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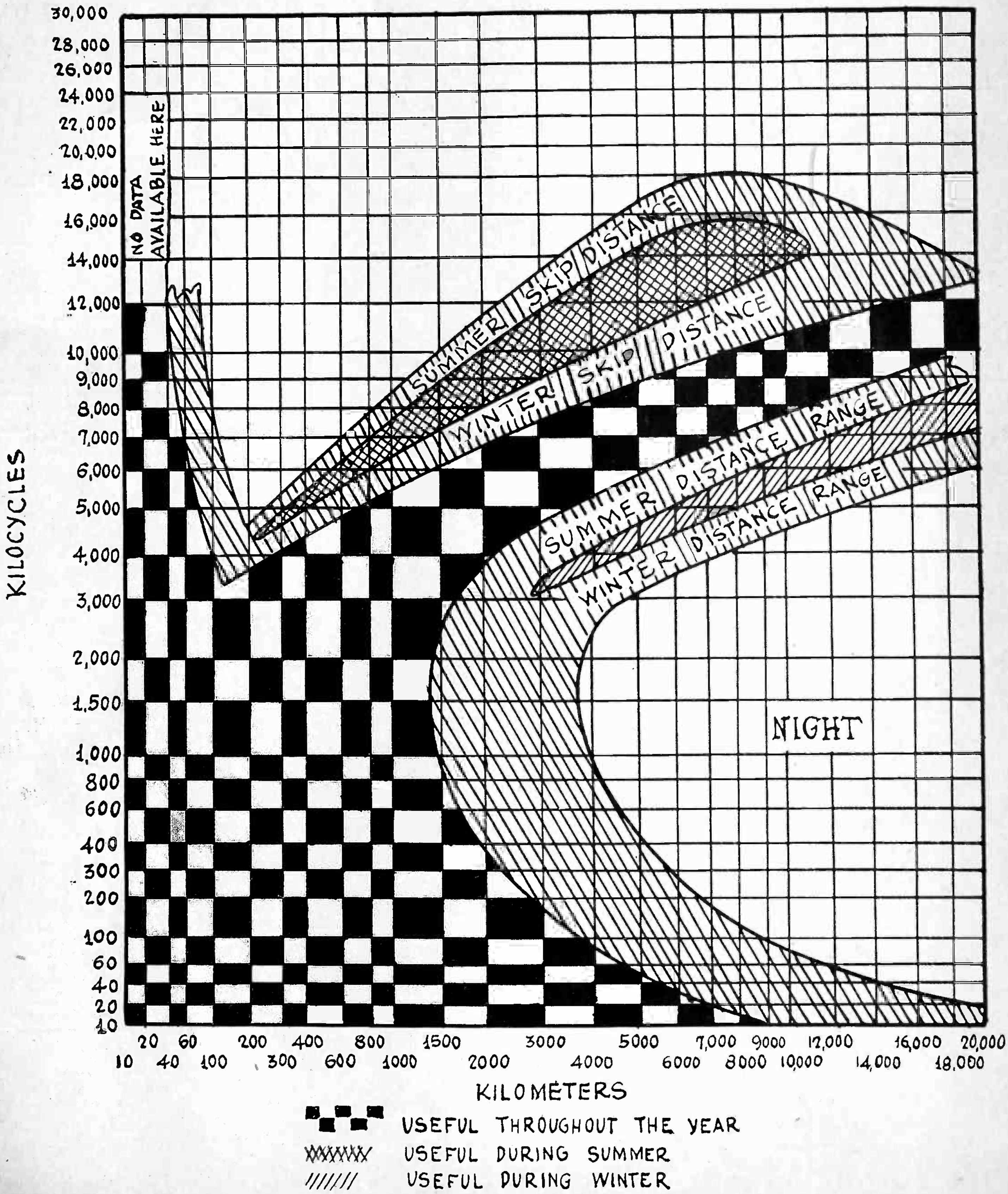

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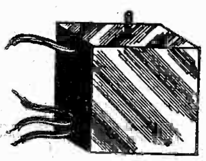

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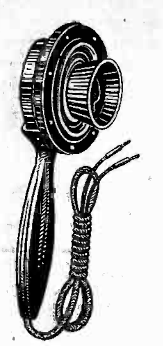

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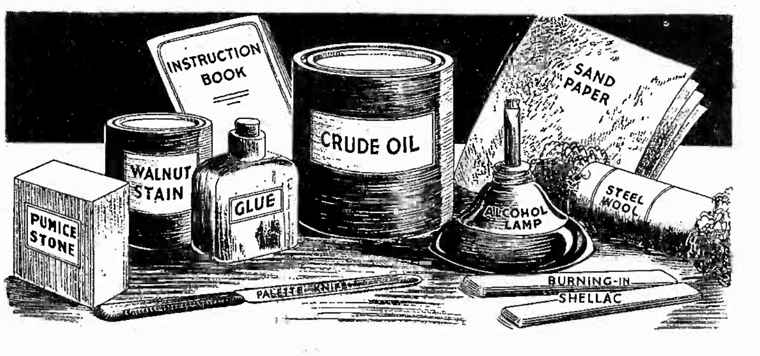

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RADIO WORLD

TENTH YEAR

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The Super's Superiority

New Tubes and Better Transformers

By E. Bunting Moore

Designer of the Day-Lite-R Receivers for Personal Construction

[*In last week's issue the author discussed the solution of the principal superheterodyne troubles and gave padding directions. In the course of that highly interesting article he incidentally mentioned the desirability of band pass filter tuning between antenna and first tube of a superheterodyne. Consistently with this recommendation he has designed a 6-tube a-c tuner—requiring external audio amplifier—that has been a sensation among those to whom he has demonstrated it privately. The tuner brings in KFI, KGO and other Pacific Coast stations, from New York City, on a few feet of aerial, almost nightly. The usual performance is 90-channel reception in daylight—thus a station on every channel except six channels—while some have tuned in the entire 96 channels day and night. It is expected this circuit can be revealed soon to our readers.* —Editor.]

THE superheterodyne circuit has been recognized for more than ten years as the most efficient circuit, yet since it was first designed much water has flowed under the bridge, and the circuit today holds its pre-eminent position for entirely different reasons than those for which it was designed.

Ten years ago the tubes available were very difficult to utilize in a cascade r-f amplifier of more than two stages. The inter-element capacity was high and while makeshifts such as neutralization were of some help, the actual gain per stage in such circuits was very low. At lower frequencies the difficulty caused by capacitative feedback in the tubes became much less bothersome, and at frequencies just above audibility almost the full theoretical gain could be obtained in a properly designed receiver, and the gain was quite a bit better than in the possibly-neutralized t-r-f sets of the day.

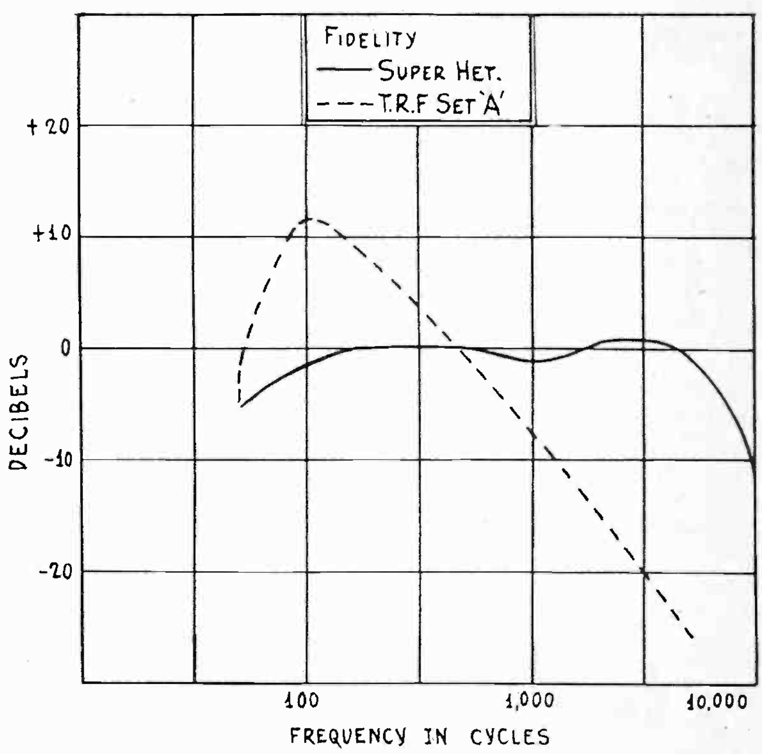
Single control was not even thought of at that time, and the supers then had, as a rule, two tuning dials, compared to three or four on other types of sets.

Troubles of Other Days

Selectivity was not in those days of the extreme importance it has since assumed. The intermediate transformers were very rarely peaked at all accurately, but since the gain was limited by feedback effects present at even the very low frequencies used, the selectivity was satisfactory, and with the two tuning dials adjustments were possible to erroneous intermediate settings.

With the advent of perfected screen grid tubes, the aspect of the superheterodyne was changed completely. These tubes were capable of great amplification and were very little troubled by feedback in the tubes themselves. Theoretical amplification figures representing a gain of several hundred were published. But to procure any useful part of this high available amplifying ability it appeared necessary to build up a plate impedance of several hundred thousand ohms.

The impedance which can be obtained in a tuned circuit varies directly with the amount of inductance that can be used and inversely with the losses in that inductance. Also, the inductance which can be used depends entirely upon the wave-length involved. At broadcast frequencies the inductance of a tuning coil rarely can be greater than about 250 microhenries, this being the customary inductance of commercial coils. At fairly high intermediate frequencies, say 175 kc, the most commonly used point, efficient circuit characteristics are possible with an inductance of fifteen to twenty times as much, with a corresponding gain in amplification.



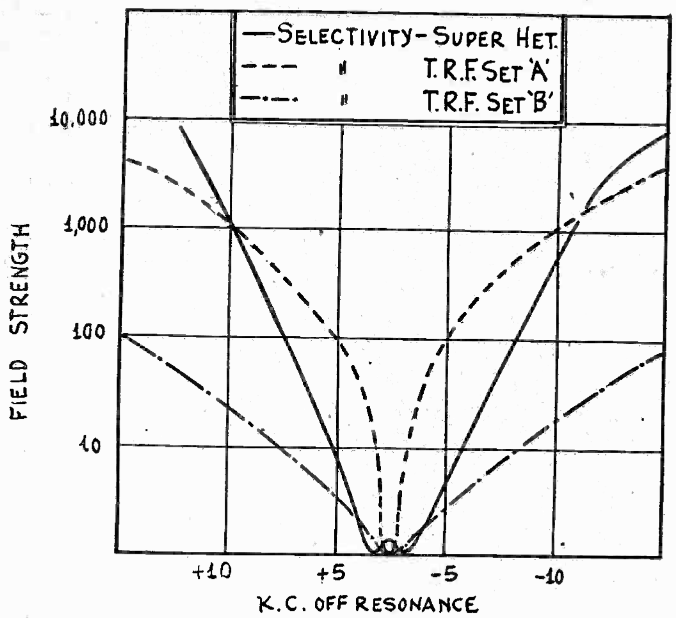
Comparative fidelity curves of a superheterodyne and a T.R.F. set.

Better Transformers Now

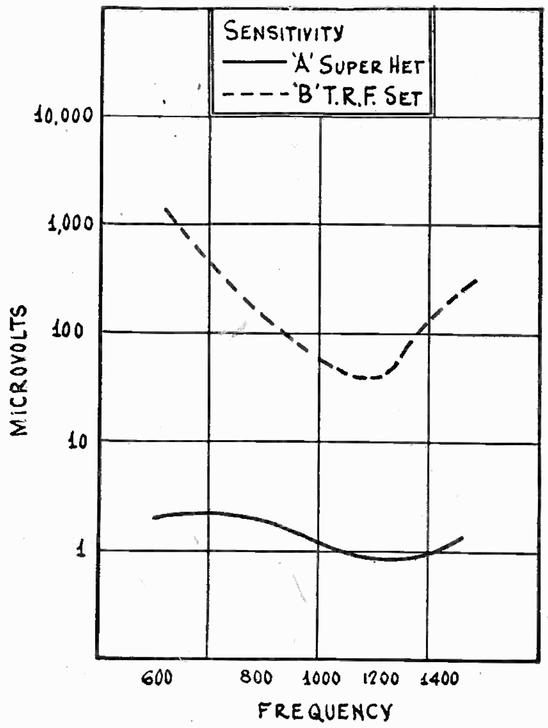
Due to the low frequencies used in early supers, the transformers used were fairly efficient amplifiers of audio frequencies. This resulted both in a tendency towards distortion, caused by overloaded tubes acting as detectors ahead of the tube intended for that purpose,

Super's Hiss Eliminated

Low-Loss Intermediate Coils Aid Solution



These curves show the different selectivities of a superheterodyne and two tuned radio frequency sets. The superheterodyne curve shows both greater selectivity and greater fidelity.



These curves show the difference in sensitivity of a superheterodyne and a tuned radio frequency set.

(*Continued from preceding page*)

and in the amplification of static discharges, tube noises, and the generally objectionable "hiss" or "fry" which became known as a characteristic of superheterodynes.

At 175 kc highly selective, low-loss transformers can be used, through which no frequencies can pass if more than 10 kc separated from 175 kc. The "hissing" and "frying" of the earlier supers is eliminated completely and the only noise remaining is due to the atmospherics present in the signal itself as received from the antenna. At the same volume level, the modern super should be even less noisy than a tuned radio frequency receiver.

The advantages of the use of multiple band-pass circuits are pretty generally known, but their adoption into trf receivers has not progressed to any great extent because of the expense involved. Instead of one variable condenser to each stage, two are required, and both the cost of the condensers, and the large amount of space occupied effectively prohibit the employment of more than one band pass stage. Other technical difficulties are involved, too. The operation of the bandpass is dependent upon the percentage of coupling between the circuits and the resistance of the circuits, and both of these factors vary as the receiver is tuned from 550 kc. to 1,500 kc.

Performance Compared

In an intermediate amplifier the situation is altered greatly. Essentially fixed capacities are used, requiring only a very small space. The intermediate amplifier operates at 175 kc only, so that the charactertistics do not change in operation. Conditions are ideal for the use of a band pass network.

Selectivity, without loss of quality from cut-off sidebands, becomes accordingly a very simple matter. Adjustment of the intermediate transformers makes easily possible a band width of 8 kc at double field strength and only 30 kc at 1,000 times field strength. In a straight tuned radio frequency job of equal sensitivity and as narrow a band width at 1,000 times field strength the sidebands would be cut so badly that speech would be almost impossible to understand, or with as broad a band at double field strength, local stations could not be separated at all.

More care must be taken to balance the super than the ordinary variety of t-r-f set, but no more than the much greater capabilities of the circuit would indicate. Automatic volume control becomes almost a necessity, for without it the tremendous amplification available when the volume control is turned up will make the speaker almost jump out of the cabinet when a local station is tuned in.

Short Antenna All-Sufficient

Antennas of more than fifteen or twenty feet in length are absolutely superfluous, and in fact, bothersome not because they broaden the tuning, but because the signal strength becomes too great.

Altogether, then the modern superheterodyne offers far greater sensitivity than any other circuit, incomparably better selectivity, and much less distortion on all stations except perhaps the very strong locals. It is a circuit not at all dependent upon long outdoor aerials often difficult to erect, but will operate satisfactorily on a short piece of wire in the house. At the same sensitivity, it brings through less objectionable noises.

The operation of either superheterodyne or t-r-f receiver today presents no difficulties. One tuning dial, one volume control and a tone control are used on either.

RESISTANCE COUPLED PUSH-PULL

In a book discussing recent radio receivers a push-pull audio amplifier is coupled to an ordinary detector by means of resistance and capacity. The grid of the second tube is connected to the grid return of the other tube through a grid leak equal in value to the leak in the first tube. The circuit looks push-pull to me and I see no reason why it should not work. Now, how do you explain why it is not possible to use resistance coupling between an ordinary detector and a push-pull amplifier?—R. T. M., Davenport, Iowa.

There is no need of our going through the explanation again just because some one else has made the same mistake. Someone's failure to understand the impossibility of it does not make it possible.

Well, What Is It?

Readers Asked to Speculate on Circuit

By Herman Bernard

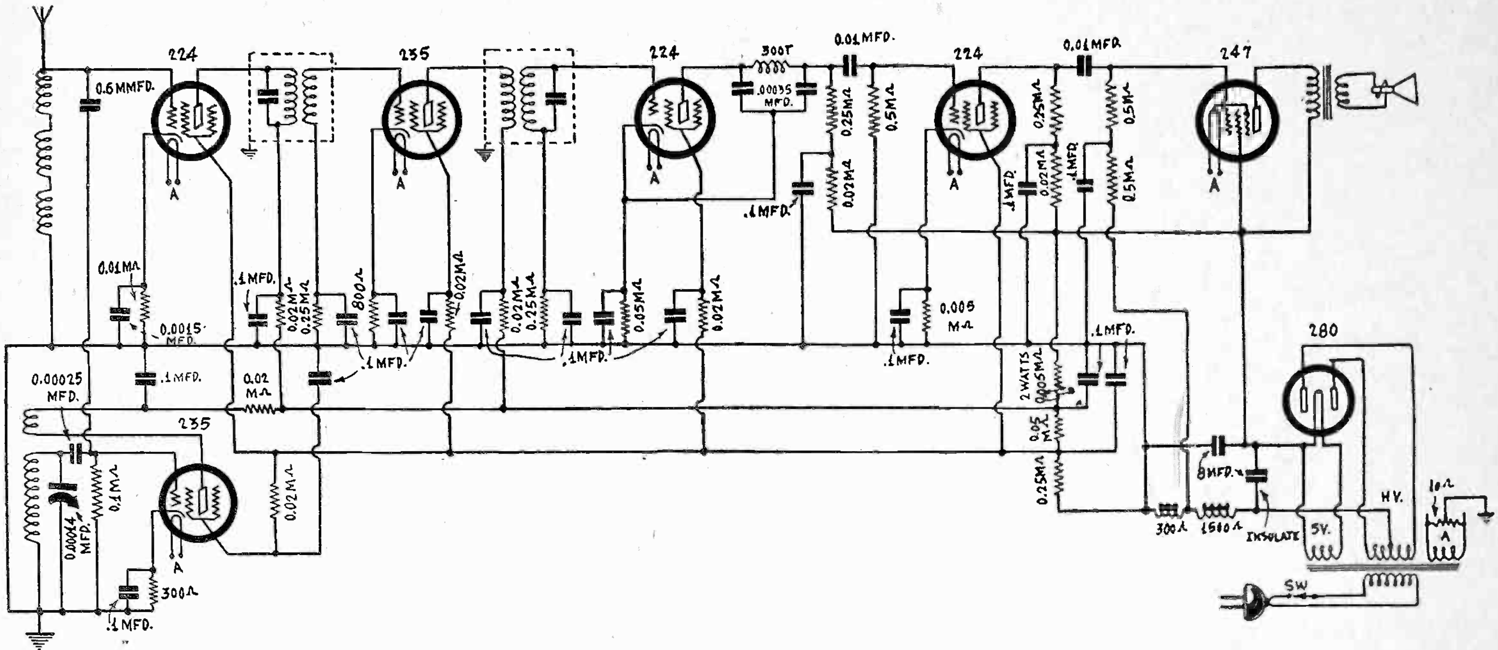


FIG. 1

Some clues to what this circuit is, or rather does, are naturally enough contained in the diagram. But there's more to it than that.

HERE is a diagram on which you may speculate. It represents a very substantial innovation, although that fact does not exist obviously on the diagram.

The answer to the problem will be printed, but meanwhile readers are asked to send in their theories about the circuit. What is it? What does it do that other circuits normally do not do?

Some hints are in order.

Preparatory to the first hint let us simply describe the circuit as a superheterodyne, in which the input to modulator is not manually tuned, the oscillator is tuned, there follow then a stage of intermediate amplification and two stages of audio, the rectifier is a 280.

Dark Assistance

The first hint is no hint at all but an unqualified and frank statement. That is, the audio and rectifier have nothing to do with the novelty of the circuit's performance.

The second hint is more in point. The three coils in series in the antenna circuit are not inductively related, and are radio frequency choke coils of dissimilar inductances. That clue should be of considerable assistance.

The third hint is very good indeed, if it has any meaning to you at all. It is this: The oscillator alone is tuned, which is not a completely satisfactory method under some circumstances, but is under the present circumstances.

A fourth hint is also to some purpose. A generous distribution of resistors and capacities is shown, constituting filtration. Now, normally in superheterodynes so much care about filtration is not exercised, perhaps because for the frequencies involved it is not necessary, so with abundant r-f filtration there should be some indication to the thoughtful reader on the topic of frequencies. Circuit behavior is different as frequencies differ, and when one knows in general what the difference in behavior is, he knows the direction in which the frequency normally used has been moved.

Foolproof Words

As a side remark, so that no one will be led astray, it should be stated that the 224 is the modulator, or first detector, and the 235 below it is the oscillator. There is no autodyne hookup, whereby the same tube performs both functions. The reason for the grid leak and condenser in the oscillator circuit is only one of stability of frequency, for it can be seen that the tube is biased for amplification, and not for detection.

As for the intermediate frequency transformers, the fact that the drawing shows primary and secondary as having the same number of turns has no significance. Schematic diagrams should not be read literally as to relative number of turns. Nor is the fact that in one instance the primary is tuned and the other the secondary fraught with particular meaning. It is preferable to have the primary tuned in the instance shown, so that the condenser used for such tuning acts as a bypass condenser for other frequencies than the intermediate frequency in the modulator.

Induction Needed

The fact is recorded that radio has taken a certain definite trend in the past several months, in regard to the range of frequencies users desire to tune in, and that thought should be borne in mind when attempting a solution of the interesting case at hand. Indeed, since the diagram itself does not give the solution offhand, it may be said with truth that the solution can be achieved only inductively—in a philosophical rather than radio sense. So here's wishing you plenty of induction.

[*Next week the number of tubes will be increased, and perhaps from what will be published then the reader can get enough information to guide him correctly, if the foregoing seemed to be rather barren.*—EDITOR.]

NEW BOOKS

"Servicing Superheterodynes," by John F. Rider, is an excellent little volume for radio service men interested in the principles and servicing of superheterodynes. It contains 161 pages, 5 x 7.5 inches, and 54 illustrations. A complete table of contents gives quick accessibility to any subject treated.

After an explanation of the principle of the superheterodyne and the different types of circuits coming under this general heading, the author breaks the circuit down and analyzes each component in order the more clearly to explain the principles. Following this he takes up trouble shooting in a systematic and thorough manner. In this portion there are many cross-references where a certain effect may be due to two or more causes or where different phenomena result from the same cause.

Consideration is given to various test circuits and equipment of peculiar value in servicing superheterodynes, such as r-f oscillators, i-f oscillators, set analyzers, tuning meters and automatic volume controls.

The book clearly recognizes the fact that to service a superheterodyne intelligently, the service man must understand the principles of the circuit, and for this reason considerable space is given to the analysis of the circuit and its component parts. It is the first book on servicing this circuit.

Covering the Band

How Some Small Changes Made Big Difference

By Conrad Knowlton

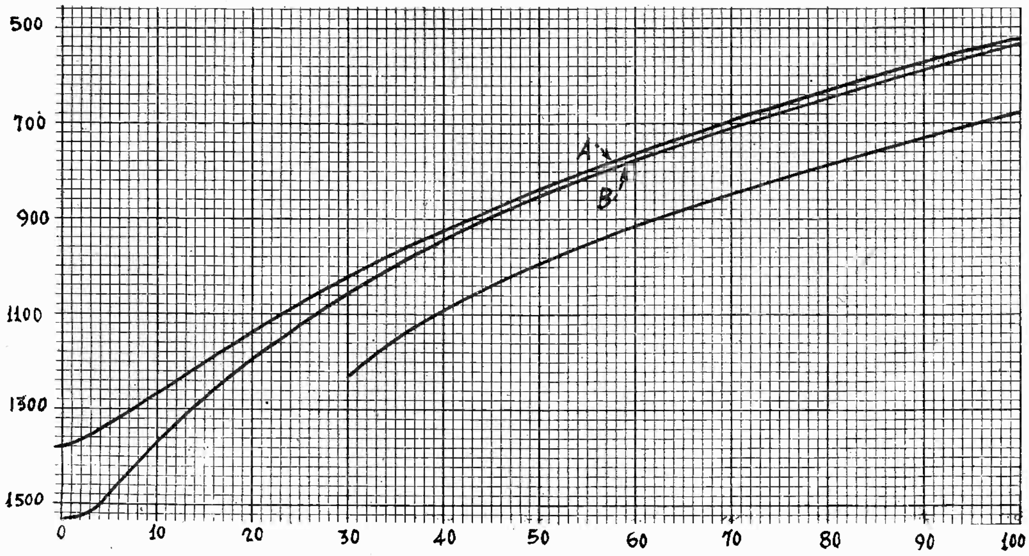


FIG. 1

Curve A shows the tuning characteristic of a circuit, with failure to reach the 1,500 kc goal, whereas curve B represents the result of removal of two turns of wire from a 100-turn secondary. The bottom curve is for part of the oscillator's tuning for 175 kc intermediate.

THE actual capacities used in tuning are seldom known, but a commercial rating of maximum capacity is about all that is obtainable, yet the problem arises of winding the right coil for the really unknown capacity. For a condenser of 0.0005 mfd. rating the turns would be on that basis, but the minimum capacity is not known, and while with the usual inductance there would be some frequency excess with such a condenser, the circuit tuned may have a high minimum capacity. Therefore a possibility exists that the wave band will not be covered completely. Just such a condition developed when using a condenser of rated 0.0004 mfd. maximum capacity, unascertained minimum capacity, and no knowledge of the circuit's minimum capacity. The secondary was wound on 1⅛ inch diameter tubing, with 100 turns of No. 31 enamel wire, primary wound over secondary, 20 turns of No. 40 single silk covered wire. Then 570 kc came in at 96 on the dial, but 1,300 kc could not be quite reached at the other extreme. Surely this was a case requiring a remedy.

The circuit happened to have an old-style switch for picking up an 80-meter tap, and this switch proved to have a high capacity, for the dial settings changed in that direction when the switch was removed.

Wave Band Covered

The trimming condensers had too high a minimum, too, and when they were replaced by smaller ones, the curve was as shown in A of Fig. 1. Curve B represents two turns removed from secondary, leaving 98 turns.

Naturally, the effect of the lower inductance was much more pronounced at the higher frequencies, and 1,500 kc came in at 4.25 on the dial, 550 kc at 97.5 The position 4.25 is not to be assumed to be much removed from the actual minimum capacity, since the condenser caused very slight reduction in capacity from 4.25 down. However, the broadcast wave band was fully covered. The curves are approximately midline. They show indirectly a maximum capacity of 0.000429, the inductance 200 microhenries.

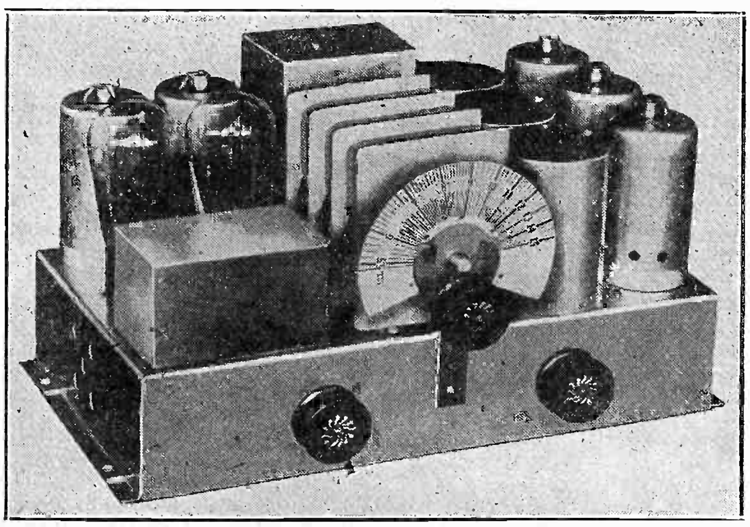
They were taken in conjunction with work on a superheterodyne, and small-sized commercial coils were used for the experimental work. To tune with a gang condenser, the oscillator would have to be padded so that at the same dial settings it would tune in frequencies higher than those of curve B by the intermediate frequency.

Part of Oscillator Curve

Thus a line may be drawn 175 kc higher than curve B, to represent most of the oscillator frequencies for the same dial settings as obtains for the modulator. The curve is terminated arbitrarily at 1,055. The low frequency extreme for tying down the oscillator at that point may well be used from such a chart, but the high frequency end should not, even if the plotting paper were wide enough originally to permit showing the setting for 1,675 kc, assuming 1,500 kc is the other point to be tied down.

The oscillator, in the padding process, should be calibrated by using a modulated oscillator that covers the desired range and preferably when the circuit conditions are exactly like those that will obtain when the total receiver is functioning. There may be a slight discrepancy, due to the capacity introduced by coupling of external oscillator, but a good approximation can be arrived at, and the trimming to a nicety done thereafter, with the total receiver functioning. Once the oscillator is tied down at the low frequency point, the trimming condenser and padding condenser in this circuit should not be touched, but the high frequency adjustment tie-down made with the trimmers on the modulator and r-f tubes.

TYPICAL TELEVISION SET



A compact and well-arranged layout for a seven-tube receiver. This one tunes in the continental television band, and the dial is calibrated in kilocycles. All tubes are shielded except the 280 rectifier and the power tube. A three-gang condenser is used for tuning. The other controls are for volume and switching.

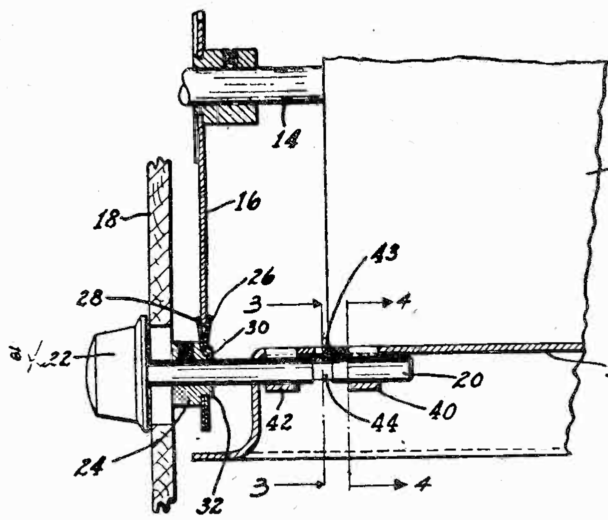
NEW PATENTS

[*Issued during recent weeks*]

[*Selected newly issued or reissued radio patents are recorded in this department. The number of the patent itself is given first. Usually only one claim is selected and the claim number also is cited. The code at the end of the title description (Cl., etc.) refers to the classification, the next number being the sub-division, which data define the nature of the patent. All inquiries regarding patents should be addressed to Ray Belmont Whitman, Patent Editor,* RADIO WORLD, 145 *West* 45*th Street, New York, N. Y.*]

1,844,519. ELECTRICAL APPARATUS. Edward B. Newill, Dayton, Ohio, assignor to General Motors Radio Corporation, Dayton, Ohio, a Corporation of Ohio. Filed Nov. 14, 1930. Serial No. 495,593. 2 Claims. (Cl. 250—16.)

1. In a control for a radio receiver having a sheet metal frame, the combination including U-shaped straps integral with said frame, and a shaft rotatably supported in said U-shaped straps so that said straps function as bearings for said shaft.



QUESTIONS AND ANSWERS

PLEASE advise if there is any way to protect my invention from some one getting ahead of me to the Patent Office while I am still experimenting on it. I am told about a paper called a caveat which can be prepared and signed, and which is much less expensive than filing an extra patent application.—H. Gray, New York, N. Y.

There is no way now to prevent some one getting ahead of you to the Patent Office with an applications for a patent on an invention without filing your application first. The law of caveat was repealed July 1, 1910. It provided for an inventor giving notice to the Patent Office of incomplete inventions by a signed paper called a caveat which explained the purpose of the invention or discovery and its distinguishing characteristics and asked protection of the invenotr's right until he should have matured his invention. It was required to be filed in the confidential archives of the office and to be kept in secrecy and it had to be renewed from year to year to keep it enforced. The person filing it was entitled to be notified of any application for a patent made during the lifetime of the caveat, which application, if granted, would interfere with the invention claimed therein, and was entitled to priority by reason thereof. The next best thing to do in the absence of your ability to file the application as soon as possible is to prepare a description and sketch of your invention known as "evidence of conception" and sign and date it before a notary and retain such papers in the event of an interference proceeding later. This might prove priority of conception and entitle you to the patent over a claimant.

* * *

AFTER my patent has issued, is it possible to get broader claims in it?—W. T., New York, N. Y.

Yes. This can sometimes be done by reissuing the patent, providing the failure to claim the invention pro^erly was due to inadvertence, accident or mistake. There are many decisions as to just what constitute these. Also the application for a reissue must be filed within two years of the issued date of the patent.

Tuning the Hammarlund Comet

By Lewis W. Martin

[*This is the third and concluding instalment of the serial article on the Hammarlund Comet. The other instalments were published February 27th and March 5th.*—EDITOR.]

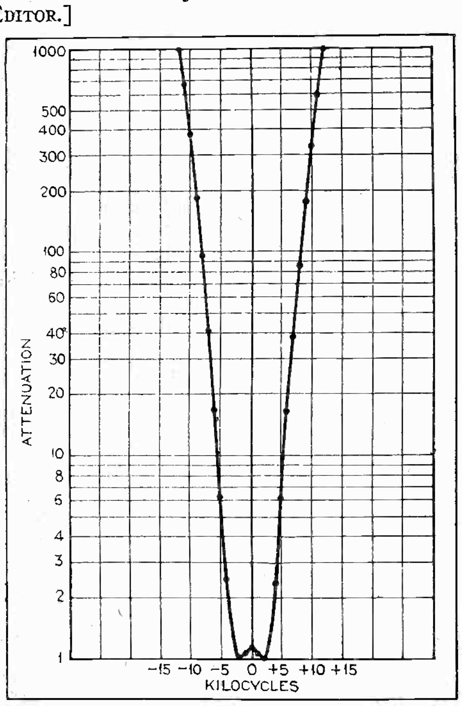


FIG. 4

The attenuation curve of a complete band pass filter having six tuned circuits. The attenuation is plotted against kilocycles off resonance of any one of the circuits standing alone.

The receiving range of the Comet is limited only by the "noise level." This is generally very high in the congested districts of large cities. Also, in such locations the field strength of signals from distant stations is greatly reduced by the presence of large steel buildings, power and communication wiring, and other obstructions. Nevertheless, phenomenal reception has been had with the Comet even under such adverse conditions.

In the outskirts of cities, or in average suburban residential areas, the results are quite different. Here the "noise level" is ordinarily much lower and the arriving signals much stronger. Consequently, in such localities reception from stations thousands of miles away is the rule rather than the exception. From such a location in the outskirts of New York City (but still several miles inside the city line), West coast stations in the broadcast band were consistently received in the evening. Short-wave broadcasting from such stations as Rome and London was regularly received during the day. I.C.W. code signals were heard from great distances, one from Siam and another from Java being received at 9:30 in the morning. With the aid of the long wave (or intermediate frequency) oscillator, C.W. code signals could be copied from any distance. All of this was accomplished on the loudspeaker—phones were not used even for tuning—and in practically all cases the signals were audible throughout a four-room apartment. Substantially the same, or even better results, were obtained when the receiver was taken to a residential section of New Jersey.

In tuning the set, it has been found that stations on the 15 to 20 meter band are heard best during the daylight, or from daybreak to 2:00 p.m. From noon to 10:00 p.m. stations in Europe operating from 20 to 33 meters can be heard. Stations to the west on 20 to 33 meters are heard best from 10 p.m. to daybreak. Darkness is required to listen in to stations operating from 33 to 75 meters. Stations above 75 meters usually can be heard during all hours.

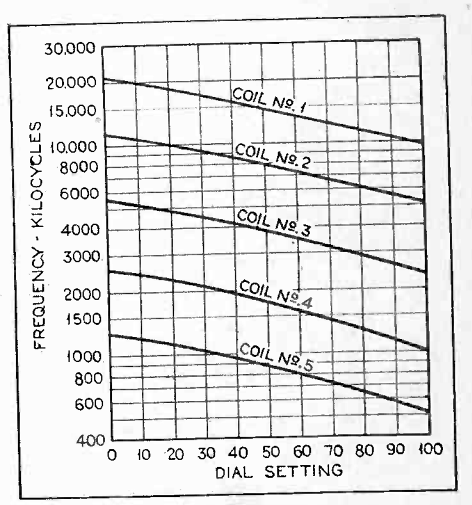


FIG. 5

Calibration curves of the coils in the receiver. The five curves cover the band from below 550 up to over 20,000 kc, with ample overlap between adjacent coils.

Equal Secondaries in a Short-Wa
Circuit Adapt

By J. E.

Cathode Coupling, Frequency Stabilization of Oscillator in Fine Converter

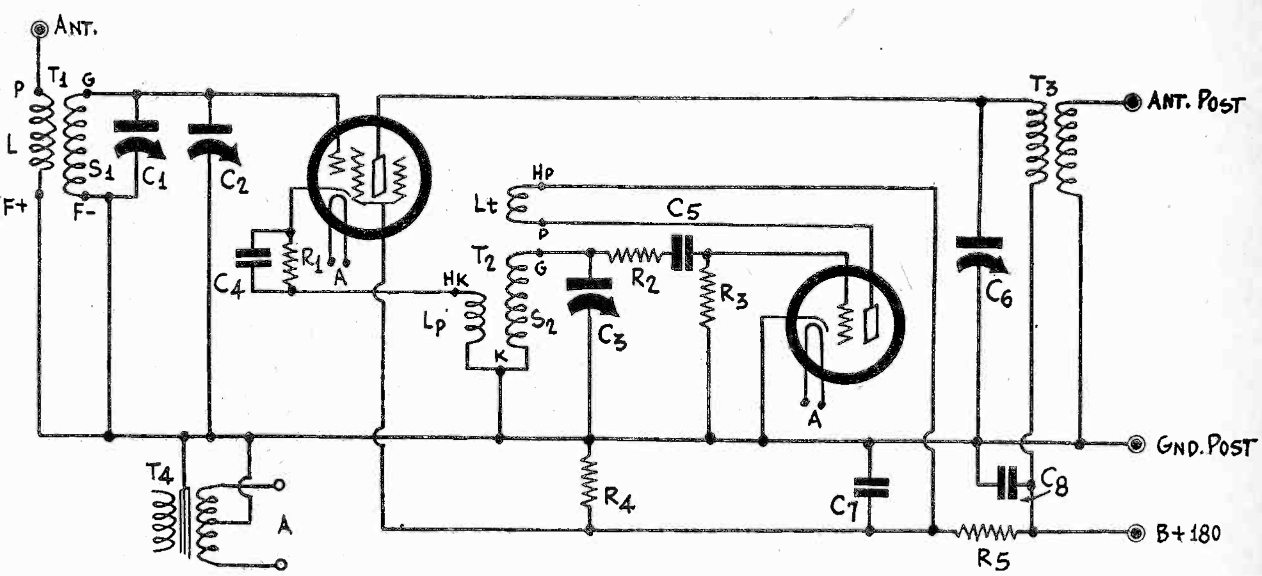


FIG. 1

The circuit of a two-tube short wave converter designed for high sensitivity. Plug-in coils for greatest efficiency.

A SHORT-WAVE converter converts a broadcast receiver into a short-wave superheterodyne. We have broadcast superheterodynes of high merit, and the principles of correct design for such circuits have been carefully worked out. Why should not the same principles be applied to the design of a short-wave converter? There is no reason why they should not, and many why they should. Hence let us build a short-wave converter along the pattern of broadcast superheterodynes.

But right away we have to deviate from this course because of the exigencies of the situation. A single coil will not cover the entire band of frequencies we wish to cover. Hence we must decide whether we want to use plug-in coils or switch-operated coils. Electrically, plug-in coils are better; practically, the switch-operated coils are more convenient. It is easier to change the wave band by turning a switch than by shifting coils. But this time we prefer electrical efficiency to practical expedients. Hence we decide to use plug-in coils.

Making It Simple

We wish as simple a converter as is possible, consistent with good results. The first simplification which we can introduce is the omission of the B supply. Nearly always the plate voltage can be obtained from the set with which the converter is to be used, in fact, always, if we are willing to enter the set and bring out a lead. Taking enough power from the set to operate the two tubes in the converter will not change the voltages in the set appreciably, so that it is not strictly necessary to build a separate B supply into the converter.

Not so with the filament supply, however. While it may be possible to take the filament current also from the set, it cannot be done as easily nor as safely as taking the plate voltage from it. For this reason it is better to build a filament transformer into the converter. This transformer is labeled T4 in the diagram. It is to serve only the two tubes. Note that the case and the core, as well as the center point of the secondary, are grounded. This is important, as it helps to eliminate tunable hum that is often encountered in short-wave sets and converters.

It is assumed that the first tube, or mixer, in the converter is a 224 tube and that the oscillator is a 227. If the filament transformer has a voltage of 6 to 7.5 volts, instead of 2.5 volts, the tubes could also be a 236 and a 237 without any other change than the filament voltage. And if no filament transformer is available and if a 6 volt storage battery is, the 6 volt tubes could be used on the battery by connecting the two heaters of the automotive tubes in parallel across the battery. No other change would be needed.

Importance of Tuned Output

It is important that there should be a tuned circuit in the plate of the mixer tube, and that this be tuned to the frequency to which the broadcast receiver is tuned. This tuned circuit not only improves the detecting efficiency of the mixer but it also helps to couple the converter to the broadcast set more efficiently.

The only weak point in the method of coupling, and there is always a weak point here, is that the tuned output circuit is coupled to another tuned circuit in the set, which is tuned to the same frequency. The better way of coupling would be to

LIST OF PARTS

Coils

T1—One set of r-f transformers as described and specified in the table.
T2—One set of oscillator coils as described and specified in the table.
T3—One r-f transformer as described.
T4—One filament transformer with secondary voltage suitable to tubes used.

Condensers

C1, C2, C3—Three 150 mmfd. midget tuning condensers.
C4—One 0.01 mfd. condenser.
C5—One 0.001 mfd. condenser.
C6—One variable condenser as described.
C7, C8—Two 0.1 mfd. by-pass condensers.

Resistors

R1—One 30,000 ohm resistor.
R2—One 5,000 ohm resistor.
R3—One 100,000 ohm grid leak.
R4, R5—Two 15,000 ohm resistors.

Other Requirements

Three UY sockets.
One UX socket.
Four binding posts.
One grid clip.

ve Converter; able to A-C or Battery Operation

Anderson

connect the point marked "Ant. Post" to the grid of the first tube in the set. However, if this is inconvenient the connection can be done as indicated, but in this case it is well to experiment a little with the coupling until the best combination is obtained. For example, a small condenser could be placed between the output post of the converter and the input post on the set.

The difficulty presented by this coupling is not so great as at first appears, because after the broadcast receiver has been set at some desired frequency, the tuned output circuit in the converter can be adjusted by means of C6 until the maximum sensitivity is obtained. The coupling between the secondary and primary of T3, moreover, will be made relatively loose to minimize any detrimental effects of the double tuning.

Ganged Condensers

The two tuning condensers C1 and C3 are ganged, although, if desired, they may be separately tuned. When they are ganged, it is necessary to have another condenser C2 in parallel with C1 for manual trimming. It is better to have two equal condensers ganged and another condenser of the same size across the r-f tuning section than to have two independent condensers. This is because when there is a manual trimmer equal in capacity to the ganged section, the r-f and oscillator coils may be of the same inductance and there will be a minimum need of the manual trimmer.

The capacity of each of the condensers C1, C2, and C3 should be 150 mmfd. The tuning coils will be designed for this capacity and for an intermediate frequency of 550 kc. A higher intermediate frequency can be used if desired and to change it it is only necessary to reset the broadcast tuner and the adjustment of C6. Incidentally, the value of C6 may be the same as the value of the tuning condensers in the set and the condenser may be of the same type. It may also be a trimmer type condenser. This has the advantage that it will require less room, but the disadvantage that it will not provide the same latitude of adjustment as an air condenser.

In case C6 is an air condenser of 350 mmfd., the coil T3 may be a regular broadcast coil designed for this capacity. The large winding should be used as primary and the small winding as secondary. For loose coupling the small winding should have about one-fifth as many turns as the tuned winding. If the output is coupled directly to the grid of the first tube in the receiver, the secondary should have many more turns, say equal to the number of turns on the tuned winding.

Design of Coils

The r-f coil requires a form which plugs into a four contact socket and the oscillator coil a form that plugs into a five contact socket. It is advisable to use different sockets and plugs so that there will be no danger of plugging in the coils in the wrong sockets. The turns for the various plug-in coils will be based on the supposition that the diameter of the form is 1.25 inches, a form that is available for both four and five point sockets.

If the converter is to go from 1,500 kc up, and if the intermediate frequency is 550 kc, the oscillator must be tuned from 2,050 kc up, while the r-f circuit must go from 1,500 kc up. If the tuning condenser in the oscillator is 150 mmfd., the total capacity when the condenser is fully meshed will be about 160 mmfd., allowing 10 mmfd. for distributed capacity. Thus we require an inductance of 37.6 microhenries. If the capacity of each of the condensers in the r-f circuit is 150 mmfd., the total maximum will be about 310 mmfd., allowing the same distributed capacity as before. Hence in the r-f circuit we need an inductance of 36.3 mm. microhenries. Therefore the coils are very nearly equal and it is all right if we make them exactly equal. This equality we can maintain for all the coils in the plug-in set. When the signal frequency is very high the oscillator and the r-f frequencies will be very nearly the same and we could use the same inductance even if we did not have the extra trimmer condenser in the r-f circuit. But the trimmer is manually accessible and we can always set it at zero when we don't need any of its capacity. In all cases it is there to be used as a trimmer when needed.

Table of Turns

In the table below are given the turns data for the various windings. In this L stands for the number of turns on the primary of the r-f coils, S1 and S2 for the turns on the tuned windings in the r-f and oscillator coils, Lp for the number of turns on the pick-up winding on the oscillator, and Lt for the number of turns on the tickler on the oscillator coil. The largest coil is supposed to use No. 24 enameled wire for all windings. For the smaller coils the same size wire may be used, but it is all right to use heavier wire. Indeed, it is recommended if larger wire is available.

L	*S1, S2*	*Lp*	*Lt*
10	36	3	25
4	15	2	12
2	7	1	5
1	3	1	3

The number of turns on the tickler is increased relatively to the tuned winding on the oscillator because as the inductance decreases the intensity of oscillation decreases also, and if the tickler were not increased relatively oscillation might stop on the smaller coil.

On the smaller coils the pick-up turns are also increased relatively, but this is because it is not practical to use less than one turn. To offset this increased pick-up on the smaller coils the pick-up turn should be placed farther away from the tuned winding.

Excessive pick-up will cause overloading and lack of selectivity. For example, when the pick-up winding is too large and too closely coupled to the tuned winding, there may be no apparent selectivity in the first tuner. This is not serious, however, but if the pick-up is too great the oscillation may stop or the mixer tube may become overloaded. Hence if any of these effects appear, reduction of the pick-up will help.

Design of T3

T3 can be wound on a one inch form with No. 32 enameled wire. If the tuning condenser is a 700 to 1,000 mmfd. trimmer, the primary should have such inductance that when the condenser is set at 1,000 the circuit should tune to 550 kc. This will be given by 56 turns of the wire specified on the one inch form. The secondary in this case should be about 20 turns if there is a tuned circuit ahead of the first tube in the broadcast set and about 60 if the winding is to be connected to the grid of the tube. It is well to shield this coil.

The trimmer condenser will not tune to a very high frequency because its minimum capacity is 700 mmfd. Therefore the highest frequency will not be greater than 660 kc. A tap on tuned winding at the 25th turn would permit tuning to about 1,500 kc.

An air condenser of 350 mmfd. would cover the entire broadcast band if the inductance were 240 microhenries. This can be obtained with 120 turns of No. 32 enameled wire on the one inch form. The untuned winding should bear the same relation to the tuned in both cases. If space permits it is best to use the air condenser, but it is not necessary to have the control on the panel. In nearly all cases one particular intermediate frequency is selected and the converter is operated on that at all times. This frequency may be any one on which there is no local station.

Assembly of Converter

There is no best way of assembling the parts of the converter. They may be assembled on a wooden, bakelite, or metal subpanel. There are many different ways of laying the parts out on the panel, one just as good as another. The only thing that should be guarded against is to see that the two coils are not too close together. If they are six inches apart that is all right. If they are closer, there should be a grounded metal shield between them. There should be no metal can over either one but there may be a complete shield around the converter as a whole. If a shield is used between the two coils, there should be at least one radius between the coil and the shield. For example, the coil is 1.25 in diameter. Therefore the radius is 5/8 inch. There should be at least 5/8 inch between the shield and the coil. Hence if the coils are placed side by side their centers should be not less than 2.5 inches apart. The thickness of the shield can be disregarded.

If the two main tuning condensers are to be ganged, one will be back of the other and it is always possible to make connecting shaft just long enough.

In arranging the tubes due regard should be paid to the length of high voltage leads, that is, high signal voltage leads. These are the leads that run from the G posts of the coil sockets to the stators of the condensers and to the grids of the tubes. Another is the pick-up lead. However, there is no sense in sacrificing a good, symmetrical layout just to save an inch or so of lead. About the same effect can be obtained by running the lead so that it is as far as practicable from other leads and grounded conductors.

*[Further details of J. E. Anderson's converter will be published in an early issue.—*EDITOR.*]*

Two Very Simple Converters, Batt
Semi-Tuned Intermedi

By Jack

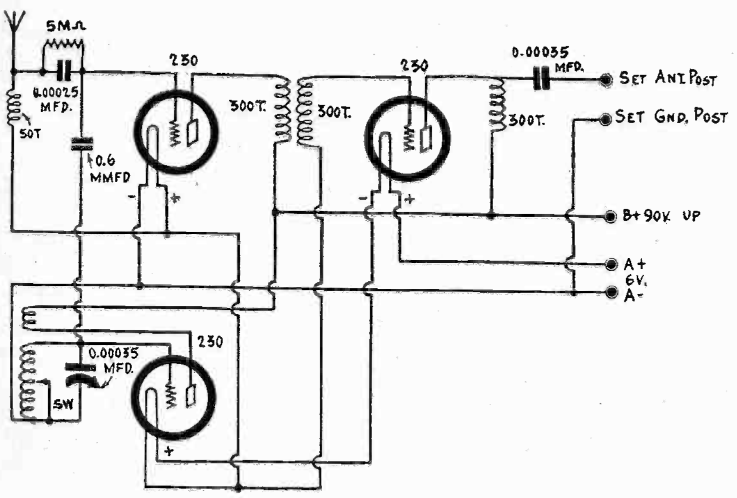


FIG. 1

Using the 6-volt storage battery and the B batteries of a receiver, this converter may be powered. It consists of an untuned modulator, tuned oscillator and semi-tuned intermediate stage, using 230 tubes with filaments in series.

TWO very simple short-wave converters are shown, one for battery operation, the other for a-c operation. The range is from about 35 to about 200 meters. A shorting switch is used to cut out part of the tuned winding for the waves from about 67 to 35 meters.

While the system does not represent perfection, it is nevertheless one that affords good results, and many may desire to make their first attempt at converter construction with either of these models, because the parts required are so few and so inexpensive.

Taking up the battery model first, we find that three 230 tubes are used. These tubes require 2 volts across the filament, so if the filaments are connected in series across a 6-volt storage battery each tube will get one-third of the battery voltage. That total voltage will vary from 6.3 volts, at full charge, to 5.7 volts at a condition of discharge requiring recharging, so that the tube voltages will be from 2.1 to 1.9 volts, which is within the allowable limits even for the 230 tubes.

Moreover, by connecting the filaments in series in a particular order it is practical to obtain bias voltage, thus dispensing with biasing batteries. The minus lead from the storage battery is connected to the minus of the modulator (first detector) tube, upper left, Fig. 1. This is the left-hand filament connection as you regard the socket with filament terminals toward you. If the positive side of the first detector's filament is connected to negative side of the oscillator's filament, it is clear that a grid return for the oscillator, if made to negative of the A battery, will be negative in respect to negative filament of the oscillator by the amount of the voltage drop in the first detector's filament, or about 2 volts, which is satisfactory. The same method is applied to the other 230 tube, which is an intermediate amplifier. Its grid return is made to negative filament of the oscillator, to afford a bias equal to the voltage drop in the oscillator's filament.

It is assumed that one has a battery-operated broadcast receiver, and therefore the 6 volts for the filaments are obtainable from the A battery, and also the 90 volts or more for the B supply of the converter from B batteries used on the set. If, however, the receiver proper has its filaments powered by smaller A batteries, then the supply for the converter may consist of four No. 6 dry cells in series.

Total Filament Drain 60 ma.

Each such cell has a voltage of 1.5 volts, and will stand up to 0.25 ampere drain, so as the filament drain is only 60 milliamperes, this is well within the steady operating rating of the specified cells. The reason why the total is only 60 milliamperes is that the tube filaments are in series and the same current flows through all, with the minor exception that the plate currents are cumulative.

The antenna input is through a 50-turn honeycomb choke coil, which is a commercial product, and can not well be duplicated at home in just that form, but if you desire to use a home-made coil you may wind 100 turns of No. 40 enamel wire on a 3/8 inch wooden dowel or piece of a pencil. The oscillator coils consists of two windings: the grid winding, which is tapped, and the plate winding. Using 2-inch diameter and No. 28 enamel wire, the number of turns for the grid winding is a total of 21, while the tap is the eighth turn from the ground end. The plate winding is put on at the opposite end and consists of 20 turns of any kind of insulated fine wire, separation between primary and secondary 1/16 inch. The windings are put on in the same direction, the connections being: outside terminal of grid coil to ground, tap to switch, inside extreme to grid of the oscillator; inside terminal of plate winding (adjoining grid connection on other coil) to plate of the oscillator, outside terminal of plate winding to B plus.

Semi-Tuned Intermediate Stage

The voltage of 90 volts is nearly always sufficient, but oscillation may not result when the tap for the shorter waves is used if the voltage is much less than 90 volts. Hence the designation "90 volts up," to show that any change should be in the direction of increase, not decrease.

The same data for the coil for the battery model apply to the a-c model.

The seemingly untuned transformer, consisting of two 300-turn honeycomb choke coils, has its windings tightly coupled. Two of these honeycombs are so placed that the short ends of the dowels on which they are wound face each other. Then a machine screw can be put through the hole in the cores for mounting this transformer. The direction of connections is not important, so long as one winding is in the modulator plate circuit and the other in the intermediate grid circuit.

The output r-f choke is also one of 300 turns. This should not be coupled to the other chokes, therefore the single and the pair should be at least 3 inches apart.

The inductance of these 300-turn chokes is about 1.3 millihenries. If you want to make substitutes you can wind 250 turns of No. 40 enamel wire on diameters of about 1 inch.

The transformer constituted of the two 300-turn chokes seems to be untuned, but in fact there is broad tuning at around 700 kc., and thereby there is good gain in the intermediate channel for any intermediate frequency (the one to which your set will be tuned), except at the very high frequencies of the broadcast band (1,500 kc., 1,400 kc., 1,300 kc., etc.) Any intermediate frequency from about 1,200 kc. to the lowest to which your set will tune can be used.

Small Coupling Condenser

Usually some coil system is shown for coupling modulator and oscillator, but in the present instance a small capacity is used instead. This is 0.6 mmfd.—six-tenths of one micro-micro-

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LIST OF PARTS
For Fig. 1

Coils

One 50-turn honeycomb coil, midget size
Three 300-turn honeycomb coils, midget size
One oscillator coil as described

Condensers

One 0.00025 mfd. grid condenser with clips
One 0.6 mmfd. coupling condenser
One 0.00035 mfd. tuning condenser
One 0.00035 mfd. fixed condenser

Resistors

One 5 meg. tubular grid leak

Other Requirements

One panel, 5 x 6.5 inches, drilled for three with three UX sockets
One on-off switch (SW)
One dial
One six-lead cable
One cabinet to fit
One dozen 6/32 machine screws and nuts
Two 6/32 machine screws 2.5 inches long, with two machine nuts, for mounting the honeycomb coils
One 5/8-inch bracket to support oscillator coil
Three 230 tubes

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ery-Operated and A-C; te Stage of Amplification Built In

Tully

LIST OF PARTS
For Fig. 2

Coils

One 50-turn honeycomb coil, midget size
Three 300-turn honeycomb coils, midget size
One oscillator coil as described

Condensers

One 0.00025 mfd. grid condenser with clips
One 0.6 mmfd. coupling condenser
One 0.00035 mfd. tuning condenser
One 0.00035 mfd. fixed condenser
One 0.0015 mfd. fixed condenser

Resistors

One 5 meg. tubular grid leak
One 800 ohm pigtail resistor

Other Requirements

One panel, 5 x 6.5 inches, with three UY sockets
One on-off switch
One cabinet to fit
One dial
One six-lead cable
One dozen 6/32 machine screws and nuts
Two 6/32 machine screws 2.5 inches long, with two nuts, for mounting honeycomb coils
One 5/8-inch bracket to mount oscillator coil
One 2.5 volt filament transformer
Three 227 tubes

farad—and yet it is quite sufficient to produce all the coupling that is needed. In fact this parallel capacity is equivalent to a series capacity of 0.05 mfd. The series capacity of that value would be used if the 50-turn coil and the oscillator grid winding had their low potential ends tied together and the common condenser completed the circuits to ground. However, that is the equivalent capacity at 1,500 kc. of received signal, but here the frequencies will be higher, and the coupling still stronger. It should be noted that for volume there must be pretty tight coupling. For other reasons the coupling should be loose, but one must strike some sort of compromise, and 0.6 mmfd. is it.

The connection to make are as follows, for both the battery model and the a-c model: disconnect aerial from your receiver and connect it instead to the antenna lead or post of the converter; connect the output of the converter (marked "Set Ant. Post" in diagram) to the vacated aerial post of the receiver, connect the ground post of the converter (marked "Set Gnd. Post" in diagram) to the ground post of your receiver, and leave the ground at the receiver, also. Although the aerial is moved over to the converter, the ground is not disconnected from the set. Connect the heater or filament leads to the supply.

A-C Model Discussed

Since only the oscillator is tuned, any intermediate frequency may be used in the receiver. One should be selected that is free from direct interference by a broadcasting station. Hence no frequency at or near one occupied by a strong local can be used. However, the lower frequencies will give better response, in general, due to the semblance of tuning in the intermediate stage.

The circuit can be worked with a plain dial, or a vernier dial may be used.

The a-c model is as closely similar to the battery model as conditions permit, allowing for the difference in tubes. Here three 227 tubes are used. For detection by the grid leak-condenser method the first detector has its cathode returned to ground (zero bias), whereas the two other tubes have a common bising resistor of 800 ohms, the Lynch metallized pigtail type having been used in the laboratory. Across this resistor it is necessary to put a bypass condenser, which may be of any value from 0.00025 mfd. up. The value 0.0015 mfd. is shown in the diagram.

Two extra connections are required, for a-c feed to the heaters. A 2.5 filament transformer is recommended. If desired, this transformer can be built into the same cabinet, but not using the compact design shown, which may be followed for the battery and a-c circuits as diagrammed. If the filament transformer has a center-tapped secondary, ground the center tap. If not, then ground one side of the heater secondary. This grounding is not diagrammed, as it is not known whether

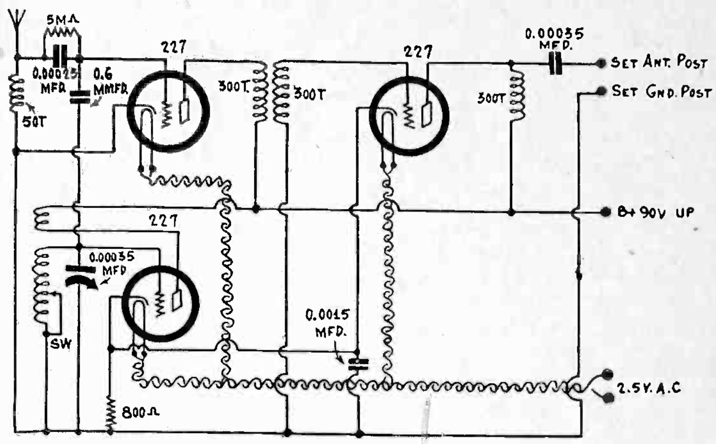

FIG. 2

The equivalent design for a-c operation. A 2.5-volt filament transformer is recommended to supply the heaters of the tubes.

a center-tapped or non-center-tapped transformer will be used.

The B voltage for the a-c model may be taken from a receiver. If you can pick up the high voltage B feed, introduce it to the converter through a 20,000-ohm 2-watt resistor, and put a bypass condenser of 0.00025 mfd. up, from the lead marked "B plus 90 volts up" to ground. In a 247 pentode receiver this voltage may be taken off the pentode screen. However, do not take the heater voltage off a set, as the current may be too high for the secondary in the set. It is 5.25 amperes.

It is practical to use 90 volts of B battery with the a-c model by connecting B minus to ground and B plus to the proper point.

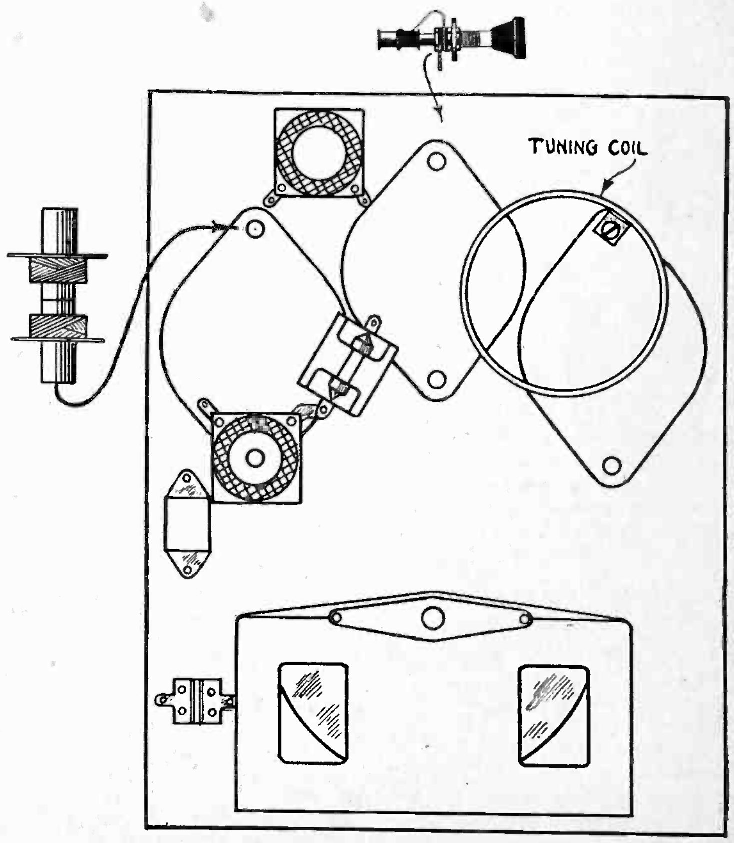

FIG. 3

Layout of parts for either battery or a-c model.

Two Very Simple Converters, Batt
Semi-Tuned Intermedi

By Jack

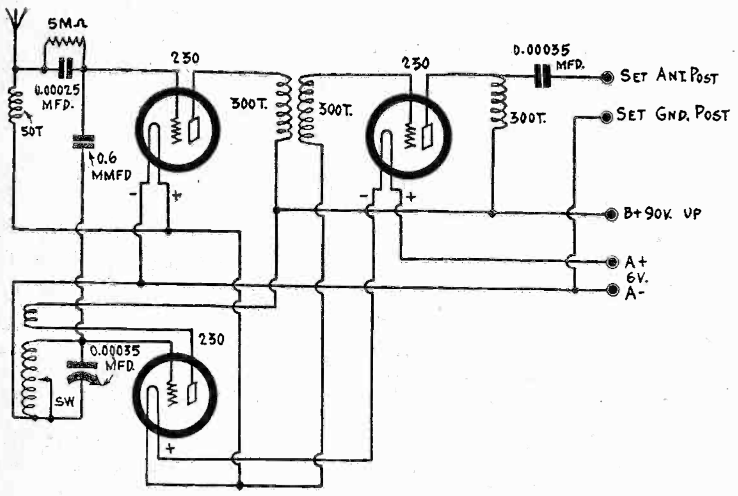

FIG. 1

Using the 6-volt storage battery and the B batteries of a receiver, this converter may be powered. It consists of an untuned modulator, tuned oscillator and semi-tuned intermediate stage, using 230 tubes with filaments in series.

TWO very simple short-wave converters are shown, one for battery operation, the other for a-c operation. The range is from about 35 to about 200 meters. A shorting switch is used to cut out part of the tuned winding for the waves from about 67 to 35 meters.

While the system does not represent perfection, it is nevertheless one that affords good results, and many may desire to make their first attempt at converter construction with either of these models, because the parts required are so few and so inexpensive.

Taking up the battery model first, we find that three 230 tubes are used. These tubes require 2 volts across the filament, so if the filaments are connected in series across a 6-volt storage battery each tube will get one-third of the battery voltage. That total voltage will vary from 6.3 volts, at full charge, to 5.7 volts at a condition of discharge requiring recharging, so that the tube voltages will be from 2.1 to 1.9 volts, which is within the allowable limits even for the 230 tubes.

Moreover, by connecting the filaments in series in a particular order it is practical to obtain bias voltage, thus dispensing with biasing batteries. The minus lead from the storage battery is connected to the minus of the modulator (first detector) tube, upper left, Fig. 1. This is the left-hand filament connection as you regard the socket with filament terminals toward you. If the positive side of the first detector's filament is connected to negative side of the oscillator's filament, it is clear that a grid return for the oscillator, if made to negative of the A battery, will be negative in respect to negative filament of the oscillator by the amount of the voltage drop in the first detector's filament, or about 2 volts, which is satisfactory. The same method is applied to the other 230 tube, which is an intermediate amplifier. Its grid return is made to negative filament of the oscillator, to afford a bias equal to the voltage drop in the oscillator's filament.

It is assumed that one has a battery-operated broadcast receiver, and therefore the 6 volts for the filaments are obtainable from the A battery, and also the 90 volts or more for the B supply of the converter from B batteries used on the set. If, however, the receiver proper has its filaments powered by smaller A batteries, then the supply for the converter may consist of four No. 6 dry cells in series.

Total Filament Drain 60 ma.

Each such cell has a voltage of 1.5 volts, and will stand up to 0.25 ampere drain, so as the filament drain is only 60 milliamperes, this is well within the steady operating rating of the specified cells. The reason why the total is only 60 milliamperes is that the tube filaments are in series and the same current flows through all, with the minor exception that the plate currents are cumulative.

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Semi-Tuned Intermediate Stage

The voltage of 90 volts is nearly always sufficient, but oscillation may not result when the tap for the shorter waves is used if the voltage is much less than 90 volts. Hence the designation "90 volts up," to show that any change should be in the direction of increase, not decrease.

The same data for the coil for the battery model apply to the a-c model.

The seemingly untuned transformer, consisting of two 300-turn honeycomb choke coils, has its windings tightly coupled. Two of these honeycombs are so placed that the short ends of the dowels on which they are wound face each other. Then a machine screw can be put through the hole in the cores for mounting this transformer. The direction of connections is not important, so long as one winding is in the modulator plate circuit and the other in the intermediate grid circuit.

The output r-f choke is also one of 300 turns. This should not be coupled to the other chokes, therefore the single and the pair should be at least 3 inches apart.

The inductance of these 300-turn chokes is about 1.3 millihenries. If you want to make substitutes you can wind 250 turns of No. 40 enamel wire on diameters of about 1 inch.

The transformer constituted of the two 300-turn chokes seems to be untuned, but in fact there is broad tuning at around 700 kc., and thereby there is good gain in the intermediate channel for any intermediate frequency (the one to which your set will be tuned), except at the very high frequencies of the broadcast band (1,500 kc., 1,400 kc., 1,300 kc., etc.) Any intermediate frequency from about 1,200 kc. to the lowest to which your set will tune can be used.

Small Coupling Condenser

Usually some coil system is shown for coupling modulator and oscillator, but in the present instance a small capacity is used instead. This is 0.6 mmfd.—six-tenths of one micro-micro-

LIST OF PARTS
For Fig. 1

Coils

One 50-turn honeycomb coil, midget size
Three 300-turn honeycomb coils, midget size
One oscillator coil as described

Condensers

One 0.00025 mfd. grid condenser with clips
One 0.6 mmfd. coupling condenser
One 0.00035 mfd. tuning condenser
One 0.00035 mfd. fixed condenser

Resistors

One 5 meg. tubular grid leak

Other Requirements

One panel, 5 x 6.5 inches, drilled for three with three UX sockets
One on-off switch (SW)
One dial
One six-lead cable
One cabinet to fit
One dozen 6/32 machine screws and nuts
Two 6/32 machine screws 2.5 inches long, with two machine nuts, for mounting the honeycomb coils
One 5/8-inch bracket to support oscillator coil
Three 230 tubes

ery-Operated and A-C;
te Stage of Amplification Built In

Tully

LIST OF PARTS
For Fig. 2

Coils

One 50-turn honeycomb coil, midget size
Three 300-turn honeycomb coils, midget size
One oscillator coil as described

Condensers

One 0.00025 mfd. grid condenser with clips
One 0.6 mmfd. coupling condenser
One 0.00035 mfd. tuning condenser
One 0.00035 mfd. fixed condenser
One 0.0015 mfd. fixed condenser

Resistors

One 5 meg. tubular grid leak
One 800 ohm pigtail resistor

Other Requirements

One panel, 5 x 6.5 inches, with three UY sockets
One on-off switch
One cabinet to fit
One dial
One six-lead cable
One dozen 6/32 machine screws and nuts
Two 6/32 machine screws 2.5 inches long, with two nuts, for mounting honeycomb coils
One 5/8-inch bracket to mount oscillator coil
One 2.5 volt filament transformer
Three 227 tubes

farad—and yet it is quite sufficient to produce all the coupling that is needed. In fact this parallel capacity is equivalent to a series capacity of 0.05 mfd. The series capacity of that value would be used if the 50-turn coil and the oscillator grid winding had their low potential ends tied together and the common condenser completed the circuits to ground. However, that is the equivalent capacity at 1,500 kc. of received signal, but here the frequencies will be higher, and the coupling still stronger. It should be noted that for volume there must be pretty tight coupling. For other reasons the coupling should be loose, but one must strike some sort of compromise, and 0.6 mmfd. is it.

The connection to make are as follows, for both the battery model and the a-c model: disconnect aerial from your receiver and connect it instead to the antenna lead or post of the converter; connect the output of the converter (marked "Set Ant. Post" in diagram) to the vacated aerial post of the receiver, connect the ground post of the converter (marked "Set Gnd. Post" in diagram) to the ground post of your receiver, and leave the ground at the receiver, also. Although the aerial is moved over to the converter, the ground is not disconnected from the set. Connect the heater or filament leads to the supply.

A-C Model Discussed

Since only the oscillator is tuned, any intermediate frequency may be used in the receiver. One should be selected that is free from direct interference by a broadcasting station. Hence no frequency at or near one occupied by a strong local can be used. However, the lower frequencies will give better response, in general, due to the semblance of tuning in the intermediate stage.

The circuit can be worked with a plain dial, or a vernier dial may be used.

The a-c model is as closely similar to the battery model as conditions permit, allowing for the difference in tubes. Here three 227 tubes are used. For detection by the grid leak-condenser method the first detector has its cathode returned to ground (zero bias), whereas the two other tubes have a common bising resistor of 800 ohms, the Lynch metallized pigtail type having been used in the laboratory. Across this resistor it is necessary to put a bypass condenser, which may be of any value from 0.00025 mfd. up. The value 0.0015 mfd. is shown in the diagram.

Two extra connections are required, for a-c feed to the heaters. A 2.5 filament transformer is recommended. If desired, this transformer can be built into the same cabinet, but not using the compact design shown, which may be followed for the battery and a-c circuits as diagrammed. If the filament transformer has a center-tapped secondary, ground the center tap. If not, then ground one side of the heater secondary. This grounding is not diagrammed, as it is not known whether

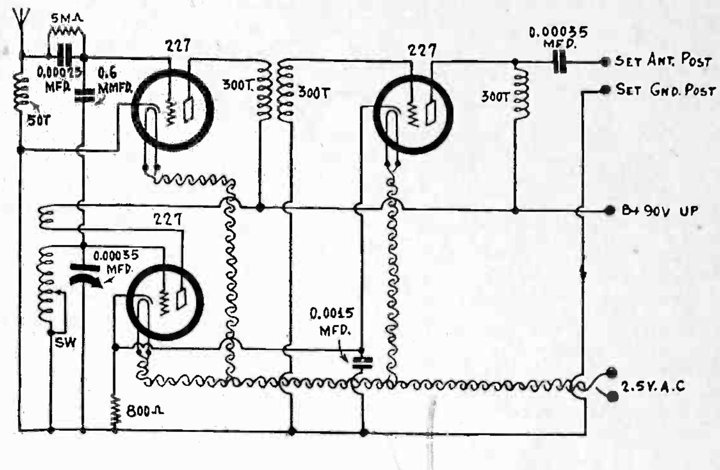


FIG. 2

The equivalent design for a-c operation. A 2.5-volt filament transformer is recommended to supply the heaters of the tubes.

a center-tapped or non-center-tapped transformer will be used.

The B voltage for the a-c model may be taken from a receiver. If you can pick up the high voltage B feed, introduce it to the converter through a 20,000-ohm 2-watt resistor, and put a bypass condenser of 0.00025 mfd. up, from the lead marked "B plus 90 volts up" to ground. In a 247 pentode receiver this voltage may be taken off the pentode screen. However, do not take the heater voltage off a set, as the current may be too high for the secondary in the set. It is 5.25 amperes.

It is practical to use 90 volts of B battery with the a-c model by connecting B minus to ground and B plus to the proper point.

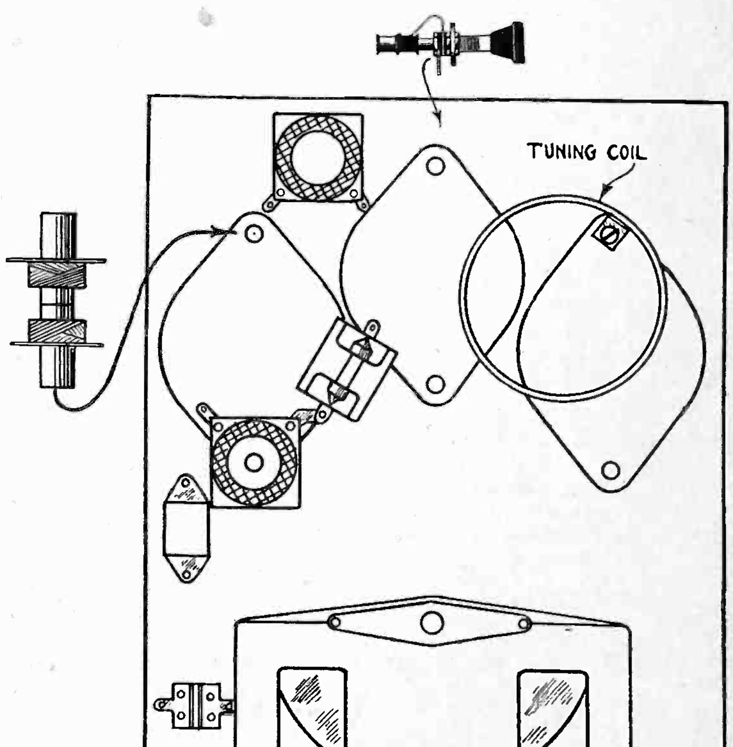


FIG. 3

Layout of parts for either battery or a-c model.

Two Very Simple Converters, Batt
Semi-Tuned Intermedi

By Jack

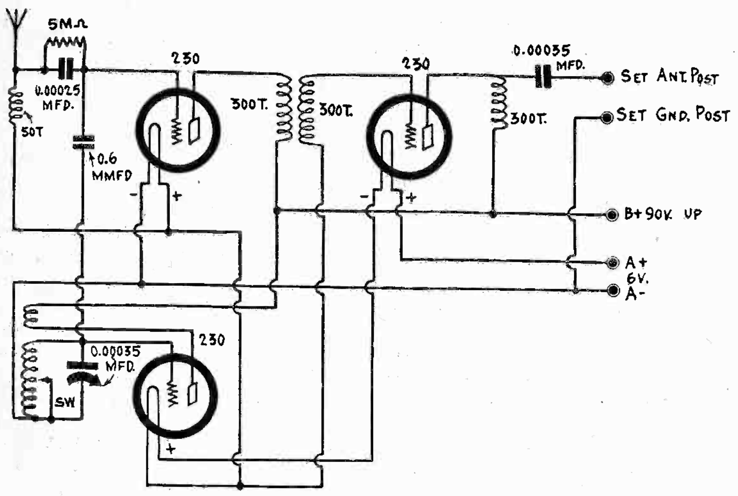


FIG. 1

Using the 6-volt storage battery and the B batteries of a receiver, this converter may be powered. It consists of an untuned modulator, tuned oscillator and semi-tuned intermediate stage, using 230 tubes with filaments in series.

TWO very simple short-wave converters are shown, one for battery operation, the other for a-c operation. The range is from about 35 to about 200 meters. A shorting switch is used to cut out part of the tuned winding for the waves from about 67 to 35 meters.

While the system does not represent perfection, it is nevertheless one that affords good results, and many may desire to make their first attempt at converter construction with either of these models, because the parts required are so few and so inexpensive.

Taking up the battery model first, we find that three 230 tubes are used. These tubes require 2 volts across the filament, so if the filaments are connected in series across a 6-volt storage battery each tube will get one-third of the battery voltage. That total voltage will vary from 6.3 volts, at full charge, to 5.7 volts at a condition of discharge requiring recharging, so that the tube voltages will be from 2.1 to 1.9 volts, which is within the allowable limits even for the 230 tubes.

Moreover, by connecting the filaments in series in a particular order it is practical to obtain bias voltage, thus dispensing with biasing batteries. The minus lead from the storage battery is connected to the minus of the modulator (first detector) tube, upper left, Fig. 1. This is the left-hand filament connection as you regard the socket with filament terminals toward you. If the positive side of the first detector's filament is connected to negative side of the oscillator's filament, it is clear that a grid return for the oscillator, if made to negative of the A battery, will be negative in respect to negative filament of the oscillator by the amount of the voltage drop in the first detector's filament, or about 2 volts, which is satisfactory. The same method is applied to the other 230 tube, which is an intermediate amplifier. Its grid return is made to negative filament of the oscillator, to afford a bias equal to the voltage drop in the oscillator's filament.

It is assumed that one has a battery-operated broadcast receiver, and therefore the 6 volts for the filaments are obtainable from the A battery, and also the 90 volts or more for the B supply of the converter from B batteries used on the set. If, however, the receiver proper has its filaments powered by smaller A batteries, then the supply for the converter may consist of four No. 6 dry cells in series.

LIST OF PARTS
For Fig. 1

Coils

One 50-turn honeycomb coil, midget size
Three 300-turn honeycomb coils, midget size
One oscillator coil as described

Condensers

One 0.00025 mfd. grid condenser with clips
One 0.6 mmfd. coupling condenser
One 0.00035 mfd. tuning condenser
One 0.00035 mfd. fixed condenser

Resistors

One 5 meg. tubular grid leak

Other Requirements

One panel, 5 x 6.5 inches, drilled for three with three UX sockets
One on-off switch (SW)
One dial
One six-lead cable
One cabinet to fit
One dozen 6/32 machine screws and nuts
Two 6/32 machine screws 2.5 inches long, with two machine nuts, for mounting the honeycomb coils
One 5/8-inch bracket to support oscillator coil
Three 230 tubes

Total Filament Drain 60 ma.

Each such cell has a voltage of 1.5 volts, and will stand up to 0.25 ampere drain, so as the filament drain is only 60 milliamperes, this is well within the steady operating rating of the specified cells. The reason why the total is only 60 milliamperes is that the tube filaments are in series and the same current flows through all, with the minor exception that the plate currents are cumulative.

The antenna input is through a 50-turn honeycomb choke coil, which is a commercial product, and can not well be duplicated at home in just that form, but if you desire to use a home-made coil you may wind 100 turns of No. 40 enamel wire on a 3/8 inch wooden dowel or piece of a pencil. The oscillator coils consists of two windings: the grid winding, which is tapped, and the plate winding. Using 2-inch diameter and No. 28 enamel wire, the number of turns for the grid winding is a total of 21, while the tap is the eighth turn from the ground end. The plate winding is put on at the opposite end and consists of 20 turns of any kind of insulated fine wire, separation between primary and secondary 1/16 inch. The windings are put on in the same direction, the connections being: outside terminal of grid coil to ground, tap to switch, inside extreme to grid of the oscillator; inside terminal of plate winding (adjoining grid connection on other coil) to plate of the oscillator, outside terminal of plate winding to B plus.

Semi-Tuned Intermediate Stage

The voltage of 90 volts is nearly always sufficient, but oscillation may not result when the tap for the shorter waves is used if the voltage is much less than 90 volts. Hence the designation "90 volts up," to show that any change should be in the direction of increase, not decrease.

The same data for the coil for the battery model apply to the a-c model.

The seemingly untuned transformer, consisting of two 300-turn honeycomb choke coils, has its windings tightly coupled. Two of these honeycombs are so placed that the short ends of the dowels on which they are wound face each other. Then a machine screw can be put through the hole in the cores for mounting this transformer. The direction of connections is not important, so long as one winding is in the modulator plate circuit and the other in the intermediate grid circuit.

The output r-f choke is also one of 300 turns. This should not be coupled to the other chokes, therefore the single and the pair should be at least 3 inches apart.

The inductance of these 300-turn chokes is about 1.3 millihenries. If you want to make substitutes you can wind 250 turns of No. 40 enamel wire on diameters of about 1 inch.

The transformer constituted of the two 300-turn chokes seems to be untuned, but in fact there is broad tuning at around 700 kc., and thereby there is good gain in the intermediate channel for any intermediate frequency (the one to which your set will be tuned), except at the very high frequencies of the broadcast band (1,500 kc., 1,400 kc., 1,300 kc., etc.) Any intermediate frequency from about 1,200 kc. to the lowest to which your set will tune can be used.

Small Coupling Condenser

Usually some coil system is shown for coupling modulator and oscillator, but in the present instance a small capacity is used instead. This is 0.6 mmfd.—six-tenths of one micro-micro-

ery-Operated and A-C; ate Stage of Amplification Built In

Tully

LIST OF PARTS
For Fig. 2

Coils

One 50-turn honeycomb coil, midget size
Three 300-turn honeycomb coils, midget size
One oscillator coil as described

Condensers

One 0.00025 mfd. grid condenser with clips
One 0.6 mmfd. coupling condenser
One 0.00035 mfd. tuning condenser
One 0.00035 mfd. fixed condenser
One 0.0015 mfd. fixed condenser

Resistors

One 5 meg. tubular grid leak
One 800 ohm pigtail resistor

Other Requirements

One panel, 5 x 6.5 inches, with three UY sockets
One on-off switch
One cabinet to fit
One dial
One six-lead cable
One dozen 6/32 machine screws and nuts
Two 6/32 machine screws 2.5 inches long, with two nuts, for mounting honeycomb coils
One ⅝-inch bracket to mount oscillator coil
One 2.5 volt filament transformer
Three 227 tubes

farad—and yet it is quite sufficient to produce all the coupling that is needed. In fact this parallel capacity is equivalent to a series capacity of 0.05 mfd. The series capacity of that value would be used if the 50-turn coil and the oscillator grid winding had their low potential ends tied together and the common condenser completed the circuits to ground. However, that is the equivalent capacity at 1,500 kc. of received signal, but here the frequencies will be higher, and the coupling still stronger. It should be noted that for volume there must be pretty tight coupling. For other reasons the coupling should be loose, but one must strike some sort of compromise, and 0.6 mmfd. is it.

The connection to make are as follows, for both the battery model and the a-c model: disconnect aerial from your receiver and connect it instead to the antenna lead or post of the converter; connect the output of the converter (marked "Set Ant. Post" in diagram) to the vacated aerial post of the receiver, connect the ground post of the converter (marked "Set Gnd. Post" in diagram) to the ground post of your receiver, and leave the ground at the receiver, also. Although the aerial is moved over to the converter, the ground is not disconnected from the set. Connect the heater or filament leads to the supply.

A-C Model Discussed

Since only the oscillator is tuned, any intermediate frequency may be used in the receiver. One should be selected that is free from direct interference by a broadcasting station. Hence no frequency at or near one occupied by a strong local can be used. However, the lower frequencies will give better response, in general, due to the semblance of tuning in the intermediate stage.

The circuit can be worked with a plain dial, or a vernier dial may be used.

The a-c model is as closely similar to the battery model as conditions permit, allowing for the difference in tubes. Here three 227 tubes are used. For detection by the grid leak-condenser method the first detector has its cathode returned to ground (zero bias), whereas the two other tubes have a common bising resistor of 800 ohms, the Lynch metallized pigtail type having been used in the laboratory. Across this resistor it is necessary to put a bypass condenser, which may be of any value from 0.00025 mfd. up. The value 0.0015 mfd. is shown in the diagram.

Two extra connections are required, for a-c feed to the heaters. A 2.5 filament transformer is recommended. If desired, this transformer can be built into the same cabinet, but not using the compact design shown, which may be followed for the battery and a-c circuits as diagrammed. If the filament transformer has a center-tapped secondary, ground the center tap. If not, then ground one side of the heater secondary. This grounding is not diagrammed, as it is not known whether

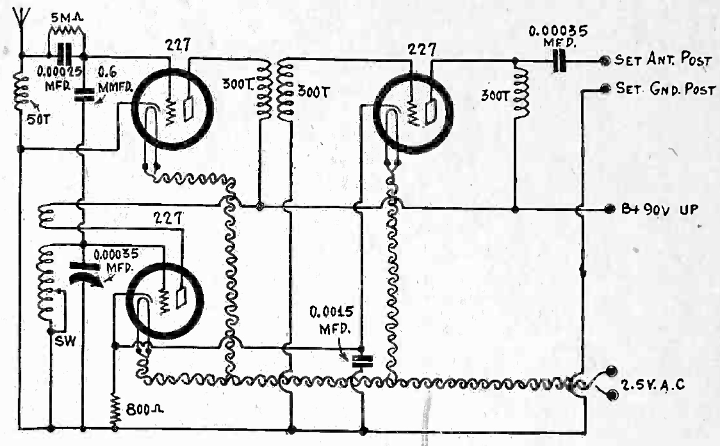


FIG. 2

The equivalent design for a-c operation. A 2.5-volt filament transformer is recommended to supply the heaters of the tubes.

a center-tapped or non-center-tapped transformer will be used.

The B voltage for the a-c model may be taken from a receiver. If you can pick up the high voltage B feed, introduce it to the converter through a 20,000-ohm 2-watt resistor, and put a bypass condenser of 0.00025 mfd. up, from the lead marked "B plus 90 volts up" to ground. In a 247 pentode receiver this voltage may be taken off the pentode screen. However, do not take the heater voltage off a set, as the current may be too high for the secondary in the set. It is 5.25 amperes.

It is practical to use 90 volts of B battery with the a-c model by connecting B minus to ground and B plus to the proper point.

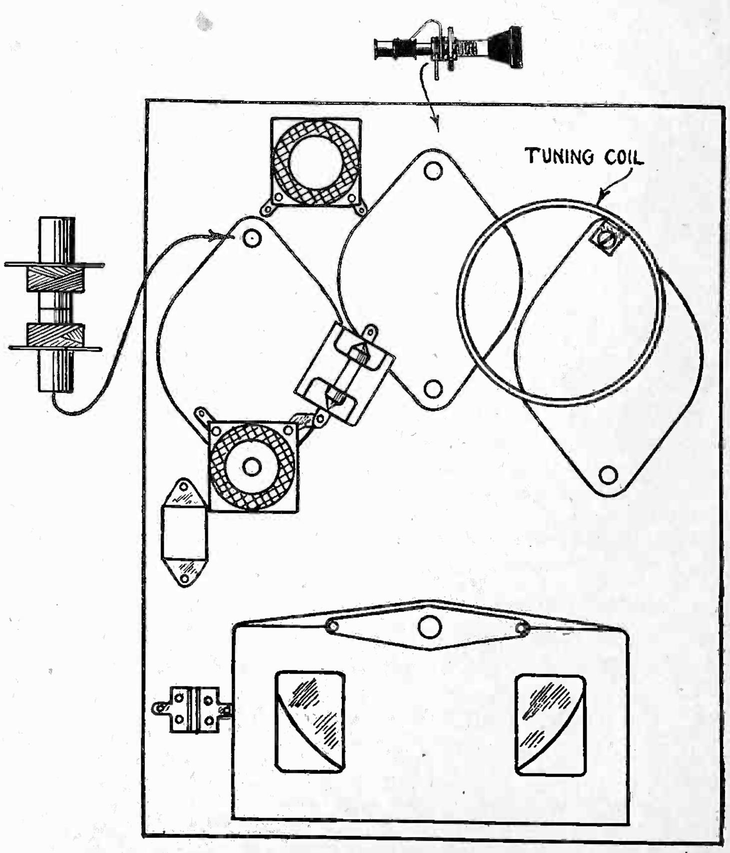


FIG. 3

Layout of parts for either battery or a-c model.

Charts Show Distances Waves Night and DayResul

By Bru

THE Bureau of Standards, Washington, D. C., has issued a set of charts showing the average reception conditions for day and night and for Winter and Summer for all frequencies from 10 to 30,000 kc. These are of utmost importance to all who are interested in getting DX, especially on short waves.

In Fig. 1 is the "Day Chart," which covers both Winter and Summer reception, and in Fig 2 is the "Night Chart," which covers both Winter and Summer. We quote from Letter Circular No. 317 of the Bureau of Standards, which discusses the subject of wave propagation:

"With present knowledge of propagation conditions, **it is impossible** to postulate any formulas or make any tables or charts which could be used to determine distance range over any given path accurately. The attached graphs give average distance ranges as observed by a number of experimenters to occur most frequently over a number of transmission paths. Through certain frequency ranges, available data were so incomplete as to require extrapolation which may be considerably in error. Wide variations of distance range and skip distance must be accepted as normal.

Scales Used

"The scales of abscissas and ordinates are cubical (i. e. numbers shown are proportional to cube of distance along scale, or distance along scale is proportional to cube root of numbers). This was chosen because it spaces the data satisfactorily. A linear scale would crowd the low values too much and a logarithmic scale would crowd the high values too much.

"The graphs show the limits of distance over which practical communication is possible. They are based on the lowest field intensity which permits practical reception in the presence of actual background noise. For the broadcasting frequencies this does not mean satisfactory program reception. The limiting field intensity is taken to be 10 microvolts per meter for frequencies up to 2,000 kc., decreasing from this value at 2,000 kc. to about 1 microvolt per meter at 20,000 kc. When atmospherics or other sources of interference are great, e. g., in the tropics, much larger received field intensities are required and the distance ranges are less. The graphs assume the use of about 5 kilowatts radiated power, and non-directional antennas. For transmission over a given path, received field intensity is proportional to the square root of the radiated power or received field intensity."

Distances along the axis of ordinates are given in kilometers and run from 10 kilometers, 6.21 miles, to 20,000 kilometers, 12,420 miles. The circumference of the earth is very nearly 40,000 kilometers so that the greatest distance on the charts represents a semi-circumference of the earth. On the night chart it will be noticed that there is a frequency band in which communication can be carried on half way around the earth.

Meaning of Symbols

On the graphs the checkered portions represent the ranges and distances that are useful throughout the year. The cross-shaded areas represent distances and ranges useful during the Summer, and the shaded areas with lines sloping upward to the right represent distances and ranges useful during the Winter only. The areas shaded with lines sloping upward to the left represent propagation that is uncertain and indicate divergences among different observers. The skip distance ranges are also shaded in this manner.

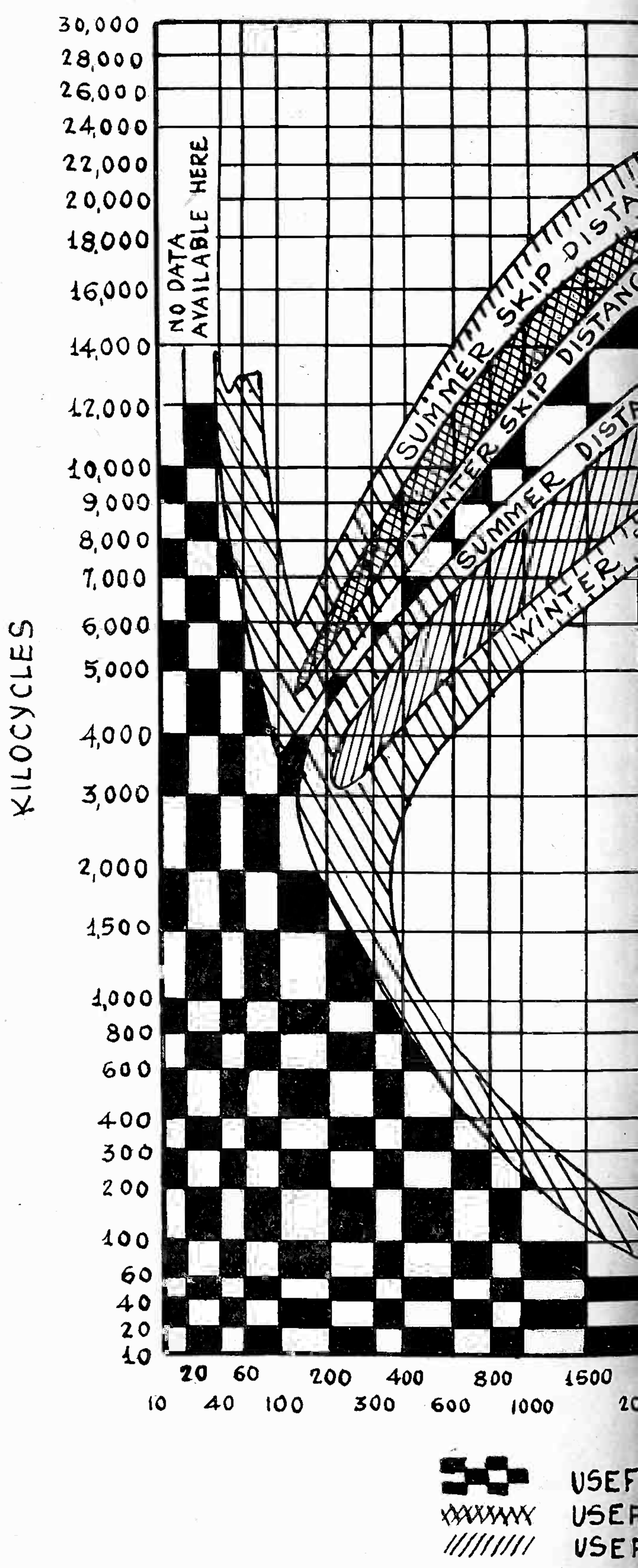
The main body of checkered area on either chart represents the propagation by the ground wave while the offshoot areas represent propagation due to the Kennelly-Heaviside layer, the cause of skip distance and to anomalous propagation.

It will be noticed that the ground wave decreases rapidly with distance as the frequency increases. At a frequency of 10 kilocycles the limit of dependable propagation is between 9,000 and 12,000 kilometers in the day time and about 9,000 kilometers at night. At 1,000 kc. the day and night distances are about 400 and 1,500 kilometers, respectively. At 10,000 kilocycles these distances have been reduced to about 40 kilometers for both day and night. Beyond the 12,000 kc. there are no available data on the propagation by the ground wave.

The propagation by the ground wave is quite regular and does not differ greatly between night and day, except that, as a rule, the distances are greater at night.

The Reflecting Layer

Great distances on short waves are achieved only by virtue of the Kennelly-Heaviside layer. The effect of this layer begins to appear at 2,000 kc., both day and night. At about 16,000



This charts from what distances radio waves of diffe receiver. The chart covers distances up to

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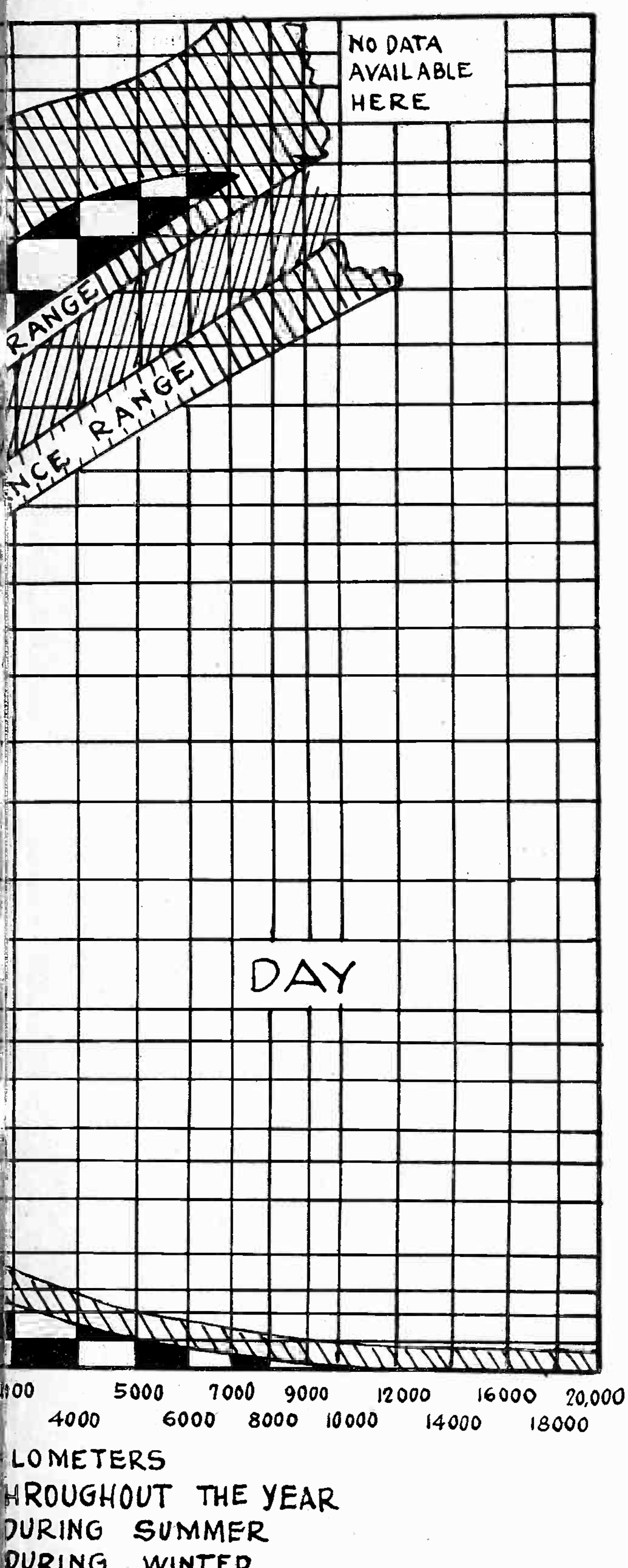

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equencies can be received when there is day at the kilometers, or up to about 12,000 miles.

kc. the greatest Summer distance is about 8,000 kilometers, while during the day the greatest distance is about 7,000 kilometers at 20,000 kc.

The charts answer many questions which often come up when receiving short waves. For example, if it is desired to receive stations half way around the earth at night, that is, night at the receiver, what frequency range is most likely to give results? On the night chart we find that the all-year reception from 20,000 kilometers is best between 10,000 and 13,000 kc. If it is Winter at the receiver we can extend this frequency range down to 7,000 kc. Little hope of success can be expected at other frequencies.

Again, suppose we wish to pick up the signals from a given station 4,000 kilometers away which is operating on a frequency of 5,000 kc. At what time is it most likely to be received? On the day chart the intersection of the 4,000 kilometer and 5,000 kc. co-ordinates is blank and therefore we cannot hope to receive the station during the day, either Summer or Winter. On the night chart the two co-ordinates intersect in an area marked "Summer Distance Range." Hence we can expect to receive the station at night during the Summer, but the intersection falls near an area marked as useful throughout the year, so we have a reasonable chance of getting it at any time of the year at night.

Use of Charts Illustrated

Let us take another problem. Suppose that we wish to receive a station operating on a frequency of 6,000 kc. at a distance of 1,500 kilometers on a Winter night at the receiver. What is the chance of getting it? On the night chart we find that the intersection of the 6,000 kc. and 1,500 kilometer co-ordinates intersect in the all-year region but very near the Winter skip distance range. The chance, therefore, of picking it up is very good, but there is likely to be a good deal of fading, since it is near the boundary of the skip distance range. We would have a much better chance of picking up the station if it were operating on 4,000 kc.

Suppose we are only 100 kilometers from the 6,000 kc. station. In that case we find the intersection of the co-ordinates in a shaded area where reception is uncertain, and it would probably be unsatisfactory. If we were only 40 kilometers away we would be in the region where the ground wave predominates and reception would be good.

Now suppose that the distance to a certain station is 4,000 kilometers and that this station is operating on 18,000. We want to receive this station daily throughout the year. What chance, and what time of day? On the night graph there is a blank area at the intersection of the co-ordinates but on the day graph the intersection falls in the middle of a region indicating good reception throughout the year. Hence we listen in during the day time. Now, 4,000 kilometers is equivalent to nearly 2,500 miles, which is about the great circle distance from New York to London or to some of the other places in Europe where there are short wave transmitters. The great circle distance across the American continent is about the same. It will be noted that the good propagation range is from 3,000 to 5,000 kilometers, so there is some latitude as to distance.

Turning Kilometers into Miles

The distances on the chart can be converted into miles easily because one mile equals 1.61 kilometers, or one kilometer equals 0.621 miles. For approximate conversion we can use the factor 5/8 instead of 0.621.

There is some popular misunderstanding as to the meaning of the ground wave, some believing that it is a wave that actually travels through the ground. This is not the case. The ground wave is the wave that follows the surface of the earth in the space above the ground. The sky wave is the wave that leaves the proximity of the earth's surface and goes up to the Kennelly-Heaviside layer, about 400 miles up, and then is reflected back to the earth at some distance away. Sometimes the sky wave is not reflected and then there is no place on the earth where it can be received.

The variation in the transmission indicated in the charts with the season, the time of the day, and the frequency, is due to the shifting of the Kennelly-Heaviside layer. In the day time the layer is lower than it is at night; in the Summer it is lower than it is in the Winter. Of course, it is the sun that determines its altitude. If a radio wave travels a long distance through many degrees of longitude, the same night and day conditions will not prevail throughout its course. It may start in daylight and be intercepted at night, or the other way about.

Television's Status To-day

Problems to Be Solved—Reliability Predicted

Official Statement by Radio Manufacturers Association, Inc.

Following its policy to advise the public accurately regarding the progress of experiments in developing television, a statement was issued by Radio Manufacturers Association, Inc., the national industry organization. The statement, emphasizing that many engineering problems must be overcome before television can be a satisfactory means of home entertainment, was prepared by the Association's Engineering Division which includes prominent engineers working toward development of television broadcasting and receiving apparatus. The statement follows:

From such a confused mass of conflicting statements and data regarding television, only by picking out the pertinent facts from the work that has been done in the past and the facts that are presented in the present situation, it is possible to draw any conclusions regarding the future of television. These facts have been many times oversold, at times maligned and altogether misunderstood, not only by the public but by the leaders of the radio industry itself, which must sponsor this new art.

This statement regarding television is only intended to array the facts of the past and present to point out some of the future possibilities thus made apparent.

Nipkow's Beginning

As far back as 1884 there was recognized by Nipkow, a German experimenter, that to transmit visual images it would be necessary to resolve those images into elements, each element to be faithfully transmitted and re-converted into a corresponding light value at the receiving end. To do this Nipkow employed scanning discs, and later, in 1894, Amstutz, an Illinois experimenter, carried on the work in this country even further. In 1913 Jenkins of Washington started his work on the development of television, which resulted in 1925 in the showing of animated motion pictures by television.

In England, John Baird, after several years of work, showed his first pictures in 1926. In 1928 the Bell Telephone Laboratories transmitted a picture from Washington to New York, and since that time several other experimenters have been carrying forward the development of television. Prominent among these have been the RCA Victor Company, in Camden, N. J.; the Jenkins Television Corporation of Passaic, N. J.; Philo Farnsworth, now with the Philadelphia Storage Battery Company; General Electric Laboratories, in Schenectady, and U. A. Sanabria, of Chicago.

The problems encountered in accomplishing television transmission and reception have in the past been manifold.

First—The problem in the method of scanning, which started with the ordinary disc, was followed by a disc with lenses which greatly increased the efficiency. Then came the drums and discs with mirrors. Starting with a Russian named Rosing, twenty years ago, several experimenters have been using electrical principles of scanning which are utilized in the cathode ray oscillograph tube.

Second—The problem of transmission has proven to be very difficult. The light values of the elements of the transmitted picture must be converted to electrical values and then transmitted faithfully either by wire or by radio. This is only successfully accomplished by employing a frequency sideband of several hundred thousand cycles. This becomes of interest when compared with the width of a sideband for present day radio voice transmission, which is approximately 5,000 cycles. Modulation of the high carrier frequencies for the picture transmissions becomes very difficult.

Third—The reception of television signals has presented still more complicated problems. The radio television signals must be received, amplified, de-modulated and again amplified to operate a light source. Demodulation above 30,000 cycles has presented many engineering difficulties. Much work has been done on the light sources, the most common of which have been the neon discharge glow lamp, the Kerr cell and the cathode ray tube.

Fourth—The great problem has been that of securing finances. Unfortunately, companies have resorted to overstatements, lured prospects with the possibilities of television in order to sell stock, and often in these statements misrepresentations were made, with the result that the public has been very much confused as to the actual state and present possibilities of the television art.

A United Effort

It was early recognized that in this maze of television work some official organization, representing most of the television experimenters, should endeavor to crystallize as much as possible the growing embryonic art. Consequently, in 1928 a sub-committee of the Engineering Division of the R. M. A., known as the Committee on Television, under the direction of D. E. Replogle as chairman, was appointed. This committee not only embraces members of the R. M. A., but invites as guest members every outstanding experimenter. It has helped in encouraging experimenters along every line of development and in securing Federal aid in the wavelength assignment of television, and has been the only official recommended part in this country whose function has been to guide, if possible, this growing art. Due to the work of this committee, much confusion in regard to practices, terms and definitions of television has been eliminated.

The Present Situation

The present facts of television which are available are as follows:

First—For scanning, mechanical features using rotating parts are in wide use and offer a most practical means of securing passable television pictures.

Second—A direct pick-up system which has come to the front rapidly this year is that of the camera idea. This system can be used for television pick-up in a lighted studio, for outdoor pick-up, etc.

Third—A great deal of successful development has been made with the cathode ray tube system for transmission and reception. This system has proven technically sound and shows the greatest possibility. Its chief difficulties are in the production of large quantities of these systems at a reasonable cost.

Fourth—The television broadcast transmission spectrum allows only for five channels, namely: 2000 to 2100 kc, 2100 to 2200 kc, 2200 to 2300 kc, 2750 to 2850 kc, and 2850 to 2950 kc. This frequency spectrum for television is not adequate for good picture transmission on account of the very wide sideband frequency necessary for picture detail, so in addition to these bands, on the extreme short waves, 5 to 7 meters, frequencies from 35,000 to 80,000 kc have been requested for television service. Most of the present transmitters are operating in the first mentioned bands, but a few operate in the neighborhood of 46,000 to 48,000 kc.

Fifth—The reception of television has been possible by tuning with either a superheterodyne or tuned radio frequency receiver designed for television reception. Synchronized sound very often accompanies the picture transmission and it is common practice to receive the voice transmission on the standard broadcast receiver. This required two receivers for receiving synchronized sound and picture transmission. In the television receivers, mechanical scanning and cathode ray electrical scanning have been employed. The cathode ray type of scanning has been capable of excellent results and shows great possibilities for further development.

Sixth—With the present economics of broadcasting, it has been impossible to secure much data on the entertaining value of the subjects that can be broadcast due to the cost in presenting programs. The Federal Radio Commission has up to the present time considered television only experimental and will grant no commercial rights. This means that all broadcasting must be done for the experimental value only and no paid programs can be transmitted by television. This ruling has made impossible the receipt of any money in staging television programs. With commercial rights granted by the Federal Government, the problem will still be complicated as to whether advertisers will continue to assume the increased costs that television must impose for its successful operation, or whether the public can satisfactorily be taxed to bear this burden.

Problems to Be Overcome

Many problems appear which must be overcome before television can be a satisfactory means of home entertainment. The most important of these are listed as follows:

1. Greater detail should be obtained in received picture.
2. Television transmission pick-up equipment should be portable and as easily used as present day sound picture pick-up equipment.
3. Transmitting systems must be evolved which will have a satisfactory and reliable service range.
4. Receivers as simple in operation as our present radio receivers must be designed and built at a reasonable cost.
5. Quiet and satisfactory illuminated picture equipment for the home must be designed and built at a reasonable cost.

Regardless of the present problems that confront the industry, there has been enough work done to justify some predictions which can be conscientiously made.

(*Continued on next page*)

Cheap Lenses Needed

Precision at Low Cost a Television Need

By William Hoyt Peck

[*A detailed illustrated article on the new system of mechanical scanning invented by the author of this article was published last week, issue of March 5th.*—EDITOR.]

THE first cameras to be built used pinhole "lenses." A pinhole lens is nothing more than a tiny hole in a sheet of metal, pasteboard or other opaque material. Such lenses give good definition, but do not permit very much light to pass. The same principle is used in the simple scanning discs for television.

But in photography, the pinhole lens was soon abandoned, to be replaced with large lenses made of glass. The early lenses—and today's cheap lenses—permit the passage of much more light, but distort the beams which pass through portions other than the center. Optically perfect lenses, such as are used in the best cameras and projectors, do not suffer from this defect but are complicated and costly.

Inexpensive Lenses Required

Some time ago lenses made their appearance in television scanning wheels. However, when a sixty line standard image is being received the scanning wheel must contain sixty lenses. This makes it essential to use a cheap type of lens, for if optically corrected lenses were used, each wheel would cost at least $400. It is impossible to get good definition when using a wheel made up of simple lenses, due to the spherical aberration in them. Concave reflectors also give spherical aberration, and so can never prove satisfactory.

However, a reflector fully corrected and optically perfect can be made of glass at a cost of but a few cents. All the light from the original source is concentrated through a system of condenser lenses, and a small aerial image is projected at the focal point of the optically perfect glass reflector. No stray light is permitted to reach any other part of the scanner, and each of the reflectors is tilted precisely at the correct angle so that the beam of light it reflects is projected in its proper position on the screen.

Calls Reflectors Optically Correct

Further, each reflector is tilted on its nodal point so that the beam of light strikes it in exactly the same point. Contrast this with the customary lens scanning wheel, in which only lens No. 30 of the sixty used satisfies this condition.

The optically correct reflectors used in my system can be made to project a flat field at an extremely wide angle. At present the widest angle system of scanning which I have constructed will afford an image 16 inches wide when the wheel is 12 inches from the screen upon which the image is projected. This results in a very compact unit particularly adapted to use in a console cabinet for home reception of television. It is the first wide angle reflector system to do away entirely with spherical aberration, chromatic aberration and coma. It is anastigmatic and gives a flat field.

At the present television transmission systems make use of sixty lines to the picture. We employ sixty lenses. Each lens includes an angle of 6° because 60 lenses x 6° = 360° (the circle). So the vertical ratio to the 6° width would be 5° (5 to 6 ratio). Dividing 60 lenses into 5° equals 5' (minutes) for each lens in vertical shift—and as reflecting the image doubles the shift when the angle is changed, each reflector is actually shifted 2½' to get it in correct position.

Thus the image obtained is in the ratio of 5:6. In other words, we obtain a perfect image 15 inches high when 18 inches wide.

One Dial to Tune in Sight and Sound Track

By Hollis Baird

The sound to accompany a television program probably will be sent out on a special ultra-short wave-length, right beside the wavelength carrying the pictures. This will be possible in the use of ultra-short waves for television where there is sufficient room in the ether for wide bands which means pictures of great detail as well as accompanying voice channels.

The Television Committee of the Radio Manufacturers Association has already discussed the possibilities of one control television tuning on this basis. For each picture channel there will be an accompanying voice channel a certain frequency distance from the sight channel, either above or below it, this detail to be fixed by agreement. Thus all sound channels always will be the same tuning distance from the accompanying sight channels. It will then be easy to connect the tuning condensers of the television receiver onto the same shaft with the tuning condensers of the sound receiver and as one tunes to the right point on the dial, the sight and sound will come simultaneously.

By this planning of transmission coordination the television set of the future will be as simple as the one dial radio set of today. Even the present day television set does not have the complicated controls that marked the earlier broadcast receivers so that this future simplicity is easily assured.

Courageous Co-operation Called Television Need

(*Continued from preceding page*)

With the development of the new short-wave channels, at frequencies higher than 35,000 kc, reliable transmission of television can be predicted. Ample room for an adequate number of transmitting stations can be visualized in this short-wave region. It is perfectly conceivable that a sight-and-sound service can be worked out to be received on a single receiver with a simplified tuning and control mechanism.

As never before, the new art of television is going to require the rigid and sure hand of a governing body to set up the standards for both transmission and reception. Surely no better body is suited for this task than Radio Manufacturers Association, Inc., which embraces both transmitting and receiving set manufacturers. Because of this situation, television presents a real challenge to the R. M. A., which if accepted, can and will bring new prosperity to its members but only if this challenge is correctly and courageously met by the entire co-operation of its members.

Short Wave Club

The following is a list of new members of the Short-Wave Club:

Harry L. Shoemaker, 5721 Kenwood Ave., Chicago, Ill.
J. R. Ketyon, 508 Ash St., LaFollette, Tenn.
Fred Strauch, Box 209, Singac, N. J.
Joe Tagart, 3619 No. 21st St., Philadelphia, Pa.
Russell Rankins, 62 Walnut St., Mohawk, N. Y.
Robert Handley, 305 N. 2nd St., Olean, N. Y.
Smith Radio Service, 102 Waco St., Wichita Falls, Texas.
Al Birkby, 13517 Charest Ave., Detroit, Mich.
Hugh McConnell, Hamiota, Manitoba, Canada.
Charles W. Cooper, 949 N. Main St., Royal Oak, Mich.
W. Pelham, New Harmony, Indiana.
Eldon W. Payne, P. O.Box15,Hudson, N. C.
Ansel F. Lewis, Box 74, Erin, Tenn.
Chas. W. Koch, 715 28th St., Union City, N. J.
G. Tyler Byrne, 14 Lippold St., Methuen, Mass.
Ray Glancy, 340 Ferry St., Ashland, Ky.
Francis L. Rippeon, 439 W. South St., Frederick, Md.
Andrew Larkin, 835 Ocean Ave., Monterey, Calif.
Jasper McClure, Tascosa, Texas.
Arlis L. Anderson, 739 W. Maple St., Sleepy Eye, Minn.
William P. Tryon, Box 123, Chesterhill, Ohio.
E. E. Brewer, 10008 106th St., Edmorton, Alberta, Canada.
Robert C. Simmons, Leaders' Height, R.F.D. No. 9, York, Pa.
Frank Russell, P. O. Box 313, Quinton, Okla.
Julian A. Lubinski, 7332 Roland Ave., Detroit, Mich.
Simon Gordon, 562 Ashford St., Brooklyn, N. Y.
A. B. Henry, 719 S.W. 6th St., Miami, Fla.
Ernest E. Wild, Jr., Box No. 85, Hanover, N. J.

Short Wave Editor, RADIO WORLD, 145 *West* 45*th St., New York.*

Please enroll me as a member of Radio World's Short Wave Club. This does not commit me to any obligation whatever.

Name ....

Address ....

City.................................. **State**..................

Why Not Arc Lights?

Television Lamp's Modulation Discussed

By F. B. DuVall

Engineer, Jenkins Television Corporation, De Forest Radio Company

TO turn to the use of crater tubes is the natural trend of experimenters and research workers in television. The one big factor in visual reception today is obtaining a light source of sufficient intensity to permit projection of pictures. To lay minds a light source seems simplicity in itself and they wonder why a carbon arc, such as is used in theatre work, or a powerful 5,000 or 10,000 watt bulb such as is used in some projectors and searchlights, cannot be employed. If we could only use such simple instruments, we would have theatre television today, but a very important factor remains to be considered and that is the modulation of the light.

Television signals vary at the rate of 43,320 times per second in present day transmission. This means our light source must also be able to vary in intensity or brilliance 43,320 times per second. As an illustration, try to switch a lamp on and off in your home either by hand or by mechanical means, 43,320 times in one second. You will agree that it is some task. The equivalent must be done in television.

86,400-Cycle Modulating Frequency

The transmitting camera employed in television has a standard 60 hole disc rotating at 1200 r.p.m., which gives us 20 pictures per second (this in accordance with one of the practices recommended as standard by the Radio Manufacturers Association of which D. E. Replogle is chairman of the Television Section). It is used by all the Eastern stations who are broadcasting television. The frame or picture picked up by the television camera is 60 elements high and 72 elements wide, which gives us 4,320 light impulses of varying intensity to the photo-cell in 1/20 of a second. As there are 20 pictures per second, we have a modulating frequency of 86,400 cycles per second, which means the lamp or light source used at the receiver must follow faithfully that many interruptions or shadings of light to obtain a picture with a good degree of detail.

Neon tubes have been with us many years and due to their construction and placement in the circuit, follow very faithfully up to the highest frequency employed. The neon lamp has a flat plate, or cathode, and a metallic ring a fraction of an inch in back of the plate, which is called the anode. The glass bulb housing these elements contains neon gas. Neon gas has been used for many reasons, principally because it glows with an orange hue and the human eye is much more responsive and sensitive to orange than to any other color in the spectrum, and with a given amount of illumination the picture appears brighter with this color than with any other one; also the voltage necessary to ionize neon is sufficiently low so that a normal plate supply in a receiver is all that is necessary. The neon tube is a linear device. By this we mean the light given by this tube is dependent upon the current flowing through it. Therefore by placing the neon tube in the plate circuit of the power stage of a television receiver the variations in the plate circuit give corresponding variations in light, much the same as the variations in the plate circuit of a broadcast receiver produce varying sound waves which eminate from the speaker.

Goal of Experimenters

Let us again turn to figures. At any given instant for any one hole in front of the glowing neon plate we are only using 1/4320th of the total light available. If our scanning aperture is 1.5 inches and our disc is covering 1.5 inches of a glowing plate and our plate is covered by 4,320 elements, 60 high and 72 across (our mosaic built by the scanning disc), then one hole that is emitting the light is only, as we mentioned before, 1/4320th. In other words, a device that would permit the utilization of all the light at any given hole in the disc would result in increased light better than 4,320 times. Toward this end experimenters have worked to get a light source that would give the desired result.

Let us start at the beginning. Neon glows in the presence of an ionizing voltage, or voltage sufficient to break down the atoms of gas which will give up one or more electrons that will travel against the potential and create the current flow. Also in their travel, and as a result of colliding with other atoms, they vibrate at light frequencies, and being more pronouncedly in vibration at the plate of the tube cause the plate glow we see.

In experimental work it was noticed that wherever the gas was confined, such as in a crack or break in an electrode, ionization became much more intense and the resulting glow also became much more intense at this point. This gave the crater its start. With this fact in view early developers tried boring a hole in the negative electrode and surrounding it with a positive anode, which resulted in a concentrated current flow and a very intense point of light. While light was achieved, again we had a disturbing factor in the heating up of the negative electrode, sputtering, and darkening the walls of the tube.

New Tube Developed

Water cooling, large fins to radiated the heat and various other methods were tried. Some were successful but the majority were not so successful. In a new tube of large globular shape there are fins on the electrode. This combination permits ready dissipation of heat, so that in use the tube is just warm to the touch of the hand, like a —45 power tube in your radio set. The elements are far enough away from the glass not to have a darkening effect on it should a slight sputtering occur. The good feature in respect to this tube is its low current requirement. It will operate very satisfactorily in the plate circuit of two —45 tubes in parallel, or approximately 55 to 65 mils. This tube, known as the De Forest Type 604 crater tube, when used in the above mentioned circuit, will project a picture over two feet square with the proper adjustment and lens system.

Now we must have a system of conveying this light to a ground-glass screen or similar surface to present our picture. Many methods may be used, such as vibrating mirrors, stacked mirror wheels, prismatic discs, mirror drums, etc., to make our spot scan the necessary screen. A successful one is the lens disc developed by C. Francis Jenkins.

Square or Round Spot

The lenses are set in 60 holes spaced evenly radially around the outer rim or periphery of the disc and converging gradually toward the center. Each lens has the action of a pin hole camera when in proper focal relation and produces a brilliant spot of light on the screen, which spot may be either square or round, the shape being optional and set by the aperture contained in the tube proper. An aperture in the tube itself does away with the necessity of condensing lenses and apertures on the outside and makes for the conservation of space and greater illumination. The standard aperture in the 604 is .012 of an inch.

This tube is not recommended for use with the pentode tube as an output, due to the frequency discrimination exercised by the pentode with changing plate inpedance.

CATHODE RAY SCANNING

There is considerable work being done with cathode ray scanners, and many claims are made for them. The advantage of the cathode ray is that there is no limit to the speed of the scanning beam and no great mechanical difficulties. However, this scanner has disadvantages all its own. For example, the reproduced light is a weak green of the phosphorescent type, and it is accompanied by X rays. Special electrical circuits are needed to make the scanning beam move across the screen uniformly, that is, with the same speed at every point in every scanning line.

The cathode ray is a beam of electrons from a heated cathode. The electrons are given a high velocity by a positive voltage. They are made to strike a phosphorescent screen where they give rise to a light. The beam is made to move in the horizontal direction by one electric force to generate the scanning lines, and it is made to move in the vertical direction by another electric force. Ordinarily the beam moves back and forth across the screen in a zig-zag fashion. Thus the order of scanning is not the same in the cathode ray scanner as in the disc scanner. Hence a picture sent by a disc scanner cannot be received with a cathode ray scanner, for every other line would be reproduced backward. And this is not the only complication.

Nearly all scanners are reversible. That is, they can be used either for scanning the original scene or for reconstructing the image. This does not apply to the cathode ray. Hence some other device will have to be used for scanning the original when the cathode ray is used for reception.

A Question and Answer Department conducted by Radio World's Technical Staff. Only Questions sent in by University Club Members are answered. Answers printed herewith have been mailed to University Members.

Radio University

To obtain a membership in Radio World's University Club for one year, send $6 for one year's subscription (52 issues of Radio World) and you will get a University number. Put this number at top of letter (not envelope) containing questions. Address, Radio World, 145 West 45th Street, New York, N. Y.

Annual subscriptions are accepted at $6 for 52 numbers, with the privilege of obtaining answers to radio questions for the period of the subscription, but not if any other premium is obtained with the subscription.

Neon Tube in Stroboscope

IT IS my understanding that a neon glow tube that is operated on alternating current goes on and off twice every cycle. If this is the case, it seems to me that a neon tube could be used in conjunction with a stroboscope where rotating or reciprocating machinery is to be synchronized with the line frequency, or to one of its harmonics. What do you say?—F. R. R., Carson City, Nev.

The neon tube is excellent for this purpose, provided that it is powerful enough to illuminate the machinery. Since most neon tube lights are weak, it would be necessary to have the subject in the dark except for this light, or at least have the illumination subdued so that the neon lamp adds considerably to the total illumination. Any periodic motion can be studied this way, such as a chain and sprocket going at high speed, a piston, or a wheel revolving rapidly. Any of these motions can be slowed down, apparently, so that the operation can be viewed at leisure. In case it is desired to measure the speed, the lamp can be operated with a current of variable frequency, and by changing the frequency the motion can be "stopped." If the frequency is then known, the speed is known, for there is a simple relationship between the two. This stoppage is often observed in the movies when an automobile pulls into view and stops. At a certain speed the wheels appear to stand still and the spokes stand out distinctly. The intermittent light necessary to produce this stroboscopic effect comes from the projection shutter. During the dark period the wheel moves exactly one spoke, or two, or some other whole number. If the wheel turns just a little faster it appears to turn forward, and if it turns just a little more slowly it appears to turn backward.

* * *

Amplifier for Television

WHAT kind of audio amplifier can be used for amplifying television signals when the frequency range must be from about 10 to 50,000 cycles? I understand that resistance coupled amplifiers, which have the widest frequency coverage, cannot go down as low as 10 cycles nor much higher than 10,000 cycles. If that is right they certainly cannot be used for high quality television. Any suggestion would be appreciated.—G. H. A., Salt Lake City, Utah.

It is not difficult to design a resistance coupled amplifier that will go down to 10 cycles per second. All that is necessary is to use large enough stopping condensers and high enough resistances in the coupler. However, the use of high resistances in the plate and grid circuits will cut off the high frequencies, and it is very likely that not even 10,000 cycles per second can be amplified appreciably. This difficulty could be overcome by combining resistance and tuned impedance coupling. For example, if it is necessary to amplify up to 50,000 cycles, it would be possible to put in parallel tuned circuits in addition to the resistances and then tune these circuits to 50,000 cycles. This would take care of the highest and the lowest frequencies. There would be a certain range in between where the amplification would be poor. By adding other tuned circuits to intermediate frequencies the amplification at these frequencies could also be boosted. Such devices are known as equalizers of the amplification. It is not easy to do and even those who work with amplifiers all the time have difficulty in making perfect equalization over such a wide band. Another possibility is to have a series of amplifiers and filters, making each amplifier cover a certain frequency range.

* * *

Using Tracking Condenser in a Super

When using a tracking condenser in a superheterodyne should the inductance of the oscillator coil be equal to or smaller than the r-f coils? I have such a tracking condenser and have built a superheterodyne with it but so far I have not been able to get much sensitivity or selectivity out of the receiver. Is it necessary to do any padding when a tracking condenser is used?—R. E. Y., St. Paul, Minn.

What size inductance to use in the oscillator depends entirely on the cut of the plates in the oscillator condenser. They are usually cut for one intermediate frequency and one particular inductance, as well as for one frequency range. That is, a tracking condenser may have been built for a frequency range of 550 to 1500 kc, for an intermediate frequency of 175 kc, and for an inductance of 240 microhenries. There is no reason why such a tracking condenser can be made so that all the inductances are the same, but whether a particular condenser is so made or not no one can say without testing it. In your case try equal inductance in all the tuned circuits, that is, in the oscillator as well as in the r-f tuners. Then try the circuit on different signal frequency in the band covered by the tuner. If the circuit is sensitive and selective throughout you probably have the right combination. If you have a calibrated oscillator calibrate the r-f and the oscillator circuits separately and note whether the oscillator is always higher than the r-f at every setting of the dial. If the i-f is 175 kc, the oscillator should always be 175 higher than the r-f. If this turns out to be the case and the circuit is still unselective and insensitive, check the intermediate frequency tuning. The i-f tuner may not be tuned to 175 kc. In fact, this test should be made first.

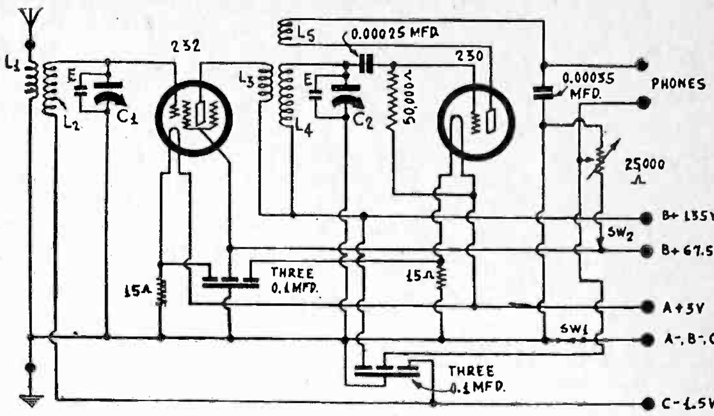


FIG. 994
This little circuit is suitable for reception with headphones. It is sensitive, capable of compactness, and economical to operate.

* * *

Greenwich Time to Local Time

WILL you kindly give a simple rule by which Greenwich Civil Time can be changed to local meridian time?—T. H. L., Marion, Ind.

GCT begins at midnight and runs to midnight from 0000 to 2400. The first two figures are hours and the last two are minutes. Greenwich time is earlier than local time in the western hemisphere by an amount depending on the longitude of the locality. Suppose you are located at 80 degrees, 30 minutes west longitude. One hour of time is equivalent to 15 degrees of longitude. Therefore divide your longitude by 15 to get the number of hours time difference. In the assumed case the longitude is 80.5 degrees and therefore the time difference is 80.5/15, or 5.36 hours behind Greenwich time. But 5.36 hours equals 5 hours and 21.6 minutes. This number of hours and minutes should be subtracted from Greenwich Civil time. If the resulting time is less than 12, the local time is a. m. If the resulting time is more than 12, subtract 12 and call it p. m. Thus if GCT is 2300, we have 5:78.4 p. m. local time on the 80:30 W. meridian. In the United States and Canada we are never using local time, but Standard Time. The time zones are the 75th, 90th, 105th, and the 120th meridian times, respectively EST, CST, MST, and PST. The respective time differences are 5, 6, 7, and 8 hours. If the time zone boundaries were exact in all cases, any locality having a longitude of 80:30 W. would come in the EST zone and we would use 5 hours instead of 5 hours and 21.6 minutes. In any case subtract the number of hours of time difference from GCT. If the time is less than 12, the result is a, m,; if the number is greater than 12, subtract 12 more and call it p. m. Thus when GCT is 1800, the time in the MST zone is 18:00—7:00, or 15:00. This is greater than 12. Hence the time is 3:00 p. m. MST.

* * *

Headphone Receiver

KINDLY publish a circuit of two tubes of the two volt variety in a regenerative hook-up. Headphones will be used for listening in. Please indicate all values on the diagram.—R. C. W., Cleveland, Ohio.

Fig. 994 depicts such a circuit. All the values are given except those pertaining to the tuners. There should be one r-f coil and one three circuit tuner, and the condensers should be matched to the coils. The trimmer condensers E are not needed if the two tuning condensers are controlled separately.

* * *

Winding Data For Plug-in Coils

HOW many turns of No. 24 enameled wire will be necessary to form an inductance on a 1.25 inch plug-in coil that will tune in the broadcast band with a 350 mmfd. condenser?—J. M. B., Brooklyn, N. Y.

You will need 160 turns, and this will make a winding nearly 3.5 inches long. It is not practical for a plug-in coil. It is better to use finer wire. No. 30 enameled wire would require 104 turns, the length of the winding being 1.16 inches. This leaves room for the primary or the tickler.

A THOUGHT FOR THE WEEK

RADIO WORLD is not a luxury. It is a publication of value and service. Please always bear that in mind.

RADIO WORLD

The First and Only National Radio Weekly

Tenth Year

Owned and published by Hennessy Radio Publications Corporation, 145 West 45th Street, New York, N. Y. Roland Burke Hennessy, president and treasurer, 145 West 45th Street, New York, N. Y.; M. B. Hennessy, vice-president, 145 West 45th Street, New York, N. Y.; Herman Bernard, secretary, 145 West 45th Street, New York, N. Y.
Roland Burke Hennessy, editor; Herman Bernard, managing editor and business manager; J. E. Anderson, technical editor; J. Murray Barron, advertising manager

Television Assayed

FROM the statement of Radio Manufacturers Association, Inc., it is plain that, despite technical advances, television is having tough sledding. It costs money to maintain transmitting stations and furnish programs of sufficient interest, and as the Federal Radio Commission so far has refused to permit any paid advertising on television programs, the experimental agencies themselves have had to bear all the cost. The statement may be read as a suggestion to the Commission that it remove television from the purely "experimental" classification that prohibits paid advertising. Even so, the proceeding would be in the nature of a test, the statement sets forth, since it is not known how far advertisers will go in bearing the mounting cost of putting on acceptable programs.

While the technical difficulties that still exist are frankly stated, and encompass the entire process from beginning to end, nevertheless recognition is given to what has been accomplished, the lens disc coming in for favorable side reference because of the greater efficiency compared to the peep-hole type. However, the statement did not sufficiently stress the recent emergence of television from a peep-hole stage to projected pictures, with good definition up to 5x6 inches. The statement surveyed television in the light of a commercial service finally to be rendered to the public. Such service must afford projected pictures, and here we have projection in our midst, of such pretensions as the transmission permits. Nor was anything said about the necessity for a greater number of scanning lines than the 60 now most popular, for the number of lines is, in a sense, a measure of the definition of the picture.

The statement, as a whole, is an excellent one, and though coming from a committee composed of leaders in television endeavor, who have their fortunes tied up in the television undertaking, it is sensibly conservative. A dig is made at those who have over-rated television for exploitation purposes, principally sale of stock, while the statement itself seeks neither to overrate nor understate. In fact, a quite hopeful prophecy is made—"reliable transmission of television can be predicted."

And so indeed it can, with justice. The national trade body believes that because of the great width of the sidebands required for good pictures the future lies in the ultra frequencies, and mentions favorably the possibility of sight-and-sound service from a single receiver. On the ultra waves this could be done by having the sound track near enough in frequency to the vision carrier so that the wide-band receiver would bring in both, the output being divided, so that the vision goes to one audio channel, and the sound to another.

The statement is a frank admission that television at present is not good enough for the general public, but predicts that it will become good enough in time, and that finally it will resolve itself into cathode ray scanning and ultra frequency transmission.

Range Defined

THE Bureau of Standards has done excellent work in plotting the results of reception, so that from charts it is possible to obtain some data on the average coverage, considering frequencies, time of reception and distance. While many of the data are the result of actual tests, some are interpolative, hence possibility of errors is admitted. Nevertheless the charts represent a real contribution, as little work of this nature has been done, and the correlation serves a guiding purpose to all radio experimenters.

The effect of the Kennelly-Heavyside layer on transmissions on different frequencies is pointedly brought out, and it is encouraging again to find that the layer is and does as was expected. Only six years ago there was a hot debate among radioists as to whether the layer existed. Many called it a pure fiction. Since then the fact has been confirmed not only that there is such a layer, but indeed that it is twins!

SUNDRY SUGGESTIONS FOR WEEK COMMENCING MARCH 13, 1932

Sun., March 13: Footlight Echoes, WOR, 10:30 p. m.
Mon., March 14: Evening in Paris, WABC, 9:30 p. m.
Tues., March 15: Billy Jones and Ernie Hare, WJZ, 7:45 p. m.
Wed., March 16: Big Time, WEAF, 8:00 p. m.
Thurs., March 17: Golden Blossoms, WJZ, 8:30 p. m.
Fri., March 18: Corse Payton's Stock Co., WOR, 8:30 p. m.
Sat., March 19: Leopold Stokowski, WABC, 8:00 p. m.

HAROLD SMITH SUCCEEDS DAVIS

Harold Smith, vice-president of the Westinghouse Electric & Manufacturing Company, was elected a member of the board of directors of the Radio Corporation of America to fill the vacancy caused by the recent death of H. P. Davis.

Forum

I read with much satisfaction that Congress is taking steps to curb commercial advertising over the radio. Everybody reads newspapers and magazines, which are the legitimate media for advertising. Why should these business fellows resort to the radio, airplane, theatre, and every other agency under the sun to advertise their wares? Why should our religious and home joys, our meditations, our intellectual and aesthetic pleasures and satisfactions, our finer instincts, in short, our whole life, be drowned in a muddy flood of commercial exploitation? "Is not the life more than meat, and the body than raiment?" Does the advertising of some tawdry gimcrack over the radio afford us a thousandth part of the pleasure we feel when we hear one of Mozart's divine melodies? Who that has a soul one size larger than a rat, takes as much pleasure in eating and drinking, in fine clothes and a handsome house, as he does in a kind thought, in a good impulse, in a quiet conscience, in good work well done, in beautiful music, in noble writing, in some soul-stirring inspiration whose home is not on earth? There is no money in any of these things; therefore they are not advertised much. But every man knows in the best part of his heart that without some of these mental and spiritual joys and satisfactions, life would not be worth living. They are the fences that separate the kingdom of men from the herds and hordes of animals.

Some one said that one good thing about radio is that it has helped to reintroduce people to their homes. But a home is a place where members of families enjoy loving and instructive communion with one another. This communion cannot be enjoyed in an atmosphere of bank, factory, and shop talk, and in a blare of "jazz," cheap songs and cheap music, and the vaporings and gibberings now heard.

CHARLES HOOPER,
Cour d'Alene, Idaho.

Flechtheim Introduces Television Condensers

A. M. Flechtheim & Co., Inc., of 136 Liberty St., New York City, manufacturers of a complete line of paper-dielectric condensers, announce that their new 7,000 volt type ZX transmitting units are fast finding favor with television stations.

For the television receiver and amplifier, the Flechtheim company has introduced a brand new type of 1,000 volt filter condenser, of the very smallest physical size. Most useful in capacity-resistance coupling, as well as in the filter circuit, these units known as type HSM, are widely employed.

The latest catalogs, No. 23 and No. 24A, containing useful information regarding all types of condensers for various circuit requirements, will be sent on request.

STATION SPARKS

By Alice Remsen

An Old-Fashioned Garden

For the Yardley Program

WJZ, Sundays, 2:00-2:30 p. m.

The rose is opulent and gay;
The lily is a lady;
The violet loves to hide away
Where it is cool and shady;
The sunflower flaunts its sturdy head
Above the lovely garden;
The snowdrop droops itself instead,
As if to beg your pardon.

I love the lily's sweet perfume;
I love the blushing rose;
I love the daffodils in bloom;
And every flower that grows;
But one is dearer than the rest;
A tiny little thing,
In quaint, old-fashioned garment dressed,
And modest coloring.

But oh, it is so fresh and neat—
The charming flower of lavender;
Its perfume is so clean and sweet—
I love old English lavender.

—A. R.

* * *

And Just as Charming as the lavender sold by Yardley is the program which the concern sponsors on Sunday afternoons. It is so refreshing to hear the delightful characterizations of Beatrice Herford, in her internationally known monologues, for they are cleverly written and delivered in an authentic comedy style peculiarly her own. The music of Mischa Levitzki, distinguished American pianist, who alternates every other week with the London String Quartet, is inimitable. A program that is easy on the ears. Take my advice and listen to it.

* * *

Station KMOX, "The Voice of St. Louis," is now installing what, so it is said, will be the largest organ in the world. It is a four-manual Kilgen of concert type, with diapason and Reed choruses and a full complement of strings and woodwinds, with such solo stops as French horn, orchestral oboe, tuba mirabilis, solo violin, etc., all built up into a most interesting and legitimate concert ensemble.

* * *

Frank and Flo, Well-known Radio Comedy Team, have returned to the air via WOR. They may be heard every Monday night at 10.00 p. m. Frank and Flo have known each other all their lives, were schoolmates together and later drifted into vaudeville as Cronin and Hart.

* * *

Another Vaudeville Team Recently Recruited for Radio is Burns and Allen, who are now featured on the Robert Burns broadcast, with Guy Lombardo's orchestra on Mondays at 10:00 p.m. over WABC. In private life, George Burns and Grace Allen are Mr. and Mrs.

* * *

Allyn Joslyn, leading man of the "With Canada's Mounted" programs and actor on many other radio dramatic programs, is an accomplished continuity writer. Several of his scripts have been produced on the air, outstanding among them being the well-remembered "Shades of Don Juan."

* * *

Another New Series of Programs of Outstanding Merit is the Dupont half-hour, "Today and Yesterday." They offer musical and dramatic highlights of the past and present, presented over WABC and network from 8:30 to 9:00 p. m., E. S. T., Fridays.

* * *

There Is a Change of Talent on the Sylvanians Program. Ernie Golden and his orchestra are now featured. The Rondoliers Quartet will be heard and an added feature is the "Forty Flying Fingers," a piano quartet playing two pianos.

* * *

Norman Brokenshire Has Returned to the Air. He will be known as "Society's Playboy." Featured with him will be Welcome Lewis and Nat Brusiloff's Orchestra. The period is sponsored by Society Brand Clothes and may be heard each Tuesday, at 10:15 p. m., over WABC.

* * *

Clever Billy Jones and Ernie Hare are also back on the air with a three-year contract for Best Foods, Inc. They may be heard every day except Saturday and Sunday, at 7:45 p.m., over WJZ.

* * *

Herman Hupfield, Composer of "When Yuba Plays the Tuba," believes in dressing for the occasion. When he sang his latest opus, over WABC recently, "Baby Likes a Blue Suit Best of All," he not only wore a blue suit, but his shirt, tie, collar, handkerchief and socks were of azure hue.

* * *

Recently, at One of the National Vaudeville Artists Concerts, given every Thursday night at their Clubhouse, I heard a remarkably sweet voice singing Il Bacio. It seemed to me that I recognized the pretty little lady who was singing so charmingly. Upon further investigation I discovered I did know her. Her name is Dorothy Cartier and she broadcasts every Sunday evening over WOR with me on Footlight Echoes, as a member of the Roxy Ensemble. She is quite youthful, and with her good looks, sweet voice and such a clever teacher as Maud Marion Tracy, little Dorothy Cartier should go very far in the field of music.

* * *

And Speaking of "Footlight Echoes," what a great galaxy of stage stars graced the hour on the evening of February 28. William A. Brady as the spokesman, introduced such traditional names as Laurette Taylor, Alice Brady, Ruth Gordon, Selena Royal Bert Lytell, Roxy, Earl Carroll, Basil Rathbone, Ernest Truex, Paul Muni, Osgood Perkins, Henry Stephenson and many others. All these good people came down to WOR to speak against the proposed legislation of a further tax on amusements, and they did their job well. Mr. Brady, always a good friend of actor folk, was utterly sincere in his pleading to the public and it is to be hoped that the appeal will have a good effect. I was entirely overwhelmed at the idea of being surrounded by a million dollars worth of artists and producers, but they were all quite dears and very much in earnest.

* * *

Sidelights

THE PICKENS SISTERS are real sisters, from Georgia, and can they sing? Oh, boy! . . . FRED BERRENS, and TESS GARDELL (Aunt Jemima) are making a series of electrical transcriptions . . . ARTHUR ALLEN took his first vacation in two years recently—he had his phone disconnected . . . RAY KNIGHT is working on a new series of radio scripts, burlesques of course, entitled "Making the Movies" . . . ERNIE HARE was once a traveling salesman . . . ALICE JOY'S hobby is deep-sea fishing . . . MARIA CARDINALE wears a different evening gown for each of her Golden Blossom broadcasts . . . PHIL COOK sits on a high stool while broadcasting . . . EMIL COTE had been, at different times, an electric rivet welder, a paymaster, bookkeeper and private secretary before he became a radio bass . . . GEORGE HICKS, N. B. C. announcer, was a schoolmate of Robert Short, the American aviator killed while fighting with Chinese forces in Shanghai . . . GRAHAM MacNAMEE and GRANTLAND RICE have worked together on the Coca-Cola program for two years . . . CESARE SODERO invariably wears an old-fashioned white wash tie . . . BILLY JONES, of Jones and Hare, once worked in a bank, tended sheep in Wales, mined ore, worked on telephone poles and sang in vaudeville . . . MARION HARRIS loves London; she thinks it is so "quaint" . . . LEE SIMS cannot play piano unless his hands are wringing wet. He keeps a wet cloth on the piano when he plays and moistens his hands constantly . . . FORD BOND, N. B. C. announcer, wrote "Drifting 'Neath the Moon," used by Nat Brandwynne as a theme song . . . ROSARIO BOURDON wrote the "Cities Service March" . . . KEITH McLEOD composed "Slumber On" . . . RAY PERKINS wrote "Soft White Hands," the theme song of the Jergens program, which he himself sings and plays.

* * *

BiographicalBrevities

A Few Facts About Phil Dewey

His real name is Philip Duey, but he's given up trying to convince people. This name was bestowed upon him by his Pennsylvania Dutch father when the Reveler's baritone was born on a farm near Macy, Indiana, in 1902.

Phil was the youngest of eleven children, and with his brothers and sisters he made a regular procession to and from a typical little red schoolhouse each day. At this time, Duey Sr., led the village band of fifteen pieces. In his home, too, Phil's father had a musical group made up of the family, and it was here that his first love for music was implanted in the heart of the handsome, wavy-haired country boy. Phil played a guitar in the home ensemble, and still plays that instrument once in a while.

Phil worked his way through Indiana University for six years and managed to get his A.B. degree, in addition to earning the right to wear a Phi Beta Kappa key. Then he tried out in Chicago for a fellowship at the Juillard Musical Foundation. and married four weeks before learning of the successful outcome of the award which eventually brought him to New York. Then his mind was made up to follow a singing career and he has done so ever since. In spite of being the youngest of eleven musically inclined children of musically inclined parents, Phil is the only one who is now a professional musician. He is kept so busy with his singing over N. B. C. networks with the Revelers and his solo programs, that he has been able to return but twice in five years to his Indiana home. Before entering radio he was with the cast of "Lady Do." When this show closed he sang for several months with "Good News." While in this show he was called to fill the place of a baritone in a broadcasting quartet. Shortly afterwards he signed with the National Broadcasting Company and has been heard on its networks ever since.

Phil is happily married and is the father of two children, James Philip, five years old, and Barbara Nell, thirteen months.

* * *

(If you would like to know something of your favorite radio artists, drop a card to the conductor of this page. Address: Miss Alice Remsen, care Radio World, 145 W. 45th St., New York, N. Y.)

WIXG PREPARES FOR 24 IMAGES, USING 120 LINES

Boston.

W1XG, operated by the Shortwave and Television Corporation, of 70 Brookline Avenue, on 45 megacycles, and which is now operating, with 60-line pictures, 20 pictures per second, is installing equipment for 120-line scanning, 24 pictures per second. Thus the motor would have 1,440 revolutions per minute.

The station is not operating on a regular schedule yet, but it is expected that it will do so soon after the new scanning method is actually introduced. Now the station operates spasmodically, day or night, and sends either pictures or voice, as the operation is entirely experimental for the present.

In line with the expectation that the future of television lies in the ultra frequencies, the station is concentrating efforts on the perfection of service in this frequency area.

Better Pictures

The fact that closer scanning is about to be used is an indication also of the improvement of the pictures. If the number of lines is doubled, as now proposed, the brightness of the spot of light has to be quadrupled to get the same effective illumination result. Also the greater number of lines will result in better definition, and larger pictures may be enjoyed, although also the illumination has to be squared as the size of the picture is doubled.

The closer reduction of the spot of light toward a point provides the necessary increased brightness, provided the spot is no more than ¼ the size it previously was. Thus the lamp itself need not provide any greater quantity of light, but whatever it does emit has to be reduced to a spot ¼ the former area. However, the improved definition is looked forward to with eagerness, as the present 60-line basis does not well support a projected picture of a size greater than 5x6 inches.

24 Pictures per Second

The increase in the number of frames per second is for better illusion of motion. Formerly the moving picture industry used 16 pictures per second, but at present uses 24 per second, as a rule, the greater number having been accelerated by sound track requirements. Thus television, with 24 pictures per second, will be to that extent on the same basis as the movies.

A synchronous motor may be used, and if so the number of revolutions per minute will be unique with this station.

The number of revolutions per minute is the product of the number of frames per second and the number of seconds in a minute. Most stations use 20 frames and hence a speed of 1,200 revolutions per minute. W6XOA, Los Angeles, Calif., uses 80 lines and 15 frames, and therefore it requires a speed of 900 r.p.m. W9XAP, Chicago, and W9XD, Milwaukee, use 45 lines and 15 frames, and they also require a speed of 900 r.p.m.

At present W1XG uses W1XAU, on 1550 kc, as sound track. W1XAU also is owned by the Shortwave and Television Corporation and is the sound track likewise for the 1,600-1,700 kc transmissions of sight from W1XAV, for which sound is broadcast from 9 to 10 p.m., E.S.T. on Monday, Thursday and Friday.

The 1,550 kc sound track channel was recently allotted by the Federal Radio Commission, replacing 1,604 kc.

Art Is Exhibited Over Vision Station

The first television art exhibit went on the air recently when Malcolm Vaughn, art authority, brought his pertinent comments on the Loan American Portrait Exhibit by contemporary artists, to the radio audience via WINS, New York, and at the same time reproductions of the canvasses were shown over W2XCR.

The exhibit, held at the Anderson Galleries, was for the benefit of free coffee stations for the unemployed, a division of the Free Milk Fund, sponsored by Mrs. William Randolph Hearst. Among the canvases shown before the televisor were those depicting John D. Rockeeller, by John Singer Sargent, Judge Cardozo, by Augustus Vincent Tack, and Mrs. Grace Coolidge, by Leon Gordon.

SEEK TO SEND FROM DOG SLED

Washington.

Radio transmitters may be carried on dog sleds to facilitate communication with a new scientific expedition to the Far North if the Federal Radio Commission grants an application made by Commander F. M. Williams, Brooklyn, N. Y., who is to lead a future American Polar Expedition. The object of the radio test in the polar regions is to determine the feasibility of using radio communication between the parties in the field and their base. Radio will only be used where there is no other means of communication.

In the proposed tests, the transmitter would be operated in communication with NKF, Bellvue, Anacostia, D. C., and with W2XV, Long Island City, N. Y. In communicating with NKF the portable transmitter would use 8,030 and 4,015 kc; with W2XV the frequencies 17,300, 8,650, and 4,795 kc would be used. The call letters of the portable station would be WIOX.

SOUND TRACK BY WINS IS IN BROADCAST BAND

WINS, New York City, claims to be the only station operating within the broadcast band to present programs synchronized with television on a seven-days-a-week schedule. Other television stations have their sound accompaniment in the short-wave band. WINS presents daily television matinees from 3 to 5 p.m. in synchronization with W2XCR.

KTBS 88TH NBC MEMBER

KTBS, Shreveport, La., has been added to the Southwest Group of the National Broadcasting Company networks. The station is owned and operated by the Tri-State Broadcasting System, Inc. It operates on a wavelength of 206.8 meters, 1,450 kilocycles, with a power of 1,000 watts. KTBS brings the total of NBC network stations to eighty-eight.

TWO LICENSED FOR NEW TESTS OF TELEVISION

Washington.

Construction permits for two new visual broadcasting stations whose proposed plan of research is expected to result in "substantial contributions to the development of the art of visual broadcasting" were granted by the Federal Radio Commission.

The stations, one in Michigan and one in Ohio, propose to spend $25,000 each in an extensive program of experimental research of television transmission on low, intermediate and very high frequencies, the Commission stated in announcing its decision, pointing out that because many of the suggested experiments either have proved unsuccessful or have not yet been reported, "it is important to the art that observations and studies be made along these lines."

Experiments to Be Conducted

Applications for the permits were filed by WJR, The Goodwill Station, Pontiac, Mich., and The WGAR Broadcasting Company, Cuyahoga Heights Village, Ohio. Experiments will be conducted on frequencies between 2000 and 80,000 kilocycles, and the stations will operate with power of 500 and 200 watts, respectively. Recognized television experts and engineers will be employed to carry on the tests, according to "The United States Daily."

The program of research involves making observations in space effects, including shadows, skip distances, fading, etc., and, so far as the very high frequencies are concerned, the effect of reflection and obstacles in the way of direct line of sight.

Transmission Over Water

Because the Cleveland transmitter is so near Lake Erie, there will be opportunity to observe the effects of transmission over water, and to make comparisons with results obtained from experiments at Pontiac, where transmission conditions are regarded as unfavorable.

Tests will be made to try to determine what can be accomplished by reflection on the very high frequencies; to try out the effect of reflectors, both on the producing of larger field intensities and with regard to possible shadows on transmitters; and to carry out certain equipment experiments with receiving apparatus in an attempt to eliminate flicker. Experiments will be made also with a cathode ray to try to eliminate the scanning discs.

The Commission's decision sustained the recommendation of Examiner Elmer W. Pratt.

Powertone Manufactures Light Portable Amplifer

Powertone Radio Laboratories, Inc., 56 Vesey Street, New York City, have developed a new type light-weight portable amplifier for use in conjunction with home talkies, small halls, auditoriums and public address systems. The amplifier, which weighs 20 pounds, is made in a small carrying case and includes input transformer, a-c amplifier, dynamic speaker, and microphone, with connection for phonograph pick-up. The approximate dimensions of the portable amplifier, a number of which are already in use, are 15x15x12.

MORE RELAYS TO ALIEN SOIL AID GOOD-WILL

Washington.

Programs emanating from United States broadcasting stations will in the near future, be relayed regularly to all foreign countries, thus promoting good-will and bringing this country closer than ever before to other sections of the world, according to Commissioner Harold A. Lafount, of the Federal Radio Commission.

"Development of relay broadcasting in the United States is progressing rapidly," he said, "and it seems almost certain that our broadcasts will reach to the farthest corners of the world, bringing American good will, and American interests to stimulate more intimate contact with foreign countries."

The most recent sanction by the Commission of relay broadcasting to foreign countries, came when permission was granted the Isle of Dreams Broadcasting Corporation, Miami Beach, Fla., to erect a new relay broadcasting station to serve the West Indies and Central and South America. In granting the application the Commission said "it appears probable that such service will result in promoting good will and commerce between these countries and the United States."

In all, 25 relay broadcasting stations are now in operation in this country, nearly all of them in the East, serving countries across the Atlantic or south of North America. Seven of these operate on 40,000 watts.

Langmuir Is Awarded $10,000 Scientific Prize

Irving Langmuir, research chemist and physicist, and associate director of the Research Laboratories of the General Electric Company, at Schenectady, N. Y., is this year's winner of the Popular Science Monthly Annual Award of $10,000 for notable scientific achievement.

Dr. Langmuir's scientific career covers a period of a quarter century. Today, he is one of the foremost American physicists, noted for his contributions to the knowledge of atomic structure; the theory of the single molecular layer; the heat of atomic hydrogen and its application to electric arc welding; the effects of gases on electrically heated filaments as applied to gas-filled tungsten lamps, and the laws of electron emission as applied to radio and other vacuum tubes.

From the practical point of view, Dr. Langmuir's outstanding achievement is his invention of the nitrogen-filled incandescent electric light bulb. This improvement has reduced by fifty percent the cost of more than half the electric current bought in the United States for lighting purposes. It saves the American public more than a million dollars a night on its billion-a-year electric light bill.

CORPORATION FINANCIAL REPORTS

Baim Bros. Radio Co., Brooklyn, N. Y., capital reduced from $180,000 to $40,000.

Air-Way Electric Appliance Corporation—Year ended Dec. 31: Net loss after depreciation and taxes, $316,376, against net profit of $563,192, equivalent, after preferred dividends, to $1.07 a share on 400,000 common shares, in 1930.

McGraw Electric Company—Year ended Dec. 31: Net profit after all charges and Federal taxes, $188,931, equivalent to 75 cents a share on 250,000 no-par shares, against $405,383, equivalent to $1.62 a share, in 1930.

PETITIONS

Norman Brokenshire, radio announcer, Pelnord Apartments, Pelham, N. Y.—Liabilities, $8,205; assets, $614.

Literature Wanted

Readers desiring radio literature from manufacturers and jobbers concerning standard parts and accessories, new products and new circuits, should send a request for publication of their name and address. Send request to Literature Editor, Radio World, 145 West 45th Street, New York, N. Y.

Ernest Guevara (also "B" eliminators, set analyzers, etc.), 4711 47th Ave., Woodside, L. I., N. Y.
John C. Meyer, 310 Starr St., Chicago, Ill.
Jule Homa, 232 Chadwick Ave,. Newark, N. J.
D. H. Wantling, 508 Knoxville Ave., Peoria, Ill.
J. C. Herberg, 1176 Conway St., St. Paul, Minn.
James C. Kadlec, 2709 S. Homan Ave., Chicago, Ill.
C. D. Justis, Newport, Del.
A. B. Henry, 719 S.W. 6th St., Miami, Fla.
Julian A. Lubinski, 7332 Roland Ave., Detroit, Mich.
Roy Rosenbury, 1013 Fourth St., S.W., Canton, Ohio.
George B. Dinsmore, 740 Leonard St., Grand Rapids, Mich.
Joseph S. Hurt, R. R. No. 2, Charlestown, N. H.
George Sotos, 212 2nd St., Dundee, Ill.
Eldon W. Payne, P. O. Box 15, Hudson, N. C.
Chas. H. Dupont, 1218 Rutledge Ave., Cincinnati, Ohio.
Eugene S. Just, 1249 Edison Ave., Bronx, New York, N. Y.
Herbert Ferguson, R.F.D. No. 2, Beverly, Ohio.
Harmony Radio Concern, W. Pelham, Mgr., New Harmony, Ind.
Smith Radio Service, 102 Waco St., Wichita Falls, Texas.
Charles Schwerin, 3339 Portola St., N.S., Pittsburgh, Penna.
J. J. Boyd (Midget receivers and parts), c/o W.T.U. Co., McCamey, Texas.
Jacob Zar, 874 43rd St., Brooklyn, N. Y.
Clarence L. Dodge, 12 Main St., Springfield, Vt.
Dean Madison, Ashkum, Ill.
S. E. Gum, Box 122, Wheeler, Texas.
Gus. Lundstrom, 3320 Washington St., Jamaica Plain, Mass.
E. Ferguson, Radio, SS. Edgar Luckenbach, c/o Luckenbach Gulf Steamship Co., 810 Union Street, New Orleans, La.
H. Bernardina, 125 S. Division St., Buffalo, N. Y.
B. F. Lee, c/o Spray "Y," Spray, N. C.
Hartwell Brown, St. Mary's, Ont., Canada.
H. O. Thompson, Box 1062, Calexico, Calif.

Tradiograms

By J. Murray Barron

John F. Rider, 1440 Broadway, New York City, announces a monthly magazine, "Service," exclusively for the radio service man. It will be sold only by subscription, $1 a year.

* * *

Try-Mo Radio Corp., 177 Greenwich St., gave a public demonstration of how to hook up and use the R.C.A. microphone which they are now featuring. It was very surprising to learn the amount of real entertainment that can be had from the various hook-ups. There is some interesting literature.

* * *

S. S. Shier, an old timer in radio, has opened a new store at 89½ Cortlandt St. Parts and general radio merchandise are carried. There is a catalog for the experimenter and service man.

* * *

D. Van Nostrand Co., 8 Warren St., will move their retail book department to a new store at 123 Church St.

New Incorporations

Embassy Music and Radio Shop, Robbs Ferry—Atty., B. J. Taylor, Port Chester, N. Y.
Transcontinental Recording Corp., radio—Attys., Longo & Pinto, 66 Court St., Brooklyn, N. Y.
Europa Radio and Television Corp.—Atty., H. R. Berlinke, 551 Fifth Ave., N. Y.
Radio Electric Service Co., Inc., Wilmington, Del., radios, wireless sets—American Guaranty and Trust Co., Wilmington, Del.
Ambassador Radio Co., New York City—Atty., G. Sapan, 50 Court St., Brooklyn, N. Y.
Television Clubs of America, New York City—Attys., Miller, Fieldman & Paul, 276 Fifth Ave., New York, N. Y.

* * *

Designation

Stanford Products, California, Electric Accessories, 3,000 shares no par. The Secretary of State is named as representative.

'DOUBLE CHECK' IN WGY'S NEW TRANSMITTER

Schenectady, N. Y.

WGY, the General Electric Company's broadcasting station, has begun installing at South Schenectady one of the most modern 50-kilowatt broadcasting transmitters in the United States. The work is to be completed by May 8th.

This transmitter is designed by General Electric radio engineers for improved operating characteristics, particularly as regards frequency stability, quality of transmission and continuity of operation.

Dual Crystal Control

In the new transmitter the signals pass through a power amplifier, the first stage of which employs a 50-watt tube. The second stage consists of two 250-watt tubes operating in push-pull. After passing through this stage, the signals attain a voltage level equivalent to ten times the voltage of the ordinary lighting circuit, and the power developed is greater than that required to operate three ordinary radio receivers. Improved operation has been effected in the power amplifier circuits so that the correct phase relationship of the various frequencies is maintained. Important from the listeners' standpoint is the fact that the radio frequency for the transmitter is obtained from one of two crystal-controlled oscillators. Both oscillators are operated continuously day and night and are instantly available for use. The highest degree of frequency stability is attained, and provides maximum assurance that interference with other high-class stations will not be experienced.

From the 50-kilowatt stage—with a maximum rating of more than 200 kilowatts—combined currents are sent to the antenna over a new type of three-wire transmission line and are then broadcast to the radio audience.

Two Modulation Checks

The new remote control room will be equipped with special monitoring loudspeakers which may be connected at various points in the circuit for direct quality checking by ear. Volume controls will be used for maintaining the audio currents within predetermined limits. Two different types of modulation indicating devices are provided for checking the modulating process. One of these is an oscillograph of special design by means of which either visual observation or permanent recording of the combined currents may be made. The second device is a modulation alarm indicator equipped with an automatic alarm mechanism, so that when a predetermined degree of modulation is exceeded, it is immediately called to the operator's attention by a buzzer. These precautions are elaborate, but recent tests have shown that if the modulation is allowed to exceed one hundred per cent, an additional range of audio frequencies is produced which not only causes a loss of efficiency but may cause interference in adjacent channels because of the increased width of the sidebands.

WESTINGHOUSE SUPPLY CO. TO HANDLE KOLSTER SETS

Kolster sets will be sold in continental United States by the Westinghouse Electric Supply Company and a group of electric wholesalers doing business with that company.

ORGANIC TEST OF RADIO LAW AGAIN REFUSED

Washington.

The Supreme Court of the United States for the second time has refused to review the case of WMBB-WOK, Chicago, jointly operated stations ruled off the air by the Federal Radio Commission a few years ago as not rendering public service. The stations were joinly operated by the American Bond and Mortgage Company and Trianon, Inc., the latter concern using it in conjunction with the Trianon Ballroom.

Questions affecting the constitutionality of the radio act were raised, but they never got before the court for definite action. The court held that the questions raised were too broad.

When the stations were refused a license renewal they announced they would continue on the air nevertheless, instead of appealing to the Federal District Court, the legal procedure. Thereupon the Federal Government got an injunction, the station plants were shut down, and the present action was the result of appeals from the injunction rulings.

Thus the question of the constitutionality of the radio act, which has never been specifically decided by the Supreme Court, is left still undecided. However, there are two other cases which are in the process of an attempt to obtain a ruling, and in which the constitutionality question is raised.

RSL Converter

A new type inexpensive short-wave superheterodyne converter designed especially for late type of receivers using a pentode tube is manufactured by Radio Service Laboratories, Inc., Clinton, Iowa. The converter employs two of the new type two-volt tubes. The filament and plate voltages are obtained from the pentode tube socket. A special plug is provided.

A switch arrangement is used so that either the short-wave or regular broadcast programs can be had without the necessity of making any changes. Two separate tuning condensers are used on the greatest selectivity and sensitivity. A vernier dial is used for the oscillator condenser. The converter is unique in design and of a small size so that same can be easily placed to operate with most any type of receiver. Three plug-in coils are used to cover from 15 to 200 meters. The converter when used with any make of radio set utilizes every tube in the receiver.

Mr. Reader Kidded for 'Wife-Swapping'

"Mr. and Mrs. Reader, Those Neighbors of Yours," a morning feature of WOR, Newark, N. J., for more than a year, have switched to WINS, New York, and are on the air each morning except Sunday at 8:45 a. m.

When the girl who played the original Mrs. Reader married and retired from the air several months ago, numbers of women were tested to find a suitable substitute. Nevertheless, there were protests over the substitution. Along with the protests came praise for the new Mrs. Reader, and a host of letters kidding Mr. Reader for swapping wives overnight.

WINS sent on the following comment: "Program directors are constantly haunted by fear of something happening to a leading character in a popular sketch, knowing the reluctance of the listeners to accept any change in cast. Whereas, changes are frequently made in stage casts without an unfavorable reaction, and popular motion picture stories are refilmed from time to time with new casts, radio cannot make changes without protests from the audience."

LEAGUE WAVE TAPS WORLD

Washington.

The newly constructed League of Nations radio station is powerful enough to flash 250 words a minute anywhere in the world, according to advices received in the Transportation Division of the Department of Commerce.

The station, which stands at Nyon, a few miles from Geneva, Switzerland, with extraterritorial rights against censorship, began functioning on February 3.

It then opened Geneva's first service to Shanghai. It also opened its first direct contact with Nagoya, Japan; New York, Buenos Aires and Rio de Janeiro. Many dispatches from and to delegations and journalists went over it on the opening day, particularly to Japan.

The League Assembly in 1929 decided to provide the League with its own wireless station. It built a short-wave station combined with a long-wave station already constructed by the Societe Radio Suisse, which operates both. The whole plant passes under the League's sole orders whenever the Secretary-General notifies the Swiss Government an emergency has arisen.

BUY STATION'S OWN PROGRAM, SPONSOR TOLD

By WALTER NEFF
Assistant Sales Director, WOR, Newark, N. J.

It is better business for the prospective sponsor of time on the air to select a sustaining program the station has built up, rather than try to get up a program of his own.

A Few Examples

Now a few examples of what station programs do commercially: We had a rural sketch known as "Main Street." We knew from the mail response, 'phone calls and general comment that it was popular. Two firms were interested, one decided to buy. The other, when informed of this, negotiated for the purchase of the one performance remaining before the other contract was to start, which was agreeable to all concerned.

An announcement was made to the effect that a picture of the Main Street cast would be sent to anyone writing for it. In preparing for the possible demand for these pictures, this concern asked us for our best estimate of what could be expected and took the wildest guess made, that of 75,000 replies. The mail reached 150,000 replies, the result of one broadcast offer at one station! Have you ever heard of a new, untried program of any kind equaling or approaching it?

Clothiers' Conflicting Results

Here is another. The morning exercise periods have a remarkable history. The latest sponsor, a clothing establishment, with three active stores in New York, had to decide whether to use radio or newspapers. It decided in favor of radio and selected the morning exercise periods as their vehicle for a three-month test campaign. Results were so good that a fifty-two week contract was signed before two months of the test had expired. They credit one out of every two new customers to radio. Compare this with one of New York's best-advertised popular-priced clothing houses that has been broadcasting over a period of three years with programs of their own creation and make the positive statement that not one sale could be traced to radio. I doubt the strict accuracy of this statement very much, but what is important is that here we have two concerns conducting like businesses who used radio. One purchased an air-tested article. The other chose a new untried article.

Uncle Don went on the air three years ago as a station sustaining program every evening at 6 p. m. for thirty minutes. Today it is almost impossible to buy an Uncle Don period and a waiting list of advertisers is the usual thing.

Hundreds Failed

His mail averages 5,000 letters a week, without specials, when it reaches 15,000 or more. His sponsors sell goods and stay with him. Renewals are the rule. There are no flops.

I have recited a few cases with which I am personally familiar. Each of the more outstanding stations can tell of many similar experiences. I could tell of the hundreds of failures of so-called new programs which advertisers or their agencies insisted be carried on to the end of the contract in the hope they would "click."

Peck Working on New Tubes and Transmitting Scanner

A series of careful experiments conducted at the Hotel St. Moritz, New York City, by William Hoyt Peck has disclosed that television transmission as carried on by New York stations is highly irregular in quality. Illumination varies, and as the edge of the image is approached distortion is introduced, due to the optical inefficiency of the lenses used in the scanning pick-ups.

Therefore Mr. Peck has started work on a television pick-up, using his special system of reflecting lenses. This, he claims, makes use of all the available light, and projects it at the requisite spot without introducing distortion at any point.

His first model will produce the usual 60-line image. When he has demonstrated that an improved pick-up at the transmitter results in improved reception, he will proceed with the construction of one utilizing 180 lines to the image, and projecting 24 frames per second instead of 20, as at present.

By means of a series of tests conducted during the past six months, Mr. Peck claims to have proven that 180 lines will give detail equal to that obtained with a home movie projector.

Peck has also designed a new type of neon tube, with which he is still conducting experiments. When perfected it will, he claims, give results comparable to those obtained from a modulated arc. Intense light is essential for large images.

Quick-Action Classified Advertisements

7c a Word — $1.00 Minimum
Cash With Order

BURNED OUT CHARGER BULBS (filament or otherwise) rectify like new. Send $1.00 for hook-ups. K. Zerwick, 212 So. Mills St., Madison, Wisc.

THE FORD MODEL—"A" Car and Model "AA" Truck — Construction, Operation and Repair — Revised New Edition. Ford Car authority, Victor W. Page. 703 pages, 318 illustrations. Price $2.50. Radio World, 145 W. 45th St., New York.

"SERVICING SUPERHETERODYNES," by John F. Rider. A reliable aid to the service man or to organizations in tackling superhet service problems. 161 pages, canvas cover. Price $1.00. Radio World, 145 W. 45th St., New York, N. Y.

BLUEPRINT NO. 627—Five-tube tuned radio frequency, A-C operated; covers 200 to 550 meters (broadcast band), with optional additional coverage from 80 to 204 meters, for police calls, television, airplane, amateurs, etc. Variable mu and pentode tubes. Order BP-627 @ 25c. Radio World, 145 West 45th Street, New York City.

"THE CHEVROLET SIX CAR AND TRUCK" (Construction—Operation—Repair) by Victor W. Pagé, author of "Modern Gasoline Automobile," "Ford Model A Car and AA Truck," etc., etc. 450 pages, price $2.00. Radio World, 145 W. 45th St., N. Y. City.

"1932 OFFICIAL RADIO SERVICE MANUAL," by Gernsback. Complete Directory of all 1931-1932 Radio Receivers. Full Radio Service Guide. Leatheroid binding, $4.00. Radio World, 145 W. 45th St., New York, N. Y.

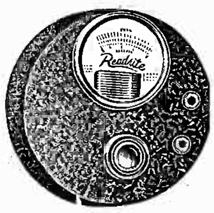
"AMATEUR MOVIE CRAFT," by James R. Cameron. A book dealing with the making and showing of 16 m/m pictures and equipment necessary for same. Paper cover, $1.00; Cloth, $1.50. Radio World, 145 W. 45th St., New York, N. Y.

THREE-IN-ONE TESTER *FREE!*

EVERYBODY who does any radio work whatsoever, whether for fun or for pay or for both, needs a continuity tester, so he can discover opens or shorts when testing.

A mere continuity tester is all right, but—

Often it is desired to determine the resistance value of a unit, to determine if it is correct, or to measure a low voltage, and then a continuity tester that is also a direct-reading ohmmeter and a DC voltmeter comes in triply handy.



So here is the combination of all three:

A 0-4½-volt DC voltmeter, a 0-10,000-ohm ohmmeter and a continuity tester. A rheostat is built in for correct zero resistance adjustment or maximum voltage adjustment. The unit contains a three-cell flashlight battery. Supplied with two 5-foot long wire leads with tip plugs. Case is 4-inch diameter baked enamel. Weight, 1 lb. Sent free with an order for one year's subscription for RADIO WORLD (52 weeks) at the regular rate of $6. Order Cat. PR-500. Use Coupon below.

Radio World, 145 W. 45th Street, New York, N. Y.

Enclosed please find $6 for one year's subscription for Radio World (one copy a week, 52 issues). Send Cat. PR-500 as premium.

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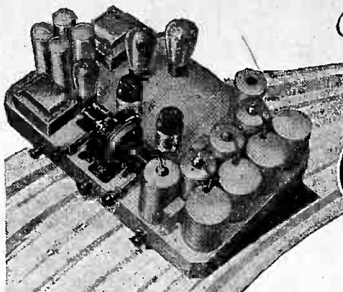

The 15 TO 550-METER COMET SUPER-HETERODYNE

YOU will search far to find the equal of the new Hammarlund COMET *Custom-Built* All-wave Superheterodyne.

A superbly efficient short-wave receiver, especially designed to cover also the regular broadcast waves up to 550 meters.

A.C. operated, using eight newest type tubes with Pentode output. Super-sensitive, super-selective, and has remarkably fine tone. Exclusive easy tuning features.

The ideal receiver for the home—office—laboratory—newspaper—police—airport—steamship.

Investigate also the COMET "PRO," the new Hammarlund custom-built 14 to 200 meter super-heterodyne for professional operators.

Write Dept. RW-35 for Details.

HAMMARLUND-ROBERTS, INC.
424 West 33rd Street, New York

CUSTOM BUILT *by* HAMMARLUND

GOOD RADIO BOOKS

"EXPERIMENTAL RADIO ENGINEERING," by Prof. John H. Morecroft, of the Department of Electrical Engineering, Columbia University. A companion book to the author's "Principles of Radio Communication," but in itself a text on practical radio measurements. Cloth bound, 345 pages, 6 x 9, 250 figures **$3.50**

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"THE RADIO HANDBOOK," by James A. Moyer and John F. Wostrel, both of the Massachusetts Department of Education. Meets the need for a complete digest of authoritative radio data, both theoretical and practical. Flexible binding, 886 pages, 650 illustrations **$5.00**

Remit with order. We pay transportation.

RADIO WORLD, 145 W. 45th St., New York, N. Y.

PHONOGRAPH PICK-UP—Made by Allen-Hough. $3.32. Guaranty Radio Goods Co., 143 W. 45th St., New York City.

115 DIAGRAMS FREE!

115 Circuit Diagrams of Commercial Receivers and Power Supplies supplementing the diagrams in John F Rider's "Trouble Shooter's Manual." These schematic diagrams of factory-made receivers, giving the manufacturer's name and model number on each diagram, include the **MOST IMPORTANT SCREEN GRID RECEIVERS.**

The 115 diagrams, each in black and white, on sheets 8½ x 11 inches, punched with three standard holes for loose-leaf binding, constitute a supplement that must be obtained by all possessors of "Trouble Shooter's Manual," to make the manual complete. We guarantee no duplication of the diagrams that appear in the "Manual." Circuits include Bosch 54 D. C. screen grid; Balkite Model F, Crosley 20, 21, 22 screen grid; Eveready series 50 screen grid; Erla 224 A. C. screen grid; Peerless Electrostatic series; Philco 76 screen grid

Subscribe for Radio World for 3 months at the regular subscription rate of $1.50, and have these diagrams delivered to you **FREE!**

Present subscribers may take advantage of this offer. Please put a cross here ☐ to expedite extending your expiration date.

Radio World, 145 West 45th St., New York, N. Y.

25,000 OHM POTENTIOMETER, 90c. Direct Radio Co., 143 W. 45th St., N. Y. C.

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Get a FREE one-year subscription for any ONE of these magazines:

- ☐ RADIO CALL BOOK MAGAZINE AND TECHNICAL REVIEW (monthly, 12 issues)
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RADIO WORLD, 145 West 45th Street, New York (Just East of Broadway)

LOOKING FOR FINE GOODS AT BARGAIN PRICES? HERE THEY ARE!

WE carry a complete line of Rola dynamic speakers, all sizes, all purposes, as well as the exclusive Farrand inductor speaker for push-pull pentode output that requires no output transformer.

The Rola speakers are very popular in midget sets, both of the broadcast and short-wave type, as well as for all-wave coverage, and are used also to great advantage in automobiles.

The Rola speakers for home receivers are obtainable with field coils that may be used also as the B supply choke coil, and which field coil has a tap, so that bias for a pentode may be obtained from the field coil itslf. This method introduces audio regeneration, which improves tone and sensitivity. The tapped coils have a total resistance of 1,800 chms and the tap is at 300 ohms from the ground end. The grid return of the power stage is connected to the tap. This is the method used in all our a-c circuits.

Rola dynamic speaker, 1,800 ohm field coil, tapped at 300 ohms. Output transformer matched to single pentode is built in. Diameter of cone is 7 inches. Cat. RO-18 @ $4.50

Same as above, except that cone diameter is 10.5 inches. Cat. RO-18-10 @ $5.85

Same as above, except that cone diameter is 12 inches. Cat. RO-18-12 @ $7.25

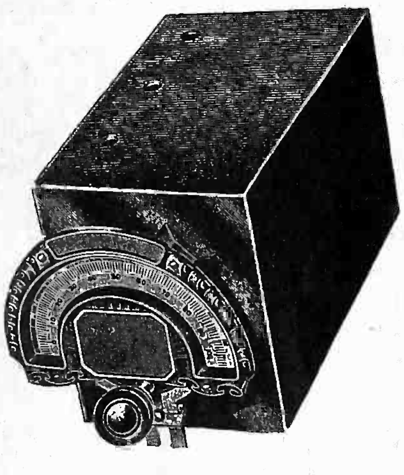
Magnavox dynamic 6 inch cone for automobile sets, 6 volt field to be connected to car's storage battery. Speaker fits on bulkhead under the instrument board. Shielded cable is supplied with each speaker. Cat. M-AU @......$4.95

TAPPED COILS FOR BAND SHIFTING

For 80-600 meters, for use with 0.00035 mfd. three gang, order Cat. M-35-C (three coils, three shields at this price) @ $2.45

For 0.00046 mfd. order Cat. M-46-C MSSC @......$2.45

For 0.0005 mfd. order Cat. M-05-C @............$2.45

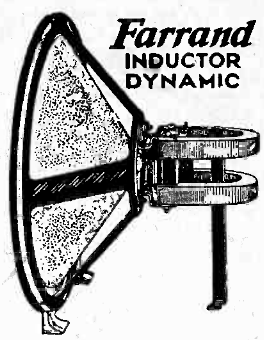


MATCHED COMBINATION TUNING UNIT, to cover from 80 to 600 meters, using a coil system including a single tap on each secondary, and serving as the tuning adjunct in superheterodynes with an intermediate frequency of 175 kc. The tap need not be used if only the broadcast band is desired. The oscillator circuit is accurately padded for that intermediate frequency. The matched tuning unit includes a three gang, brass-plate, steel-frame condenser, with stator shields built in, the entirely shielded again, with extra partitions built inside to serve as rotor shields (illustrated). Low vibration factor to avoid grunting of some types of superheterodyne condenser construction. Three trimmers are built in. The three shielded coils, of the same general appearance as the one illustrated at upper position on this page, and dial are supplied. The oscillator coil is already padded. Order Cat. CMTU @....$6.65

Set of three shielded coils, padded for 0.00035 mfd., for use with 175 kc. intermediate amplifier. Tap is included. Cat. SUC-35 @ $3.10

Same as above (set of coils) except for 0.00046 mfd. Cat. SUC-46 @..............................$3.10

Same as above, except for 0.0005 mfd. Cat. SUC-5 @ $3.10

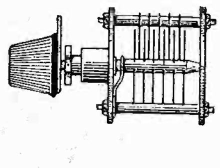


FARRAND inductor dynamic, for pentode push-pull requiring no output transformer. Simply connect the two tipped leads to the plates of the pentodes and connect the untipped (yellow) lead to the maximum B plus voltage. By this method no plate current flows through the winding, only signal current so there is no danger of burnout or premature saturation, and the tone quality is superb.

This speaker has one of the best audio curves of any ever produced, but it is not quite so sensitive as other type dynamic speakers, and therefore should be used on high powered sets. It is suggested therefore that it be used on a-c sets having no fewer than six tubes or battery sets having fewer than seven tubes. It is strongly recommended, however, that the speaker be used on all high powered sets using push-pull pentode output. These pentode speakers are not generally obtainable. We're privileged to have a source of supply that enables us to fill the needs of those most discriminating as to tonal values. Order Cat. FAR-PENT @ $8.75

MIDGET CONDENSER

The rotor has no end stop and therefore precision calibration of oscillators and tuners is not upset by dial-jarring.



A MIDGET condenser for high frequency work, equipped with knob and pointer, and including a milled bushing that can be attached for taking ¼ inch dial hub. This condenser may be used either as a trimmer for a main condenser or alone for tuning in the high frequencies. Particularly valuable for amateur wave reception, short wave converters and short wave sets generally, where wide dial spread is highly desired, and five coils are used for coverage of 200 to 15 meters. The capacity is 0.000045 mfd. (45 mmfd.). Cat. CHMG-45 @..............................$0.69

The same model condenser also is obtainable in 0.000055 mfd. (55 mmfd.) capacity. Order Cat. CHMG-55 @ .... .59

Eveready Raytheon Tubes

227 @$0.60	245 @$0.66	240 @$1.80	236 @$1.65
224 @ .96	250 @ 3.60	112A @ .90	237 @ 1.65
235 @ .96	U-99 @ 1.50	222 @ 2.70	238 @ 1.65
247 @ .93	V-99 @ 1.68	230 @ .96	239 @ 1.65
226 @ .48	120 @ 1.80	231 @ .96	280 @ .60
171A @ .54	201A @ .45	232 @ 1.30	281 @ 3.00
210 @ 4.20	200A @ 2.40	233 @ 1.65	Neon @ 4.50

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BARGAINS in first-class, highest grade merchandise. Phono-link pick-up with vol. control and adapter, $3.32; .00025 mfd. Dubilier grid condenser with clips, 18¢. P. Cohen, Room 1214, at 143 West 45th Street, New York City.

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This binder is made of fine brown Spanish fabricoid and will hold 52 issues of Radio World. Year 1931-32 stamped in gold on front cover. A very limited supply on hand. Sent free to new yearly subscribers who send $6 direct to publication office before March 25, 1932. If already a subscriber, send $6 and 52 issues will be added to present subscription. No other premium with this offer.

RADIO WORLD, 145 WEST 45th STREET, NEW YORK CITY

Your Choice of NINE Meters!

To do your radio work properly you need meters. Here is your opportunity to get them at no extra cost. See the list of nine meters below. Heretofore we have offered the choice of any one of these meters free with an 8-weeks' subscription for RADIO WORLD, at $1, the regular price for such subscription. Now we extend this offer. For the first time you are permitted to obtain any one or more or all of these meters free, by sending in $1 for 8-weeks' subscription, entitling you to one meter; $2 for 16 weeks, entitling you to two meters; $3 for 26 weeks, entitling you to 3 meters; $6 for 52 weeks, entitling you to six meters. Return coupon with remittance, and check off desired meters in squares below.

RADIO WORLD, 145 West 45th Street, New York, N. Y. (Just East of Broadway)

Enclosed please find $..........for ....weeks subscription for RADIO WORLD and please send as free premium the meters checked off below.

☐ I am a subscriber. Extend my subscription. (Check off if true.)

- ☐ 0-6 Voltmeter D.C. ....No. 326
- ☐ 0-50 Voltmeter D.C. ....No. 337
- ☐ 6-Volt Charge Tester D.C. ....No. 23
- ☐ 0-10 Amperes D.C. ....No. 338
- ☐ 0-25 Milliamperes D.C. ....No. 325
- ☐ 0-50 Milliamperes D.C. ....No. 350
- ☐ 0-100 Milliamperes D.C. ....No. 390
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BLUEPRINTS OF PRIZED CIRCUITS

8-TUBE AUTO SET

Sensitivity of 10 microvolts per meter characterizes the 8-tube auto receiver designed by J. E. Anderson, technical editor of Radio World, and therefore stations come in with only six feet of wire for aerial, and without ground. Most cars will afford greater aerial pickup, and besides the car chassis will be used as ground, so with this receiver you will get *results*. The blueprint for construction of this set covers all details, including directions for cars with negative A or positive A grounded. The circuit features are: (1) high sensitivity; (2), tunes through powerful locals and gets DX stations, 10 kc either side; (3), latest tubes, two 239 pentode r-f, two 236 screen grid, two 237 and two 238; push-pull pentodes, all of 6-volt automotive series; (4), remote tuning and volume control on steering post, plus automatic volume control due to low screen voltage on first detector; (5), running board aerial. The best car set we've published. This circuit was selected as the most highly prized after tests made on several and is an outstanding design by a recognized authority. Send for Blueprint 631, @ 50c

SHORT-WAVE CONVERTER

If you want to build a short-wave converter that costs only a very few dollars, yet gives good results, furnishing all its own power from 110 volts a-c, and uses no plug-in coils, you can do so from Blueprint 630. Price.........25c

5-TUBE AC, T-R-F

Five-tube a-c receivers, using variable mu r-f, power detector, pentode output and 280 rectifier, are not all alike by any means. Forty circuits were carefully tested and one selected as far superior to the others. This prized circuit was the 627, and if you built it, you will always be glad you followed our authentic Blueprint, No. 627. This is the best 5-tube a-c t-r-f broadcast circuit we have ever published. Price 25c

A-C ALL-WAVE SET

An all-wave set is admittedly what many persons want, and we have a circuit that gives excellent broadcast results, and is pretty good (not great) on short waves. No plug-in coils used. Cost of parts is low. Send for Blueprint, No. 628-B, @..........25c.

In preparation, an 8-tube broadcast superheterodyne for 110v d-c. Write for particulars.

RADIO WORLD, 145 West 45th Street, New York, N. Y.