RADIO LORE FOR NOVICE AND EXPERIENCED FAN

Tubes Are Principal Factor of "Erratic Deterioration" in Set

When Bulbs No Longer Agree Upon Mutual Points of Oscillation They Should be Tested at High, Low and Medium Frequency and Re-Matched

BY FRANK C. VOGAN

I feel somewhat in the humor of a person who has passed by innumerable pleas for charitable helps and who is suddenly moved by one so poignant and deserving that one simply has to give. Almost every reader has experienced this. It seems that the last week has been selected as an official one during which many sets agreed to stop work. I have had my attention directed to more "bum radios" recently than ever before.

Of course, it is true that a tube is a tube, but what is inside of the tube has a lot to do with our sets. Certainly, condensers, rheostats, wires and all those things do help to make receivers work, but the heart of the whole business is the tube.

We too often take for granted that the tubes are all right and they are seldom thought of being the vital factors that they are in a radio set. Tubes seem, so far, to be the only element in a receiver to which few have had the nerve to apply the "lo-loss" probe. We tinker with this, that and the other thing in a set, but the "insides" of a vacuum tube have us "stopped."

What stops us? That is something we can only answer with a smile. Think how we go after everything else in the set, fool with it, poke into the plates of the condensers, stab this and that with screw drivers, etc., but the tiny thin glass wall over the vacuum tube absolutely protects it.

I do not think that there is in existence a fan who purposely has ever stuck anything into the vitals of a tube. I am glad about this and so are you. The insides of a vacuum tube present factors in radio circuits no more peculiar than our coils and condensers, yet how decently we let them alone. We let them alone because they come to us all assembled and sealed in behind a wall of glass—and how zealously they have maintained their mysteries!

Tube elements are delicate, to be sure, and they can fail just as any other part of a receiver. That's the point—they often fail "in part," not wholly, and then they have us guessing. "Dead" tubes provide their own obsequies, but those that are more or less "diseased" and linger on are the ones which perplex us. It is difficult, indeed, for the broadcast listener quickly to detect the partial failure of a tube.

Many tubes that light up just as good as the first time we used them probably are as dead as doornails, from a radio standpoint!

You and I have listened to many a story of how well a set worked when it was first purchased and how its efficiency has gradually lessened until now—"oh, well, there's something wrong with it; it isn't as good as it used to be!"

There are two angles to the condition just outlined. The listener frequently mistakes over-enthusiasm for super-performance. After a while "enthusiasm" cools down to a "normalcy" and the set is blamed. Understand, the set may be just as good as the day it was bought, but we, in time, find ourselves and judge performance with more placid minds and less emotion. That's the first angle.

Now the second angle is really a serious one; it deals with no myths but facts. Radio sets actually do deteriorate. The gradual deterioration can work out along many different lines. For instance, resistances will frequently age. Fixed resistances that are made from carbon powders mixed with binder pastes, unless sealed in tubes away from atmospheric changes, will often crystalize.

Condenser plates will oxidize, soldered joints will crystallize, heat in the cabinet will warp parts out of alignment; any number of such trifles could be mentioned. They are small, individually, but they have a cumulative effect just the same.

Getting back to tubes, they are principal factor of "erratic deterioration" in a receiver. Tubes probably give more trouble than anything else concerned with the set. Accepting this as a fact, how is the fan or listener to know wherein the trouble really lies? The disappointment is, he usually cannot tell what is the matter. As time goes on this condition will no doubt be remedied through the establishment of proper tube service stations.

The root of the evil is that all of the tubes in a multitube receiver do not age exactly alike or at the same rate of time interval. This raises havoc, for, remember, all the tubes may still light up and the receiver may still function, but with marked reduction in efficiency. This situation has puzzled and still is puzzling many fans. Putting in new batteries or, in fact, putting in new tubes will frequently fail to restore the receptive power of the set.

You say that's queer, but I must tell you the rest of the story. In seeking to improve the set the operator is likely to replace the suspected tube or tubes with others equally as poor as the one removed, or, again, the new tube or tubes probably will not work well in company with those remaining in the set. There is a serious fault here, and after we focus attention on the fault we will discuss the remedy.

Take the case of a neutrodyne or a "superhet," or, in fact, any receiver whose efficiency is based in one way or another on delicately-balanced interstage couplings. The design of these circuits presumes that the tubes used will have characteristics of certain magnitude. When the receivers are used with tubes possessing nearly these qualities they work beautifully.

Then, some fine day, one of the many tubes in the set gets "electrically tired" and begins to loaf on the job—it no longer keeps up with the rest of its mates. The fan may reason this out and buy a new tube, replacing the one he doubts, only to find that no improvement results. It is very annoying I'll agree with you. If, after fussing around with several tubes the set still doesn't get back to normal performance this is what will likely happen—some dealer is due to have a set returned to him. And why? All because the tubes "got out of step."

You see, when the first tube failed it started sort of a "family row" among the other tubes and they could no longer agree upon mutual points of oscillation. This "row business" is costly and demoralizing, whether tubes or people are concerned, and, when it happens, good-by efficiency. When one tube pulls best at 300 metres and some other one pulls best at 500 metres one can readily see that team work in the receiver has "gone to pot."

How can it be corrected? Well, this matter really involves laboratory work, but the beauty of it all is, however, that the test required can be easily performed away from the laboratory simply by using the proper instruments and a little common sense.

Some dealers in the past, and probably some are still doing it, pass out to the purchaser tubes which they claim are "tested." Tested for what? That is the question! A tube may be tested for its plate-current conductivity at various plate voltages, and it is not unusual to be able to select several from even a small lot in which this factor will be nearly similar.

But in a radio circuit the tube has to do vastly more than pass just so much plate current at certain voltages. A tube should be tested for oscillation qualities in an oscillation circuit. This is the real test and one too seldom made. Tubes to be used in multitube sets should always be "matched" in consequence of tests made for oscillation at a high, low and medium frequency within the broadcast band. The advent of multitube sets is certainly hastening the day when this method of testing will become common practice and the problem, as far as tubes are concerned, will not be solved for the listener until it is employed.

As the efficiency of tubes vary in the process of usage we find that some very interesting things happen. A lot of new tubes may start off with nearly similar oscillation characteristics; that is, they may be well matched. As an example, take three 201-A tubes in a neutrodyne. These tubes should show nearly similar value of grid-current conductivity or at least three different points of frequency. If test shows that they do little trouble will be experienced in neutralizing the set in which they are used. If, however, two of the tubes "match up" and the third one is found to be a poor oscillator at, say, 300 metres, it will be almost impossible to keep the set in which the combination is used stable in operation.

The aggravating condition mentioned would, of course, be greatly magnified in the case of a set using six, eight or 10 tubes. The problem of matching tubes does not affect the audio stages so much—it's in the radio steps that the trouble becomes particularly pronounced and hard to handle.

Tubes which vary greatly as to common points of oscillation will not give proper performance in a super-heterodyne. Experimenters well know this and fans should should take the matter into account.

Out of a group of 201-A tubes lying about the laboratory here, eight have been picked at random to test as a demonstration concerning oscillation ability. Bear in mind that this test is totally apart from showing what plate current the tubes will pass. It is a test to show what the tube will do when used with high-frequency currents equal in value to the frequencies of the corresponding wave lengths in actual reception.

The values given in the table were taken from the instruments when the tubes were subjected to exactly five volts D.C. across their filaments and when the plate potential was fixed at 45 volts.

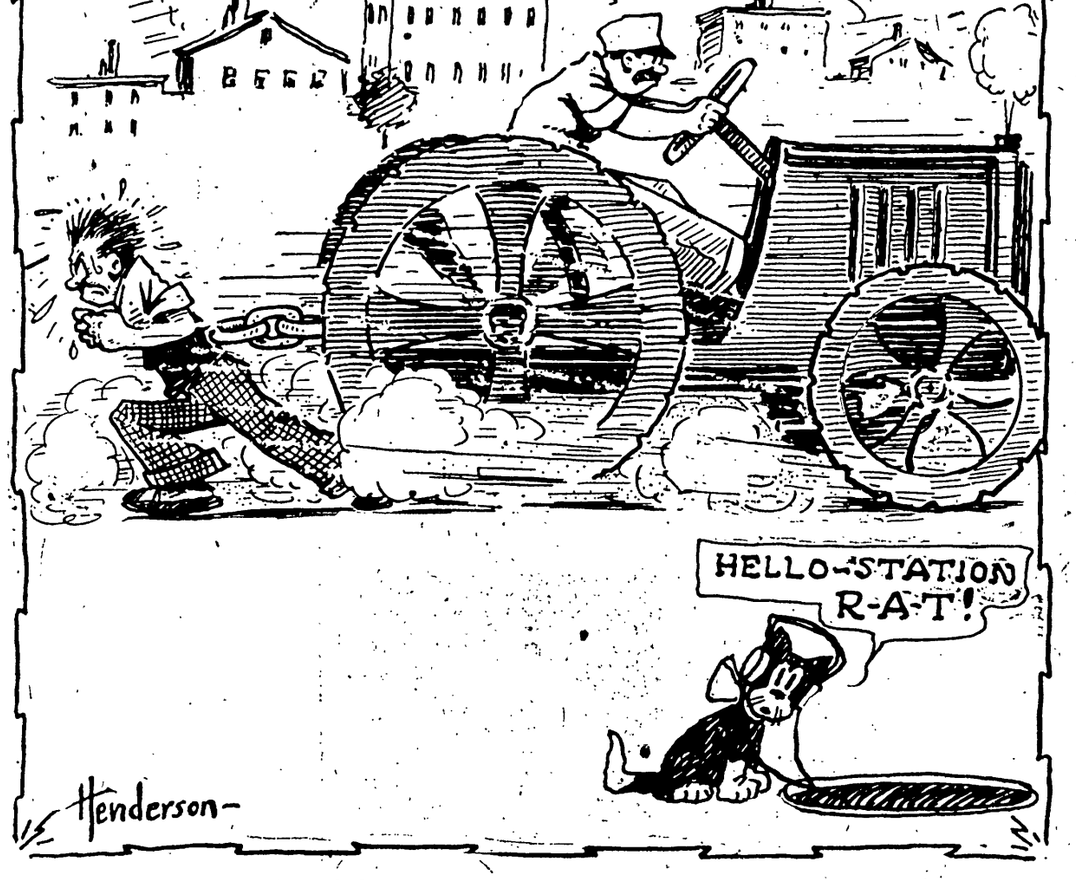
Reference to the schedule will show the fan how the characteristics of tubes picked at random really vary. If tubes numbered 1, 3 and 4 were placed in a radio-frequency amplifier having capacitance stabilizers, one can readily imagine the results. The consequence is that at 300 metres the set cannot be neutralized.

Now, turn from this to a combination of tubes numbered 1, 5 and 8. When these were used stability of operation was maintained even down to 222 metres. A radio friend once said to me that there are only two kinds of radios, "those that oscillate and those that don't," to which I shall add, "tubes that do, and don't!"

Fans must not take too much for granted about tube performance. Remember that the elements inside of a vacuum tube are separate parts of a receiver circuit in that same sense that coils and condensers are, only, in the case of a tube, the parts are definitely assembled and arranged to maintain their very delicate adjustment.

The parts and their adjustments, however, are not "eternally fixed," but are subject to change.

To-day's Hook-Up



The Only Way to Keep Him Away From the Set

SCHEDULE

Tubes No.	Cycles in Radio-Frequencies 900,000	760,000	590,000
	Milliamperes of Current		
1	48	58	75
2	46	53	66
3	36	46	53
4	28	28	19
5	48	58	75
6	45	57	73
7	49	59	78
8	47	58	74

No special remark is directed to the actual numerical values shown in the foregoing schedule, but the attention of the fan should centre in the fact that for certain tubes in the list the values of current for respective frequencies are very similar.

JOHN SMITH AND HIS RADIO

REFLEXING MADE PLAIN.

Smith had reached the point where he could look over a wiring diagram of a receiving set and see something besides lines, but when he purchased a bookful of hook-ups for reflex sets he found himself just about where Smith, Jr., would be with a calculus text book.

"I looked into this reflexing business," he explained, "because I imagined it was one of the simplest arrangements in radio. I've a friend at the office who always tells me that if I had a reflex set I wouldn't have to have so many tubes. And he even simplifies reception by using a loop aerial exclusively. He says half of my equipment is unnecessary, and that by means of the reflex idea one can make one tube do the work of two."

"That's true, but your friend isn't much of a hand for considering the law of compensation," I replied. "Water power is far simpler than power generated by burning fuel, but you've got to have a suitable dam or a waterfall. Those tiny engines that run the foreign automobiles are very economical but owners have to put up with a lot of gear shifting. It's the same with radio. The reflex idea is excellent, but it's complicated. Reflex sets are extremely sensitive, but their very sensitiveness is often a handicap. For local stations it is necessary to operate them on a loop so as to take advantage of the directional effect, but you would not like to see a loop in the living room when it is possible to have a radio set that looks like a piece of furniture.

"So much for the disadvantages. I have seen reflex sets of the simplest sort perform some splendid work because of their extreme sensitiveness, and you must recognize that they are more economical than many sets which require twice as many tubes for the same results. And you must also recognize their value as self-containing sets, since some of them do not need anything but dry batteries and the loop. No ground connection is required. Everything is rather compact. Naturally, these features are highly desirable in many cases.

"I think you're a little confused over these hook-ups because you've got reflexing mixed up with the regenerative idea. In the latter, the output from the plate circuit of the detector is fed back to the grid of the detector tube so as to increase the strength of the incoming signals and thus increase the corresponding signals in the plate circuit, which is affected proportionally. In the reflexing process, however, the idea is simply to use the same tubes for radio and audio frequency amplification."

Smith admitted that all this sounded simple enough but pointed to the complicated diagrams and asked wherein they suggested any such simplicity. The trouble was that he was looking at a two-tube reflex hook-up employing a fixed crystal detector. This provided for two stages of radio frequency amplification and two of audio, making the set the equivalent of a neutrodyne which employs five tubes.

There was only one thing to do, and that was to look up a diagram of the simplest reflex set—a single-tube reflex receiver employing a crystal detector. Here, however, it was necessary to digress a moment to explain why crystal detectors are usually preferred in reflexes. Because there is such intensive use made of the tubes in a reflex set, the quieter detector is the better. Crystals, being quiet in operation, are accordingly preferred.

What worried Smith most with the single-tube reflex diagram was that the audio frequency process seemed to come first, judging from the odd position of the earphones. Smith had been accustomed to seeing the earphones in the plate circuit, or at least beyond the detector.

"Reflexing is a simple enough process," I told him, "but the method of arranging the various units is ingenious. What you really do in the simplest reflex set is to pass the tuned radio frequency current through the tube as an amplifier. Then you pass it through a radio frequency transformer, through the crystal detector and then through an audio transformer. The current is then pulsating direct current instead of alternating, and you pass it back through the tube. The phones are placed between the plate of the tube and the radio frequency transformer. In this position they seem to be on the radio frequency side of the detector, and in reality they are, but if you follow through the transformers and the detector and then back through the tube again you'll see that they are just about where you would expect them. They're right in a direct circuit with the 'B' battery and the plate of the tube despite their unique arrangement."

Smith went home to his radio set that evening with considerably more respect for the men who originally thought out all this, and he began to understand why the true radio fan wants to build a set of his own, even if he has a manufactured one.

Building Costs to Be Cut Down.

The general introduction of electric welding promises to be the means of reducing building costs. The parts of steel building are now riveted together and much care is expended in getting the rivet holes to register accurately as they must do, but with arc welding this is no called for and the weld has many other advantages over the older form. The strength of the weld is equal to that of the parts welded, the weld is impervious to the action of oil or water and the cost of welding is three-fourths that of riveting.

USE OF PROPER ANTENNA URGED

Should be Planned with Same Care Given Receiver.

Proper Balance Between Receiver and Aerial Results in General Improvement in Operation and Places New Stations Within Easy Reach.

BY BRAINARD FOOTE.

When we build a radio receiver we take for granted that it will work with any ordinary antenna without any further adjustments. We provide an antenna binding post and hook the lead-in to it with no thought as to the proper relationship between that particular aerial and that particular receiving set.

As a result our receiver does one of three distinct things:

First. It works well.

Second. Tuning is extremely sharp, with no volume.

Third. Tuning is poor, with strong volume.

In addition to these we often notice that the set has a "dead spot" down in the lower wave-length region. Perhaps stations between 250 and 300 metres come in "all jumbled up" and without satisfactory strength. Or, as is more common, we learn that stations below a certain wave length aren't received at all.

To remedy the situation there are two problems confronting us, both of which must be solved before the receiver will perform with full success and will cover the broadcast wave-lengtl. band with uniformity. These are:

First. To get the "natural" wave length to be received.

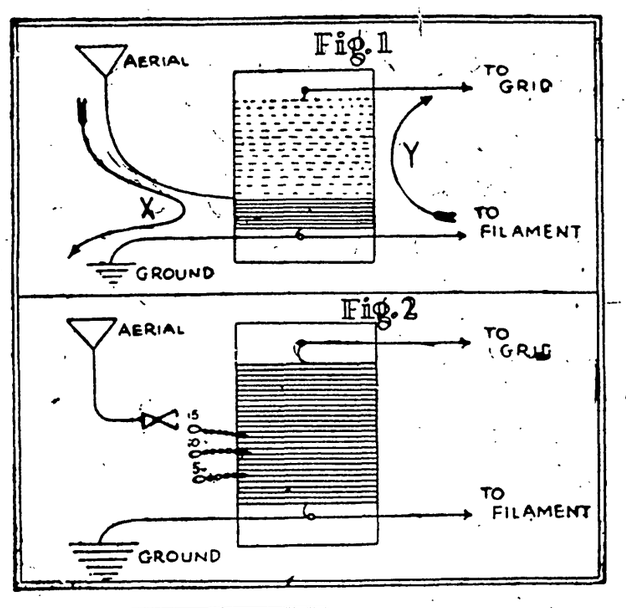
Second. To arrive at the maximum degree of coupling between aerial and set at which volume is good and selectivity satisfactory.

There are two methods by which the antenna is coupled to the receiving circuit. One of these involves what is termed a "coupling coil." This is merely a small coil of wire, usually between eight and 15 turns of about a three-inch diameter core, inserted between the lead-in and the ground wire and placed alongside of the grid coil of the receiving tube.

In the other method of coupling, the principle is the same, although the aerial is merely connected to a tap on the grid coil. This latter scheme is convenient inasmuch as it obviates the necessity for winding an extra coupling coil and thus saves labor and space.

The tap method is shown in Figure 1. The grid coil is the entire winding and is a part of the grid circuit shown by the arrow "Y." Part of the coil is used both as the entire antenna coupling winding and as a part of the grid coil.

Now for the antenna wave length. The wave length is dependent upon the length of the aerial, its height from the ground, the number of turns included in the antenna coupling winding and the length of the ground lead. To prevent upsets in the receiving set, the wave length of the antenna circuit should be about 200 metres or less. In cases where it isn't practicable to attain such a low "natural" as this, a series condenser may



be inserted in the lead-in to lower the wave length.

Assume that the antenna circuit "X" of Figure 1 has a natural wave length of 231 metres. Suppose we try to receive Station WTAX of Streator, Ill., operating on that wave length. As soon as we endeavor to tune the grid circuit to that wave length and increase regeneration by advancing the tickler coupling, we discover that we cannot make the receiver oscillate at all.

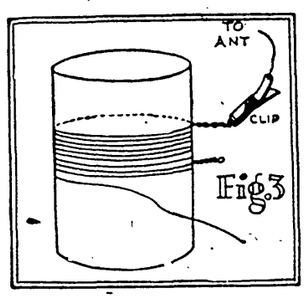
However, with the tickler coil stationary we note that the receiver oscillates as the grid circuit is tuned to wave lengths above and below 231 metres. Right at the "dead spot" the absorption of energy by the antenna is so great that there is not enough power left in the plate circuit to make the tube oscillate.

Much the same thing is true with a tuned radio frequency circuit, such as a neutrodyne. Using radio-frequency tuned transformers, wound for fairly uniform sensitivity over the broadcast range, the sensitivity is very poor near and at the antenna's natural wave length and the "mutual inductance" effect between the two tuned circuits—antenna and grid—renders accurate wave length settings almost impossible to obtain.

Take the same circuit, however, and insert a small fixed condenser in series with the lead-in, of .0005, .00025 or whatever capacity is found necessary, and immediately the tuning is cleared up and the desired stations found with as much ease as at any other point on the dials. Except in extreme cases, either a .00025 mfd. or .0005 mfd. fixed condenser solves the wave-lenth problem. If you have a spare variable condenser this may be used and left set at the proper value.

It should be borne in mind, nevertheless, that it is far better to use an antenna having a natural wave length of about 200 metres than to reduce that of a longer one by fixed condensers. For this reason the aerial should be high, rather than excessively long, and an aerial 50 feet long, but 50 feet high will perform with far more all-around satisfaction than one 100 feet long and 25 feet high.

To keep the natural period as low as possible, the aerial should be elevated as high as can be above near-by objects like buildings, roofs, chimneys, smokestacks and metal structures of all sorts. Moreover, on its way down to the lead-in bushing, the lead-in wire should be



far out from the wall, four to six feet away from it, if this is practicable.

The degree of coupling best for each installation depends upon the nature of the circuit to some extent, but in larger measure upon the size of the aerial system. Hence, a receiver affected by oversharpness or overbroadness of tuning and having a dead spot can be remedied usually by alterations not only in the aerial's dimensions, but also in the coupling.

A useful method of providing variations in the coupling is given in Figure 2. The grid coil is rewound with the same number of total turns originally employed in the set, but having several "taps" taken out. Tapped at the fifth, the 10th and the 15th turn, a grid coil may be coupled properly to practically any antenna, large or small.

Where interference between broadcasting stations is experienced, there is too much coupling, and a reduction of the number of turns in the coupling portion of the grid coil will remedy the trouble. But, with a smaller aerial, where volume is poor and selectivity very pronounced, more turns should be cut in.

The tap may be easily made by forming a little loop in the wire as the coil is wound and twisting it securely. Contact may be made to the tap by means of a spring clip, to which the wire from the antenna binding post is attached. See Figure 3.

A proper balance between antenna and set always results in a general all-around improvement in the operation of the receiving set and at the same time places a worthwhile number of new broadcasting stations within easy reach.

RADIO PROGRAMMES

What will undoubtedly be the final radio address by President Coolidge until after he returns from his vacation will be put on the air by Station WJAR to-morrow evening at 8:30 o'clock. The occasion will be a meeting of the Bureau of the Budget in Washington. The programme by "Roxy and His Gang" will be cut short this evening for a concert to be given by Goldman's Band in New York which will be broadcast by seven stations, including WJAR. The band concert will be a regular Sunday evening feature in place of the organ recital. WEAN announces a varied musical programme for the week, including the usual church services and afternoon concert to-day.

WEAN, THE SHEPARD STORES
(270 METRES)

TO-DAY

10:45 a. m.—Service broadcast from Mathewson Street Methodist Episcopal Church.
1:30 p. m.—Concert, Yoeng's Orchestra, relayed from Station WNAC.
7:30 p. m.—Service broadcast from Grace Church.

MONDAY.

11:55 a. m.—Time signals.
12:00 m.—Shepard Colonial Concert Orchestra.
12:10 p. m.—Organ and piano duets by Alvan Winslow, organist; Frank E. Streeter, pianist.
12:30 p. m.—Musical programme.
4:00 p. m.—Musical programme.
4:35 p. m.—Tenor solos by Robert E. Case, Dennis O'Connell, accompanist.
6:30 p. m.—WNAC dinner dance, Billy McBride's Beacheroft Orchestra, relayed from WNAC.
7:35 p. m.—Concert broadcast from Copley-Plaza Hotel, Copley-Plaza Orchestra, relayed from WNAC.
8:00 p. m.—Emily Smith, contralto soloist and assisting artists, relayed from WNAC.
8:30 p. m.—Programme to be announced.
9:00 p. m.—Dance music, Pippin Lee's ladies' orchestra, relayed from WNAC.
9:30 p. m.—Joe Beal and his entertainers, relayed from WNAC.

TUESDAY.

11:55 a. m.—Time signals.
12:00 m.—Shepard Colonial Concert Orchestra.
12:10 p. m.—Weather report.
12:15 p. m.—Musical programme.
4:00 p. m.—Musical programme.
4:30 p. m.—Home Service talks by Miss Gladys L. Peckham.
4:45 p. m.—Continuation of musical programme.
6:30 p. m.—WEAN dinner dance, Shepard Colonial Orchestra.
6:45 p. m.—Irving Crocker, singer.
8:00 p. m.—Talk, relayed from WNAC.
8:10 p. m.—Orchestra, relayed from WNAC.

WEDNESDAY.

11:55 a. m.—Time signals.
12:00 m.—Shepard Colonial Concert Orchestra.
12:10 p. m.—Weather report.
12:15 p. m.—"Fifteen Minutes of Music Appreciation."
4:00 p. m.—Musical programme.
6:30 p. m.—Dinner concert by Schrafft Ensemble, relayed from WNAC.
7:00 p. m.—WNAC dinner dance, broadcast from Shepard Colonial Restaurant, Shepard Colonial Orchestra.
8:00 p. m.—Programme to be announced.
8:15 p. m.—Talk, "Home Preservation of Foods."
9:30 p. m.—Dance music by Rhodes Orchestra, direction Charles E. Cuiverwell, broadcast from Rhodes-on-the-Pawtuxet.

THURSDAY.

11:55 a. m.—Time signals.
12:00 m.—Shepard Colonial Orchestra, Harold Sheffers, director.
12:10 p. m.—Weather report.
12:15 p. m.—Musical programme.
4:00 p. m.—Programme to be announced.
4:30 p. m.—Home service talks by Miss Gladys L. Peckham.
6:30 p. m.—WEAN dinner dance, "Lar Potter's Orchestra."
6:45 p. m.—Piano duets by Mrs. Redstone and Mrs. Parsons.
Silent night.

FRIDAY.

11:55 a. m.—Time signals.
12:00 m.—Shepard Colonial Concert Orchestra.
12:10 p. m.—Weather report.
12:15 p. m.—WEAN Noonday Club.
4:00 p. m.—Programme to be announced.
6:30 p. m.—WEAN dinner dance, Shepard Colonial Orchestra, Harold Sheffers, director.
8:00 p. m.—Musical programme.

SATURDAY

11:55 a. m.—Time signals.
12:00 m.—Shepard Colonial Concert Orchestra.
12:10 p. m.—Weather report.
12:15 p. m.—"Fifteen Minutes of Music Appreciation."
4:00 p. m.—Programme to be announced.
6:30 p. m.—WEAN dinner dance, Shepard Colonial Orchestra, Harold Sheffers, director.
8:00 p. m.—Ole Plantation Concert: spirituals and old Southern melodies, staged and directed by Virginia Hardy of North Carolina; musical director, Charles Johnson of Cambridge, Mass.
10:00 p. m.—Dance music, broadcast from Copley Plaza Hotel, Copley Plaza Orchestra, direction W. Edward Boyle; popular songs, Irving Crocker and George Rogers, relayed from WNAC.

WJAR, THE OUTLET CO.
(306 METRES)

TO-DAY

7:20 p. m.—Musical programme by Roxy and His Gang, direct from the Capitol Theatre, New York city, by courtesy of the Capitol Theatre management and S. L. Rothafel (Roxy). The first part of the programme will be taken from the sage of the theatre and will consist of music by the featured artists and the Capitol Grand Orchestra. The second part of the programme will consist of a special presentation by Mr. Rothafel of vocal and instrumental artists direct from the broadcasting studio in the theatre.
8:30 p. m.—Goldman band concert, Edwin Franko Goldman, conductor, direct rfom the Hall of Fame, New York city. Soloist, Helena Marsh, contralto.

MONDAY

10:00 a. m.—Housewives' Radio Exchange. A department conducted by Mrs. Wood on all matters of household interest.
1:05 p. m.—Twin Elm Orchestra, under the direction of Joseph McNamara.
7:15 p. m.—Berry Spring Dance Hour."
8:30 p. m.—Regular meeting of the Bureau of the Budget (the business organization of the Government) direct from Continental Memorial Hall, Washington, D. C. Addresses by Calvin Coolidge, President of the United States, and General Lord, Director of the Bureau of the Budget. Music by the United States Marine Band, Captain William Santelmann, director.
10:00 p. m.—Invisible choir of Washington relayed from the Continental Memorial Hall, Washington, D. C.

TUESDAY

1:05 p. m.—Providence-Biltmore Concert Orchestra, under the direction of Erwin White, relayed from the dining room of the Providence-Biltmore Hotel.
7:30 p. m.—Troubador Male Quartet.
8:00 p. m.—George L. Miner, speaking under the auspices of the Providence Safety Council. Subject, "Traffic Problems."
8:30 p. m.—Gold Dust Twins, relayed from the New York city studio.
9:00 p. m.—"Eveready Hour."

WEDNESDAY.

10:00 a. m.—Housewives Radio Exchange. A department conducted by Mrs. Wood on all matters of household interest.
1:05 p. m.—Studio programme.
7:30 p. m.—A. Russ Patterson and His Artists direct from the New York studio.
8:00 p. m.—Concert by the United States Navy Band under the direction of Lieut. Charles Denter, direct from Washington, D. C.
9:00 p. m.—Mozart String Quartet, assisted by Mabel Corlew, soprano, and Raymond Hunter, baritone.

THURSDAY.

1:05 p. m.—Studio programme.
8:00 p. m.—William G. Usher, baritone, and Edward C. Boulay, painist.
8:15 p. m.—Elton A. Cook, bass soloist, accompanied by Miss Gladys E. A. Smith.
8:35 p. m.—Joint recital by Mme. Agnes Goulin Pouliot, soprano, and Gertrude Joseffy Chase, pianist.
9:00 p. m.—"Atwater-Kent Radio Artists."
10:00 p. m.—The Silvertown Cord Orchestra under the direction of Joseph Knecht.

FRIDAY.

10:00 a. m.—Housewives Radio Exchange. A department conducted by Mrs. Wood on all matters of household interest.
1:05 p. m.—The Woodstock Orchestra under the direction of Martin J. Casey.
6:00 p. m.—Twin Elm Orchestra under the direction of Joseph McNamara.
7:00 p. m.—Miss Margaret Reid, children's librarian, Elmwood Public Library.
7:30 p. m.—Programme under the direction of the V. F. W.
9:00 p. m.—Maine Creamery hour.
11:00 p. m.—Providence Biltmore Hotel Dance Orchestra under the direction of Erwin White, relayed from the dining room of the Providence Biltmore Hotel.

SATURDAY.

1:05 p. m.—Studio programme.
Silent night.

WDWF, DUTEE W. FLINT, INC.
(441 METRES)

TUESDAY.

9:30 p. m.—Arcadia Dance Orchestra.

Continued on Page Eleven.

RADIO PROGRAMMES

Continued from Page Ten.

THURSDAY.

7:30 p. m.—Narragansett Hotel Orchestra.

WHN, NEW YORK CITY
(361 METRES.)

TO-DAY

1:00 p. m.—Organ recital from Loew's Lexigton Theatre.
3:00 p. m.—Queens County Christian Endeavor programme.
5:00 p. m.—Roseland Dance Orchestra.
5:30 p. m.—Olcott Vail's String Trio.
10:00 p. m.—Entertainers.
10:15 p. m.—Janssen's Hofbrau Orchestra.
11:15 p. m.—Signing off for DX fans.

WMCA, NEW YORK CITY
(341 METRES)
TO-DAY.

11:00 a. m.—Services from First Church of Christ, Scientist.
3:00 p. m.—Hettie E. Matthews, soprano.
3:30 p. m.—Arpad Rado, violinist.
7:00 p. m.—Ernie Golden and his Hotel McAlpin Orchestra.
7:35 p. m.—Health talk.
7:45 p. m.—William Leibling, baritone.

WNYC, NEW YORK CITY
(526 METRES)
TO-DAY.

9:00 p. m.—Programme by direct wire from stage and studio of Brooklyn Mark Strand Theatre, under direction of Edward L. Hyman.

KDKA, EAST PITTSBURGH, PA.
(309 METRES)
To-day.

10:45 a. m.—Services of the Point Breeze Presbyterian Church, Pittsburgh, Rev. Percival H. Barker, pastor.
4:00 p. m.—Organ recital by Dr. Charles Heinroth, Director of Music of Carnegie Institute, Pittsburgh, broadcast directly from Carnegie Music Hall, Pittsburgh.
4:45 p. m.—Vesper services of the Shadyside Presbyterian Church, Pittsburgh, Rev. Hugh Thomson Kerr, pastor.
7:45 p. m.—Interdenominational openair services from the Calvary Episcopal Church, Pittsburgh.

KFI, LOS ANGELES, CAL.
(467 METRES)
To-day.

2:00 p. m.—Morning services under the direction of Los Angeles Church Federation.
3:00 p. m.—Temple Baptist Church Services.
8:00 p. m.—Vesper services under the direction of the Federated Church Musicians.
10:30 p. m.—MacDaniel's Nightly Doings.
10:45 p. m.—Father Ricard's Sun Spot Weather Forecast. Music Appreciation Chat.
11:00 p. m.—Programme presented by Albert Kaufman from the Stage and Studio of the Metropolitan Theatre.
12:00 midnight—Classic hour, featuring national classics.
2:00 a. m.—Packard Six Orchestra, under the co-direction of Bill Hennessy and Chet Mittendorf.

KGO, OAKLAND, CAL.
(361 METRES)
To-day.

3:00 p. m.—Service St. Luke's Episcopal Church, San Francisco; Rev. W. W. Jennings, rector.
7:30 p. m.—Concert, KGO Little Symphony Orchestra, Carl Rhodehamel, conductor; Arthur S. Garbett, musical interpretative writer; guest artist.
12:00 midnight—Service, St. Luke's Episcopal Church, San Francisco; Rev. W. W. Jennings, rector.

KGW, PORTLAND, ORE.
(491 Metres.)
TO-DAY.

2:30 p. m.—First Presbyterian Church services, Dr. Harold Leonard Bowman, pastor.
11:45 p. m.—First Presbyterian Church services.

KNX, LOS ANGELES, CAL.
(337 Metres.)
TO-DAY.

2:00 p. m.—First Presbyterian Church of Hollywood, Rev. Stewart P. MacLennan.
10:30 p. m.—Hollywood Unitarian Church, Rev. Theodore Curtis Abel, pastor.
11:00 p. m.—First Presbyterian Church of Hollywood, Rev. Stewart P. McLennan.
12, midnight—Ambassador Concert Orchestra, Josef Rosenfeld, leader.
1:00 a. m.—Midsummer Night's Dream programme.

KOA, DENVER, COL.
(322 Metres.)
TO-DAY.

2:00 p. m.—Service of Trinity Methodist Episcopal Church, Denver, Rev. Loren M. Edwards, D. D., minister; Shad J. Tinsley, organist and director.
7:00 p. m.—Sunday music hour; organ and Trinity Orchestra from Trinity Methodist Episcopal Church, Denver, Shad J. Tinsley, organist and director.
10:45 p. m.—Service of Trinity Methodist Episcopal Church, Denver, Rev. Loren M. Edwards, D. D., minister; Shad J. Tinsley, organist and director.

KYW, CHICAGO, ILL.
(536 METRES).
TO-DAY.

12:00 noon—Church service to be announced by radiophone.
5:00 p. m.—Studio concert.

WBZ, SPRINGFIELD, MASS.
(333 METRES)
TO-DAY

10:55 a. m.—Church services from the Church of the Unity, Rev. Charles A. Wing, pastor. Music by the Philharmonic Male Quartet, Raymond C. Hodge, first tenor; Howard I. Smith, second tenor; William H. Lippmann, baritone; George B. Dowd, bass, and Robert W. Field, organist and director.
9:00 p. m.—Broadcast direct from the Estey Organ studio of programme arranged by Ernest Makeshnie.
9:30 p. m.—Concert broadcast direct from the Estey Organ studio by Florence Owen, contralto; Howard S. Layman, pianist; Jack Battle, violinist, and William S. Self, organist.

WBCN, CHICAGO, ILL.
(266 METRES)
TO-DAY

11:30 a. m.—Morning service from People's Liberal Church.
5:00 p. m.—Lain & Son classical concert; vocal and instrumental artists, with pipe organ accompaniment.
8:00 p. m.—Classical concert; Walther League, vocal and instrumental artists.
9:00 p. m.—Popular programme.

WCAP, WASHINGTON, D. C.
(469 METRES)
TO-DAY

11:00 a. m.—Service from Metropolitan Methodist Church of Washington. Rev. G. S. Johnson, pastor, will preach the sermon.
4:00 p. m.—Outdoor service held at the Peace Cross, Washington. Cathedral of the Episcopal Church, Mt. St. Alban, Washington.
7:20 p. m.—"Roxy and His Gang."
8:30 p. m.—Goldman Band concert.

WCAE, PITTSBURGH, PA.
(461 METRES)
TO-DAY

3:00 p. m.—People's Radio Church services.
4:00 p. m.—John Wesley Quartet.
6:30 p. m.—Dinner concert transmitted from William Penn Hotel.
7:20 p. m.—"Roxy and His Gang."
8:30 p. m.—Goldman Band concert.

WCTS, WORCESTER, MASS.
(268 METRES)
TO-DAY

7:20 p. m.—"Roxy and His Gang."
8:30 p. m.—Goldman Band Concert.

WEAF, NEW YORK CITY
(492 METRES)
TO-DAY

3:00 p. m.—"Sunday Hymn Sing," auspices Greater New York Federation of Churches.
4:00 p. m.—Interdenominational services, auspices Greater New York Federation of Churches. Address by Rev. J. Fred Bindenberger, D. D., pastor of Trinity Methodist Episcopal Church, West Brighton, S. I. Music by Aida Brass Quartet.
7:30 p. m.—"Roxy and His Gang."
8:30 p. m.—Goldman Band concert.

WCCO, MINNEAPOLIS-ST. PAUL
(416 METRES)
TO-DAY

12:20 p. m.—Plymouth Congregational Church, Minneapolis, Rev. H. P. Lewey, D. D., pastor.
6:10 p. m.—House of Hope Presbyterian Church, St. Paul, Rev. H. C. Swearingen, D. D., pastor.
9:45 p. m.—Hennepin Avenue M. E. Church, Minneapolis, Rev. Lucius H. Bugbee, D. D., pastor.
11:00 p. m.—Weather report and baseball score.
11:15 p. m.—Classical concert.

WEEI, BOSTON, MASS.
(476 METRES.)
TO-DAY.

7:20 p. m.—"Roxy and His Gang."
8:30 p. m.—Goldman Band concert.

WEAR, CLEVELAND, OHIO.
(390 METRES)
TO-DAY.

4:30 p. m.—Afternoon musicale by the Hotel Cleveland Orchestra, Ivan Francisci conducting.
8:00 p. m.—Musical programme by Park Theatre Orchestra, Angelo Vitale conducting.
9:00 p. m.—Metcalf Memorial Organ recital by Vincent H. Percy.
10:00 p. m.—"Evening Hour," broadcast from the studio.

WGBS, NEW YORK CITY
(316 METRES)
TO-DAY.

3:30 p. m.—Programme direct from the Piccadilly Theatre.
9:30 p. m.—Opera "Giocondo," by Ponchielli.

WGR, BUFFALO, N. Y.
(319 METRES)
TO-DAY.

3:00 p. m.—Vesper services, auspices of the Buffalo Council of Churches, by the Christian Endeavor.
4:00 p. m.—Organ recital by John W. Newton.
7:45 p. m.—Pre-service organ recital by William Wall Whiddit.
8:00 p. m.—Evening service, direct from Central Presbyterian Church, Buffalo; Dr. R. J. MacAlpine, minister.

WGY, SCHENECTADY, N. Y.
(379 METRES)
TO-DAY

10:45 a. m.—Service of First Church of Christ Scientist, Schenectady, N. Y.
6:30 p. m.—Service of First Baptist Church, Schenectady.
9:30 p. m.—Ponchielli's Opera "La Gioconda."

WHAR, ATLANTIC CITY, N. Y.
(275 METRES)
TO-DAY

2:30 p. m.—Sacred recital by the Seaside Hotel Trio.
2:45 p. m.—Sermon, Rev. James Lord, of the Chelsea-Ventnor M. E. Church.
9:00 p. m.—Concert by the Seaside Hotel Trio and soloists.
11:00 p. m.—Strand Theatre, organ recital.

WHAS, LOUISVILLE, KY.
(400 METRES.)
TO-DAY.

11:57 a. m.—Organ music.
12:00 noon—Church service under the auspices of the Broadway Christian Church, the Rev. Dr. W. N. Briney, pastor; Mrs. Harry W. Long, organist and choir director.
6:00 p. m.—Vesper song service under the auspices of the First Unitarian Church, the Rev. Dr. Lon R. Call, minister.

WIP, PHILADELPHIA, PA.
(508 METRES.)
TO-DAY

7:15 p. m.—Evening service from Holy Trinity Church, Philadelphia, Rev. Floyd W. Tomkins, D. D., rector.

WJZ, NEW YORK CITY
(455 METRES.)
TO-DAY.

9:00 a. m.—Children's hour: Stories by the authors, music by the composers, comic stories by the originators of famous comedies.
10:40 a. m.—Chimes from Grace Church.
11:00 a. m.—West End Presbyterian Church services; sermon by Dr. A. E. Kiegwin.
2:30 p. m.—Sunday Radio Forum; Dr. John L. Davis, pastor of Grace Methodist Episcopal Church.
3:30 p. m.—Lillian Seckendorf Popper, pianist.
3:45 p. m.—To be announced.
4:00 p. m.—Lillian Seckendorf Popper, pianist.
4:30 p. m.—Sarah Borni, soprano; Mario Caiati, 'cellist.
7:00 p. m.—Nathan Abas's Hotel Pennsylvania Orchestra.
8:15 p. m.—Dextra Male Chorus.
9:00 p. m.—Lakewood Farm Inn Ensemble Jan Weber, conductor.
10:00 p. m.—Godfrey Ludlow, violinist.

WSAI, CINCINNATI, OHIO.
(326 METRES)
TO-DAY.

4:00 p. m.—Sermonette and chimes.
8:30 p. m.—Goldman Band concert.

WOO, PHILADELPHIA, PA.
(508 METRES.)
TO-DAY.

10:45 a. m.—Morning services from Bethany Presbyterian Church. Church services will begin at 10:45 with a sermon by Rev. A. Gordon MacLennan, pastor.
2:30 p. m.—Musical exercises opening the regular session of Bethany Sunday school.
6:00 p. m.—Old time hymns and melodies and sacred chimes recital on grand organ, Clarence K. Bawden at the console.

WWJ, DETROIT, MICH.
(353 METRES)
TO-DAY.

12:00 noon—Services at St. Paul's Episcopal Cathedral, broadcast from the cathedral.
3:00 p. m.—Orchestra.

To-day's Programmes in Brief

For the convenience of radio fans, the following hourly schedule of broadcasting to-day is given in brief form, the complete programme being given under the regular listing of announcements.

The hours are based on Eastern Daylight Saving Time.

LOCAL STATIONS

10:45—Church, WEAN.
1:30—Concert, WEAN.
7:20—"Roxy," WJAR.
7:30—Church, WEAN.
8:30—Band, WJAR.

OUT-OF-TOWN STATIONS

9:00—Children's Hour, WJZ.
10:30—Church, WGY.
10:40—Chimes, WJZ.
10:45—Church, KDKA.
Church, WGY.
Church, WOO.
10:55—Church, WBZ.
11:00—Church, WMCA.
Church, WCAP.
Chimes, WREO.
Church, WJZ.
11:30—Church, WBCN.
12:00—Church, KYW.
Church, WHAS.
Church, WWJ.
12:20—Church, WCCO.
1:00—Organ recital, WHN.
2:00—Church, KNX.
Church, KOA.
Church, KFI.
2:30—Concert, WOO.
Church, KGW.
Recital, WHAR.
Forum, WJZ.
3:00—Recital, WMCA.
Vespers, WGR.
Church, KFI.
Church, KGO.
Church, WCAE.
Orchestra, WWJ.
Songs, WEAF.
Religious Service, WHN.
3:30—Music, WGBS.
4:00—Recital, WCAE.
Church, WCAP.
Church, WEAF.
Chapel, WSAI.
Organ recital, KDKA.
Organ recital, WGR.
4:30—Recital, WEAR.
4:45—Vespers, KDKA.
5:00—Orchestra, WHN.
Concert, WBCN.
Concert, KYW.
5:30—Stringed Trio, WHN.
6:00—Organ recital, WOO.
Concert, WHAS.
6:10—Church, WCCO.
6:30—Concert, WCAE.
7:00—Recital, KOA.
Orchestra, WMCA.
Orchestra, WJZ.
7:15—Church, WIP.
7:20—Roxy, WEAF, WCAP, WEEI, WWJ, WCTS, WCAE.
Concert, KGO.
Church, WGY.
7:35—Talk, WMCA.
7:45—Church, WGR.
Church, KDKA.
8:00—Concert, WBCN.
Orchestra, WEAR.
Vespers, KFI.
8:15—Band Concert, WEAF, WCAP, WEEI, WCTS, WWJ, WCAE, WSAI.
9:00—Concert, WHAR.
Orchestra, WJZ.
Organ recital, WEAR.
Concert, WBZ.
Concert, WNYC.
9:30—Orchestra, WGBS.
Organ recital, WBZ.
Opera, WGY.
9:45—Church, WCCO.
10:00—Concert, WEAR.
Violinist, WJZ.
Specialty, WHN.
10:30—Talk, KFI.
Church, KNX.
10:45—Orchestra, WHN.
Weather report, KFI.
Church, KOA.
11:00—Concert, KFI.
Weather report, WCCO.
Church, KNX.
Recital, WHAR.
11:15—DX Signals, WHN.
Concert, WCCO.
11:45—Church, KGW.
12:00—Recital, KFI.
Church, KGO.
Orchestra, KNX.
1:00—Special, KNX.
2:00—Orchestra, KFI.