

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. YOGAN

I feel somewhat in the humor of a person who has passed by innumerable pleas for charitable help 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 "to-lose" probe. We tinkered with this, 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 recently 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 fall just as any other part of a receiver. That's the point—they often fall "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 that are made from carbon powders mixed with binder pastes, unless sealed in tubes away from atmospheric changes, will often crystallize.

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 multibeam 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 not 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 multibeam 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 multibeam 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 these 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

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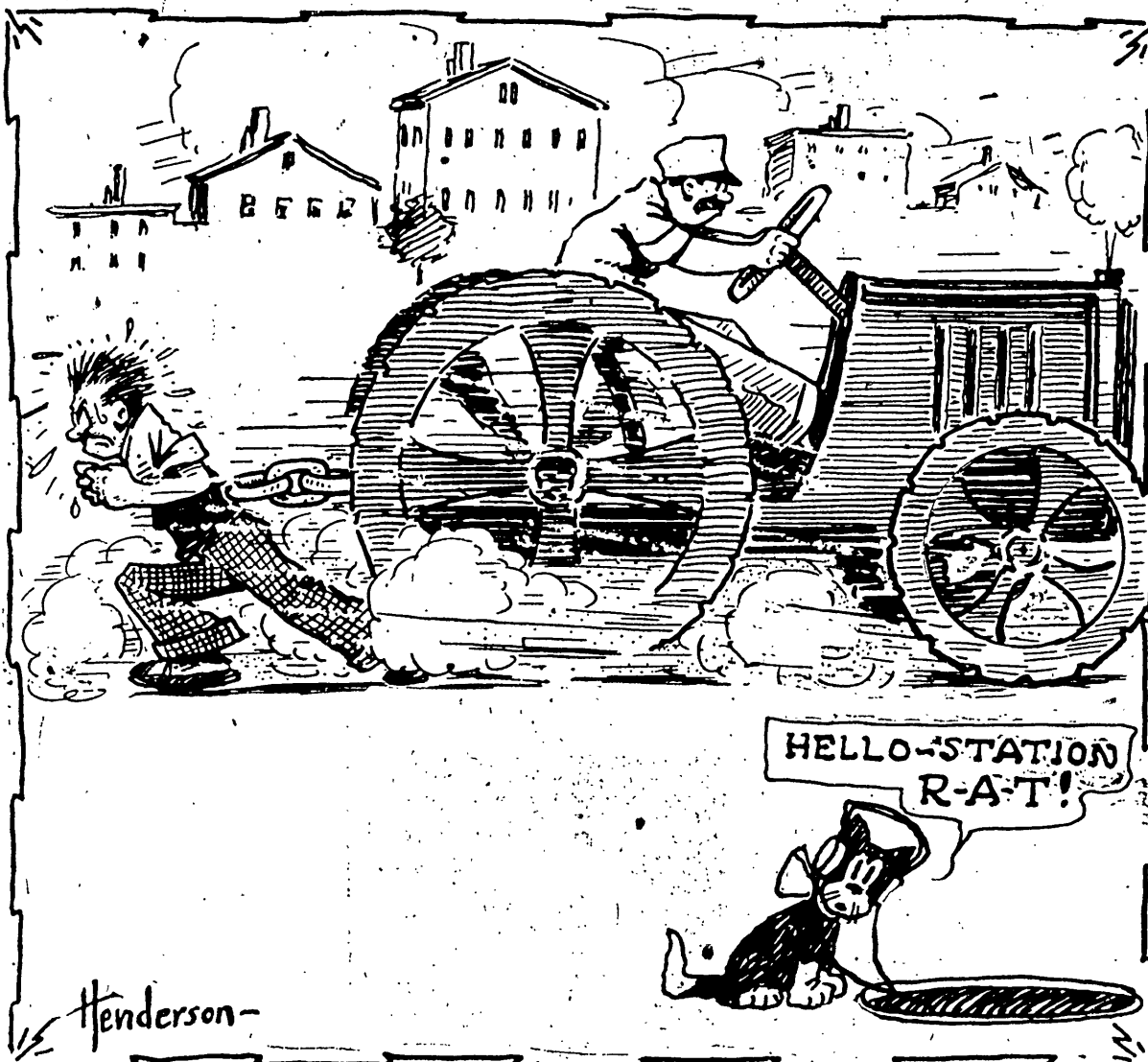
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To-day's Hook-Up



The Only Way to Keep Him Away From the Set

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 will know this and fans 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 46 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 225 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.

cycles in Radio-Frequencies

Milliamperes of Current

No. 1 48 53 66

No. 2 36 40 53

No. 3 28 28 10

No. 4 48 58 75

No. 5 45 57 73

No. 6 49 59 78

No. 7 47 58 74

No. 8 47 58 74

No. 9 47 58 74

No. 10 47 58 74

No. 11 47 58 74

No. 12 47 58 74

No. 13 47 58 74

No. 14 47 58 74

No. 15 47 58 74

JOHN SMITH AND HIS RADIO DET

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 sensitivity 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 sensitivity, 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-contained 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 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.

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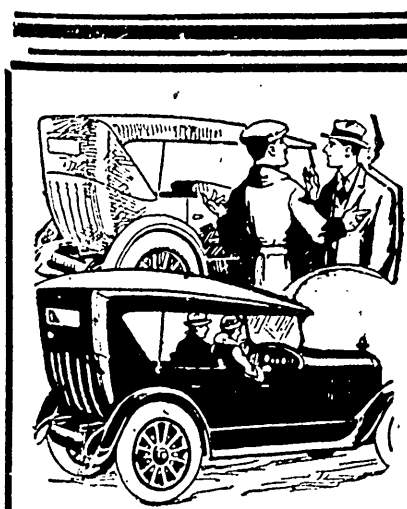
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First. It works well.

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 270 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-length band with uniformity. These are:

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

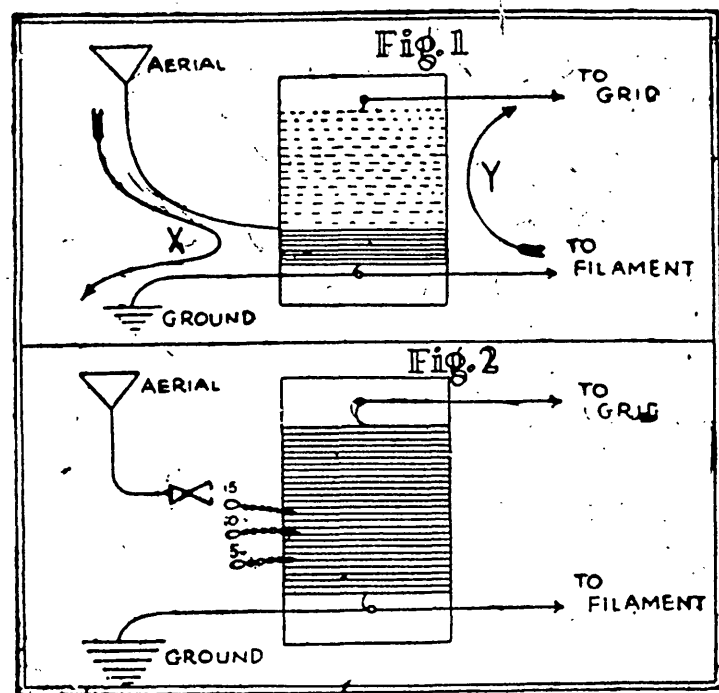
Second. To arrive at the maximum degree of coupling between aerial and set at which volume is good and selectivity satisfactory.

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 on the side 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 of Figure 1 has a natural wave length of 231 metres. Suppose we try to receive Station WTAX of Stretcher, 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.

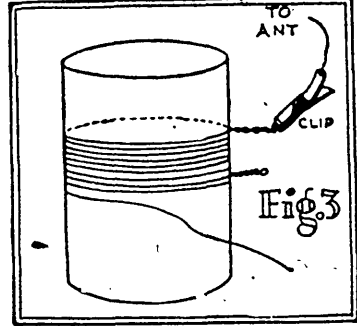
However, with the tickler coil stationary we note that the receiver oscillates as the grid circuit is tuned to wave lengths above and below 231 metres. Right at the "dead spot" the absorption of energy by the antenna is so great that there is not enough power left in the plate circuit to make the tube 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 dial. Except in extreme cases, either a .00025 mfd. or .0005 mfd. fixed condenser solves the wave-length 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 over-sharpness 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.

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. (304 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 from 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 of the Budget of the United States. 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.—Tribune 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, pianist.

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 Joselyne, 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.

8:00 p. m.—Twin Elm Orchestra under the direction of Joseph McNamara.

7:00 p. m.—Miss Margaret Reld, 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

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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, Yeong'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.

4:45 p. m.—Tenor solos by Robert D. Case, Dennis O'Connell, accompanist.

6:30 p. m.—WNAC dinner dance, Billy McBride's Beacherot 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 Bent 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.—"Fifteen Minutes of Music Appreciation."

1:00 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, Harold Sheffers, director.

8:00 p. m.—Musical programme.

11:55 a. m.—Time signals.

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."

1:00 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, Harold Sheffers, director.

8:00 p. m.—Musical programme.

11:55 a. m.—Time signals.

THURSDAY.

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."

1:00 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, Harold Sheffers, director.

8:00 p. m.—Musical programme.

11:55 a. m.—Time signals.

FRIDAY.

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."

1:00 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, Harold Sheffers, director.

8:00 p. m.—Musical programme.

11:55 a. m.—Time signals.

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."

1:00 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, Harold Sheffers, director.

8:00 p. m.—Musical programme.

11:55 a. m.—Time signals.

SUNDAY.

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."

1:00 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, Harold Sheffers, director.

8:00 p. m.—Musical programme.

11:55 a. m.—Time signals.

MONDAY.

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."

1:00 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, Harold Sheffers, director.

8:00 p. m.—Musical programme.

11:55 a. m.—Time signals.

TUESDAY.

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."

1:00 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, Harold Sheffers, director.

8:00 p. m.—Musical programme.

11:55 a. m.—Time signals.

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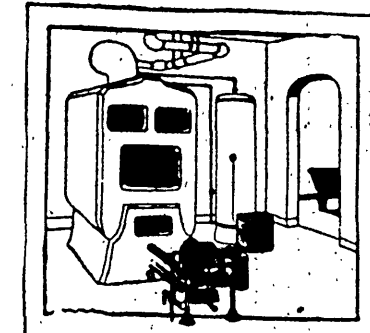
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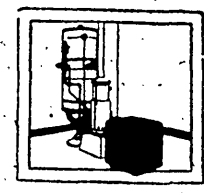
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RADIO PROGRAMMES

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 Lexington Theatre.
3:30 p. m.—Queens County Christian Endeavor programme.
5:00 p. m.—Roseland Dance Orchestra.
5:30 p. m.—Olcott Wall'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.

WNYS, NEW YORK CITY (526 METRES.)

TO-DAY
8:00 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 open-air 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 Richard'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. (401 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. (317 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. MacLennan.
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. (336 METRES.)

TO-DAY
12:00 noon—Church service to be announced by radio.
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 Eatey Organ studio of programme arranged by Ernest Makeshine.
9:30 p. m.—Concert broadcast direct from the Eatey 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.

WCAE, WASHINGTON, D. C. (460 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

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, WVJ.
12:20—Church, WCCO.
1:00—Organ recital, WHN.
2:00—Church, KNX.
Church, KOA.
Church, KFI.
2:30—Concert, WGBS.
Church, KGW.
Recital, WHAR.
Forum, WJZ.
3:00—Recital, WMCA.
Vespers, WGR.
Church, KFI.
Church, KGO.
Church, WCAE.
Orchestra, WVJ.
Songs, WEA.
Religious Service, WHN.
3:30—Music, WGBS.
4:00—Recital, WCAE.
Church, WCAP.
Church, WEA.
Chapel, WSAI.
Organ recital, KDKA.
Organ recital, WGR.
4:30—Recital, WEA.
4:45—Vespers, KDKA.
5:00—Orchestra, WHN.
Concert, WBCN.
Concert, KYW.

1:30—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—Roxie, WEA, WCAP, WEEL.
WVJ, WCAE.
Concert, KGO.
Church, WGY.
7:35—Talk, WMCA.
7:45—Church, WGR.
Church, KDKA.
8:00—Concert, WBCN.
Orchestra, WEA.
Vespers, KFI.
8:15—Band Concert, WEA, WCAP, WEEL, WCAE, WVJ, WCAE, WSAI.
9:00—Concert, WHAR.
Orchestra, WJZ.
Organ recital, WEA.
Concert, WEA.
Concert, WNYC.
9:30—Orchestra, WGBS.
Organ recital, WEA.
Opera, WGY.
9:45—Church, WCCO.
10:00—Concert, WEA.
Violinist, WJZ.
Specialty, WHN.
10:30—Talk, KFI.
Church, KNX.
Orchestra, WHN.
10:45—Weather report, KFI.
Church, KOA.
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.

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 Blindenberg, D. D., pastor of Trinity Methodist Episcopal Church, West

Brighton, S. I. Music by Alde 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.
8:10 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 scores.
11:15 p. m.—Classical concert.

WEEL, BOSTON, MASS. (476 METRES.)

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

WEAR, CLEVELAND, OHIO. (399 METRES.)

TO-DAY
4:30 p. m.—Afternoon musicale by the Hotel Cleveland Orchestra, Ivan Francis 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 Ploceadilly Theatre.
9:30 p. m.—Opera "Glocondo," by Ponchielli.

WGB, 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, pas-

tor; Mrs. Harry W. Long, organist and choir director.
9:00 p. m.—Vesper song service under the auspices of the First Unitarian Church, the Rev. Dr. Lon R. Call, minister.

WIP, PHILADELPHIA, PA. (506 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 (453 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. Kieglwin.
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 Casti, 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.
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 melo-

dies and sacred chimes recital on grand organ, Clarence K. Bawden at the console.

WWJ, DETROIT, MICH. (333 METRES.)

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



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Cadillac 4-wheel, \$15.62	Jordan (10) \$8.31	Palge (6-66) \$9.96
Chandler \$8.41	Lincoln \$14.33	Pierce Arrow \$13.86
Chevrolet (400) \$4.00	Marmion \$11.09	Pierce Arrow \$13.86
Chrysler \$13.96	Maxwell \$8.93	Reo \$9.00
Cleveland \$8.78	Moore \$8.59	Rickenbacker \$7.83
Cole \$10.75	Nash (small) \$7.83	Rickenbacker 4-wheel \$15.09
Dodge \$7.50	Nash (big) \$10.83	Star \$3.00
Durant (4) \$7.63	Oldsmobile 4-wheel \$13.94	Studebaker (6) \$8.25
Durant (6) \$7.63	Oldsmobile 4-wheel \$13.94	Studebaker \$8.75
Essex (6) \$8.43	Oldsmobile 4-wheel \$13.94	Willys \$8.75
Flint \$8.84	Oldsmobile 4-wheel \$13.94	Willys \$8.75

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BIG 31ST SEMI-ANNUAL SALE ON
OPEN SUNDAY FOR INSPECTION

Chrysler—Sedan, not sold, \$1500;
Willys-Knight Limousine, sacrifice.
Buick—1924 Master Six "6" touring, lot of extras, extra tire; \$300 cash, balance \$200.
Star—1923-24 touring with many extras; private car, traded for new sedan only; \$125 down, balance very easy; a great bargain in a light car.
Buick—Six coupe, late model 6-48, fine order, private car, lot of extras; sale price \$200 cash, balance \$240.
Flint—Model 55 touring car, fine order, \$400 cash, balance easy, terms.
Model "55" Flint coupe, 4-pass., fine order, full guarantee; \$500 cash, balance easy.
Ford—1924 coupe, new condition; \$175 cash, balance to suit. Also various other line type Fords at clearance prices.
Hudson—Speedster, 4-pass., private car, 2 extra tires; \$200 cash, balance \$200.
Nice Hudson coupe and touring; bargains, also.
Maxwells—4 to select from; \$150 up.

Oakland—Sedan, \$200; \$75 cash, balance \$225 month, good rubber and in good running condition. Also Oakland touring at big concessions.
Durant touring cars, \$350 up; four to select from. Also sedan, coupe and roadster, best bargains in New England.
Nash "6," late, 4-pass. coupe, good order, 2 new tires, \$200 cash, balance \$485.
Dodge—1924 touring car; \$200 cash, balance \$455; also a Dodge coupe, and roadster.
Durant—1923 "4" sedan, fine order, full guarantee, \$300 cash, balance easy; 1923 Durant six sedan, fine order, full guarantee, \$350 cash, balance easy.
Flint—Model "40" 1925 touring car, full guarantee, traded for closed Flint, good opportunity.
Flint—46 brougham, 1925, new condition, traded for larger model, \$500 cash, balance to suit.
Star—1924 sport touring car; \$150 cash, balance to suit.

Stutz—6 pass., wire wheels, very fast, sporty car; \$300 cash, balance to suit.
Chevrolet—1923 coupe; \$125 cash, balance easy. Also a touring.
Cadillac "8" touring, 7-pass., good order; \$200 cash, balance \$335; big value. Another touring also at big cut.
Peerless roadster; \$150 down, easy balance. Peerless 7-pass., fine order; \$150 cash, balance on easy terms.
Dort sedan, late, \$250 down, balance very easy. Also Dort roadster.
Studebaker 1924 special six touring, a beauty, coating over \$2000; our price \$350 down, balance easy.
Scripps Booth touring at \$125 down, easy balance.
Haynes—1924 touring; private car; very fine shape; \$100 down, easy balance.
Overland—1924 touring; nice value; \$150 down, easy balance.

Reo sedan, fine order, late car, a nice bargain; \$250 cash, balance \$485.
Star—sedan, 1924; fine shape; some of the finest bargain to be had in light cars; \$200 cash, easy balance, also coupe and touring bargains also.
1923 Durant 6 Roadster.
1924 Durant 4 Roadster.
Studebaker Special Six touring, private car; \$225 cash, balance \$108, low terms; also Studebaker "6" touring at \$150, \$75 cash, balance \$5 a week. Several others.
Buick Six Touring, winter enclosure, \$65 cash, balance \$65; new terms.
Buick 1925 roadster, balloon tires, extra tire, windshield wiper, spot light.
Chandler roadster; \$180; touring, \$250 up.
E. & V. Knight "4" coupe, 4-pass.; \$250 cash, balance easy.
Winton touring at huge concessions.
Chevrolet 1924 Coupe, superior, \$150 cash, balance \$240.
Ford 1924 Roadster, \$125 down, easy balance.

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