The Radiobuilder

No. 8

SM

Dec. 15th, 1928

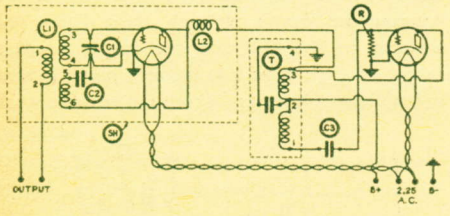
# Modulated R. F. Oscillator Facilitates Receiver Testing

With the possible exception of a voltmeter or ammeter there is no more valuable instrument for the experimenter or service man than a modulated radio-frequency oscillator. Such an oscillator, to-vaccum tube voltmeter described in issue No. 3 of the RADIOBUILDER, and an A.C. voltmeter, comprise the most important elements of a good test outfit.'

The unit described below may be constructed from standard parts that should be on the shelf of any S-M service station. It may be built in less than an hour, at very little cost, and the multiplicity of uses to which it may be put make it invaluable.

It may be used as a variable radio-frequency oscillator to cover the broadcast band, as a fixed frequency audio-frequency oscillator working at about 300 cycles, or as a modulated radio-frequency oscillator.

The advantage of using such a unit to determine the general nature of any trouble in a receiver lies in the fact that the test is made under actual operating conditions. Voltage and current readings of direct and power frequency alternating currents do not have to be translated into troubles at radio and audio-frequencies. Once the general nature of the trouble has been determined with the oscillator the other measurements may be used to find the specific cause.




The aluminum shield houses the radio-frequency oscillator circuit, which uses a 227 type tube in a conventional tuned grid oscillator circuit. The coil, condenser, socket and radio-frequency choke are arranged in it as shown in the photograph. The coil socket is mounted on ¾ inch studs which raise the coil sufficiently to place it symmetrically with respect to the shield. The variable condenser is fastened to the base board with machine screws which are countersunk from the under side. The small fixed condenser immediately to the right of the coil base is the .00025 mfd. condenser shown in the schematic wiring diagram.

**As this issue of the Radiobuilder reaches the many friends of Silver-Marshall, the Christmas Season is in full sway. While this is a time of universal good will and good cheer, we can not help thinking that of all the workers in Christendom, perhaps the builder of radio sets has the most reason to feel an honest glow of happiness. For nothing since the world began has been so potent in bringing beautiful music, the embodiment of Christmas cheer, into the homes and hearts of millions—in secluded spots as well as in the city's marts—as the little nest of copper and steel with its half-dozen glass globes. Long may its devotees live and prosper, and well may they take pride in their liberal contribution to the joy of the world!**

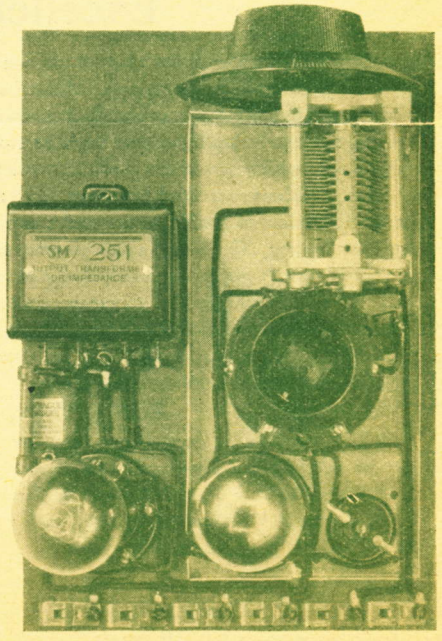
The Fahnestock clips, reading from left to right, should be connected to ground and B—, B+, the next two to a 2 to 2.5 volt A.C. source capable of supplying 3.5 amperes, and the right-hand pair are from 1 and 2 of the coil base which in turn connect to the variable coupling coil (rotor). The photograph and schematic wiring diagram show the wiring and assembly clearly.

To use the unit as a straight radio-frequency oscillator, connect a 45 volt B battery to clips 1 and 2, as mentioned above, and a 2.5 volt A.C. source to clips 3 and 4. With a sensitive receiver there will be sufficient coupling to the oscillator if it is placed within a few feet of the receiver. If the receiver gain is low or if the shielding is exceptionally good more coupling may be provided by grounding one lead of the coupling coil and attaching a few feet of wire (to serve as a small antenna) to the other coupling coil clip.

To calibrate the oscillator, tune in some reliable broadcasting station on a receiver and vary the oscillator condenser (with A.F. tube removed) setting until the beat frequency is very low. Using the dial setting of the oscillator and the frequency or wavelength of the station, one calibration point may be plotted on "cross-section" or co-ordinate paper. Eight or ten such points properly spaced will permit a smooth curve to be drawn. The condenser used gives very nearly a straight-line wave-length curve. This particular coil and condenser gave wave-lengths of 300, 400 and 500 meters at dial settings of approximately 30, 60 and 90 respectively. The unit should be calibrated with the shield in place and it should not be removed when the calibration chart is to be used since the frequency is changed several per cent.

If close coupling to some circuit is wanted, a coil of 8 or 10 turns, 2.5 or 3 inches in diameter, should be connected to clips 5 and 6. This coil is coupled to the external circuit. In using the unit, it was found that sufficient coupling could be used to induce a current of 40 milliamperes in a good circuit without upsetting the frequency of the oscillator more than 0.2 of one per cent.

Once the unit is calibrated, the reverse procedure may be used to determine the frequency of some broadcast station. If the calibration has been carefully made and if the heater and B battery voltages are kept reasonably constant, and using the same 227 r.f. tube, it will be accurate within a fraction of one per cent. When fishing for




DX the oscillator (with A.F. tube removed) may be made to beat with the DX station and produce

an audible signal before the set has been closely enough adjusted to give a readable signal from the station itself.

The radio-frequency oscillator may be used to match coils and condensers, to measure coil and circuit losses, and for a large number of common laboratory tests.

### The Audio Frequency Oscillator.

The unit may be used as a straight audio-frequency current source by connecting the circuit to be supplied in series with the negative B battery lead. If the external circuit is not continuous, a 1000-ohm resistor may be connected in series with the B — lead, and the drop across this used as a 300 cycle source. A 0.1 mfd. condenser may be connected between one side of the resistor and the external circuit, to isolate the D.C. plate current. The 227 r.f. tube may be removed to conserve B battery current.

If the audio-oscillator is to be used to test the audio amplifier in a receiver, the B— lead of the receiver should be connected to the B— clip of the unit (clip 6) and the positive clip of the unit (number 5) should be connected to the detector plate lead of the receiver. (The set B supply then operates the a.f. oscillator.)

To provide a modulated radio-frequency source, both 227 tubes should be used. The unit may then be coupled to receiver as described above.

### Receiver Test Procedure

When the unit is used as a modulated oscillator for receiver testing, it should be loosely coupled to the receiver under test, as described above. If good tubes, batteries, and a good speaker are used, and no signal is heard in the speaker when the oscillator is tuned over the whole range, it indicates definitely that the set is "dead." The unit may then be used as an audio-frequency oscillator to feed the audio-frequency amplifier. By connecting it successively to the primaries of the first and second stage audio frequeney transformers, the source of trouble may be determined.

Once the audio amplifier is known to be working properly, the unit should be used as a modulated oscillator in locating trouble in the radio-frequency end. Ground one side of the coupling coil, and run an insulated lead (in series with a .00015 mfd. condenser) from the other coupling coil terminal to the plate of the radio-frequeney tube preceding the detector. Tune the oscillator over the whole range until the signal is received. If no signal is heard, the trouble is in the detector. By connecting this lead successively to the plate terminals of the radio-frequency stages nearer the antenna stage, the stage in which the trouble exists may be located. A slight readjustment of the oscillator condenser may be necessary to give maximum signal strength. Further details on other tests, and a method of determining the relative sensitivity of receivers, will be given in a future issue of the "RADIOBUILDER."

### Parts Required

T 1—S-M 251 Output transformer
C1 1—S-M 320R .00035 mfd. condenser
C2 1—Sprague .00025 condenser
C3 1—Sprague ¼-mfd. condenser
SH 1—S-M 631A Aluminum stage shield
with 1—S-M 515 Universal coil socket
L1 1—S-M 111A Plug in coil (200 to 550 meters)
L2 1—S-M 275 r.f. choke
2—S-M 512 Tube sockets
R 1—Durham 25,000 ohn resistor
6—Fahnestock clips
1—Kurz Kasch 4 inch dial

# Peculiar Short-wave Adapter Shows Excellent Results

Mr. Edgar A. Suter, operator of an Authorized S-M Service Station in Winnipeg, Manitoba, Canada, sends in some very interesting data on a short wave adapter employing the super-heterodyne principle which he has designed, and which may be used with any standard broadcast receiver without alteration to enable it to receive short wave broadcasting. The editor takes pleasure in stating that shortly after this description was received, its author sent in the statement quoted below, and also advised of fairly consistent reception of 5SW, at London, England, by his short wave converter located in western Canada!

*This is to certify that we heard the TUNNEY-HEENEY bout described round by round from the ringside picked up on 26.5 meters from 8XAF on a Short Wave Frequency Changer developed by Mr. E. A. Suter of 24 Touraine Apartments, Ellice Avenue, Winnipeg, Man., Canada.*

*(Signed)*

*T. Jefferson—229 Kennedy Street, Winnepeg*
*G. Crane—Aberdeen Hotel, Winnipeg*
*R. MacLean—52 Berrydale Ave., Winnipeg*

The unit is constructed at very little cost; it consists of a short wave detector and oscillator. The heterodyne principle is used, the "Intermediate Frequency" being that to which the broadcast receiver is tuned.

### Parts Required

C1 1—S-M 340 midget condenser
C2 & C3, 2—S-M 316A .00035 variable condensers
C4 1—Sangamo .0025 mfd. fixed condenser
C5 & C6, 2—Sangamo 0.5 mfd. condensers
C7 1—Sangamo fixed condenser to "peak" L4 (See text)
R1 1—Carter 6 ohm rheostat
2—Vernier Dials. (Must be good, NO BACK-LASH)
4—S-M 511 sockets
2—Carter Imp Jacks & Plugs
1—S-M 631 Stage Shield
2—UX201A Tubes
1—Panel 7 x 12 Inches
1—Baseboard 8 x 10 Inches
¼ lb. Spool No. 26 D.S.C. Magnet Wire.
2 in. Length 1 in. diam. tubing for L3 (or S-M 277 r.f. Choke)
Length of tubing for L4 (See text).
4 Burned Out UX201A tubes (or S-M 130P coil forms)

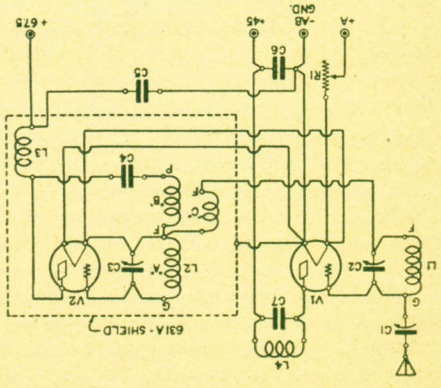
NOTE. Substitutions for the parts specified can be made if so desired, but cheap parts are not recommended in a circuit of this type.

### Constructional Data

Owing to the possible substitution of parts, details of laying out the panel and baseboard are not given. In order that the wavebands may be covered efficiently, "plug in" coils are used; the writer is using two sets, one covering the 20 and 40 meter bands, the other the 80 meter band. These coils are wound with No. 26 D.S.C. wire on bases of burned out UX 201A tubes from which all glass, etc., has been removed. (S-M 130P coil forms will do nicely—Ed.) To prevent the oscillator coils' (L2) magnetic fields from affecting the detector, it is necessary to wind them "Figure 8" fashion, also to shield the oscillator circuit to prevent capacity coupling between the oscillator and detector.

The oscillator coils (L2) are constructed as follows: A ¼ inch slot ¾ inch deep is cut in the top of the tube base (or S-M 130P form). The beginning of the wire is soldered to the grid prong in the same manner as the original tube connections were made. For the 20 and 40 meter band 7 turns are required, passing the wire alternately around one half then the other. A tap is taken off at the end of the fourth turn and soldered to one of the filament prongs; the end of the winding is soldered to the plate prong, thus completing the grid and plate coils (A & B, L2) in one operation. The "pick up" coil (C, L2) consists of 2 turns wound ⅛ inch above the plate coil; the beginning of this coil is soldered to the same filament prong to which the tap was soldered, the other end being soldered to the remaining filament prong. For the 80 meter coil 19 turns are required; the tap is taken off at the end of the twelfth turn, taking care it is soldered to the same filament prong in both coils.

The detector coil (L1) for the 20 and 40 meter range consists of 5 turns, and for the 80 meter coil 12 turns, these coils being wound in the regular manner. Two small holes are drilled in the side of the tube base, immediately under one another, about ¼ inch apart. The ends of the winding are drawn through these holes and soldered to the grid and one filament prong, taking care the same side filament prong is used in both cases. Other sets of coils can be constructed




to cover any wavelength range desired, remembering not to increase the number of turns of the

"pickup" coil, nor to place it nearer the plate coil than ⅛ inch.

Possibly 2 turns on the "pick up" coil will be too many in some cases, and will stop the oscillator from oscillating; reducing to 1½ turns or increasing the distance from the plate coil will remedy this condition These coils are plugged into UX. sockets wired according to the schematic diagram; the prongs to which the ends of the coils are soldered are marked on the diagram for convenience.

L3 is an r.f. choke consisting of 50 turns of the same wire wound on the 2 inch length of 1 inch diameter tubing. (S-M 277 r.f. Choke will do nicely—Ed.)

L4 is the coil which is coupled to the broadcast receiver, either to the secondary of the first r.f. Transformer or to the Loop if one is used. *This coil must be tuned to exactly the same wavelength as that to which it is decided to set the receiver.* If this is not done good results on long distance are not guaranteed. A variable condenser can be used when testing out the unit for the first time, after which a fixed condenser .0003 to .0005 mfd., can be substituted. The writer suggests that 50 turns of the same wire be wound on a length of 3 inch tubing; when the setting of the broadcast receiver is decided upon, remove a turn at a time until the coil is in resonance with the receiver, a fixed condenser as suggested being in shunt with the coil while this is being done. Most broadcast receivers tune slightly above the broadcast band; a setting of the receiver above 550 meters where there is no interference from broadcast stations is recommended, but of course if interference from ships operating on 600 meters is experienced some other setting will have to be chosen.

## S-M Unipac Goes Unscathed Through Florida Disaster

West Palm Beach, Florida

Silver-Marshall, Inc.,
Chicago, Ill.
Dear Sirs:

While stopping to catch my breath, I will relate a storm experience with an S-M 685. Many of the radio sets in my collection were lost when my house was very badly torn up by the storm. The 685 was missing for four days, and I found it resting in a pool of water. I tried it and *it worked.* Think of that—soaked in water for four days and still in working condition!

Here is how I dried it. I took the bulkhead from the case, and then placed bulkhead, case and all in the sun for five days; as far as I can see, it is just as good as ever. Any radio apparatus that can stand such a test is SOME RADIO!

B. C. Holder,
Box No. 3043

## It Hasn't!

I have built about every kit set on the American market, and find the 720 will "outperform" any make, tube for tube, regardless of price. I am expecting a good deal of business this winter, as a set like this will not go by unnoticed.

Carl B. Williams, Phillipsburg, N. J.

# Fine Points in Tuning The Sargent-Rayment Seven

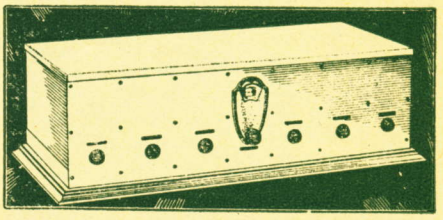
Something of the same sensation as skimming over the water in a hydroplane at sixty miles an hour, and then coming smoothly into floating position as the motor is slowed down, has been experienced by listeners using the Sargent-Rayment Seven (S-M 710). The analogy, of course, is to the two functions of this receiver—as an ultra-sensitive "distance getter" with individual peak tuning in each of its five resonant circuits, and as a single-dial set for high-quality musical reproduction of programs well above the local noise level.

Generally speaking, a strictly single-dial set for extreme long-distance reception is hardly to be expected in the present state of the art. The reason for this is, of course, that for any set to do its maximum in the way of selectivity, all of its tuned circuits must match or "gang" together *perfectly*. While some of the more expensive manufactured receivers may approach very closely to this ideal, it is safe to say that as long as things human are imperfect, any strictly one-dial set which proves effective for tuning past local interference would prove still more effective if its various tuned circuits were each provided with some sort of "trimmer." For the veteran "DX" fan it may, therefore, be assumed that no receiver will be entirely satisfactory unless it contains some means by which he can satisfy himself that all circuits are peaked absolutely together at the moment when he is "splitting hairs" to get some hard-sought station. This requirement the Sargent Rayment fulfills perfectly, owing to its complete set of individual circuit verniers.

However, some care in the management of the verniers is necessary when "slowing down the motor" (turning down the volume control) and converting the "DX getter" into the single-dial instrument. That is, when the verniers are properly set for resonance at some suitable point, all stages must remain sufficiently accurately matched throughout the whole wave range for the reception of local and reasonably distant stations. Obviously, this point (at which the verniers are to be tuned together at times when the set is to be left ready for use as a single-dial instrument) should be somewhere near the center of the range. Some station of medium frequency can thus be taken as a standard reference point, and, at the close of a session of distance-testing, the main dial may be turned to this predetermined point and all verniers adjusted for resonance to the "reference" station commonly received there. The Sargent-Rayment is thus converted into a "parlor musical instrument"—until it is next called upon to dig down along the noise level. This means that a log of all stations within reasonable range, previously made with verniers similarly adjusted, will hold good.

Should it be desired, however, to log the set with great accuracy for distance reception—as is desirable if one wishes to be in a position to demonstrate quickly its ability to bring in "one station on every channel"—then some additional care in the way of standard vernier adjustments is necessary. Log settings for extreme accuracy in distance work are best recorded to tenths of a division—the tenths being estimated, of course, by the position of the pointer between the marks. But in order that a very weak signal may be brought in again at the same setting as previously, it is necessary that all verniers be set exactly as they were in the previous case—and this is not so easy to do, unless a definite method is followed. One can, of course, estimate the angles at which the knobs of all verniers are set and record this as part of the log, but this is neither convenient nor necessary. It will be found in practice that a method somewhat as follows gives great ease of picking up distant stations previously logged—assuming that each station stays precisely on its assigned frequency, as the Federal Radio Commission is now trying to compel them to do.

Select, then, the two or three verniers which show least variation in resonant points from one end of the dial to the other: these are likely to be verniers 2, 3, and 4. Select one of these as a standard of reference, and find some setting of it with which all other verniers can be brought to a perfect peak *near both ends of the main-dial scale* as well as near the middle. This setting of the vernier selected as reference standard may be conveniently noted as simply the pointing of the arrow toward one of the nearby screws on the front panel.

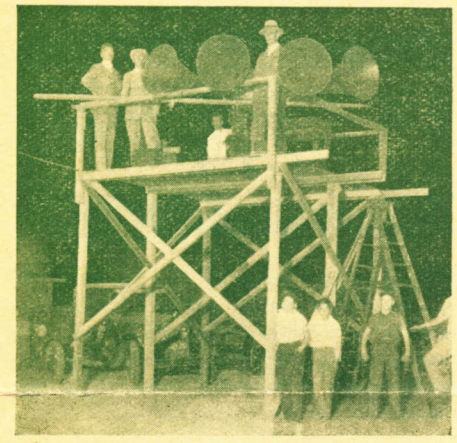


The procedure then, when it is desired to pick up some distant station previously logged, is to turn the main dial to the exact point shown on the log (for example: 48.6 as found for KGO on one Sargent-Rayment set at Chicago) and also set the standard "reference vernier" to point directly towards the same screw as previously used. Then, by trial, bring the other verniers into peak also. It will no doubt be a little more difficult, when

logging a station originally, to adjust the main dial so that perfect matching is secured *with the reference vernier at its standard setting*—but the reward is found in a really dependable log. And in this way it is possible to arrange a wonderfully impressive demonstration of the promptness with which the Sargent-Rayment is able to pick up various stations, the getting of which is considered in the locality as proof of a set's prowess.

Of course, no amount of precision in tuning methods can be guaranteed to bring in a certain station merely because it was found before at that exact point. Besides the well-known propensity of all far distant stations for coming in loudly one night and being utterly imperceptible the next night, all stations vary in frequency within limits which, while not of great consequence with ordinary receivers, become considerable when attempting a highly accurate log of an extreme-precision set. But as the diligence of the Radio Commission in "policing the air" gradually increases, it becomes more and more practicable—and certainly more and more profitable to a professional setbuilder—to make and to use a really accurate log, so that he may have, as to distant stations, the confidence which a southern darkie is said to have ascribed to the German long-range gunners during the war—"All dey needs is yo' address."

## S-M Unipac at a Football Game



**At a recent football game in El Paso, Texas, an S-M 685 Unipac, installed by the Radio Electric Service Co., was much appreciated by such of the 9,000 spectators as did not get "seats on the 50-yard line."**

**SILVER-MARSHALL, INC., Dept. 18,**
**846 W. Jackson Blvd., *Chicago, U. S. A.***

Please put me on the subscription list to receive "THE RADIOBUILDER" regularly. Stamps or currency enclosed as indicated below:

- ☐ Enclosed is 50 cents for next 12 issues.
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## Maximum Voltage Rating of UX281 and CX381 Rectifier Tubes

Since the appearance of the last issue of the RADIOBUILDER, in which was described the new S-M type 324 power transformer for use with UX281 (CX381) rectifier tubes to furnish voltages of 550 to 750 volts or more, an important matter has been called to our attention concerning the present operating voltage ratings of CX381 Cunningham tubes.

While R. C. A. UX281 tubes are rated (as when first introduced) for operating with power transformers developing up to 750 volts (r. m. s.) for secondary, CX381 Cunningham tubes are now rated for a maximum of only 700 volts or slightly above, when operating into a $\pi$-section filter system. Higher secondary voltages are permissible when operating a T-section filter (one having no input capacity; see Cunningham Tube Data Book for actual values).

Since it is recommended that the 324 transformer be operated into a $\pi$-section filter having a fairly large input capacity, in order that the plate supply for a push-pull 250 amplifier stage may be obtained from the filter *input*, without filtration, it has seemed wise to reduce the power transformer voltages to a value suited to CX381 tubes. In consequence, all type 324 transformers will be furnished with 720 volt secondaries, so that they may safely be used with UX281 and CX381 rectifier tubes. For practical operating purposes the regulation curves appearing in the last RADIOBUILDER may be relied upon.

At this point it seems well to comment again upon the safe operating plate voltage of UX250 and CX350 rectifier tubes. In practice, little will be gained through the use of plate voltages above 500 volts, and higher voltages will materially shorten tube life. (In the matter of maximum plate voltage ratings as power tubes, it is always well to observe R.C.A. and Cunningham maximum ratings closely.

## Surplus Stock Bargains

While it is standard S-M policy to sell through jobbers and dealers equipped to render the prompt and efficient service on small orders which is not possible for the factory, such methods of distribution do not lend themselves to the disposal of surplus stocks, and in consequence the material listed below is offered for shipment direct from the factory at the net prices quoted. All orders must be accompanied by full remittance, plus an allowance for postage or express charges. This should work no great hardship, as the items offered are priced below manufacturing cost, and are bargains.

*Tobe 660 Filter Condenser Banks.* These standard Tobe blocks are left over from the S-M "660 series" of Unipacs. They consist of one 4-mfd. condenser, one 2-mfd. condenser, three 1-mfd. condenser and a common lead. The total of 9-mfd. is adequate for a 180 to 220 volt ABC supply and power amplifier. May be used with S-M 331 Unichoke or any other standard filter chokes. Priced at $3.00 each net, their actual cost is but 40c per microfarad, or manufacturer's cost.

*Type 675-678 Unipac cases.* These brown crystalline steel cases, with hinged and removable covers, are furnished with ventilating louvers, and are offered exactly as used on original S-M 675 Hivolt and 678 Unipac. Each case is complete having a pierced central partition to carry all bolts, with two tube shelves; one equipped with two sockets, and the second shelf with one socket. These cases are ideal for power amplifiers or B and ABC power units. **They are 8⅝ in wide, 12¼ in. long and 8½ in. high.** Price, $1.95 each, net.

*Lincoln Folding Loops.* A quantity of genuine original Lincoln Loops, some centre tapped and some with a four point switch, are offered in original cartons. These loops, wound with silk-covered Belden cable on walnut frame, tune from 200 to 550 meters with a .00035 mfd. condenser, and are really excellent values. Originally sold at $6.50 and $8.50 each, they are offered at $2.25 each, net.

## Chicago Lady Hears Los Angeles at 11:00 A. M.

In the December 8th issue of "Oak Leaves," "the hometown weekly" of Oak Park (an exclusive Chicago suburb), Mrs. Harry B. Davis tells her experiences with various radio sets. Her letter is so interesting we should like to reprint it in full, but space permits only a few extracts. Mrs. Davis writes:

"About three years ago my husband and I bought a very gorgeous Chinese Wall cabinet to house 'The Radio.' The only trouble was that there was no radio good enough in all that time to be put in our choicest possession, the Chinese cabinet. Instead we have had radio in all sorts of disguises. All the circuits my husband had heard highly praised were tried out, some mounted on a plain pine board, some in a packing box, some in copper cans, aluminum boxes, some even had all the trimmings, including a small cabinet . . . But it is a long road that has no turning. Behold the miracle—we now have 'The Radio' in our cabinet . . .

"About a month ago he heard of the Sargent-Rayment circuit, and how marvelous it was. Of course he had to try it out . . . He turned the single control on the set, and more beautiful tones came from our loud speaker, but the biggest surprise was the announcement—WEAF, New York, for it was playing as loud and clear as the local station had been. . .

"The next morning I took the station log he had made the night before and started tuning for my own amusement. Just for fun I thought I would try for Los Angeles, station KFI, and no one could have been more surprised than I when I got them at 11:15 A. M. I stood entranced at the thought of listening to Los Angeles early in the morning. . .

"It is with great contentment, pleasure and a profound belief in miracles that I sign this article."