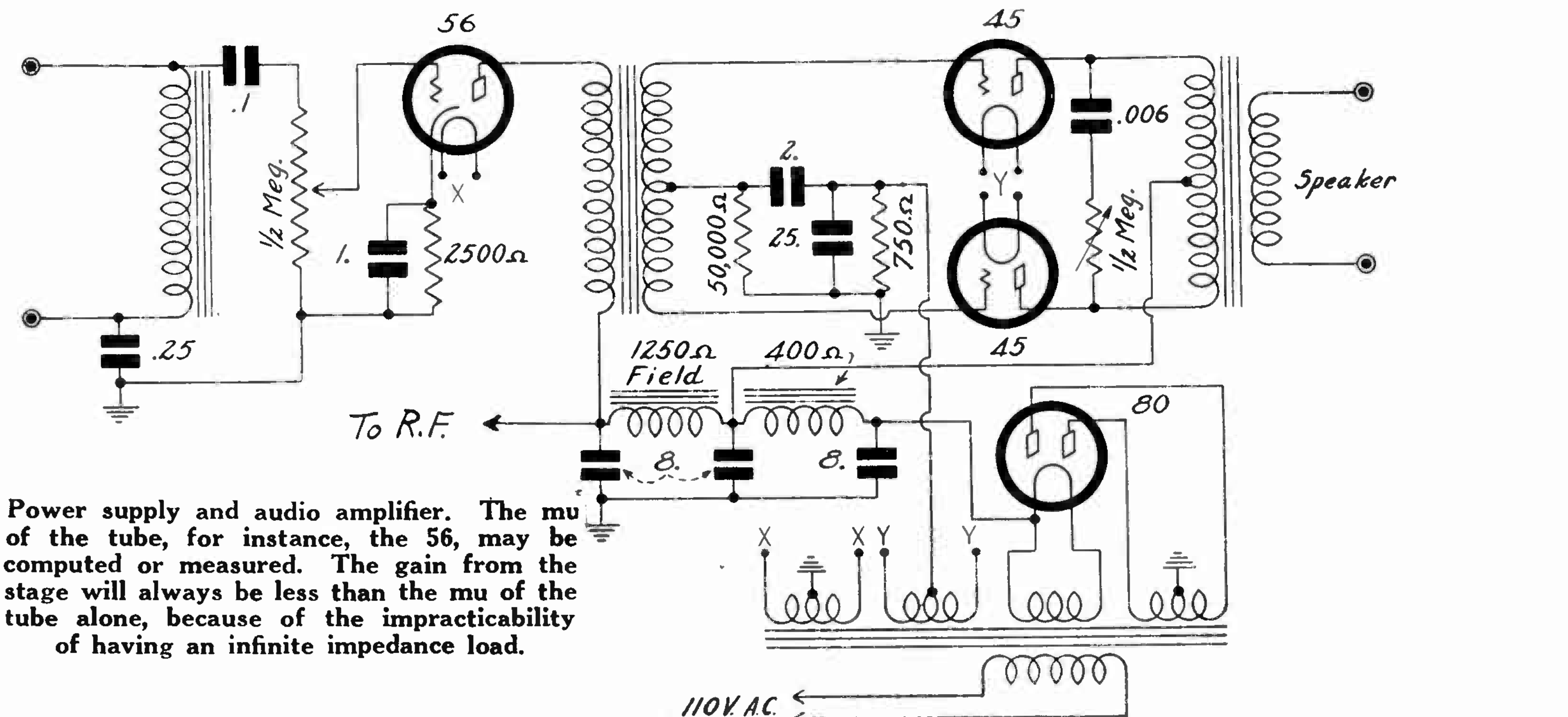
THOSE NEW CHAINS they've all been talking about are working their way into the notice of listeners-in and advertisers. There's the new Mutual Broadcasting System, headed by W. E. Macfarlane, who, besides being president of the new corporation, also is business manager of the Chicago "Tribune" and vice-president of WGN, Inc. Interested actively in the new chain are WGN, Chicago; WOR, Newark, N. J.; WLW, the Crosley station in Cincinnati, and WXYX, Detroit.

This makes the second good-sized chain that has come into the picture this year, the other being the American, which seems to be getting air accounts—and folk who know will tell you this means that the milk is rich and that the cream is coming to the top. Incidentally, the older chains, while apparently not worried by these new developments, have gone ahead and made some new expensive as well as expansive changes in their programs, and the public seems to like them immensely, if we still can judge by the fan mail.

The Tubes in A-F Amplifiers

Amplification Factor, Practical Gain Per Stage and Load Conditions

By Morris N. Beitman
Engineer, Supreme Sound Systems



Power supply and audio amplifier. The mu of the tube, for instance, the 56, may be computed or measured. The gain from the stage will always be less than the mu of the tube alone, because of the impracticability of having an infinite impedance load.

IRRESPECTIVE of its application an audio amplifier is used to amplify the frequencies of the audible range. It is possible, without imposing too drastic complication, to design amplifiers to reproduce faithfully to a marked degree audio frequencies between approximately 60 and 8,000 cycles per second. Since most of the broadcasting stations do not go beyond this range, it would prove of no avail to use audio amplifiers with a larger range.

Audio amplifiers are entirely dependent upon the use of the vacuum tube as an amplifier. This use falls into two classes: (1) where voltage amplification is the object, and (2) where power output with little distortion is desired. Power tubes used in the last stage of an amplifier are in this latter class. Tubes preceding the power stage are primarily voltage amplifiers with the exception of the driver stage in Class B amplifiers, which must also supply power to the grids of the final stage.

Formula for Mu

The amplification ability of the tube is due to the nature of the construction which causes a small grid potential change to have the same effect upon the plate current as a much larger plate potential change. The ratio of the change in the plate voltage E_p to the change in grid voltage E_g, that will vary the plate current by an equal amount, is called the amplification factor, or μ. Mathematically:

$$\mu = \frac{\alpha E_p}{\alpha E_g}$$

where α means the differential, a very small change.

For example, a type 56 tube operating in a conventional circuit with:

$E_g = -13.5$ volts
$E_p = 250$ volts
$I_p = 5$ milliamperes

will have a one milliampere drop by either a change of .87 volts in E_g, or a change in the plate voltage of approximately 12 volts. The ratio of the two will give about 13.8 as the amplification factor.

The plate resistance (r) of the tube is the resistance to alternating current in the path between the plate and cathode. It is the ratio of a small change in the plate voltage to the corresponding change in the plate current.

Transformer Difficulties

The current change in the plate circuit may produce a voltage variation across a resistance, a high impedance, or the impedance of the primary of a transformer. With a transformer it is possible to step up the voltage by a small ratio in the order of 3 to 1, or less. The turns ratio N is found from the formula:

$$N^2 = \frac{\text{secondary impedance}}{\text{primary impedance}}$$

If N is made as large as 7, for example and the plate resistance of the tube working into the primary is rather high, requiring a high load resistance or what corresponds to the same thing a high primary inductance in the order of 80 henries or more, complications arise in the design of the secondary. This transformer, computing from the formula, would require a secondary inductance of 3,920 h., and such a transformer cannot be constructed without having a very large capacity between turns. This capacity would act as a shunt for high frequencies. Transformers at best can only give partly true reproduction, but may be designed to give only negligible variations in the needed audio range.

With the advent of high-gain tubes, resistance coupling between stages is becoming more and more in vogue, with impedance coupling finding but little present-day application. Direct coupling, although having the advantage of the most nearly perfect reproduction obtainable and the least amount of voltage loss in transfer, is not used because of the very high voltage required.

If the plate current is passed through a high resistance connected between the plate and the positive side of the B supply, voltage variations are produced in proportion to the changes in the plate current. The voltage drop distributes itself in proportion to the resistance of the tube (r) and the load (R). The voltage amplification is a fraction of μ, expressed by the relation:

$$\text{VOLTAGE AMPLIFICATION} = \frac{\mu R}{R + r}$$

Can't Reach the Mu

From the above it is seen that as the load resistance is increased without limit, the voltage amplification will approach the amplification factor. This, of course, is impossible since the current of the tube must pass through the resistance (R) and, therefore, the IR drop will cause some of the plate supply voltage to be "lost."

Judging from this, high load resistance would necessitate a very high B voltage. A satisfactory value of the resistor is found by experiment and is usually suggested by the manufacturer. It is possible with small type tubes such as the 57 to obtain a peak output of 200 volts by using 500 volts across tube and plate coupling resistor of 250,000 ohms.

The voltage variations are coupled to the grid of the following tube through a condenser of suitable capacity. The size may be found approximately from the formula below, where R_g is the grid coupling resistor of the next tube in ohms.

(Continued on next page)

Use of Tubes As Amplifiers for Audio

(Continued from preceding page)

$$C = \frac{0.04\ (R + \mu)}{R_g\ (R + \mu) + rR} \text{ farads}$$

The grid resistor serves to release the electrons that may have accumulated at the grid. This prevents the blocking of the grid. If this resistor is made small very little voltage will be impressed upon the grid, if unreasonably large it will defeat its own purpose. Here again a value is usually suggested by the tube manufacturer.

Power Output

The grid is biased sufficiently negatively that from a practical viewpoint no current flows in the grid circuit and no power is consumed here. The grid resistor does use some power.

From this we see that a certain amount of power amplification always takes place in a vacuum tube circuit, but so far our primary consideration was in regards to voltage amplification. However, the last stage of the amplifier must transmit power and not merely voltage to the loudspeaker. Usually a power tube is used which is designed to fufil this requirement.

A tube of the triode type is used in the output stage as a Class A power amplifier to supply large power with little distortion to the loud speaker. To accomplish this power-sensitivity is sacrificed. The pentodes have comparatively high power-sensitivity, but add considerably more distortion.

Distortion arises from operating the tube over the curved part of its characteristics. It usually resolves itself into harmonics of which the second harmonics are by far of the greatest magnitude. The push-pull amplifier cancels even-order harmonics, requires less filtering of its plate supply, and permits somewhat larger input voltages without causing additional distortion due to overloading. This last item makes it possible to obtain greater power from two tubes operating in push-pull than from the same tubes in parallel.

Class B

In Class B operation the tubes are biased or designed with a sufficiently high amplification factor to cut off the plate current with no input signal. When a signal sufficient to swing the grids is introduced, the negative portion of the cycle will add only to the bias, and, therefore, plate current will flow only during the positive half of the cycle. A large amount of even-order harmonics will of course be produced. However, the use of two tubes in a balanced circuit eliminates these harmonics from the output.

Since at times the grids are driven positive, the preceding stage must be capable of supplying the power drawn by the grids under this condition. This is accomplished by using for a driver stage a Class A power amplifier of suitable size coupled by a transformer possessing the proper characteristics. This transformer is usually of the step-down type and of high-efficiency design.

With Class B it is possible to obtain high power output with comparatively small tubes operating at ordinary plate voltages. Since very little power is consumed with no signal, economy is another advantage.

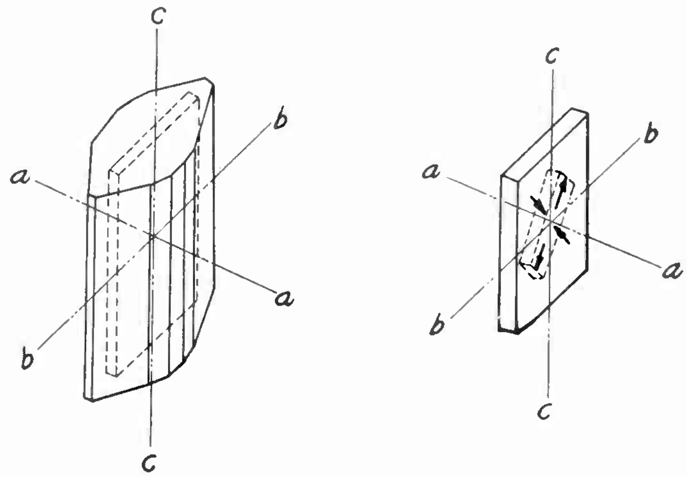
Voice Coil

To offset these good points, the distortion present is always somewhat larger than for the same power obtainable from larger Class A tubes, and the power supply must have very good regulation to maintain proper operating voltages with considerable current variations. The so-called A-prime or Class AB amplifier operates somewhere between the two types discussed.

When large differences in impedance appear between two circuits that are to be coupled, a transformer must be used to transform power without appreciable loss. The voice coil of an average dynamic speaker has a resistance of about 4 ohms while the usual load resistance of the tube is in the order of several thousand ohms. Here again the turns ratio is determined from the square root of the ratio of the two impedances under consideration. When the secondary is shunted by the low resistance of the voice coil, it may be considered short circuit. Under this condition the primary of the transformer will appear to the tube as pure resistance; a thing very much desired to eliminate variations due to the change in impedance with signal frequency.

The Three X, Y and Z Axes Prod

By Edward C.



Imagine yourself approaching a crystal with point of knife toward the ceiling. Pass the knife through the crystal at left along the line CC and you have made a Z cut. The natural period will depend on the thickness of the cut, as determined by where you pass the knife a second time. The two other cuts are on the opposite plane and are the X and Y cuts. The lines aa and bb indicate that the X and Y cuts are at right angles. At right the relative positions are brought out a little better by using a square-faced prism. Actually the crystal before cutting has six sides.

CRYSTALS used for a constant source of fixed frequency are usually of quartz, although other crystalline substances may be used, for instance tourmaline and rochelle salts.

The crystal slabs as found are not all suitable for the purpose. Only in two or three places on earth are satisfactory crystals for this object consistently obtained.

The crystal may be taken as an object such as that shown at left. If one held a knife up straight, cutting edge at right angles to ceiling and floor, and approached the slab with the knife, assuming the knife would cut right through the crystal, the cut would be along the line CC. The two pieces would fall to the sides. Then another cut would be made close to the former one on either piece, and we would have a slab that had been cut along the Z axis of the crystal. This is also known as the optical axis, for it is the one along which the polarization of light takes place. Also this is called the geometric axis.

X and Y Axes

The crystal will be observed to have six faces. If instead of doing the cutting from the side we do it from the top, with the knife edge parallel with the floor and ceiling instead of at right angles to them, we could cut from the half-way point on one face to the equal position on the opposite face, and call it a side-to-side cut, which would be along the Y axis. The other axis is the X axis, which is at right angles to the Y axis, and approximately from corner to corner, that is, the knife edge is directed in the path of the points of the V's formed by the faces of the crystal.

The lines aa and bb indicate that the cuts are at right angles for X and Y-cut crystals. At right the representation is carried out with the simplified representation of a prism with square face, so bb represents more clearly the Y axis, or side-to-side cut, while aa indicates that the X cut is at right angles and approximately to the corners.

The odd thing about these crystalline substances is that they have no center of symmetry, and therefore, depending on the cut, they will work in different directions. If they are subjected to tension, that is, mechanical strain, they will set up electrical forces. If they are subjected to an electrical force they will set up within themselves mechanical strain. Therefore, if mechanical oscillation is applied to them, electrical oscillation will be produced. And if electrical oscillation is applied, mechanical oscillation will be produced.

A Bit Off Crystal Resonance

In radio the electric cause is introduced and the mechanical effect results. Moreover, the crystal will follow the exciting force, expanding and contracting in different directions, and thus, though it has to be driven, it will maintain an electrical circuit in a frequency-stable state, at one frequency.

It is of course possible for any given

Crystal Cuts
uce Different Results

Warburton

crystal to oscillate at more than one frequency, and two or more frequencies of oscillation may be present at once. However, a tuned plate circuit usually aids in driving the crystal to the desired frequency, this circuit being detuned slightly from the natural period of the crystal. Should there be B current through the crystal, as with crystal connected from plate to grid, the tuned circuit would be set a bit lower in frequency while for crystal used across an otherwise untuned grid coil, the tuned plate circuit would be set to a frequency somewhat higher than the crystal's natural frequency.

The crystal cut determines somewhat the relative confinement to a given frequency. For instance, the Y cut produces a strong lower frequency and a weak higher frequency, especially as it has two directions of oscillation, but the X cut, or Curie cut, has only one direction of oscillation. The X cut is generally preferred for low frequencies.

Though the X cut has only one direction of oscillation, both surfaces move, as in the two other examples.

Possesses Elasticity

Thus the crystal can be seen to possess elasticity. If a rubber band is pulled at the ends, it will stretch, hence become longer, but the width of the rubber band will decrease as the length is increased, and the mass will not change. There is just as much rubber band as before. The distribution has changed. So it is with the crystal, for the pressure-electric effect, or piezo-electric effect, as it is more commonly called, is simply that of elastic behavior, coupled with the extraordinary quality of responding instantly, as a neon tube responds in its illumination to variations of current passed through it. Variations may be millions of cycles per second, yet the crystal responds.

Thus the crystal suffers a separation of charge when strained mechanically, or if put in an electric field, suffers change of shape. There takes place an expansion lengthwise and a contraction sidewise.

The crystal in the circuit alters the conventional resonance curve. Instead of the gradual change of current with change of frequency, with no great change at resonance, compared to a point a bit off resonance, there develops, with the crystal in circuit, an enormous change at resonance.

99% Change for 1% Shift

For instance, suppose that the crystal's natural period is 100 kc. Measure the current and call the value 100 per cent. At 99 kc the current may be only 1 per cent. Here for a 1 per cent. change in frequency there was a 99 per cent. change in current.

The resistance of the crystal increases at resonance. Therefore a larger voltage drop will be present across the crystal at resonance. Were it not for this fact the change in current, comparing resonance with some point a bit off resonance, would be even greater.

The crystal should be kept at a constant temperature. Some cuts are more temperature-proof than others, it is said, but in general for precision work some form of temperature oven is used. This consists of an automatic device for keeping the temperature constant, with the aid of thermostat control. There are numerous ways of doing this.

A rise in temperature causes a decrease in frequency, but the change is not sufficient to make necessary the use of a temperature oven where the crystal is used in a room that is maintained at a fairly even temperature, as the ovens accompany precision work only, and are not needed for general utility.

Crystal Holders

Crystals are put in a holder of some sort. Such holders often have small brass plates that act also as the plates of a small condenser that delivers the electrical charge to the crystal, to set the crystal in mechanical operation. Thus if a vacuum tube with tuned plate circuit is used, the tube is the driver of the crystal, and the circuit is referred to as one consisting of a tube-maintained crystal.

There should be some small freedom for the crystal to move, since obviously it has to move to work, hence extremely rigid compression of the brass plates against the crystal is to be avoided. For filter purposes, where oscillation is not actually needed, the pressure is usually even lighter, because the driving force is normally weaker. An oscillating tube, though its oscillation may be due partly to the presence of the crystal, will drive the crystal with great gusto, so to speak. Simply turning on the tube, by applying heat in the usual electrical manner, with consequent electron flow from cathode, will be enough to charge the small condenser associated with the crystal and put the crystal into operation for its uncanny contribution.

"Final" End of Feedback Case Reached

Like the ultimatum that does not ultimate, the feedback case has been in its "final" stage for years, and now there is another "final" decision but it seems to be more final than any of its predecessors.

It will be remembered that the United States Supreme Court decided that Lee De Forest was the inventor of the feedback method, or regenerative tube action, and held that De Forest had heard a "clear heterodyne" before Edwin H. Armstrong, then a student at Columbia University, had struck upon the same phenomenon.

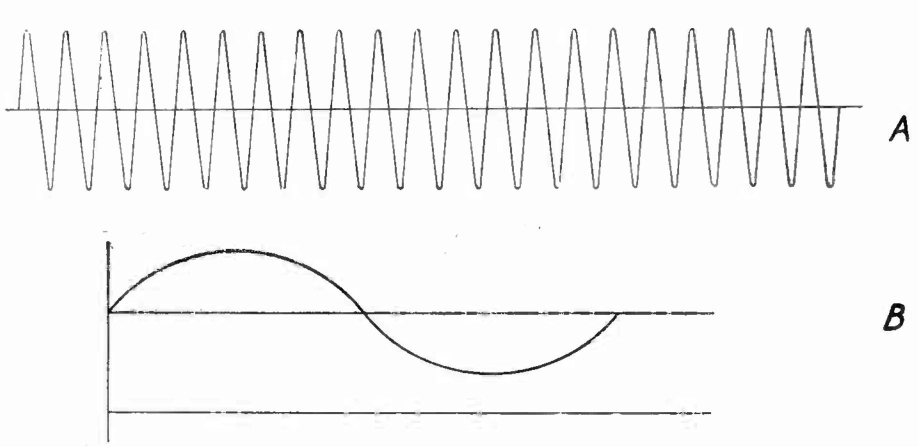
Maj. Armstrong petitioned for a rehearing, and the latest decision is a denial of that application.

The feedback circuit is the one on which all present-day radio is built, for it alone enables the practical sending of carrier waves and the program modulation, by virtue of the action of vacuum tubes as generators, or producers of alternating current. And now practically all up-to-date receivers have feedback, too, principally in the local oscillator of superheterodynes.

The court changed a bit the language of its decision, to state that De Forest said that the frequency of generation could be changed by simple means. Previously the court had assumed responsibility for the declaration.

SIDEBANDS SIDETRACKED LIKE SIDEBURNS, OR RETAINED AS REALITY?

Technicians debate whether sidebands are a reality. One group says that there are no sidebands, as such bands call for the existence of side frequencies, and there are no side frequencies, and only the amplitude is being changed, by the modulation, carrier frequency fixed. The group that states there are actual sidebands maintains that frequency modulation is a reality, and points to the fact that the effect can be seen as a frequency, using the cathode-ray oscilloscope. Mathematically the expression of the theories of both groups is exactly the same. The reason for the difference of opinion lies in the interpretation of the mathematical identity in terms of different physical concepts.

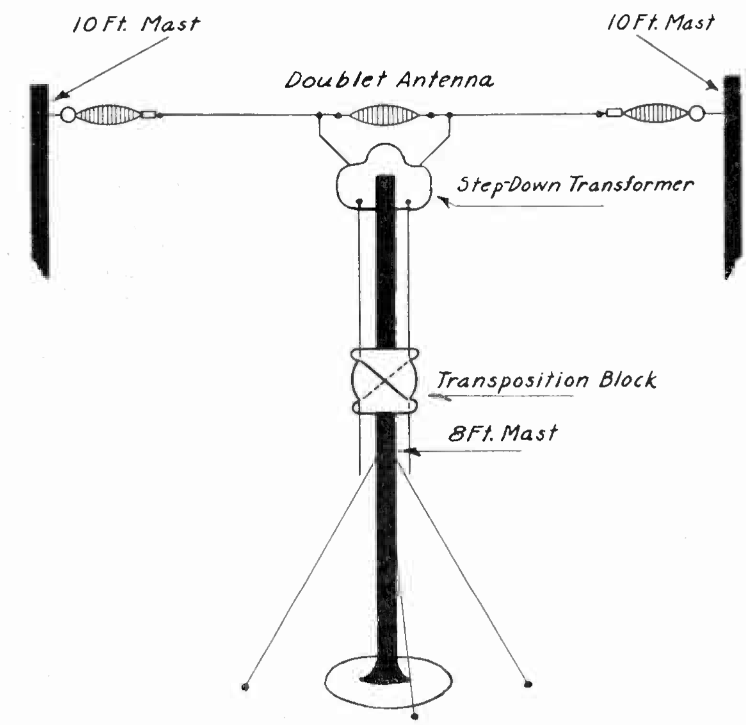


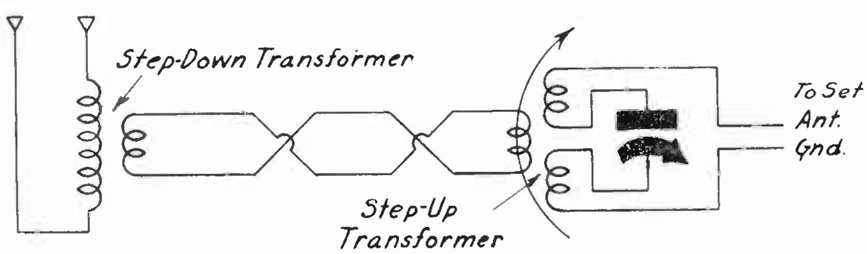
The radio-frequency carrier may be represented as shown at A. The modulation is present, but can not well be shown, as to its effect, because of the small relative difference between modulated and unmodulated carrier. After the modulation has been removed it may be represented as shown at B. Therefore, the two are the same in principle, only the audio frequencies are less numerous per second.

All-Wave Antennas

And Use of Single Transformer for Coupling for Wide Frequency Differences

By Amos L. Gatlun





The doublet antenna consists of a short stretch of equal wire either side of an insulator, two wires being brought down from the points of contact at the insulator to the input to the receiver. Twisted pair may be used, but this method introduces loss due to capacity. A transposed-feed transmission line is preferable, as shown at left above. Sometimes transformation is used at both ends. The diagram represents a current-fed line, because of the large step-down transformation. That is, the power is unchanged, but it is made predominately current. Extremely low resistance transmission is necessary to avoid losses.

THERE is practically unanimous opinion in favor of the use of a noise-reducing antenna system, for short-wave or all-wave sets, although the methods used will differ, and some designers have more confidence in one way than in another. The main object is to prevent pickup by the leadin, so that the antenna is the antenna, and not that the leadin is the antenna or much of it. And while the object is clear, certainly nobody would want to introduce any serious losses in the process of reducing the noise.

It is hard to see how losses can be avoided by present methods. It is true that losses may be kept down. This is done principally by avoiding the serious capacity of a twisted pair, which would effectuate a bypass of much of the energy. Therefore a transposed leadin may be used, being better. There are other methods, some not followed in practice, particularly the best one of the lot, consisting of concentric copper tubings, one inside the other, the impedance of which can be computed closely, depending largely on the ratio of the diameters, and having nothing whatever to do with the length. This hollow tubing transmission and is as near to utter perfection as anything in science. Of course there are mechanical drawbacks to its use, for one must provide the straight path up and down.

What Kind of Wire?

The type of wire to use on antennas and transmission lines has been and still is a matter of dispute. The solid type wire has been preferred for installations that have anything to do with short waves. However, there have been articles in British magazines reporting the field strength at the receiver input, using different types of wire, and stranded wire was reported as furnishing the best results, over a wide span of frequencies. The National Physical Laboratory is said to have taken cognizance of the fact, also, and that is an institution akin to the National Bureau of Standards of our own Department of Commerce.

When anybody mentions coverage of wide frequencies, it at once suggests to the technically-minded radioist that something in the way of tuning has to be done. Now, it is well known that a commercial effort is subjected to the desires and prejudices of indolent customers. Hence if some coupling is to be used between an antenna and a set, fixed coupling is selected. The author hereby states that he has spent some twelve years in radio and has studied a great deal of the technique, some of it rather closely, and does not know, and never has heard of, any system for wide frequency coverage that can be served admirably by a so-called untuned system.

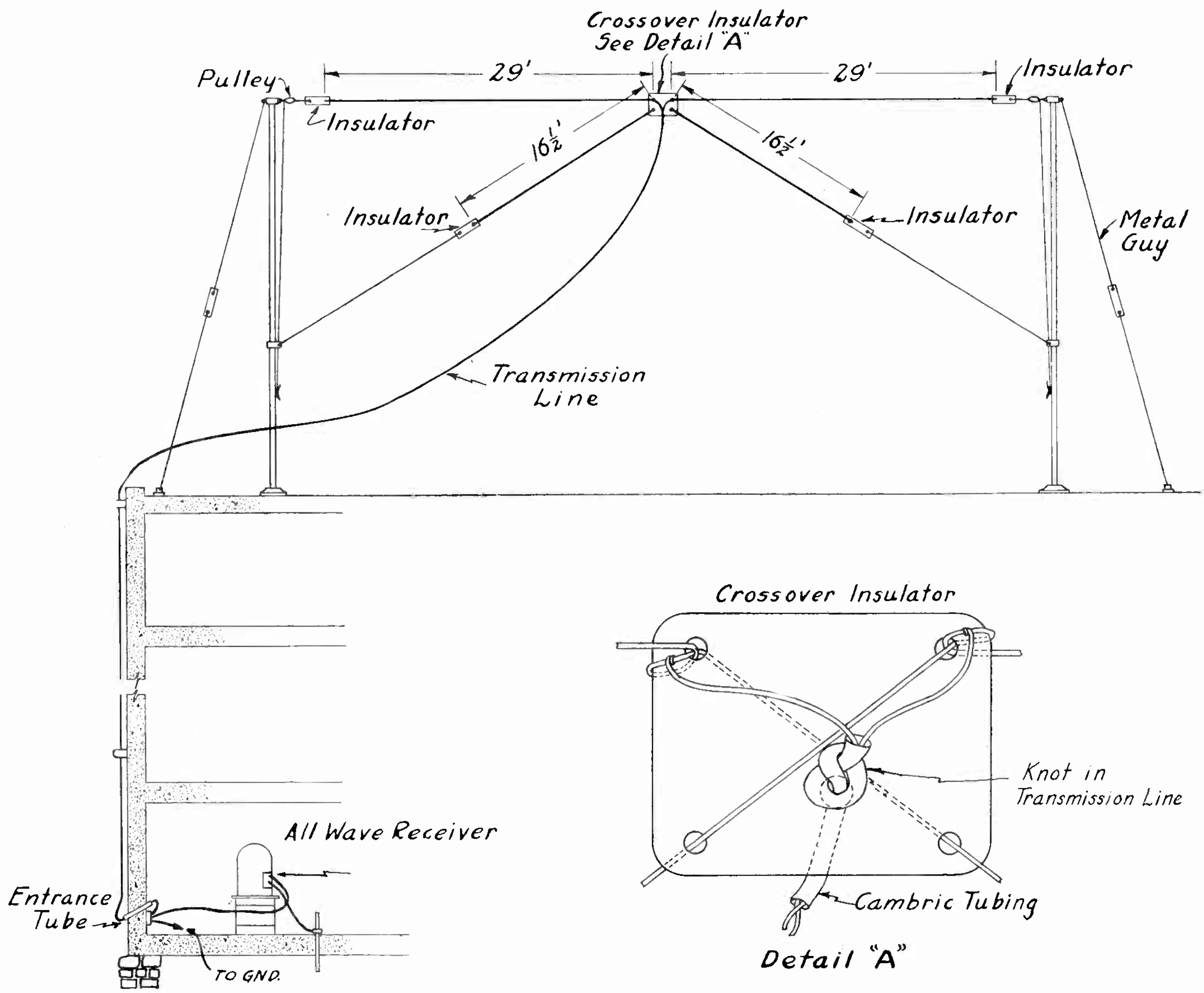
And the same holds for the antennas themselves. It is not possible to have a maximum-efficiency antenna for the broadcast band, or the low frequencies to 150 kc as tuned in on truly all-wave sets, and still have that unchanged antenna an efficient one for short waves, say, of 20 mgc. It would be like saying that the inductance and capacity necessary to tune in 150 kc are exactly the same, and circuited precisely the same, as for tuning in 20,000 kc. You can neither agree with or laugh at the one statement without doing the same as to the other.

The Two Feeds

Some recognition of this fact has been made, and transformation introduced. The practice at the antenna is to step up the voltage and then at the receiver, just before the input, to step down the voltage. This results in unchanged power, but the energy transmitted is largely constituted of voltage. Small indeed is the current. If the capacity to ground is very small this is an excellent procedure, and hams, I believe, prefer the voltage-fed line. And the capacity can be held fairly low.

The other method, which so far as I know has no commercial application as yet in radio, is to have a current-fed line, meaning that there is a stepdown transformer between antenna and line, and a stepup transformer between other end of the line and set. Obviously just the opposite takes place—the current is made very large, the voltage small, the total power unchanged. Small transformer losses may be ignored.

The current-fed line must be of astonishingly low resistance—so low that perhaps it might be considered impractical to attain it—and the voltage-fed line is probably preferred because of the comparative ease of keeping the capacity small. Whether the capacity is small or large must be judged in comparison to the frequency, and above 10 mgc all capacity present in all present-day commercial feed lines for radio may be rated as large.



Consideration given to differences on bands by using a dual doublet.

That brings us back to the current-fed line, because the loss due to capacity is extremely small, possibly a fraction of 1 per cent. of the same loss produced by the capacity to ground when the voltage-fed method is used. That is because the voltage drop in the small capacity is large but the current through this stray capacity is very small, and since (in a large sense) it is current we are endeavoring to conduct we economize, if the line resistance is extremely low.

Difference of Degree

But no matter what type of line is to be used, it is obvious that for full capitalization of the antenna system, tuning has to be done. It is about the same necessity as the presence of tuning in the receiver itself. The only difference is one of degree. Therefore it is suggested that either the additional tuning be done in the set, where there might be a built-in system, requiring separate manipulation from the receiver tuning itself, or that there be an auxiliary coupler of the switch type, instead of so-called fixed transformers, or double-position switch types. Best results are obtained by following the frequencies through with the suitable impedances for them.

Series Condenser

All radio technicians are familiar with the simple tuning device known as the series antenna condenser. When this is variable it has the effect of electrically lengthening or shortening the aerial, in respect to condenser at half-way position. Considering the antenna with any series condenser, the effective capacity is always less than that of the antenna alone, because series capacity is always by way of reduction. But a certain mean series capacity is considered, so variation may be introduced either way. Thus, for truly all-wave work perhaps 0.0005 mfd. would be a good variable-condenser value, while for short waves, near the 15-meter end, a capacity of 20 mmfd. maximum would be more suitable. So it seems that two condensers are advisable, either in series with each other or in parallel. If in series, the large condenser is set to different positions, and the small one always used for closer adjustment. This tuning is by no means critical.

Can't Do Everything

It is recognized that all the niceties of technical requirement can not be met in practice. Give the public some more knobs to turn and interest in the manipulation of the radio set may be diminished. And yet there is quite a number of radioists willing to go in for extra work, as it were, to gain the benefit of extra reception. It seems that the best catches are made by those who will stop at nothing to get them.

Nevertheless, some recognition of the different conditions required for effective work on different frequency bands is being shown, even now, and there are noise-reducing antenna systems that have dual doublets, one for the higher frequencies, the other for the lower frequencies. Necessarily compromises must be struck. Yet there is improvement. The higher frequencies are more active on the doublet intended for them and the lower frequencies on the doublet intended for them.

The transmission line is carried down as clear of the antenna field as practical, insulating knobs being used to hold the line firmly in place.

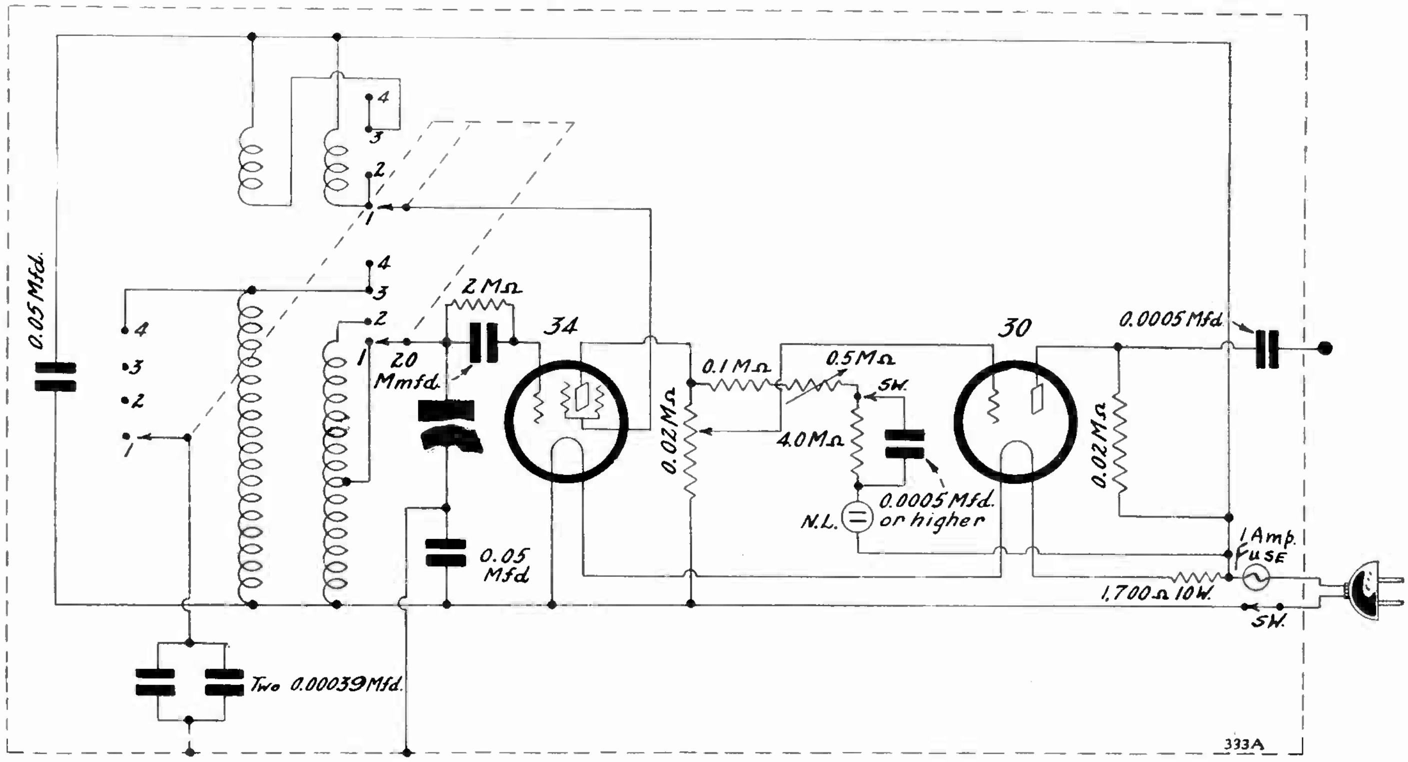
The antenna systems called noise-reducing are not only that, but are better suited for the reception of short waves, discriminating perhaps a bit against the broadcast waves and lower frequencies (if lower ones are covered) because there is plenty to spare in those realms. And while it is true that for short waves the ground connection does not often improve the signal strength, it does so in a relative sense if it conducts interfering noise to ground, and for that reason a ground should be used, and a good one.

A Disturbing Wire

In fact, the distance between the ground post of the set and the actual ground should be as short as can be, and the connection between any transformer that connects to the receiver should be by a wire measuring the least practical distance, not more than a few inches. It has been found that this particular wire can be a source of much trouble in picking up noise, and thus partly offsetting the benefits attempted by the installation of the noise-reducing antenna.

It must not be assumed that the antenna alone is to be considered. The receiver should be so designed and constructed that it will give the signal a big lift and not contribute a lot of noise itself. This part of the engineering problem has not advanced very far. Perhaps in the future there will be receivers that have a relatively high intermediate frequency, but step it down so that much amplification can be carried on at a frequency level that is almost noiseless.

COINCIDING SCALE AND CIRCUIT



A four-band fundamental signal generator, the 333-A, with 34 r-f oscillator, neon tube modulator and 30-tube amplifier. A tapped coil is used for 1,400 to 5,000 kc. (tap to ground), full winding, 540 to 1,600 kc, same tickler for both. The 140-500 kc. r-f band is next (position 3), and the 83 to 99.9 kc. band next (position 4), accomplished by introducing 780 mmfd. across the tuning condenser.

WHILE the problems connected with the use of signal generators for wide-frequency measurements by harmonics have been solved recentlly, as set forth in the series of intimate articles printed in these columns, there is of course a strong demand for signal generators that cover at least four ranges on fundamentals, so that the harmonics may be used for frequencies, say, above 5,000 kc. Such a signal generator is the 333-A, construction of which was discussed in the September 8th, 15th and 22nd issues of RADIO WORLD, the present discussion having to do with lining up this instrument, which requires considerable care, and using the device.

For the benefit of those who have not read the articles on this generator, a brief summary will be given:

The four fundamental frequencies covered are 83 kc to 99.9 kc; 140 kc to 500 kc, and 1,400 kc to 5,000 kc. The low-frequency band also is calibrated in wavelengths, 3,010 to 3,600 meters, enabling not only measurement of the fundamental of this range in meters, but also use of the scale as a frequency-wavelength conversion device.

A Careful Scale

The tuning condenser used has a literal capacity of 25 to 406 mmfd. There is no trimmer on the condenser. However, this does not mean that there is no capacity adjustment. There are, in fact, two capacity adjustments. One of them is the grid condenser, which should be finally around 20 mmfd., the other is the series condenser that completes the tuned circuit, and which is marked 0.05 mfd., connected between rotor of the tuning condenser and one side of the line.

The scale has been very carefully prepared, and is accurate when the circuit is adjusted to the scale. In fact, on the broadcast band such a high order of accuracy has been achieved that it has not been possible by mere observation to disclose any deviation between the true frequency and the frequency read on the scale, for they appear as the same frequency. So far as is known by the author, this is the first time that any such achievement has been offered in any save the precision type generators that cost a great deal of money.

Taking the intermediate band of 140 to 500 kc, it can be seen that the frequency ratio taken from the calibration is 3.57, however, not the whole span of frequencies is included in the calibration, there being a small uncalibrated excess, so the real ratio is even greater, about 3.6. This means the capacity ratio is 12.96, which is admittedly large. And it is attained by omission of the parallel trimmer usually found on condensers and by using a small value of grid condenser.

What a Difference!

Those not familiar with the effect of the grid condenser on input capacity will be surprised to learn that the value of the grid condenser is extremely critical, or that the frequency is changed a great deal by a small quantitative difference in capacity. For instance, 10 mmfd. compared to 50 mmfd. changed the frequency to 1,500 kc from 1,450 kc, in other words, threw the oscillator off the scale by 50 kc out of, say, 1,500, or 3.3 per cent. Since a difference of 0.5 per cent. can be spotted by casual glance, and a difference of 0.25 per cent. noted without difficulty, and since the generator can be made so accurate that no difference appears, it is obvious that the grid condenser capacity adjustment has to be just right.

Another thing to consider is that when the capacity adjustment is made for the broadcast band's higher frequencies it applies to the higher frequencies of the two other bands, as there is no independent adjustment, because the scale was calibrated on one adjustment, and when that is properly achived, the whole system works with splendid accuracy. The broadcast band is the most accurate calibration. The intermediate band, 140 to 500 kc, is accurate to 1 per cent., meaning at no point should it be off more than 1 per cent. in either direction, although in fact most of the frequencies are generated at less than 1 per cent. off from the calibration. The low-frequency band, 83 to 99.9 kc, is accurate to better than 1 per cent., while the intermediate-short-wave band, 1,400 to 5,000 kc, is read from the intermediate band, 140 to 500 kc, by multiplying the readings for that band by 10. Harmonics are not used, merely the same scale for two bands.

Closer Determinations

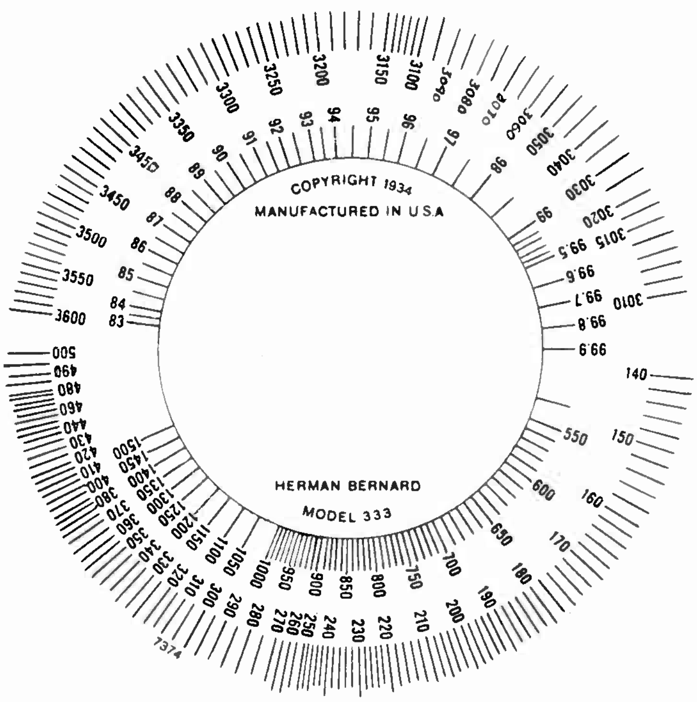
For still closer determination, the read-

Adjustments and Uses
of the 333-A Four-Band Signal Generator

By Herman Bernard

ings for the intermediate-short-wave band, the actual frequency generated may be referred to the broadcast band calibration, and a factor determined. Thus, if the frequency is 1,450 kc when the pointer reads 530 kc, the factor would be 1,450/530 or 2.736. So, using switch position 1, read the broadcast scale and multiply by 2.736. However, these matters will be taken up in detail when we come to the directions for use of the instrument.

As we find we must set the grid condenser closely, and as a small capacity is required, we must inquire what type of condenser to use. A compression type will not stay put. Either an air-dielectric type would have to be used, say, 25 mmfd., adjusted properly, or a condenser improvised. An excellent improvisation can be made by twisting together two pieces of insulated stranded flexible wire equivalent to No. 18 solid, the twisted result 6 inches long, the total twisted length finally turned around a lead pencil and held in place by any adhesive handy. One fellow used chewing gum, Another preferred sealing wax. Another used liquid solder, which is excellent. Of course the dielectric constants of these different compositions are not the same, but the capacity will be nearly right, and, if anything, too large, and may be reduced by cutting off a small part of the wire at a time, even only one leg. It is understood that we have formed a condenser, and put it across the grid leak, and that the two "plates" of the condenser are not made conductive, that is, metal of one does not touch metal of the other.



The scale of the 333-A. The numbers at left are the wavelengths in meters of the lowest-frequency band. The equivalent frequencies adjoin the wavelengths. Inside right is the broadcast band, outside right the r-f band, 140 to 500 kc. The fourth band is 1,400 to 5,000 kc., for which multiply the outside right band by 10, or multiply the broadcast band by a factor as explained in the text.

Broadcast Band as Basis

It is necessary now to have some standard of frequency. This likely will be a broadcasting station. One used in tests was on 1,250 kc. When the correct grid condenser was used, and there was zero beat at 1,250 kc, with dial scale reading 1,250 kc, the tracking was perfect to the high-frequency end, 1,600 kc.

Going to the low-frequency end, the generation was slightly off from the calibration, but it will be noted that there is the series condenser in the tuned circuit, marked 0.05 mfd., and while something around this value will be necessary, actually commercial condensers are not very accurate for values of this nature, and besides circuit conditions impose their own necessities. For the series capacity, if the frequency read too low, increase the series capacity marked 0.05 mfd. and if the reading in frequency is too high, increase the series capacity. So all that can be said further is that this series capacity be made such that at or near the low-frequency end coincidence with some station frequency is established on the dial. Up to 0.2 mfd. may have to be used. In a given instance 570 kc was selected. After this adjustment is made it is necessary to check back on the high frequency end, as the small capacity difference introduced since the grid condenser was adjusted will have an effect. If the frequency reads too low at the high-frequency end, increase the grid condenser capacity. If it reads too high, decrease the grid condenser capacity. This is the general rule for all instances.

After these adjustments have been made the circuit is lined properly. The broadcast band is the preferable one to work on for the adjustments.

There are two escutcheons, one on each side. At first the dial is placed on the condenser shaft so that with plates entirely enmeshed the pointer indicates 83 on the low-frequency scale. If it seems that the dial has been calibrated with numbers upside down, and that "a new dial has to be made" on account of "an awful boner," shift the dial 180 degrees and the numbers will read correctly, and the responsibility for the "boner" can then be authentically assigned at your leisure.

The two escutcheons used are of the double-pointer type, and the two indicating points are not in perfect alignment. This is due to the die construction. However, the calibration was made with due respect to this condition, the misalignment first having been measured as being 1 degree of arc. The scales on any one side are displaced this amount. This means that there is one right way of putting on the escutcheons, that is, they are not reversible, as to top and bottom, although reversible as to the side of the knob at which they are used. The escutcheon at left may be checked by so putting it on that when one pointer indicates 83 kc for the low-frequency extreme, the equivalent wavelength is read exactly on the corresponding pointer as the 3,600-meter bar. Do not mistake 3,600 to 3,010 as representing frequencies. For the other escutcheon, 1,600 kc and 440 kc would be the exact indicating points for correct top and bottom position of the indexes.

The panel is drilled so that the two mounting holes for the escutcheons are in perfect alignment, and the differences just explained are taken up by the adjustment of the relative top and bottom positions of the pointers with the fact of aligned panel holes in mind.

So far nothing has been said about the condition under which all frequency alignments are made. It is understood that the generator is in a metal shield cabinet. Now, the setting, when made absolutely correct for one point, when the chassis is outside the box, will not be correct when the chassis is slid into the box. In fact, with the chassis out of the box the perfect tracking is impossible, since the scale was calibrated with the chassis inside the box, and strange differences arise when this condition is not duplicated. Therefore if an adjustment made outside the box for the high frequency end (grid condenser adjustment) is checked when the chassis is slid into the box, a frequency difference is noted, and its direction, and the grid condenser readjusted to take up this difference. The action required is reducing the grid condenser capacity, as the coil capacity is increased, inductance unaffected, when the chassis is slid into the box. Therefore a little sliding to and fro has to be done before the adjustment is finally correct.

Now, as for the use of the generator.

The cable plug is connected to the a-c line (90-125 volts, any commercial frequency) in either direction, but if a d-c line is used the generator will work only

(Continued on next page)

(*Continued from preceding page*)
when the connection is in a particular way. Connecting the wrong way is harmless, except that there is no generation. Reverse the plug in the wall socket and the oscillator will work.

Do Not Ground Generator

The ground post is not to be used, as the generator was calibrated without ground. Using a ground would upset the calibration a little. *Therefore strictly avoid using a ground on this generator.*

Connect a wire from the output post of the generator to the circuit to be measured. Be very careful that the connecting wire, where joined to the post, if stranded wire, has no spread strands, otherwise the output will be shorted. Also, have the bared end of any wire small for this connection for the same reason of avoiding possible short to the metal cabinet.

If the intensity of the generation is too great, cut down the output by manipulation of the attenuator. It is not possible to remove the modulation on a-c use, because the hum of the line frequency is the modulation, but on d-c use not only may the modulation be removed entirely, but also the percentage modulation is under control by a separate attenuator.

If a superheterodyne is to be lined up at the intermediate level, remove the antenna connection from the receiver, and if easily done, stop the local oscillator from oscillating, as by putting a shorting "strap" across the oscillator's tuned circuit, including any series padding condenser, that is, from grid to grid return.

Scales Discussed

The uses of the scales follow:

83 to 99.9 kc. The calibration is in steps of 0.5 kc to 99.5 kc, while from 99.5 to 99.9 kc the calibration is in steps of 0.1 kc. The companion index on the escutcheon serving this band indicates the wavelengths, which are in steps of 10 meters from 3,600 meters to 3,100 meters, and in steps of 5 meters from 3,100 meters to 3,015 meters, while from 3,015 meters to 3,010 meters the bars are in 1-meter steps.

It is understood that one switch position (No. 4) controls the frequency and wavelengths for this single band, which is merely plotted in both kilocycles and meters. Two 0.00039 mfd. precision condensers, in parallel, are cut in, to establish this band, using the same coil as serves the intermediate band of 140 to 500 kc.

140 to 500 kc. This intermediate band is calibrated on the outside of the other half of the scale. All the popular intermediate frequencies are right on the fundamental, the bars being 2 kc apart from 140 to 250 kc, and 5 kc apart from 250 to 500 kc. Thus set the dial to the switch stop for this band (No. 3) and turn the dial knob until the desired frequency is indicated. Then this is the fundamental emitted.

Broadcast Band

540-1,600 kc. This is the broadcast band, calibrated in steps of 10 kc from 540 to 1,100 kc, and in steps of 50 kc from 1,100 kc to 1,600 kc. The physical separation of bars is better at the low-frequency end, and therefore it is suggested that second harmonics be used as final checks on desired frequencies not represented by bars at the high-frequency end. For instance, suppose you want to line up an r-f channel at 1,150, 1,200, 1,250, 1,300 kc, etc., that is, frequencies from 1,100 kc to 1,600 kc, 50 kc apart, then use the calibration as you find it. But suppose you want to line up at 1,220 kc. This is not a part of the calibration of higher frequencies of the broadcast band. However, turn to about midway between 1,200 and 1,250 kc, and you have the approximate setting. Then tune the generator to a frequency half the desired one, in this instance 1,220/2 or 610 kc. This is very accurately established, and the second harmonic is used without confusion for measuring 1,220 kc.

Since the low frequencies are calibrated in steps of 10 kc fundamental differences, second harmonics will be in calibration steps of 20 kc differences. The example of 1,220 kc happened to produce a low frequency that is a multiple of 10, but suppose that 1,230 kc was the one to be measured. Do as before, getting about half way between 1,200 and 1,250 kc, for the approximate setting, then as the low frequency will be 1,230/2, or 615 kc, simply set the generator dial to indicate the half-way position between 610 and 620. This half-way position always can be accurately established by visual interpretation, especially as the escutcheon pointers are sharp and the distance between pointer and scale small.

Thus the entire broadcast band can be taken care of in steps of 10 kc. The calibration is directly in 10 kc steps from 540 to 1,100 kc, with wide separation. From 1,100 to 1,600 kc would it be necessary to use second harmonics for four-fifths of the frequencies 10 kc apart in this span, or 555 kc to 800 kc, where the bars are widely spaced, in a relative sense. The illustration does not show the 10 kc bars from beyond 1,000 kc, but they have since been included to 1,100 kc.

The Higher Frequencies

1,400-5,000 kc. The intermediate short-wave band may be used directly for covering the frequencies ten time those of the intermediate low-frequency level, that is, 1,400 to 5,000 kc. This will be a sufficiently satisfactory use and method, and also the frequencies in this span may be used for their harmonics, to measure up to 20 mgc anyway, and even higher. How much higher depends on the sensitivity of the receiver, rather than on the generator, since the harmonics are strong, and of course are enhanced by the amplifier stage. The generator has a 34 r-f oscillator, a 30 amplifier and a neon tube modulator, hence is a three-tube device.

The scales are legible in the usual way, except that for the 140-500 kc band, toward the high-frequency end, be careful to note that the frequencies represented by numbers may have the numbers a bit removed from the bars to which they pertain, but there is a little hook on the end of the bar, leading to the number pertaining to that bar, so notice the hooks and avoid any confusion.

Second Harmonics

For measurements, using harmonics, the second harmonics will take care of 2,800 to 10,000 kc, but as the fundamentals of the band covered up to 5,000 kc, the second harmonics need be used only for from 5,000 to 10,000 kc, in 100 kc steps. The numbers read on the 140-500 kc scale are multiplied by 20. If closer reading is necessary, find the approximately correct position by the second-harmonic method, and use the third harmonic of lower frequencies. For instance: the frequency to be measured is 5,310 kc. Dividing by 20 would require estimating between 265 and 270 on the scale, for 265.5. So instead of 5,310/20, or 265.5 try 5,310/3, after setting the approximate frequency on the second harmonic. The lower frequency is 1,770, read as 177. This can be read closely, half way between 176 and 178. The reading is multiplied by 30 for the third-harmonic use in conjunction with the 140-500 kc scale.

The detailed methods of use of harmonics sometimes do not make the most interesting reading, nevertheless are very important and should be consulted in the September 22nd and 29th and the October 6th and 13th issues of RADIO WORLD. Use of the systems therein outlined, and preferably use of the systems identified as the most accurate, will enable measurements of a very high order of accuracy. And since the broadcast band is very, very accurately calibrated, all harmonic uses may be referred to that band, and still extension to 20 mgc is very simple.

For use of the wavelength scale to find the wavelength of a measured frequency, select some frequency on the 83-99.9 kc scale that divides easily into the frequency in mind, remember the factor, note the wavelength of the low frequency, and divide this wavelength by the factor.

Check-up of low frequencies of the generator can be made by using generator harmonics to beat with station frequencies. Take the local stations and divide their frequencies by 2, 3, 4, etc., up to 20. This is done on the accompanying table for some metropolitan New York stations. Harmonic orders are under H.

H									
1	570	660	710	760	810	860	940	1180	1250
2	285	330	355	380	405	430	470	590	625
3	190	220	236.666	255	270	286.666	313.333	393.333	416.666
4	142.5	165	177.5	190	202.5	215	235	295	312.5
5	114	132	142	152	162	172	188	236	250
6	95	110	118.333	126.666	135	143.333	156.666	196.666	208.333
7	81.428	94.286	101.428	108.571	115.714	122.857	134.286	168.555	178.555
8	71.25	82.5	88.75	95	101.25	107.5	117.5	147.5	156.25
9	63.333	73.333	78.888	84.444	90	95.555	104.444	131.111	138.88
10	57	66	71	76	81	86	94	118	125
11	51.818	60	64.545	69.091	73.636	78.182	85.455	107.273	113.635
12	47.5	55	59.167	63.333	67.5	71.667	78.333	98.333	104.167
13	43.869	50.7 9	54.615	58.462	62.308	66.154	72.308	90.762	96.154
14	42.142	47.142	50.714	54.286	57.857	61.428	67.143	84.278	89.278
15	38	44	47.333	50.667	54	57.333	62.667	78.667	83.333
16	35.625	41.25	44.375	47.5	50.63	53.75	58.75	73.75	78.75
17	33.529	38.823	41.765	44.706	47.647	50.588	55.294	69.412	73.529
18	31.667	36.667	39.444	42.222	45	47.778	52.222	65.556	69.44
19	30	34.736	37.368	40	42.632	45.263	49.474	62.105	65.789
20	28.5	33	35.5	38	40.5	43	47	59	62.5

Literature Wanted

Readers desiring radio literature from manufacturers and jobbers should send a request for publication of their name and address. Address Literature Editor,* RADIO WORLD, *145 West 45th Street, New York, N. Y.

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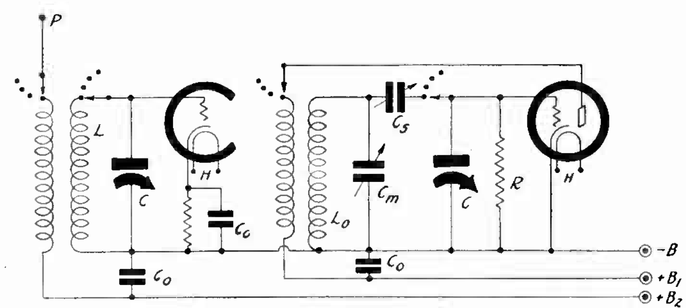
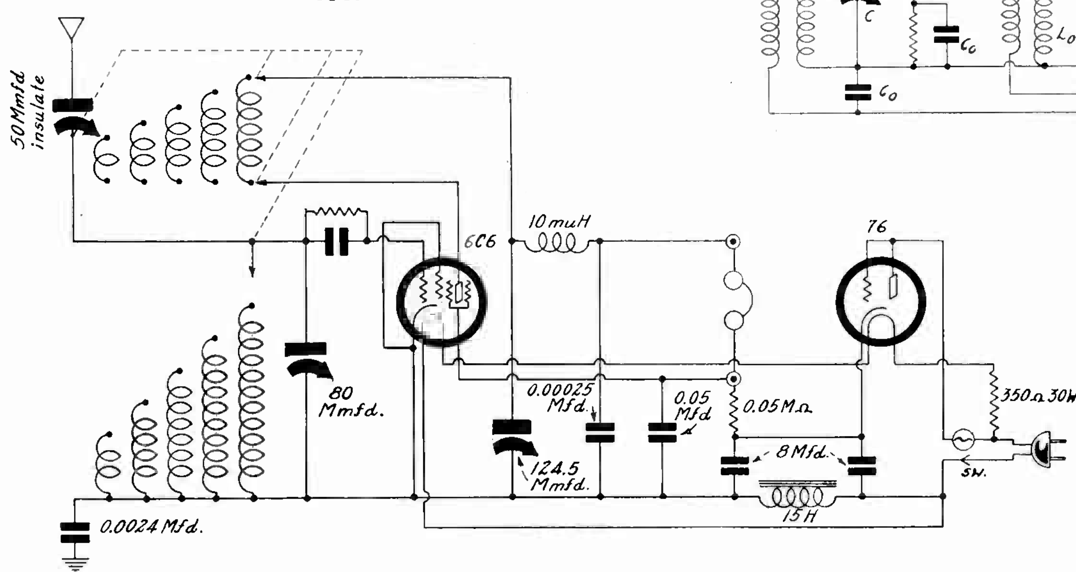
SWITCHING FEEDBACK SETS

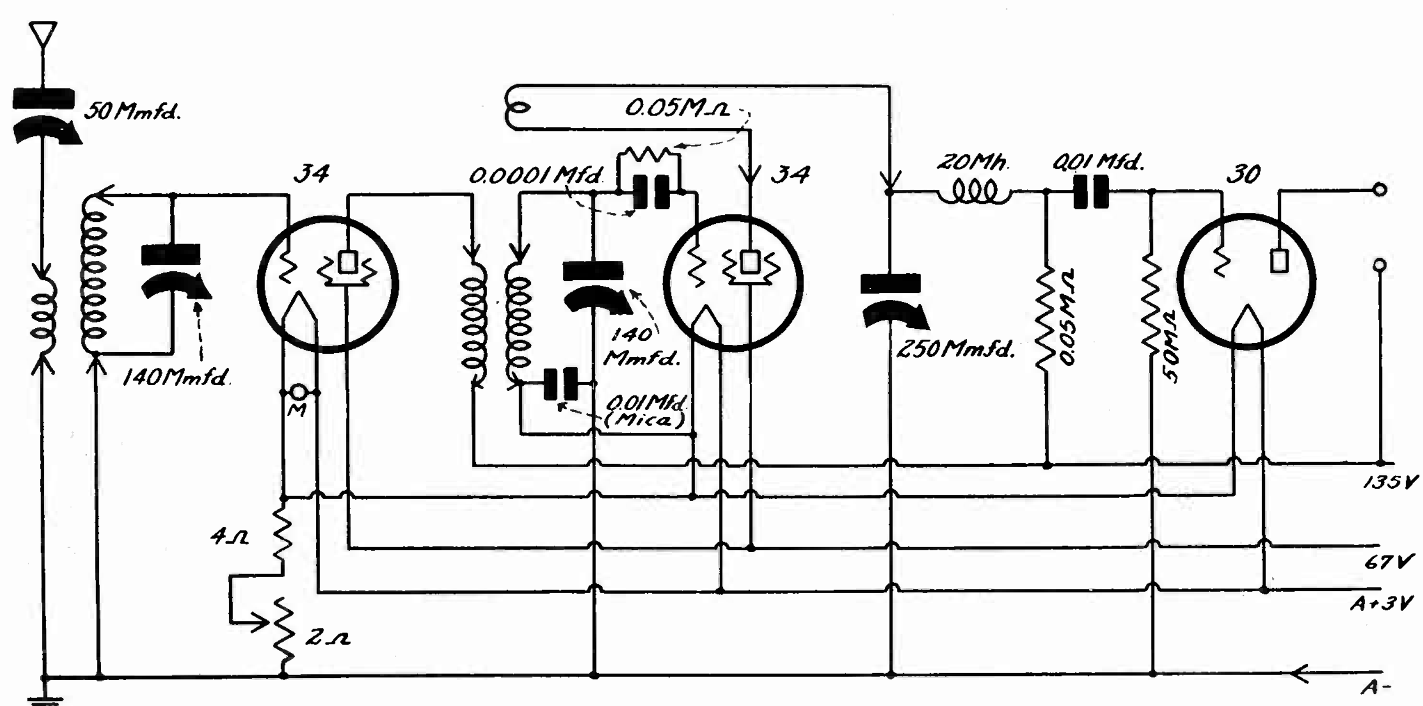
Style Used in Supers Now Being Adopted for Regenerators

The two-stage regenerative short-wave tuner is appearing commercially with switch selection of wave bands. The general method used is the one illustrated at right, which however depicts a super's mixer. Where frequency calibration appears on the dial an antenna primary is used and of course that is switched, too.





Both terminals of the tickler coil are "hot," as in the diagram at left. This condition is true always in regenerative sets. Therefore both terminals of the tickler are switched. Thus the condition existing for an oscillator of a superheterodyne (directly above) is different.



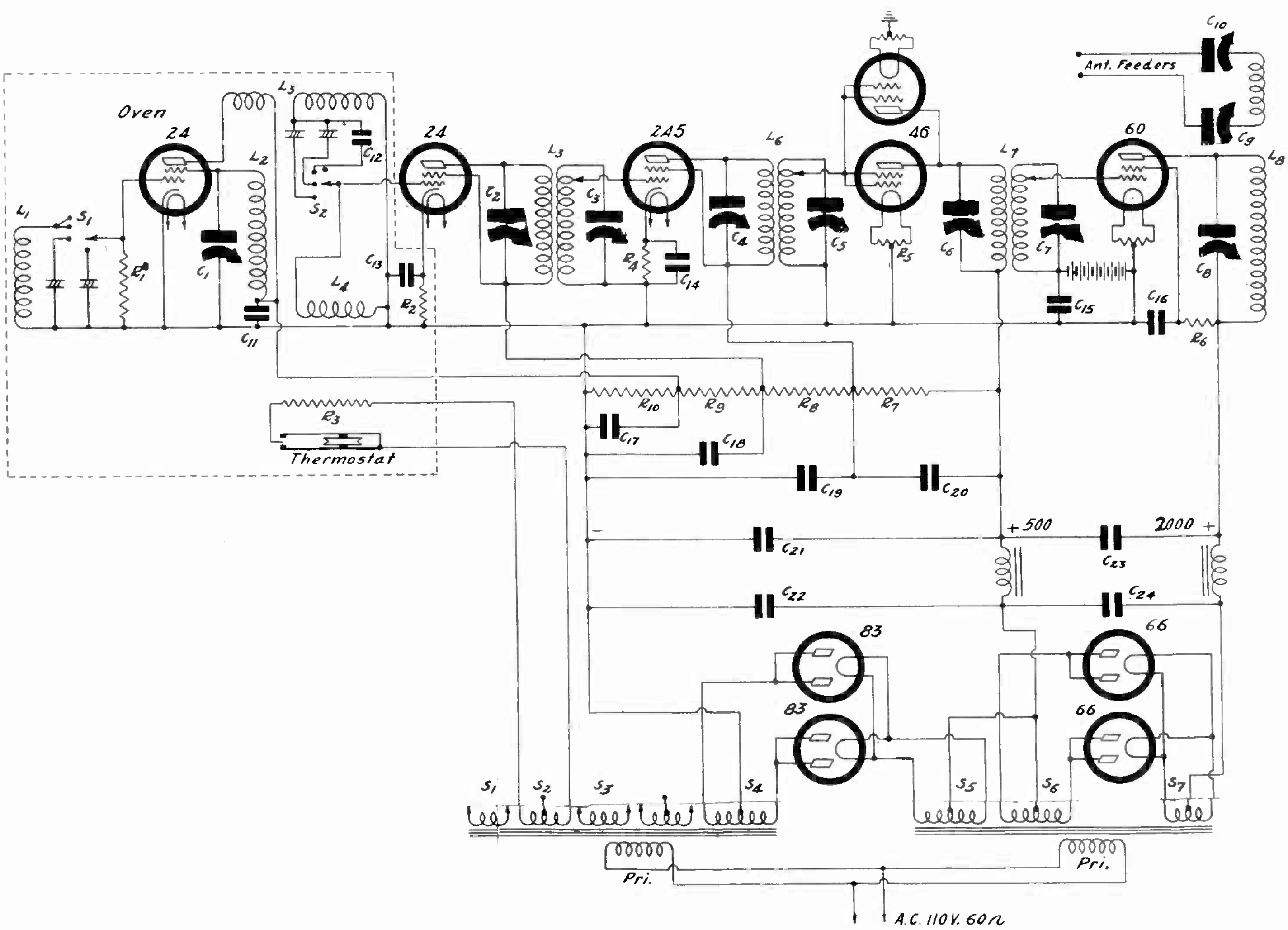
A stage of tuned radio-frequency amplification is almost always included in the switch-type regenerative receivers that are now beginning to appear on the market. The models are obtainable in kit form and also wired. The diagram above is a rather unusual one in that the low-potential terminals are subjected to switching, also. This is not deemed necessary, but simply a meticulous precaution. This circuit is for battery operation, while the one second from top is of the universal type, 90-120 volts, a. c., of any commercial frequency, or line d. c. The 30 tube in the battery model is the audio-frequency amplifier. The two circuits are for earphone operation.

An Up-to-Date Transmitter

Crystal Control and Temperature Oven Included

By Russell De Jonge
W8DIB, Zeeland, Mich.

HAMS FLOCK TO THIS STANDARD SENDING CIRCUIT



A 10-tube transmitter for amateur use. This one the author works in the 80-meter band.

SO a radio transmitter will have enough power consistently to penetrate the overcrowded amateur bands it must have a good power supply. Generally the power is derived from an alternating source.

In the event that you are not familiar with the purpose and the function of the power supply I will give a detailed description of the happenings in the entire unit. The circuit used in this unit is universally used in radio power supplies. The constituents, however, are heavy-duty parts. A power transformer with good regulation, which of course means a transformer which has a very low resistance primary and secondary windings, is used. The filter reactors should have a high inductance and a low d-c resistance. The filter capacitators should be the high-voltage type and of large capacity. A low resistance voltage divider should be connected across the output of the 500-volt power supply so various voltages may be taken off for the different stages of the transmitter.

Voltages Identified

Now as to the actual function of each individual part. The line voltage, which in this case is 110 volts at 60 cycles, is supplied to the primaries of two power transformers, whose secondary voltages are as follows:

Secondary 1	....	2.5 volts
Secondary 2	....	5 volts
Secondary 3	....	10 volts
Secondary 4	(center-tapped) .	1,100 volts
Secondary 5	....	5 volts
Secondary 6	(center-tapped) .	3,000 volts
Secondary 6	....	2.5 volts

When the diagram which accompanies this article is followed, a fuller conception of the functions of the unit is realized. When the filaments of the rectifier tubes are supplied with a filament voltage they become hot and emit electrons. When the rectifier filaments are heated they allow currents to pass only in one direction from the cathode to the plate—when—and only when—the plate is at a positive potential in respect to the filament. This in other and more familiar words is called rectification. When the alternating high voltage of 1,500 volts is applied to the plates as shown in the diagram a process of full-wave rectification takes place, the result being a pulsating direct current of nearly 1,500 volts. Since 500 volts are applied across the first voltage divider by a similar process the resultant voltage is 2,000 volts.

The pulsating direct voltage is applied to the filter circuit, consisting of a filter reactor and two condensers. The alternating current component or ripple meets great opposition in passing through the reactor. Since the condenser readily passes the ripple it is inserted at this point to conduct ripple to the negative or ground potential. The final condenser is used to smooth out any trace of a ripple that might be present. When a resistor is placed across the power output various voltages may be taken off according to the current used and the resistance between the positive potential and the tap.

Frequency Selection

The circuit, as can readily be seen from the diagram, is the combination of the electron-coupled, tuned-plate, fixed-grid circuit, or conventional crystal-controlled oscillator. When the selector switch, S1, is at positions 1 or 2 the unit functions as a tuned-plate, fixed-grid oscillator, while at positions 3 and 4 it works as a crystal-controlled oscillator.

In the first two points of selection the signal frequency is determined by the values of the tuning coil and condenser. When Crystal No. 1 is chosen the frequency generated is 3,885 kc plus or minus 50 cycles, and when Crystal No. 2 is chosen the frequency is 3,915 kc, plus or minus 50 cycles, depending upon the temperature of crystal which is kept constant at 100 degrees Fahrenheit to a half a degree Fahrenheit plus or minus.

The radio-frequency energy is taken from the plate circuit of the type 24 electron-coupled oscillator by an untuned primary of a transformer whose secondary is tuned to the frequency of the oscillator Since the tuned secondary is anti-resonant and the crystal is resonant at a frequency depending upon its thickness, and the temperature, radio frequency passes readily on to the grid of the type 24 amplifier tube. This and succeeding amplifiers may be operated as either linear amplifiers, buffer amplifiers, or frequency doublers, depending on the class (A, B or C) of amplification desired and the frequency of the emitted signal.

The Tube Circuits

The type 24 tube in the first stage is operated as Class B at the frequency of the generated signal. This tube being operated as Class B is also operated in a linear manner, because of the anti-resonant circuit in the plate lead. Automatic bias is supplied to the tube by a potential equal to the voltage drop in the cathode resistor.

To get the greatest gain from an amplifier the secondary of the transformer as well as the primary should be tuned to the frequency of the signal which in this case is in the 80-meter amateur band. The grid of the next tube, which is a type 2A5, is connected to a clip which may be attached to various turns on the secondary, according to the voltage desired across the grid, or should I say according to the grid excitation desired. The cathode voltage or grid bias on this tube is also obtained by automatic potential difference across the resistance in the cathode circuit. The primary of a transformer, whose turns are made of one-fourth inch copper tubing, is inserted in the plate circuit of the 2A5. The primary and secondary are alike tuned to the signal.

Two type 46 tubes are connected in parallel in the next stage. The grids are all connected together and the lead from them is connected to a clip which may be connected to the coil, the excitation applied to the grids varying according to the number of turns between the clip and ground.

Safeguard Against Arcing

When the type 46 tubes are operated in the manner indicated they need no grid bias. The two plates are connected together and the primary of another transformer, also made of copper tubing, is inserted in the circuit. The primary and secondary are tuned with double-spaced high-voltage condensers that will not arc over at the peak voltage which is enormous at this point of amplification.

A type 60 tube is used in the final radio-frequency stage. The 60 was selected because of its high efficiency and the fact that it needs no neutralization. The voltage amplification of this tube is 200. Since the efficiency is so high this amplification is really using the voltages specified. The control grid of the 60 type tube is connected to a clip which may be adjusted as in the preceding stages to vary the grid excitation.

The grid bias is supplied by a set of batteries. The voltage can be varied from 200 to 300 volts, depending upon the excitation applied to the grid. The plate is supplied with a potential of 2,000 volts positive, through the primary of the output transformer whose secondary is a part of the antenna system. The screen grid is supplied with 1,500 volts positive.

The Voltage-Fed Zepp

The last, but by no means least, is the radiating system. The antenna for which this transmitter was designed is called the voltage-fed zeppelin antenna. With proper tuning of the antenna condensers, provided that the length of the antenna feeders and the aerial proper is correct, this apparatus will penetrate consistently in the congested amateur bands. When this system is tuned to the emitted signal, only the "flat top" radiates the radio wave. If, however, it is detuned, the whole system—feeders and "flat top"—radiate, but total radiated power does not equal that of the aerial alone. Therefore, great care should be taken in designing, construction and installing a radiating antenna.

The unique performance of this transmitter is due primarily to the crystal filter and oscillator located in the crystal oven, which must be maintained at a temperature of 100 degrees Fahrenheit, plus or minus one-half degree. When the crystal filter is not overloaded due to a ripple in the generated signal, or adversely affected as when being coupled to a frequency other than the resonant frequency of the crystal, its resonant frequency is dependent upon the temperature of the oven. When a crystal is kept at such a constant temperature the frequency deviation in the amateur band is 50 cycles plus or minus the pre-determined frequency.

This transmitter emits a pure sine wave, and only with such a wave can real radiophone transmission be accomplished in these days, when the bands are so crowded.

The values of resistors follow:

R1=50,000 ohms; R2=275; R3=heating element; R4=200; R5=20 ohms center-tapped; R6=10,000; R=7,000; R8=4,000; R9=4,000; R10=10,000.

The values of the condensers are in mfd.:

C1=.00035; C2=.00035; C3=.00015; C4=.00015; C5=.00015; C6=.00035; C7=.00015; C8=.00025; C9=.00035; C10=.00035; C11=.002; C12=.0001; C13=.002; C14=.002; C15=.002; C16=.001 at 2,000 volts; C17=2; C18=2; C19=2; C20=2; C21=8; C22=8; C23=4 at 2,000 volts; C24=2 at 2,000 volts.

The inductance values in turns and size of wire as well as the coil diameters are given below:

Coil No. 1, 65 turns No. 24 wire; one-inch diameter.

Coil No. 2, 55 turns No. 24 wire; two-inch diameter.

Coil No. 3, primary, 12 turns; secondary, 55 turns, both No. 24 wire.

Coil No. 4, 65 turns No. 24 wire; two-inch diameter.

Coil No. 5, primary, 8 turns; secondary, 16 turns, No. 10 wire, 3-inch diameter.

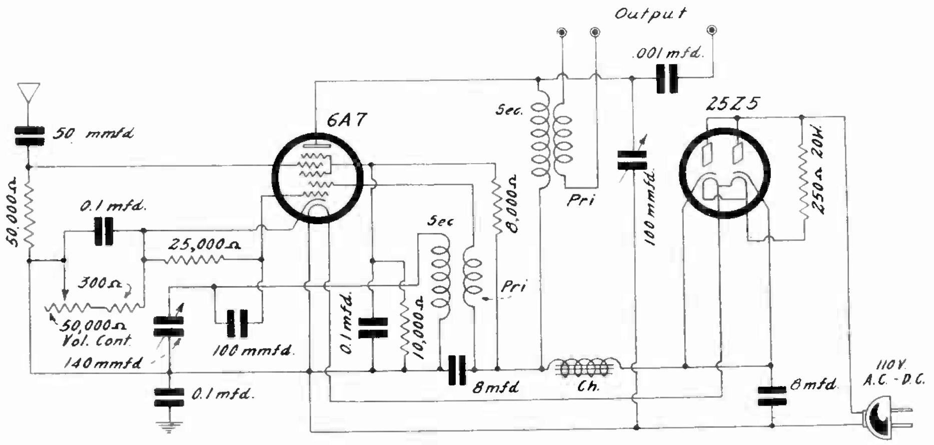
Coil No. 6, primary, 8 turns; secondary, 16 turns copper tubing, 3-inch diameter.

Coil No. 7, primary, 8 turns; secondary, 16 turns copper tubing, 3-inch diameter.

Coil No. 8, primary, 16 turns; secondary, 8 turns copper tubing, 3-inch diameter.

[Amateurs, present or prospective, may address questions to Amateur Editor, RADIO WORLD, *145 West 45th Street, New York, N. Y.]*

Converter Optional Output Connection



A novel coil s coil switch arrangement is used in this short-wave converter. The coils are retained in sockets on a moulded rack and the rack is rotated from the front panel, so that spring contacts engage the coil terminals. And the coils are really plug-in coils at that

In a short-wave converter that it has developed, Try-Mo Radio Co., Inc., of 85 Cortlandt Street, N. Y. City, offers optional output connection. It has been found that in this way the connection may be used that better suits the receiver with which the converter is worked. Some receivers have high-impedance input, others low-impedance input. The selection afforded by the converter enables working either way.

No matter which connection is used of course there will be results. However, the user will make the test for himself. Particularly may he tune in a station that ordinarily comes in rather weak, because the time of day or night is unfavorable to the frequency of transmission, and then he can well compare results. Whenever possible, comparisons of this nature should be made on the basis of small input.

Two-Tube Model

The converter uses two tubes, one the 6A7 penatrid tube for the mixer, the other the 25Z5 for the rectifier. The output referred to above may be taken from the primary of the radio-frequency transformer that has secondary in the plate circuit, or from the series 0.001 mfd. condenser. It has been found, in general, that results are more selective when the connection is made to the primary at "Output." And so one may perhaps switch from one connection to the other, depending on whether greater intensity or greater selectivity is the demand or need of the moment.

The input from anntenna to the 6A7 control grid is untuned. A series condenser offers another choice. The value is shown as 50 mmfd. and this is suitable if the receiver is sensitive. However, if one has a receiver that is rather lacking in this respect, the condenser may be made larger, and also the antenna may be lengthened besides. In fact, for a receiver very poor in its sensitivity, the series condenser could be as large as you have in mica, and the antenna as long as practical.

Novel Switch Arrangement

There are other factors that have to be considered, and the gain in strength is not without sacrifice of selectivity, yet if a receiver is very insensitive and results are desired, the long antenna is the way out.

Instead of using plug-in coils, this converter has a switch arrangement. In point of fact the coils are of the plug-in type, but they are plugged in only once, the receptacle being a moulded four-container device that is rotatable. Spring switches make the contacts as each coil is moved into position.

Another feature of the converter is the fact that an airplane type dial is used. The converter was designed for use on t-r-f sets and supers, and is the work of Herman Cosman, of the Try-Mo engineering staff.

I.F. Lowered for More Gain, Less Noise

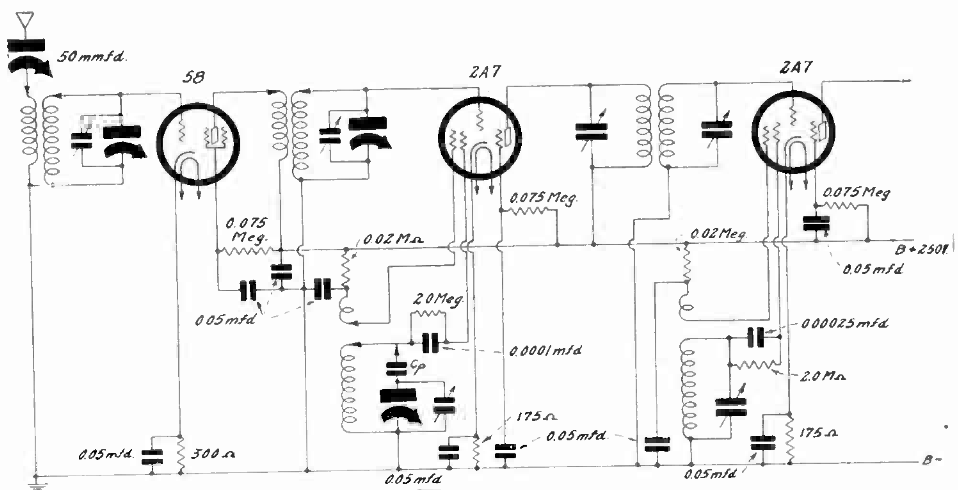
Many engineers have thought about methods of getting more gain in receivers and yet not increasing the noise. The problem arises particularly because of the popularity of short-wave reception. Not too much is said in advertising matter about what happens to the gain on short waves, say, frequencies above 10 mgc., but you can use your imagination.

If something could be done to pep up the set the results at even 20 mgc would be much better than they are, provided of course the noise were not heightened as much as the signal. How to get the gain and not the gainful loss is the problem.

Lowering the Frequency

Some engineers have been trying out the method of changing the intermediate frequency. It is desirable to have the i.f. high, not because selectivity or sensitivity is improved thereby, for neither is, but because then image suppression is a bit easier to accomplish. Some frequency between 456 and 480 kc would be used.

Now, one stage of this sort of thing would serve the purpose of giving one a bat with which to hit image interference. And then the frequency could be lowered, say, to 50 kc, if you like, and then amplification carried on in great style, practically noiselessly. The erratic omission of electrons, that causes much of the internal noise, has little such effect at frequencies of 100 kc and lower.



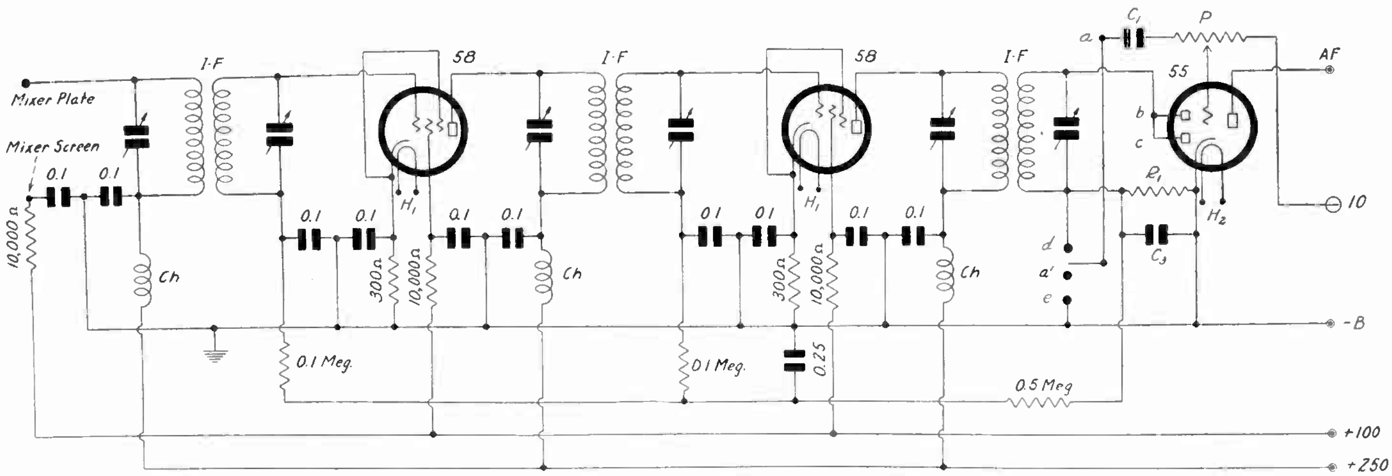
Method of lowering the intermediate frequency so that greater amplification can be carried on at less noise

The circuit diagram herewith shows how the frequency can be lowered, using a pentgrid converter tube in the first i-f stage, the fixed frequency oscillator in the triode section being at a frequency higher than the original i.f. by the amount of the new i.f. That is, for 465 kc originally, 50 kc now, the oscillation is at 515 kc.

Of course, the superheterodyne started life as a low-i-f amplifier device. The frequencies were as low as 30 kc. The transformers had so much wire on them that the wire companies made money, an unusual fact in the wire business.

Then the frequencies were increased to around 90 kc, then to 120 kc, and so on, until now some folk are talking about having "intermediate" frequencies that are really supersonic. Some readers may remember the Metaformer circuit described in RADIO WORLD in 1924. This had a supersonic frequency (higher fixed frequency of amplification than the highest frequency tuned in by the tuner). A couple of years later the infradyne came along, using the same method.

Radio University



Circuit for an intermediate-frequency amplifier. The grid biasing resistors of 300 ohms are shown bypassed by 0.1 mfd., the same as other parts of the circuit, but if there is any trouble from i-f oscillation, increase these capacities until the trouble disappears. Usually 2.0 mfd. will prove satisfactory without further trial.

Capacity per Twisted Inch

WHERE A SMALL trimming capacity is required, as across a tuned circuit, you have shown a method of twisting insulated stranded wire equivalent to No. 18 sold, using about 6 inches of length, measured for each of two pieces when not twisted, and then making twisted pair of them until the desired capacity is achieved. Can you, however, give some approximation of what the capacity is per length, twisted or untwisted, on the basis of any measurement you have made?—P. O.

Yes. If the twisting is as tight as possible, and extends straight out, the wire not being bent back on itself after twisting, the capacity is approximately 3 mmfd. per inch, for the twisted result. The measurement was made on a capacity bridge.

* * *

Vagaries of Neon Lamp

CAN YOU OFFER any suggestions for curing the following trouble: I am using a neon lamp, as directed, for audio oscillation in a test oscillator. However, I have extended the range to three bands, instead of one, and the lamp continues to modulate on the original band, but on the other bands it modulates over part of the tuning and not over the rest. I can not see that the tuning should have anything to do with an independent audio circuit, despite the coupling which is not supposed to affect voltage on the lamp, or presence of audio oscillation.—K.C.S.

Certainly the radio-frequency oscillator can have an effect on the lamp. Two factors that will stop the neon tube from oscillating at audio frequencies are that the voltage is too high or that it is too low. If it is too low the lamp will not strike. Any condition consistent with audio oscillation requires that the lamp light dimly. If the voltage is too high the equivalent resistance for the purposes of studio oscillation becomes comparatively too low. One condition that increases the lamp illumination is that the radio-frequency volts in that element of r-f tube to which audio coupling is made contributes r.f. that adds to the d.c. voltage. This is particularly true if the condenser used for audio oscillation purposes is across the resistor, instead of across the lamp. If the condenser is across the resistor, then for radio frequency purposes the resistor is practically absent, hence the voltage on the lamp is too high. This might be true over only part of the tuning, say, one in the higher frequencies of any band, where the oscillation intensity naturally is greater. A suggested remedy is to insert a series limiting resistor that is small compared to the limiting resistor used for audio purposes in connection with the lamp, but large in comparison to the radio-frequency current. Hence, if the main limiting resistor is 4.0 meg., the extra one may be .01 meg. to 0.25 meg. Another remedy, although it reduces the amplitude of the audio oscillation, is to put the condenser across the lamp instead of across the resistor, because then the bypassing effect that the condenser has when across the lamp removes practically all the radio-frequency current from the lamp circuit, which is consistent with keeping the lamp maintenance current at a steady value.

* * *

Separate I-F Channel

CAN NOT the intermediate amplifier of a superheterodyne be built separately, and then included in the receiver? I should think this would be preferable for an experimenter, as it has been known to happen that he changes his circuit completely from time to time, and of course always could use the same i-f channel. —J. K.

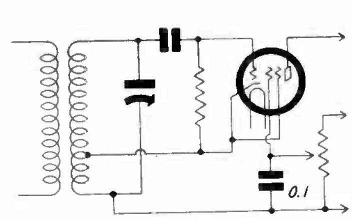
Yes, this can be done, of course, and there are even a few built-up intermediate channels on the market. The diagram herewith shows a circuit that may be followed. In the event of i-f oscillation, increase the capacity of the bypass condensers across the biasing resistors.

* * *

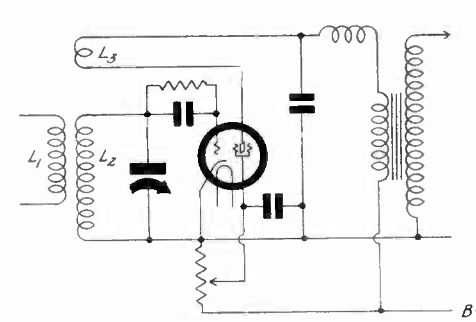
Hartley and Regeneration

IF THE HARTLEY is such a good oscillator, why is it never shown in a regenerative hookup? Is the oscillation too hard to control? What oscillator, if any, is better for regenerative purposes? —W. C. S.

The Hartley is indeed hard to control. As you know, it is a ready and violent oscillator. Therefore trying to control it often results in a plop, rather than the smooth and gradual change required for nice regenerative action. The tuned-grid type oscillator will be found preferable to the Hartley for this purpose. Practically all the other type oscillators are good for regenerative purposes, also. See the Hartley and tuned-grid oscillator diagrams on this page.

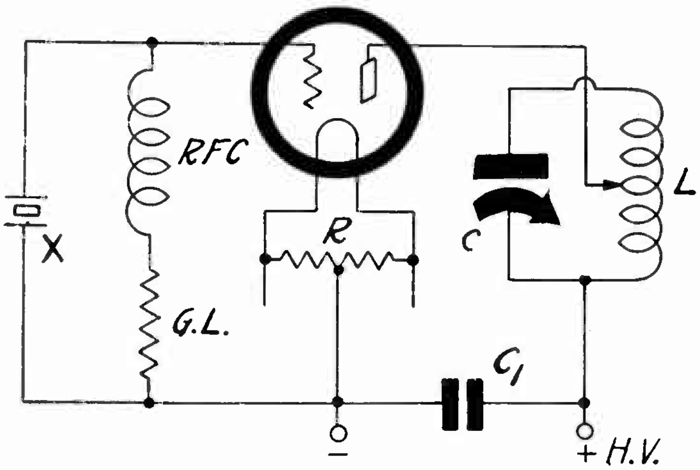


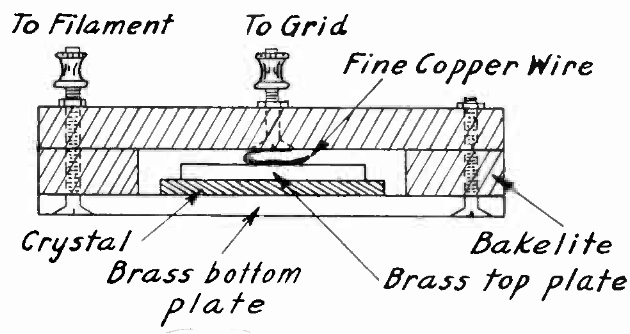
The Hartley oscillator does not lend itself so well to regenerative control, because the circuit tends to oscillate violently anyway, and if toned down may be too near the point of non-oscillation. Hence a control does not prove smooth.



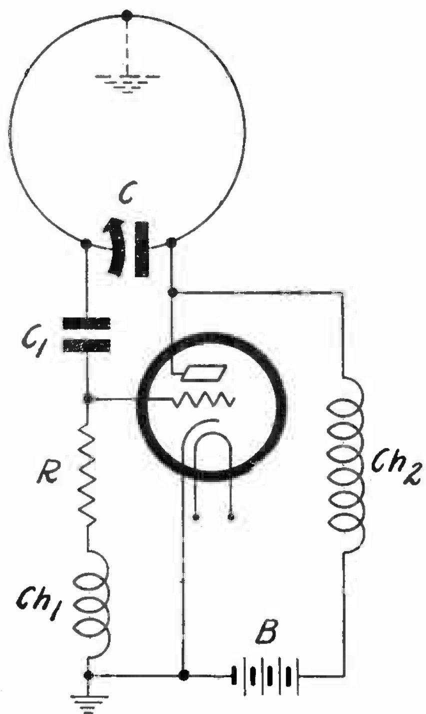
The tuned-grid oscillator is much more satisfactory for regenerative purposes than the Hartley.

Crystal Control for Ultra Frequencies? Who Wants to Do Grinding?



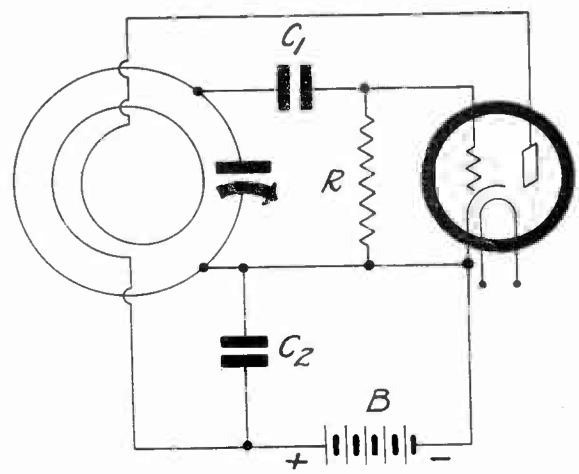


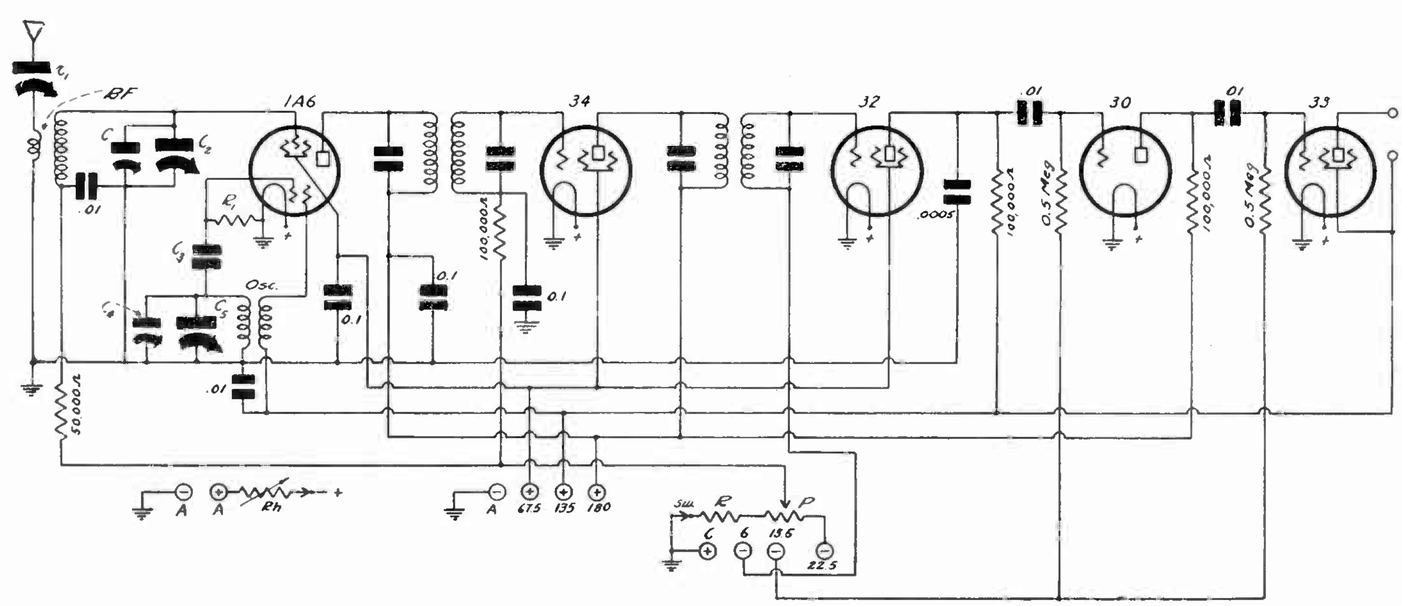
Above at left is a circuit with crystal inserted. At right the crystal mounting and connection detail, applicable to lower frequencies than the ultras, of course.. Below, at left and right, are conventional oscillator circuits for high frequencies, variable, of course, but conceivably tuned a bit off crystal resonance to excite the crystal, if any



How about trying crystals for very, very ultra frequencies? There is trouble enough grinding them at present for the medium amateur bands. If a particular frequency is desired, the quartz must be positively perfect, otherwise the slightest extra bit off the crystal increases the frequency disproportionately, perhaps skipping the very frequency wanted. And what about the capacity of the holder—its effect on the circuit? Stirring days are ahead for those who want to be crystal folk in the region below 5 meters, though this is not denying that some experimenters have gone very high in getting crystals to work.

The two oscillator circuits beside this type would fit the 955, the new "acorn" tube. Above is shown how the crystal MIGHT be used. Might not, others would say. At the left and right conventional circuits are barren of any brazen attempt to insert the crystal, knowing what the frequencies are intended to be.





The general idea of a superheterodyne is conveyed by this circuit. The super has been used for ultra frequencies. The intermediate frequency would scarcely have double-tuned circuits, primary and secondary, as the i.f would be around 50 mgc.

Station Sparks *By Alice Remsen*

IN THE 1934 MANNER

YOU WILL HEAR AN ARTIST over one certain network for a short time and then—presto! another network claims him! Peggy Keenan and Sandra Phillips are the latest examples of this shifting. Peggy and Sandra were for several seasons featured over the Columbia network; now word has come that they have signed with NBC Artists Service, and these two clever girls will soon be heard with their two pianos and their own orchestra, over NBC air-waves. They won this contract in a very novel manner; they didn't give a personal audition; they didn't make a recording of their work; oh, no; none of these old-fashioned methods for Peggy and Sandra; they just went and had a sound film made of themselves and orchestra, displayed it to NBC executives and got their contract. Good for you, gals! That's what I call initiative.! . . .

MAYBE THEY LIKE IT

Another artist, this time a very young one, has moved over to Radio City—little Sugar Cane, a child singer formerly heard over WABC on the Horn & Hardart Children's Hour, is now heard on WJZ each Sunday at 12:15 under the sponsorship of Julius Grossman Shoes. This eleven-year-old child shows a marvelous sophistication in her singing, but has the usual fault of over-coaching, and a "coon-shouting" style. . . . The Lombardo band is on the air over NBC networks from the Waldorf-Astoria Starlight Roof, every Monday at midnight; WEAF and network ....Another new program features Al Goodman and his orchestra, and Dwight Fiske, noted entertainer from smart New York night clubs, as Master of Ceremonies, opened on an NBC-WJZ network October 12th. Guest artists will be used each week. Jane Froman and Earl Oxford were on the opening program. Each Friday, at 8:30 p.m. under the sponsorship of the Emerson Drug Company. . . . Grace Albert, of "The Honeymooners," was rushed to a hospital last week for an emergency appendectomy operation; Eddie, her partner, carried on just the same, and Grace listened in to his broadcasts from her bed in the hospital. She says Eddie sounds pretty good over the air. . . . Featuring Alexander Thiede and his Gems of Melody orchestra, Eva Gingras' Melodic Tone Chorus and the Parisian Shadow Singer, a new series of Gems of Melody broadcasts will be inaugurated over an NBC-WJZ network on Thursday, October 18th, at 7:15 p.m. Presenting light classical and popular music from Brahms to Berlin, the Gems of Melody will be on the air for half an hour each Thursday, from the studios of NBC associate station WBZ in Boston, under the sponsorship of the makers of Father John's Medicine. Dwight Meade, veteran actor will act as commentator for the series. . . .

HECKLING AN ART OR SCIENCE?

Phil Baker is back from a five-weeks vacation in Italy, and Beetle, his chief heckler and haunter, is too delighted for words. Heckling fell to a new low during Baker's absence, because Floyd Gibbons, the 217-word-a-minute spieler, was being featured on the Armour program, and Beetle, try as he would, failed to get a word in edgewise. Phil, it has been reliably reported, returned because he heard a voice calling—no doubt the voice of Beetle—hoarse with longing for somebody to heckle; anyhow the said heckling and haunting will continue as usual each Friday night at 9:30 p.m. over an NBC-WJZ network—emanating for the first six weeks from Radio City, New York, and then returning to Chicago where the program originated. . . . If you like really fine music then you will bless the General Motors Corporation for sponsoring a series of symphony concerts, each Sunday evening at 8:00 p.m. over an NBC-WJZ network. In addition to a guest conductor, each program will feature a vocal or instrumental soloist of great renown. . . . And now it appears that Europe is simply wild about "St. Louis Blues" with "Ol' Black Joe" running a close second, according to Mrs. Katherine H. Talbott, who is traveling with the Westminister Choir, famous American singing group now touring Russia. The choir is always made to repeat those two numbers over and over again. . . . Oh, oh, ye contract bridge players! If you desire to polish up on your game, listen in to E. Hall Downes, the expert, and he'll acquaint you with the new bids and conventions in contract. Mr. Downes is a noted teacher, player and author of several books on bridge. You may hear him each Monday at 11:30 a.m. on the WABC-Columbia network. . . . The "Family Theatre" with Buddy Rogers and Jeannie Lang, has moved its location from the Medinah Athletic Club in Chicago, to the Locust Theatre in Philadelphia. Its time is also changed from 9:00 p.m. to 7:30 p.m. each Sunday, WABC and network. The trek East was occasioned by Buddy Rogers' engagement to appear with his orchestra at the International Cafe in Philadelphia where they will remain for several weeks.

AS OTHERS SEE US

We are to hear the impressions of a visiting Britisher as he makes a tour of this country from the Pacific Coast to New York. Commander Stephen King-Hall, commentator of the British Broadcasting Corporation, will give a series of informal fifteen-minute talks entitled "A Visitor Looks at America" each Sunday at 12:45 over WABC and the Columbia network. His talks will emanate from San Francisco, Chicago, Detroit, Washington and New York. It will be interesting to hear his viewpoint, for the Commander will probably see a great deal that we do not—being fresh and open-minded, as it were; onlookers can always see more of the game than the players. . . . Dick Messner's Orchestra, including Dick's four brothers, is heard twice a week over the WABC-Columbia network from the Hotel Lexington, New York. Their dance programs are on the air each Tuesday and Thursday at 4:30 p.m. The present series inaugurated the eleventh year of broadcasting by the five Messner brothers. Not only does the orchestra feature Dick Messner as leader, and John Messner as vocal soloist, but it also presents the Messner Brothers Trio and Quartet. Some family; eh, what! . . . Kate Smith's evening show is now heard on Fridays, instead of Thursdays, as heretofore; 10:30 p.m. . . . Hills Nose Drops—of all things! —are sponsoring the Imperial Hawaiian Dance Band every Sunday at 2:30 over the WABC-CBS network. Traditional melodies and the more popular American conceptions of Hawaiian music will be played with that wistful quality of the steel guitar. . . .

THOSE C B S MINSTRELS

True to their new policy of providing daytime listeners with extra good shows, CBS is putting on an hour-long minstrel show each Monday at 9:00 a.m. There's a first part, olio and and an afterpiece, with, of course, a grand finale. There are thirty-five in the company, with Harry Von Zell as interlocutor, John Mitchell and Lou Lubin as end men and Leith Stevens as musical director. Gordon White, who conceived the show, likewise writes and directs it, with the cooperation of Max Wylie. . . . Residents of the Murray Hill section and commuters hurrying to or from Grand Central Station are pausing these days to peer through a high wire fence surrounding a plot of ground at the corner of Park Avenue and 39th St. They see an attractive looking eight-room frame dwelling under construction, and a large sign which states that it is a demonstration home being erected by the New York Committee of the Better Homes of America, in cooperation with the Columbia Broadcasting System. I have been watching it grow, as I drive past that corner three times a week. A garden is making its appearance now; two young flowering crab trees, and a sorrell tree are already firmly implanted; several mysterious looking shrubs, wrapped in burlap, are awaiting their turn to make the little spot as attractive as possible. You will hear more of this little home over the CBS network in the near future. . . . Beginning Saturday, October 20th, the Carborundum Band, conducted by Edward D'Anna, a Columbia network feature for several seasons, will begin a new series of concerts over a nationwide network of Columbia stations, under the sponsorship of the Carborundum Company of Niagara Falls, N. Y., manufacturers of abrasive materials. Each Saturday at 10:00 p.m. . . .

LIBERTY HAS ITS SAY

Fulton Oursler is back on the air again, this time conducting "The Forum of Liberty," featuring discussions of public events and issues by leaders in industry and public life, with a setting of dramatic narrative and music. Oursler is the editor of Liberty Magazine, which sponsors the program. Edwin C. Hill, noted news commentator, will deliver the narratives; songs and music contemporary to the events described will be supplied by Edward Nell, baritone, and Arnold Johnson's orchestra. Each Thursday at 8:30 p. m., commencing October 18th. WABC and network. . . . Sponsored by the Paris Medicine Company, a new series brings Pat Kennedy, the "Unmasked Tenor," and Art Kassel and his orchestra, to the air, four times weekly. Sunday, Monday, Tuesday and Thursday at 1:45 p. m. WABC and network. . . . No longer does the old-time medicine show haunt the corner lot. Its activities have been transferred to the air—and how! . . . Frank Crumit and Julia Sanderson have taken a leaf from Vallee's book, and are adding a guest artist to each of their "Tea Shop" programs, sponsored by Bond Bread. Sundays at 5:30 p. m. . . . Lavander and Old Lace has assumed a new form. Dramatic narrative is now being woven around the musical numbers; let me see—this has been done in "Castles of Romance" since last February! . . .

AND CLARENCE, TOO?!!

"Myrt and Marge" are back for the fourth consecutive season. Welcome, girls! Mondays through to Fridays, 7:00 p. m. Sponsored as before by Wrigleys. . . . And also welcome, thrice welcome to The March of Time!!! Sponsored by Time, Inc., supervised by Arthur Pryor, Jr., and musicalized by Howard Barlow. Each Friday at 9:00 p. m. . . .

STUDIO SHORTS

Michael Tibbett, infant son of the famous NBC star, and Socks, Jimmy Melton's dog, are the best of pals. The Meltons and the Tibbetts live in the same apartment house overlooking the East River and every day Socks and Mike go walking together. . . . Anne Seymour, star of the Grand Hotel broadcasts, admits that she falls for fortune tellers—and also reads palms herself. . . . Dick Powell has

(Continued on next page)

Station Sparks

By Alice Remsen

(Continued from preceding page)

discovered that he can get more style by singing softer; he found this out by listening to himself sing over a P. A. system. . . . Nino Martini is studying English. Why?—Well, he has received several offers from motion picture companies. . . . Loretta Lee, soloist with George Hall's Orchestra, will soon be heard in her own sustaining series over CBS. . . . Isham Jones mastered eight musical instruments when a boy. . . .

Frank Parker, tenor star of NBC's "Gypsies" and other programs, has signed a contract with a newly formed British Recording Company. The first song Parker will record is "Sweet of You" from the motion picture, "Trans-Atlantic Merry-Go-Round," which he has just finished making on the Coast with Jack Benny. . . . Stars may come and stars may go, but Conrad Thibault goes on forever. He has just signed a contract with the Maxwell House Show Boat to September 1935. . . . Everett Marshall has been renewed on his "Broadway Varieties" program; he is also rehearsing for his new show "Calling All Stars." . . . Roxy "ad libs" all his patter. . . . Rosa Ponselle sings in full voice when she broadcasts, and stands seven feet away from the microphone. . . . Elaine Melchior, who plays "Ardala" in the Buck Rogers series, has recovered from a mastoid operation.

DUTIFUL DADDY

I USED to be a billiard shark, and poker cost me plenty jack,
By night I'd carom all around or track the cards that left the pack;
The boy would go to sleep at six and then I'd start my night of play
But now he's older and besides he tunes short waves both night and day.

What good my knowledge of the deck or English on the yellow ball,
Or taste of aged hundred proof, of proper glasses, large or small,
Since Junior grew to youth's estate and turned to short-wave pleasure trails?
Is PDQ in Zanzibar or MNO in New South Wales?

In what meridian is Rome? How far from Troy, N. Y., to Spain?
Is Greenwich mean or civil time affected by the snow or rain?
And dial shift from four-oh-six to four-oh-eight is what per cent?
Are shortest waves reflected back or propagated quite unbent?

It used to be a life of ease, of cards and glasses, balls and cues,
But now it's quite a life of work in poring over maps and views,
And keeping programs firm in mind, to catch elusive foreign words
To mention not the roaming chirps of image-interference birds.

Last night old Moscow came in strong, and, boy, was Daventry immense!
Like locals, both, as Junior sat with ear alert and mind intense.
And like a dad who, duty-bound, brooks no disturbance of his son,
I let him listen as I tuned the foreign locals, one by one.

—H. B.

Amateurs Pass Word Locating Man Quickly

A lawyer living in Lynbrook, N. Y., wanted to talk to his son about some law case about to go to trial, the son being a lawyer, too, but traveling somewhere in the South.

So the father, Arden Rathkopf, telephoned to the local chief of police. It really wasn't a police matter, but in Lynbrook everybody knows everybody else, and the spirit of helpfulness runs high. The father admitted he wanted to talk to his son on business. He might have said it was a "professional matter," but when lawyers talk about professional matters they say "business."

The son was motoring with his wife in the South. The father had some idea of about where the son ought to be. The police chief had some one get in touch with an amateur friend of his and start the message going that Mr. R. Sr. wanted Mr. R. Jr. to phone him at once.

It was noon when the father first broached the police chief. It was 3 p.m. when the son telephoned his father and the matter that had disturbed the parent was straightened out in grand style.

Amateurs in Alabama picking up the message telephoned it to their local police station, and a policeman in Birmingham noticed the car bearing the heralded license number parked in the street, found Mr. R. Jr. and his wife inside, and delivered his message to Garcia.

Short-Wave Time Table

The sixteen stations listed at right are additional to the list of short-wave stations printed last week, issue of October 13. The list is principally intended for foreign stations, although some domestic ones are included. The letter "B" denotes entertainment programs. The time given is Eastern Standard. For CST subtract one hour, for MST subtract two hours, for PST subtract three hours.

Call	*Location*	*Meters*	*Mgc.*	*Watts*	*Schedule*
W8XK	Saxonburg. Pa. (U.S.A.)	25.27	11.870	40,000	5:15-10 a.m.; Sun., 5:15 a.m.-1 p.m.; see 6,140 K.C. (B)
RNE	Moscow, Russia	25.00	12.000	20,000	Sun., 12-1 a.m.; 7-8 a.m.; 11-12 a.m. (B)
CT1CT	Lisbon, Portugal	24.53	12.229	500	Sun., 7-9 a.m.; Thurs., 4-6 p.m. (B)
CNR	Rabat, French Morocco	23.38	12.830	12.000	7:30 a.m. (B)
HVJ	Vatican City	19.84	15.120	10 000	6-6:15 a.m.; see 5,968 K.C. (B)
GSF	Daventry, United Kingdom	19.82	15.140	15,000	1:45-5.45 p.m. daily; 11:30 a.m. to 1:30 p.m., Sun. (B)
DJB	Konigswusterhausen, Germany	19.74	15.200	5,000	1:30-3:15 a.m.; 7:45-10:45 a.m. (B)
W8XK	Saxonburg. Pa. (U.S.A.)	19.72	15.210	40,000	10 a.m.-5:15 p.m.; see 6,140 K.C. (B)
FYA	Paris, France	19.68	15.243	12,000	8-11 a.m.; see 11,710 K.C. (B)
W1XAL	Boston, Mass. (U.S.A.)	19.67	15.250	5,000	10:50 a.m.-1:30 p.m.; see 6,040 K.C. (B)
W2XE	Wayne, N. J. (U.S.A.)	19.65	15.270	5,000	11 a.m.-1 p.m.; see 6,120 K.C. (B)
W2XAD	So. Schenectady, N.Y. (U.S.A.)	19.57	15.330	25,000	3-4 p.m. (B)
W3XL	Bound Brook, N. J. (U.S.A.)	17.33	17.310	20,000	11 a.m.-5 p.m. (B)
W3XAL	Bound Brook, N. J. (U.S.A.)	16.87	17.780	35,000	Sat. to Thurs., 10 a.m.-4 p.m.; see 6,100 K.C. (B)
GSH	Daventry, United Kingdom	13.97	21.470	15.000	11 a.m. to 1 p.m. (B)
W8XK	Pittsburgh, Pa. (U.S.A.)	13.93	21.540	40.000	7 a.m.-3 p.m.; see 6,140 K.C. (B)

STATEMENT OF THE OWNERSHIP, MANAGEMENT, CIRCULATION, ETC., REQUIRED BY THE ACT OF MARCH 3, 1933,

Of Radio World, published weekly at 145 W. 45th St., New York, N. Y., for October 1, 1934.

State of New York } ss.
County of New York }

Before me, a Notary Public in and for the State and county aforesaid, personally appeared Roland B. Hennessy, who, having been duly sworn according to law, deposes and says that he is the Editor of the Radio World, and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management (and if a daily paper, the circulation), etc., of the aforesaid publication for the date shown in the above caption, required by the Act of March 3, 1933, embodied in section 537, Postal Laws and Regulations, printed on the reverse of this form, to wit:

1. That the names and addresses of the publisher, editor, managing editor and business managers are: Publisher, Hennessy Radio Publications Corp., 145 West 45th St., N. Y. C. Editor, Roland B. Hennessy, 145 West 45th St., N. Y. C. Managing Editor, Herman Bernard, 145 West 45th St., N. Y. C. Business Manager, Herman Bernard, 145 West 45th St., N. Y. C.

2. That the owner is: (If owned by a corporation, its name and address must be stated and also immediately thereunder the names and addresses of stockholders owning or holding one per cent or more of total amount of stock. If not owned by a corporation, the names and addresses of the individual owners must be given. If owned by a firm, company, or other unincorporated concern, its name and address, as well as those of each individual member, must be given.) Hennessy Radio Publications Corp., 145 West 45th St., N. Y. C. Roland Burke Hennessy, 145 West 45th St., N. Y. C. Estate of Mrs. M. J. McArthur, 9823 Lake Avenue, Cleveland, Ohio.

3. That the known bondholders, mortgagees, and other security holders owning or holding 1 per cent or more of total amount of bonds, mortgages, or other securities are: (If there are none, so state.) None.

4. That the two paragraphs next above, giving the names of the owners, stockholders, and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company, but also, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner; and this affiant has no reason to believe that any other person, association, or corporation has any interest direct or indirect in the said stock, bonds, or other securities than as so stated by him.

5. That the average number of copies of each issue of this publication sold or distributed, through the mails or otherwise, to paid subscribers, during the months preceding the date shown above is .... weekly. (This information is required from daily publications only.)

ROLAND B. HENNESSY
(Signature of Editor.)

Sworn to and subscribed before me this 1st day of October, 1934.

[Seal.] ELIZABETH ANSBACHER.
Notary Public, New York County, N. Y., No. 68. N. Y. County Register's No. 6A144. (My commission expires March 30, 1936.)

Note.—This statement must be made in duplicate and both copies delivered by the publisher to the postmaster, who shall send one copy to the Third Assistant Postmaster General (Division of Classification), Washington, D. C., and retain the other in the files of the post office. The publisher must publish a copy of this statement in the second issue printed next after its filing.

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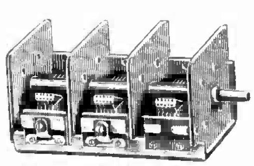

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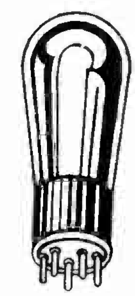

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33	53	78	89	2A3	2B7
34	59	79	1A6	2A7	6B7
					6F7

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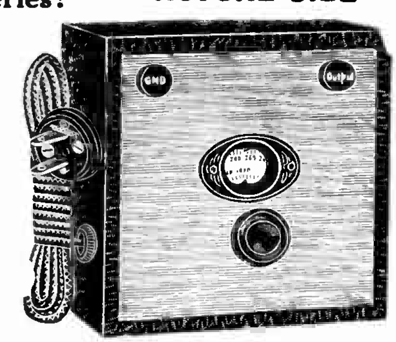

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