JULY 1st
1933

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RADIO WORLD

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The First and Only National Radio Weekly

Twelfth Year *588th Consecutive Issue*

HIGHLY ACCURATE WAVEMETER

DISTORTION IN DUO-DIODE CIRCUITS

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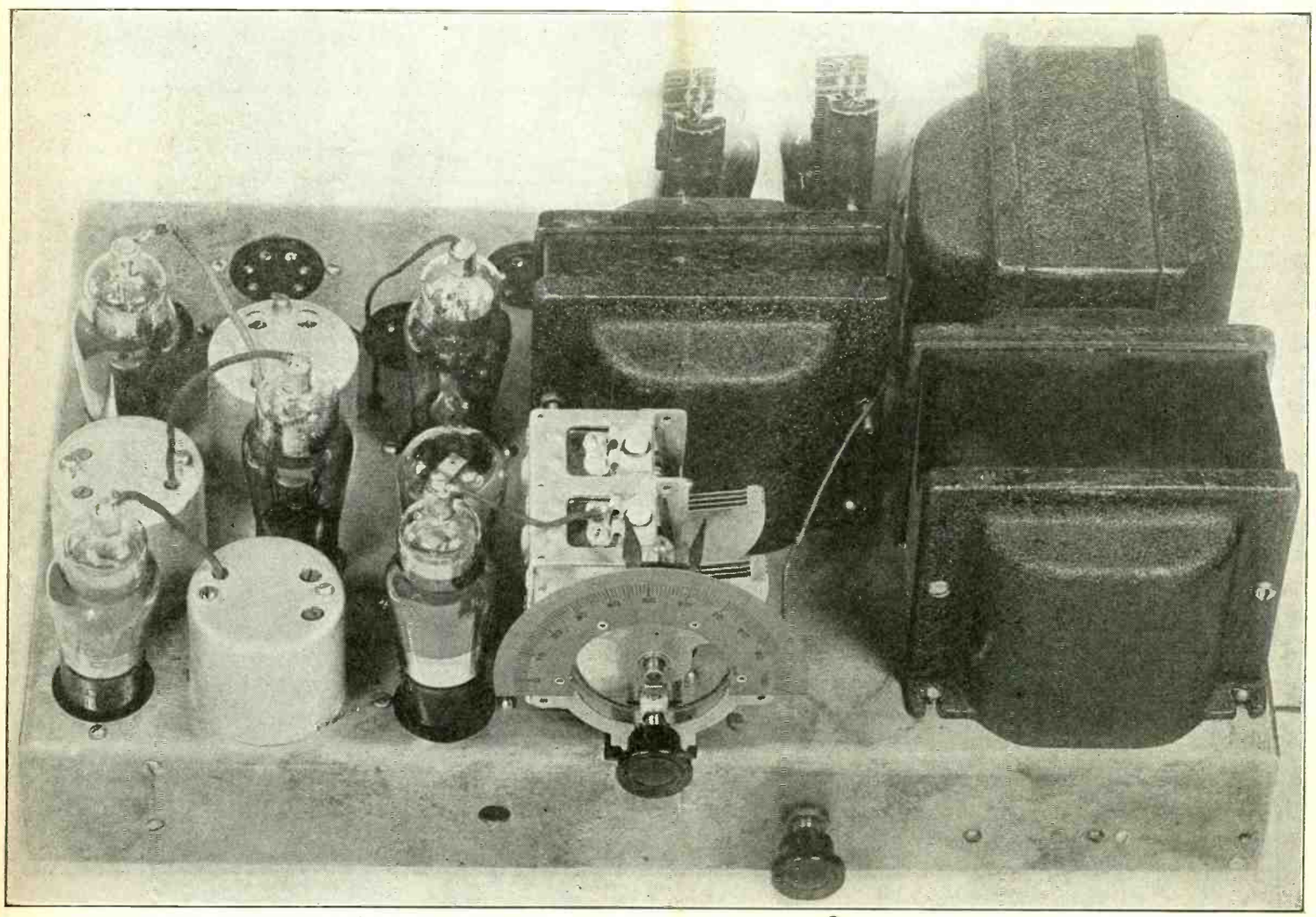

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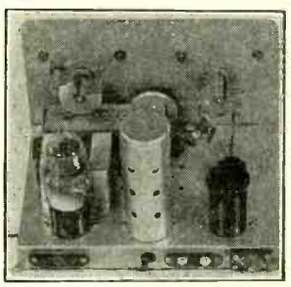

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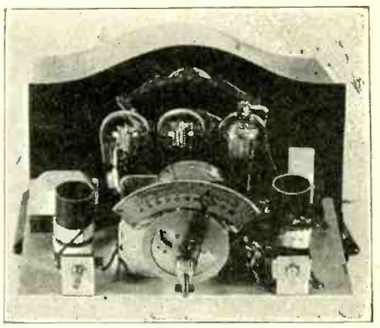

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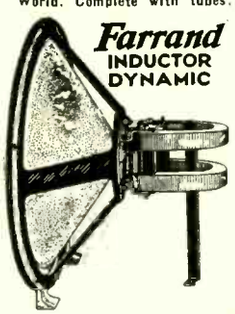

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DIODE OVERLOAD

A Cause of Double-Hump Tuning and Distortion

By Kenneth Barton Brooks

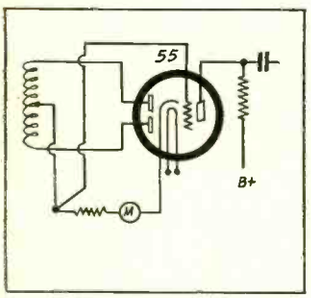


FIG. 1.
In a duo-diode circuit the rectified voltage may be read directly by putting the voltmeter in circuit as the load. The meter is shown as M, while the resistor to its left is the multiplier of the meter. The current may be computed from the formula: current in ampere equals voltage in volts divided by resistance in ohms.

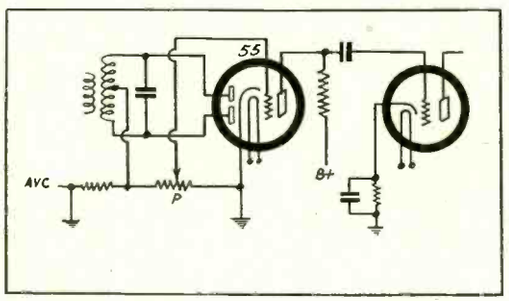


FIG. 2.
The circuit tested. Here the ful-wave type of detection is used, representing the second detector of a superheterodyne. The potentiometer P had a total resistance of 250,000 ohms, but to duplicate the meter instance in Fig. 1 would have to be of the same resistance as the multiplier. The other resistor, to left, is part of the automatic-volume control system, affecting preceding tubes. The question posed is whether the diode or the triode is overloaded first.

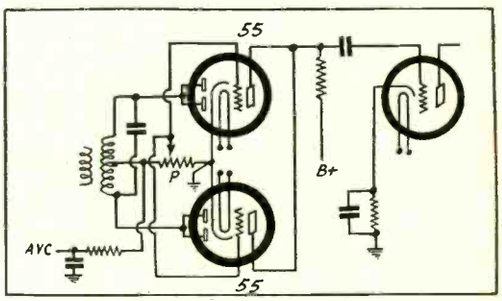


FIG. 3.
It was found that the diode was the first to suffer from overload. This was determined experimentally and subjected to triple check. Therefore, the remedy is proposed of using two tubes in the second detector position, in parallel. The nature of the circuit is not changed thereby, but the voltage-handling capability is approximately doubled. Except for paralleling, Fig. 3 is the same as Fig. 2. In each tube above the two diode anodes are made one.

THE use of the duo-diode detector, as found in the 55, 2B7, 85 and 75, has resulted in some instances in distortion, where excellent tone was expected, and this has been generally ascribed to the use of diode-biasing of the triode or pentode that is in the same envelope.

The condition arises principally in superheterodynes, and this led to the suspicion that perhaps more was being put into the diode than it could well handle. When the tube begins to saturate in this manner the quality at loud passages is poor. Moreover, there might be double-peak reception, due to the strong second harmonic generated.

Measurements were made of typical superheterodynes in which this trouble was encountered, in an effort to determine whether it arose in the diode or in the amplifier in the same envelope. Instead of a load resistor of the usual sort, e.g., a potentiometer's total resistance, the multiplier of a meter was used, and the meter included. Thus the rectified voltage was measured directly. The hookup is shown in Fig. 1.

Voltage and Current

In this way both the current flowing and the actual voltage may be determined. The

(*Continued on next page*)

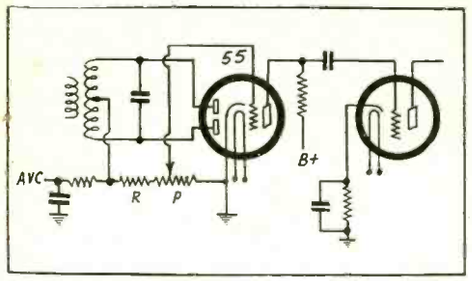


FIG. 4

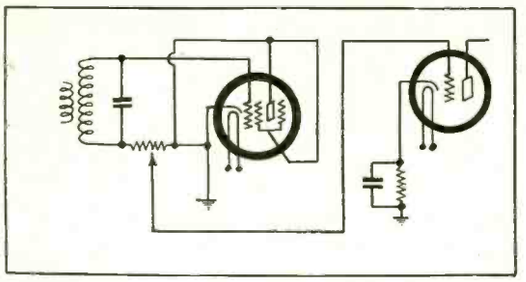


FIG. 5.

(*Continued from preceding page*)
voltage is read directly, and the meter then makes an excellent tuning meter, although it would be an expensive one. The meter used had a sensitivity of 0.5 ma at full-scale deflection and the 300-volt multiplier. in this instance also the load, was 600,000 ohms. The current could be read, too, it being proportional to the voltage read and the maximum voltage.

Four local stations in New York City were tested in this way. Two of them showed readings of 50 volts, one of 30 volts and the other of 22 volts. So for 50 volts the current flowing was 50/300 or one-sixth of 0.5 milliampere, equals a little more tha 83 microamperes. At 30 volts the current was one-tenth of 500 microamperes, or 50 microamperes. At 22 volts the current was approximately 35 microamperes.

On other local stations, where there was no double-hump tuning, tone was excellent, and these stations showed readings of less than 15 volts. The average reading was less than 10 volts for a variety of stations including distant ones, where the result was only a few volts.

Worst Instead of Best

It did not seem necessary to pursue the experiment further, as it was clear that the detector was being overloaded, and therefore not only was there a departure from desired linearity, but the result on strong locals was no better than from the worst type of detection.

The meter was equipped also with a 30-volt multiplier (60,000 ohms), and this was used. Naturally, the voltage was reduced, as the resistance was only one-tenth of what it had been, and the current increased less than the resistance had been decreased. Approximately the voltage was halved, for the strong local stations. But it is desirable to present as high a load as practical to the diode, to attain linearity, or directly portionate response in the rectified circuit, compared to the peak voltage of the radio-frequency (here intermediate-frequency) input. Moreover, the cure was not complete for that very reason, that linearity was not present on loud passages.

Slider Arm Did Not Help

If the trouble arose in the triode, whether diode-biased or independently biased, it should be correctible when the arm of the potentiometer was slid to take off some lower voltage, but this did not eliminate the trouble.

The circuit used in the set was of the full-wave input type, as in Fig. 2, where P is the potentiometer, which was 250,000 ohms. The cathode is grounded. Rectification takes place when the anode is positive in respect to the cathode, and this positive voltage is due to the radio frequency. The rectified voltage is the same as that put into the triode of the 55, and also it is the bias voltage on the triode, as the signal alone provides the bias. That is the meaning of a diode-biased triode.

While it is true that 50 volts are too much for bias of the triode of the 55, this is merely relative, in that excess bias augments the trouble, but it does not reveal the true and more important source, which is the diode. Various plate voltage values were tried, also plate load resistors, and still the trouble continued.

Two Tubes as Remedy

It was therefore deemed advisable to ascertain if the poor quality continued when the triode of the 55 was replaced with a remote cutoff tube, such as the 58 and also when the diode of the 55 was resistance-capacity coupled to the primary of the inter-stage push-pull transformer (not shown). Still the trouble continued, so the diode was the source.

If two tubes are used the trouble will disappear, and Fig. 3 shows two 55's, with anode plates of one tied together, and anode plates of the other likewise treated. Then the joined plates in each instance are treated as one anode, and indeed they are one. This approximately doubles the voltage-handlin capacity. The plate load resistor if aroun 50,000 ohms or so may be retained at the value, although if originally around 250,000 ohms may be reduced somewhat.

Not Due to A. V. C.

In all instances it was found that the automatic volume control could be tied to the maximum rectified negative voltage, as consistently diagramed in the figures, and it was confirmed that the trouble was not due to rectification in the controlled tubes. The double peak and poor tone persisted even when the automatic volume control was removed, as when returns of grids of otherwise controlled tubes made directly to grounded B minus.

In Fig. 3 is shown another method, where a fixed resistor R is made to limit the input of the triode, the diode unchanged. This was tried as another means of localizing the trouble, for if it persisted, the diode was at fault. It persisted. Therefore the Fig. 3 method should not be used as an attempted cure, but the Fig. 2 method is recommended.

The effect of overtaxing the diode is to render sensitivity low on loud locals, without affecting the weak stations. However, in a very sensitive superheterodyne tuner, since it is obvious that large rectified voltages will be present in the diode, the distortion not only results in poor quality but weak response. Therefore it is not practical to build up the volume by subsequent audio amplification to what it should be, as distortion is amplified, yet if the diode circuit is treated in the Fig. 3 method, the triode will drive push-pull output tubes.

Trouble Cumulative

Assuming that the local signal that resulted in 50 volts rectified output of the diode was subjected to a gain of only 2 in the triode amplifier, the voltage on the grid of the output tube, assuming no driver, would be 100 volts. If push-pull is used there is a transformer, and if its ratio is only 2-to-1 effective, then 200 volts go into the output tube. And if the output tubes are 2A3's the voltage to which their input is subjected, in respect to such local, is more than three times too great. So the trouble becomes cumulative.

The problem of improving tone and volume therefore may be met by the service man and experimenter by properly arranging the diode circuit, using two tubes, and one audio stage well may be dispensed with, thus yielding the desired socket. And the volume on strong locals will be full, the tone will be excellent, and the general volume, even on weak stations, will stand up sufficiently.

Not much has been said about the quantity of input that the duo-diode will stand. When the 56 was announced it was said that this tube as a diode, half-wave action, would stand 40 volts radio frequency (rms), but obviously the duo-diode as found in the stated tubes will not go that far, and a limit at around 15 volts would be considered safe by a conservative engineer.

Full-Wave Detection

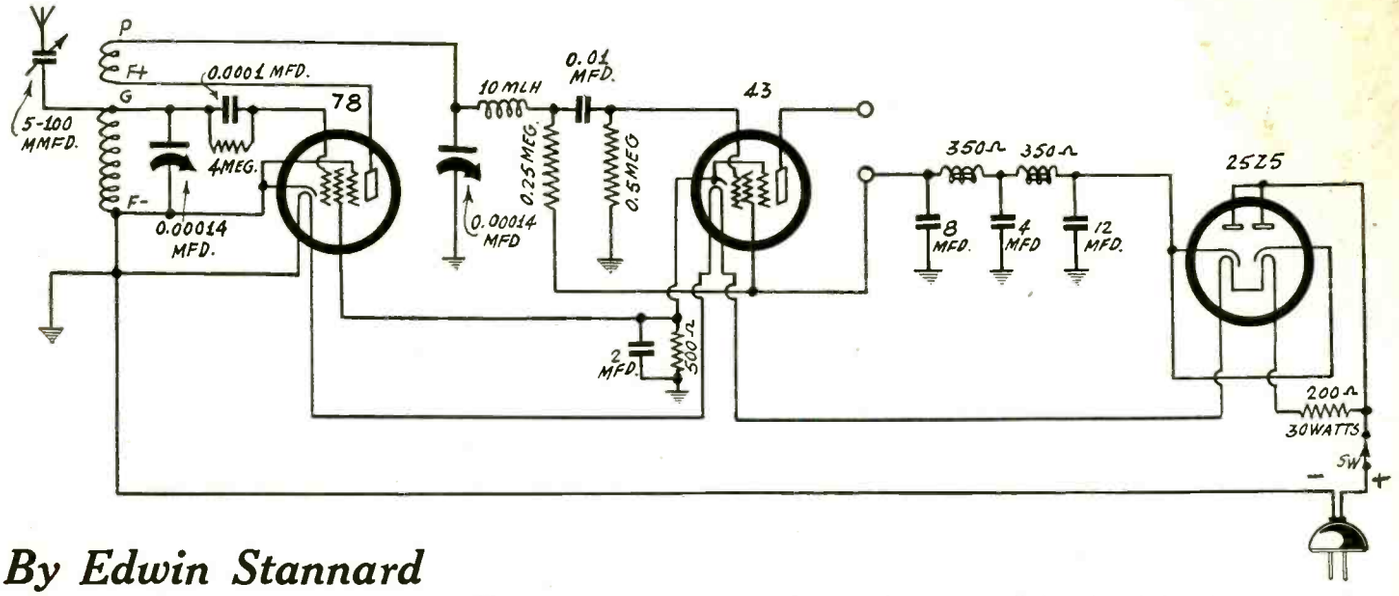
The question thus arises as to whether full-wave or half-wave rectification is preferable. By the very nature of the circuit, the voltage output from full-wave detection is half that from half-wave, since the input at any given alternation of a cycle is from only half the secondary. It is therefore imperative, with sensitive receivers, to use full-wave rectification in the second detector. Indeed, although the rectified voltage would be only one-half, as to the preferred strong local stations, the actual quantity of sound from the speaker would be greater with full-wave, because half-wave simply makes a bad situation worse, by doubling an already too-high voltage.

Aside from the duo-diode, however, if a 56 or other such tube is circuited as a diode, since it will stand more voltage, it is possible to get good results with half-wave rectification in the second detector.

Separate Diode

Fig. 5 shows a generalized circuit for a diode comprised of another type tube. If a 56 is to be used, the screen connection may be neglected. Otherwise the circuit would hold for 2A5 (tube at left), which should stand 100 volts, and cure all troubles. Plate, screen and cathode are tied together and serve as the cathode, while the otherwise grid is the anode. Then the voltage may be taken off for introduction into a subsequent amplifier tube. Of course there is no B voltage on the 2A5 and therefore considerations of high current consumption do not arise. The non-reactive coupling method to amplifier (tube at right in Fig. 5) is shown, but if transformer coupling is used, a stopping condenser may be put between the arm and P terminal of the primary, return of primary going to ground.

S-W Universal Rides Popularity Wave



By Edwin Stannard

Supertone Products Corporation

AS circuits improve they become more and more standardized, which accounts in part for the similarity of circuits. Just now there is a wave of popularity for the earphone short-wave receiver of the universal type, and in general the diagram shown in Fig. 1 is used.

This circuit uses a 25Z5 as rectifier for a-c use, floated on the line when d-c is used; a 78 detector and a 43 amplifier. Of course some locals can be heard on the speaker, but there is no speaker, for the circuit is not based on the infrequent results but on dependability.

The almost universally accepted shunt feed method of regeneration control is used, and the 78 is therefore made into an extremely sensitive detector, for without regeneration there would be little heard.

Regenerative action might not be present at any setting of the largest of the four coils used if too much of the capacity of the 5-100 mmfd. condenser were in circuit, indeed there might not be regeneration on any coil. However, that is the reason the condenser is adjustable, and it may be adjusted for regeneration on the smallest or next to smallest coil.

Larger Tickler Windings

Whether regeneration will be present will depend somewhat on the aerial itself, but adjustment of the condenser with the series finger will take care of this. If there is no regeneration, broadcasting stations around 1,500 kc, 1,450 kc and similar frequencies might come in; with regeneration they will not be received. That is simply another way of stating the well-known fact that regeneration not only increases sensitivity but selectivity as well.

The commercial type of plug-in coils may be used with this receiver, but it may be found that regeneration will not be satisfactory on all coils. However, to take care of this condition the special coils for the circuit, while having standard secondaries, have ticklers that possess twice as many turns on each of the four coils as do the general plug-in models. The reason is that the 78 tube requires such extra tickler winding, and therefore any who are thinking of building this circuit using coils they have, and run into trouble, might as well prepare to double the number of tickler turns as a sure cure for low sensitivity and vanished sensitivity.

The antenna series condenser is adjustable by the finger from the rear of the chassis in this universal short-wave set. The capacity should not be any lower than that required for regeneration. The circuit has become more or less standard in the last few months

Both condensers, the one used for tuning and the one for feed back control, are of 0.00014 mfd. capacity. Whenever the antenna condenser is to be adjusted, on whatever coil is selected for the purpose, the tuning condenser should be at maximum capacity and the regeneration condenser at about 50, or at a smaller numerical (capacity) setting.

The 78 tube is a screen grid valve and here is used as a grid leak detector. The grid current types of circuits make for excellent sensitivity, and the 78 lends itself to that use, although not so included among the formal tube data characteristics. The cathode has suppressor tied to it, both are grounded, the screen is led to the bias voltage of the 42 output tube, and a relatively large condenser across the 43's biasing resistor improves sensitivity and tone.

LIST OF PARTS

Coils

One set of four two-winding short-wave plug-in coils.
One 10-millihenry radio frequency choke coil.
Two B filter chokes.

Condensers

Two 140 mmfd. variable condensers (Hammarlund).
One 5-100 mmfd. series antenna condenser.
One 0.0001 mfd. grid condenser.
One 0.01 mfd. stopping condenser.
One 2.0 mfd. by-pass condenser.
Three electrolytic condensers, one 12 mfd., one 4 mfd., one 8 mfd.

Resistors

One 4-megohm grid leak.
One 250,000-ohm coupling resistor.
One 0.5-megohm grid leak.
One 500-ohm bias resistor (one watt).
One 200-ohm, 30-watt ballast resistor.

Other Requirements

Three six-contact sockets.
One four-contact socket (for coil).
One grid clip.
Two pairs of binding posts.
One line switch.
Two vernier dials.
One knob.
One metal chassis.
One six-foot cord with plug.
Two tube shields, large for 43 and one small for 78.

R-F Choke Coil

The choke coil in the detector plate leg is a honeycomb, which has low distributed capacity, and may be rated at 10 millihenries, or in turns, 800, although even substantially different r-f chokes will work well in this position, if of adequate inductance, so long as they are of the honeycomb type, because of the low distributed capacity.

It can be seen that the heaters are in series. This is true for both a-c and d-c use. The line voltage in either instance will be about the same. The rectifier and the power tube both have 25-volt heaters, while the detector has a 6.3-volt heater. Thus 56.3 volts are accounted for, and to take up the difference the 200-ohm, 30-watt resistor is used. It is connected between the high voltage side of the d-c line and one side of the series heater of the rectifier. Of course for d-c only the resistance of the rectifier heater is in use, and the low voltage drop in the 25Z5 itself may be rated as a small loss of B voltage due to flotation.

For Home Use or Trips

The B current drawn is small, in fact too small to require any special recognition, so the B chokes may be 350 ohms apiece, or even of greater d-c resistance, and the inductance should be as high as practical. Since the filter capacity is 24 mfd. all told in the rectifier circuit, it is sufficient, and any hum trouble may be traced to too low inductance of the B chokes.

The results, on a-c or d-c, are about the same, and many who have used this receiver report excellently clear reception of foreign

(Continued on next page)

Coil-Winding Data for 0.00014 mfd.

1¼ inch Diameter Plug-in Forms

Coil. No.	*Secondary Inductance*	*Turns for Tickler and Secondary*
1	80 mch	Tickler, 30 turns No. 26 enamel Secondary, 56 turns No. 26 enamel Separation, 1/16″
2	20 mch	Tickler, 17 turns No. 26 enamel Secondary, 22 turns No. 26 enamel Separation, 1/16″
3	5 mch	Tickler, 10 turns No. 20 enamel Secondary 11 turns No. 20 enamel Separation, ⅛″
4	1 mch	Tickler, 4 turns No. 20 enamel Secondary, 4.4 turns No. 20 enamel Separation, ⅛″

Frequency Ranges: Coil No. 1, from 1,500 to 3,300 kc; Coil No. 2, from 3,000 to 6,600 kc; Coil No. 3, from 6,100 to 13,200 kc; Coil No. 4, from 13,000 to 28,600 or somewhat higher frequency.

(*Continued from preceding page*)

stations. The whole outfit is so small that portability at once suggests itself, and thus the short-wave enthusiast has something that serves not only for home use but for camp, seashore and other vacation trips, so long as there is one type of current or other in the location.

In connecting this receiver to the a-c line no attention need be paid to polarity, but in connecting to a d-c line it is absolutely necessary to determine first the polarity of the line and then put in the plug correctly. So the plug should have positive side identified in some manner. As an extra precaution, instead of a wire connecting ground symbol to coil terminal, a condenser may be interposed as a protection in case the positive side of a d-c line is grounded. This condenser need not be more than 0.1 mfd.

The circuit diagram shows the wiring and anybody with the slightest familiarity with radio should be able to wire the set from that diagram.

Tube Connections

The tube connections may not be familiar to all. Assuming bottom view of sockets, heater prongs toward you, the 78 connections, right to left, are: left-hand heater, plate, screen, suppressor, cathode and right-hand heater.

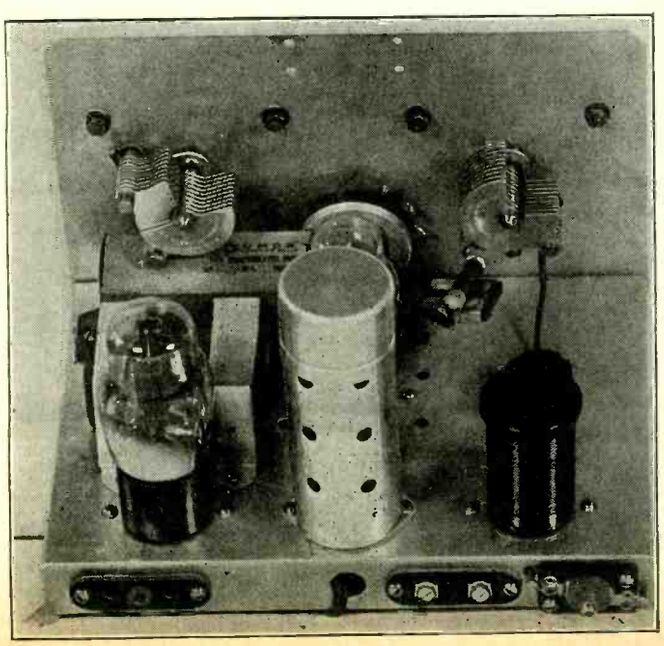
For the 43 the connections are: left-hand heater, plate, screen, grid, cathode and right-hand heater.

For the 25Z5 the connections are: left-hand heater, plate of diode 1, cathode of diode 1, cathode of diode 2, plate of diode 2, right-hand heater.

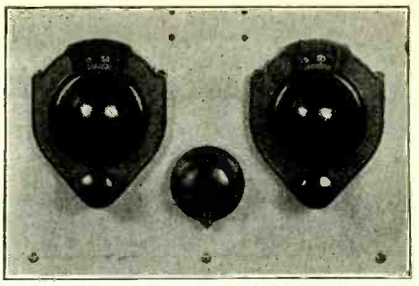
Therefore as to physical appearance of the base prongs and location of elements, the circuit diagram as to the 25Z5 should not be taken literally, although the wiring is correct. The plates are next to the heaters in the physical socket connections, not the cathodes as the circuit diagram might tend to indicate, if taken literally.

HILL'S NEW SCHEDULE

Edwin C. Hill's broadcasts of "The Human Side of the News" are now heard on a new schedule, at 10:30 p.m. E.D.S.T. Mondays, Wednesdays and Fridays over the WABC-Columbia network. In addition to his microphone duties, the colorful commentator is now being kept busy writing six syndicated newspaper articles a week.



Rear view of the Universal short-wave set for earphone use. The tuning condenser is the one nearer the coil. The other is the feedback condenser. The other front panel device would be merely the line switch.



Front View of the Set

Radio Hailed as Blessing to Blind

The radio is the greatest blessing to the blind since the development of braille, says Dr. P. C. Potts, Superintendent of the Idaho State School for the Deaf and the Blind, in an article in the June issue of " . . . AND THERE WAS LIGHT," quarterly journal of the American Braille Press, international organization which produces and distributes literature and music in raised print for the blind.

"The great joy which the blind person derives from the radio," explains Dr. Potts, "is due to the fact that it enables him to live a fuller, richer life—to enjoy everything of importance that is going on in the world. If his early educational opportunities were not of the best, he can compensate for that fact by taking courses in almost any subject.

"He can hear the current news several times a day, told by masters of the art of telling it. If he cannot afford to travel, he may obtain many of its advantages through travel talks. If the weather is bad on Sunday, he may attend good church service without leaving the house.

"He can have a teacher of physical training come right to his home and give him setting-up exercises every morning. An authority on dietetics will tell him what to eat to preserve or improve his health, and how various foods should or may be prepared. He can listen to chamber music while he eats his luncheon or dinner."

Velocity Microphones Now Used at WBBM

Chicago.

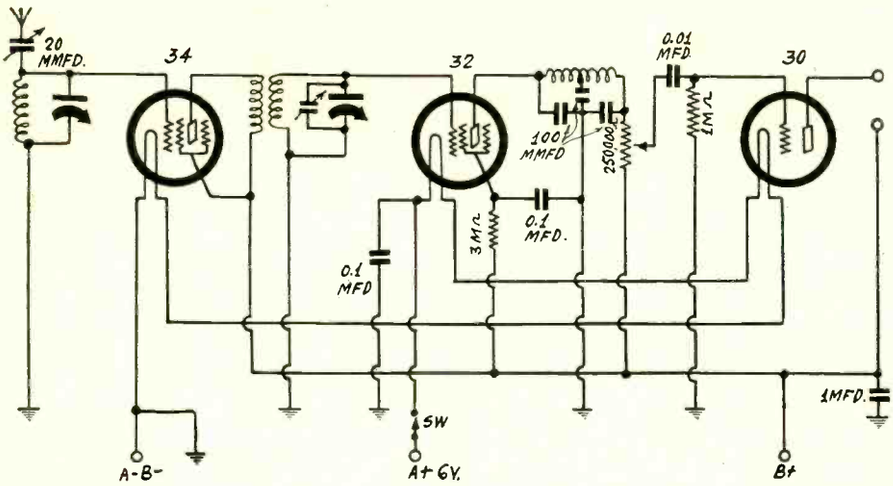
WBBM is the first Chicago station to install the new velocity or ribbon microphones in all studios.

Frank Falknor of WBBM says the technical advantages include reduction of reverberation, favorable directional characteristics, allowing for equal pickup from both sides, and making crowding of artists unnecessary. This permits uniformity of the audio frequency range, response and greater fidelity and naturalness.

The operation of the velocity microphone is that the ribbon element is caused to vibrate by the air particles of a sound wave. By its radical difference in construction, it lets the sound waves pass freely through it, betraying no distortion in the reproduction of the lowest and highest audible tones.

Proceedings of the world monetary and economic conference from the women's point of view were presented in a series of four broadcasts over the WABC-Columbia network under the auspices of the Committee on the Cause and Cure of War. Mrs. Carrie Chapman Catt was heard on the opening broadcast and other prominent women who spoke later included Miss Ruth Morgan, administrative chairman of the committee, and Miss Mary Woolley, president of Mount Holyoke.

EXPERIENCE



The circuit built by Harry W. Raymond that gave him excellent portable results

I HAVE ALWAYS desired a portable radio, but until the Four-Tube Diamond was brought out I could not find any circuit that could be converted to answer my requirements of extreme portability, low power consumption, and fair sensitivity, volume and tone. These requirements were all fulfilled beyond expectations by the set which I am about to describe.

The circuit was changed to use 2-volt tubes: a 34, a 32 and a 30, with their filaments connected in series in such a way that the voltage drop across the 30 and 34 filaments was used to bias the detector and the drop across the 34's filament supplies C potential to the 30. There may be an additional 3 volts supplied by two small flashlight batteries which is common to all three tubes, for this extra in addition to the potential already present overbiases the 30 and 32; but as far as the ear could distinguish caused no loss, and since it was substantially required by the 34 and reduced the current drain, was therefore retained.

Parts from the Four-Tube Diamond kit were used wherever adaptable, but were rearranged to occupy as little space as possible. The coils are now so close that there is oscillation over nearly half of the dial, on a short antenna and no ground; but this condition was retained as it gives additional sensitivity and can be controlled by detuning the detector circuit.

The six-volt 60 ma. A supply is derived from four flashlight batteries, and the 90-volt 8 ma. B power is supplied by two midget 45-volt B's. The total power required by the set is 0.43 watt, which for comparison is less than one-half the power required for the dial light in the ordinary radio.

The sensitivity of the set is such that all of our local 1 kw stations some six miles away can be brought in on a five-foot antenna with enough volume to be heard throughout the lower floor of an ordinary sized house; and at night New York and Chicago stations can be brought in by using a good antenna.

The tone and volume were much better than I expected; and are very good considering the size of the output tube and speaker; and the very limited power input.

I am inclosing a circuit diagram and a free-hand sketch of the set; but I have not given any details of construction as they would depend entirely upon the material available.

This set answers the requirements of real portability, low cost and performance that is truly exceptional, considering the limitations imposed upon the set. This radio should not be confused with the portable sets so popular today which are not self-contained but must have an external power supply.

HARRY W. RAYMOND,
105 Maple Ave., Riverside, R. I.

[The extra bias referred to can be inserted between the ground lead at left and left filament of the 34, removing ground from B minus.—Editor.]

* * *

How He Stops Hum

SOMETIMES considerable hum is encountered in an a-c receiver. I have been experimenting particularly with a-c circuits having push-pull output and a driver stage. I find that lack of symmetry in the push-pull circuit has much to do with the hum, and may be corrected in part by introducing a resistor from the offending grid to grid return, that is, across half the secondary. The lower the value of resistance the more effective the hum reduction, but of course the value should not be too low, for tonal reasons, and I have therefore compromised on 100,000 ohms. I pass this suggestion on to the readers of RADIO WORLD who may have been baffled by the same condition. Another favorable point in hum reduction is to include a large bypass capacity (say, 8 mfd.) from the B plus r-f feed to ground, in case the maximum voltage is reduced through a limiting resistor, as is often done. So far I have not encountered in service work or home experimenting any hum trouble that I could not cure, although some remedies were a bit different from those described. In one strange instance I found that modulation hum (no hum at no station tuned in, large hum when any station was heard) was completely cured by putting a condenser of 0.1 mfd. from one side of the a-c line (110 volts) to ground and another condenser of equal capacity from the other side of the a-c line to ground.

OTTO FREIHEIM,
Dayton, Ohio.

* * *

Speakers Utilized

FOR THOSE who have pentode tubes, but have speakers for low-mu tubes like the 45 and 2A3, I suggest they try connecting the screen of the pentode to the plate, for then they will be able to use their present speakers with good results. Another point is that output transformers are readily obtainable, and if the wrong type of output transformer is in the speaker, the right type may be easily substituted. Many think an entirely new speaker is necessary. I find it handy to have about the shop three different types of output transformers.

CONRAD J. BOOK,
Venice, California.

19, New Tube, for Class B on Battery Use

The RCA Radiotron Company, Inc. and E. T. Cunningham, Inc. have recently released to equipment manufacturers a Class B twin amplifier tube designated, the 19.

Like the types 53 and 79, the 19 combines in one bulb two triodes designed for Class B operation. It is intended for use in the output stage of battery-operated receivers and is capable of supplying approximately two watts of audio power.

TENTATIVE
RATING AND CHARACTERISTICS OF 19

Filament Voltage (d. c.)	2.0	Volts
Filament current	0.26	Ampere
Maximum Overall Length	4¼"	
Maximum Diameter	1-9/16"	
Bulb	ST-12	
Base (For connections, refer to Note 1)	Small 6-Pin	

CLASS B POWER AMPLIFIER

Plate Voltage	135 max.			Volts
Dynamic Peak Plate Current (per plate)	50 max.			Milliamperes
Typical Operation:				
Filament Voltage	2.0	2.0	2.0	Volts
Plate Voltage	135	135	135	Volts
Grid Voltage	-6	-3	0	Volts
Static Plate Current	1	4	10	Milliamperes
Load Resistance (plate to plate)	10000	10000	10000	Ohms
Average Power Input*	95	130	170†	Milliwatts
Nominal Power Output	1.6	1.9	2.1	Watts

*Applied between grids to give indicated values of power output.
†Approx.

Note 1:
Pin 1-Grid (Triode T_2) Pin 4-Filament
Pin 2-Plate (Triode T_2) Pin 5-Plate (Triode T_1)
Pin 3-Filament Pin 6-Grid (Triode T_1)
Pin numbers are according to RMA Standards.

A New Auto B Eliminator

There has just been released a brand-new and unique B eliminator for the automobile. It is actually noiseless due to the construction. This is made possible only with the use of a patented aluminum case that fits directly over the full-wave vibrator and the especially treated gum rubber case. These valuable features aid to make it actually noiseless, mechanically and electrically. Unlike others, this new Postal uses extra-heavy rod tungsten chipless steel contacts that assure excellent operation under heavy current drain, and under normal conditions cool operation.

Due to a special power transformer and heavy contacts the unit is rated actually to deliver 200 volts at 50 ma., and battery drain of approximately 2 amperes.

According to laboratory tests and reports this unit is more than 70 per cent. efficient, which to those who know is a very excellent percentage. The unit is extremely compact, measuring 6x7x2 inches, which permits of convenient mounting anywhere and can be placed in any position. It employs the 84 full-wave rectifier and is low priced, in fact, costs less than three good B batteries. All details and full technical information may be obtained by addressing the Postal Radio Corp., 135 Liberty Street, New York City.

COURSES IN BROADCAST LAW

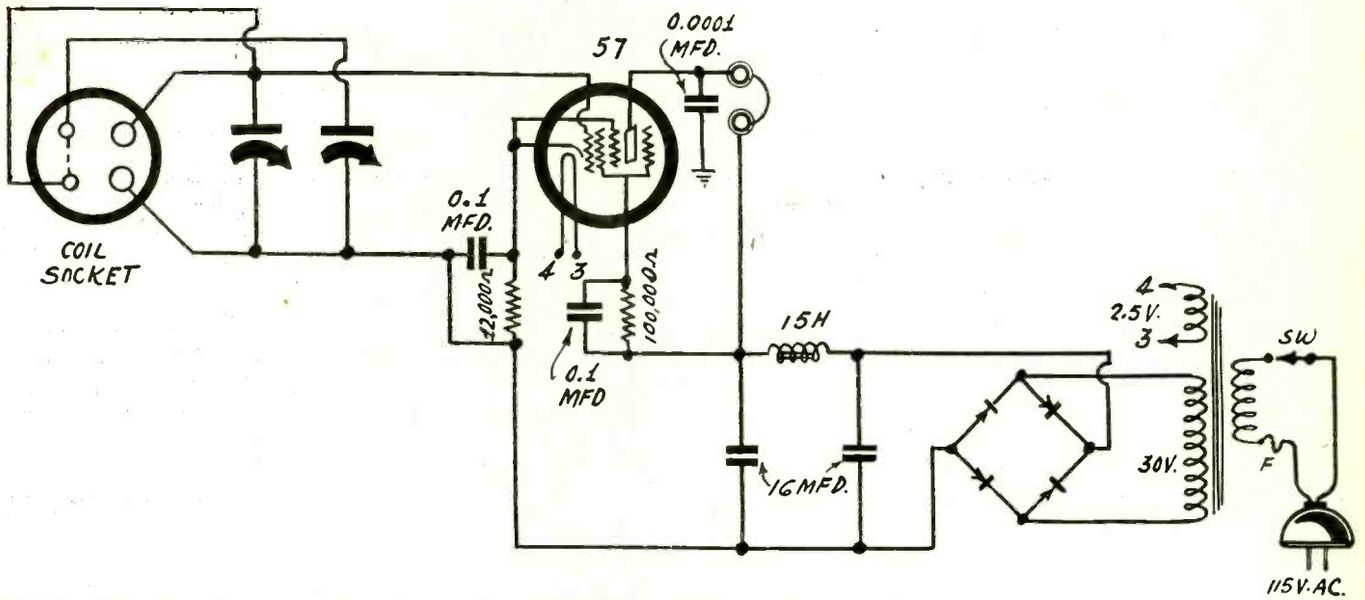
Five American universities are offering courses in radio law. They are the National University, Catholic University and Columbus University in Washington, D. C., Marquette, in Milwaukee, and the University of California, Los Angeles. Other colleges are offering courses in radio engineering, radio continuity writing and announcing. Further information may be obtained by writing to the United States Office of Education, Washington, D. C.

A FINE WA

ACCURATE MEASUREMENTS ASSURED—RANGE IS FR

DESIGNED BY ED

By Willian



Circuit diagram of wavemeter designed and built by Edward M. Shiepe for highly accurate measurements, including the calibration of oscillators, using one known oscillator frequency in relationship to harmonics spotted on the wavemeter. A 57 tube is the detector. The low-voltage B supply has a copper-oxide rectifier. High filter capacity is necessary in the B supply to avoid hum.

A WAVEMETER serves an excellent purpose to those who desire a high degree of accuracy, due largely to freedom from load effects on the frequency. Indeed, such a meter is really a frequency reter, but the word wavemeter has acquired such a firm standing that it seems impossible to dislodge it.

If the wavemeter diagramed had a feedback coil it would be an oscillator, or generator of frequencies. As it is, the device generates nothing, but it does detect radio-frequency inputs, and it is especially attractive because of its sensitivity. No input has been encountered in practice that has been too small for the wavemeter to detect.

Condensers Switched

The wavemeter was designed and built by Edward M. Shiepe, B.S., M.E.E., and used by him for precision measurements.

Due to the desire to cover a wide band of frequencies, some of which were low, the tuning condenser system consisted of a two-gang 0.00014 mfd. Hammarlund, of which both sections were in parallel for some coils, and only one section used for the other coils. Thus for low frequencies the capacity was twice 0.00014 mfd., yielding a frequency ratio of nearly 3-to-1, for the frequency separation need not be so great for low frequencies. These would include the present popular intermediate frequencies of superheterodynes. For higher frequencies the frequency ratio, single condenser, was 2.6.

In the construction of the plug-in coils on UX forms, since only one winding is used, accounting for two pins, the other pins may be shorted for the low-frequency coils. The dotted line denotes the shorting strap in those coils, and is to be read as absent for the higher frequency coils.

The tuned input to the 57 tube is rectified, and the earphones are connected in the plate circuit as the listening post. The 57 is in a power detection type circuit, the biasing resistor being 12,000 ohms, resulting in a negative bias of 3 volts, which proved to be the most suitable detecting point, considering the low plate voltage.

LIST OF PARTS

Coils

Six plug-in coils, made up as described in the text.
One power transformer.
One B supply choke coil.

Condensers

One two-gang condenser, 0.00014 mfd. each section.
Four 8 mfd. electrolytic condensers, or otherwise obtained two 16 mfd. capacities.
Two 0.1 mfd. bypass condensers.
One 0.0001 mfd. plate bypass condenser.

Resistors

One 12,000-ohm pigtail resistor.
One 100,000-ohm pigtail resistor.

Other Requirements

One chassis.
One cabinet.
Two sockets (one UX for coil form, one six-hole for 57 tube).
One pair of earphones.
One copper oxide rectifier as described in text.
One a-c switch.
One a-c cable and plug.
One 1 ampere fuse, cartridge type.
One 57 tube.

High Filter Capacities

The device is a-c operated, and the line voltage is fed through a step-down transformer to two secondaries, one of them the 2.5-volt winding, the other the "high"-voltage winding. Of course it isn't really high, indeed it is a step-down transformation, since around 115 volts were put in and around 3 volts are taken out. A transformer that will provide the 30 volts is obtainable in some bargain basements, being of the type used for feeding the rectifier of dynamic speakers of an old vintage. In that instance there would be no 2.5-volt filament winding, but a filament transformer will serve this purpose well.

The rectifier d-c output is around 23 volts. The B supply choke is 15 henries, which, due to the small B current flowing, may be almost any choke, and include even the secondary of an audio transformer, but to avoid hum the filter capacities have to be large, and 16 mfd. are shown next to rectifier and again at the end of the filter system.

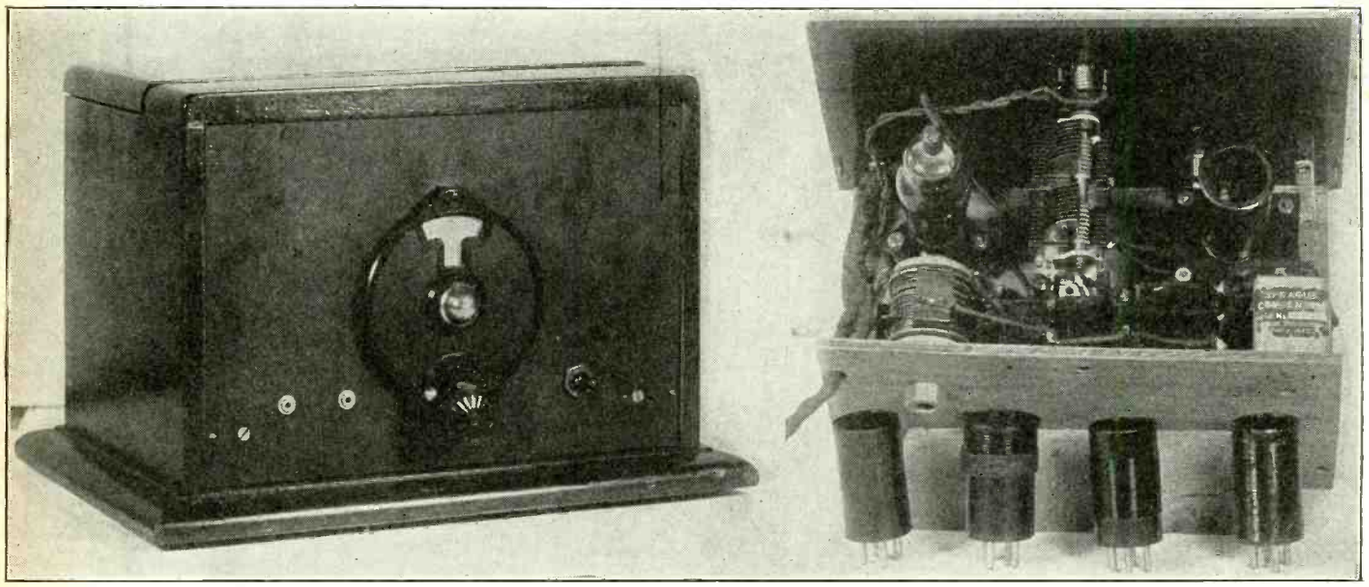
The square with arrows represents a Rec-

VEMETER

OM 100 KC TO 26,000 KC—COIL DATA GIVEN—

VARD M. SHIEPE

F. Peck



At left is the cabinet view of the wavemeter built by Mr. Shiepe. At right the chassis is shown removed from the cabinet. The two-gang condenser is used either with both sections in parallel, for low frequencies, constituting 0.00028 mfd., or one section, 0.00014 mfd., is left unused for higher frequencies.

tox copper-oxide rectifier. It is usual to figure on 4 volts maximum per disc. There are four sections for the full-wave rectifier, hence seven discs per section would suffice, a total of 28 discs. These will provide a rectifier of practically unlimited life. Indeed, the rectifier would handle for short periods quantities of current running into amperes, and yet the rectified component is less than 1 milliampere, so the safety margin is astonishingly large.

Loose Coupling

The use of the device is to test frequencies being generated elsewhere. It is possible to pick up broadcasting stations, if they are strong enough, due to the aerial effect of the coils. This is an incidental point and an aid in calibration. However, the real purpose is to take the radio-frequency output from an oscillator, to determine the frequency, or calibrate the oscillator, or the output of a set may be measured from the detector.

It has been said that the accuracy is high, and that this is due in large measure to freedom of the detuning effects of the load. However, if the unknown is coupled closely to the wavemeter the very detuning effects one desires to avoid would be introduced.

It is not necessary to use close coupling, and in most of the instances of actual use the unknown was a distance of a few feet from the wavemeter. Some measurements were made at distances of 5 feet. Thus only the ether constituted the coupling medium, and the freedom from detuning was practically 100 per cent.

The wavemeter may be calibrated, and Mr. Shiepe prepared some charts that accurately plotted the frequencies, and also demonstrated how small an output from an unknown would produce a distinct sound in the phones.

'Phones Are Sensitive

"Earphones constitute one of the most sensitive instruments in general laboratory use," said Mr. Shiepe, "and in a wavemeter it is a considerable advantage to have earphones."

Of course the source must be a modulated wave, for it is the modulation that actuates the 'phones. The carrier is removed by detection, and if there were no modulation there would be nothing left. However, nearly all oscillators are modulated, or have modulation optional, so care must be taken to use modulated service when operating the wavemeter.

While calibration of the wavemeter is handy, and indeed important, it is also true that the wavemeter may be used without direct calibration. Suppose that one has a modulated source of frequency at 550 kc. One may wind a suitable coil for this purpose and pick up the signal. It is extremely important not to be misled by harmonics. and the frequency of the fundamental is the lowest one that will yield a response. Now that 550 kc frequency has been spotted on the wavemeter, if this is done somewhere near maximum capacity of the tuning condenser, the second harmonic of the source can be picked up by the wavemeter and in a few instances, using low-frequency coils. possibly the third harmonic.

Alternatives

Hence the known has been extended to include 1,100 kc. There would be no method of ascertaining where 1,100 kc came in on the tested device (say, oscillator), without such comparison, and the wavemeter, while not directly calibrated of itself, permits fixing the frequency position of the oscillator. Depending on what extra frequencies are desired by the harmonic method, the fundamental is chosen accordingly. Thus, also, one may go from one coil range to another. The third harmonic certainly would be picked up on the next highest frequency coil in any instance.

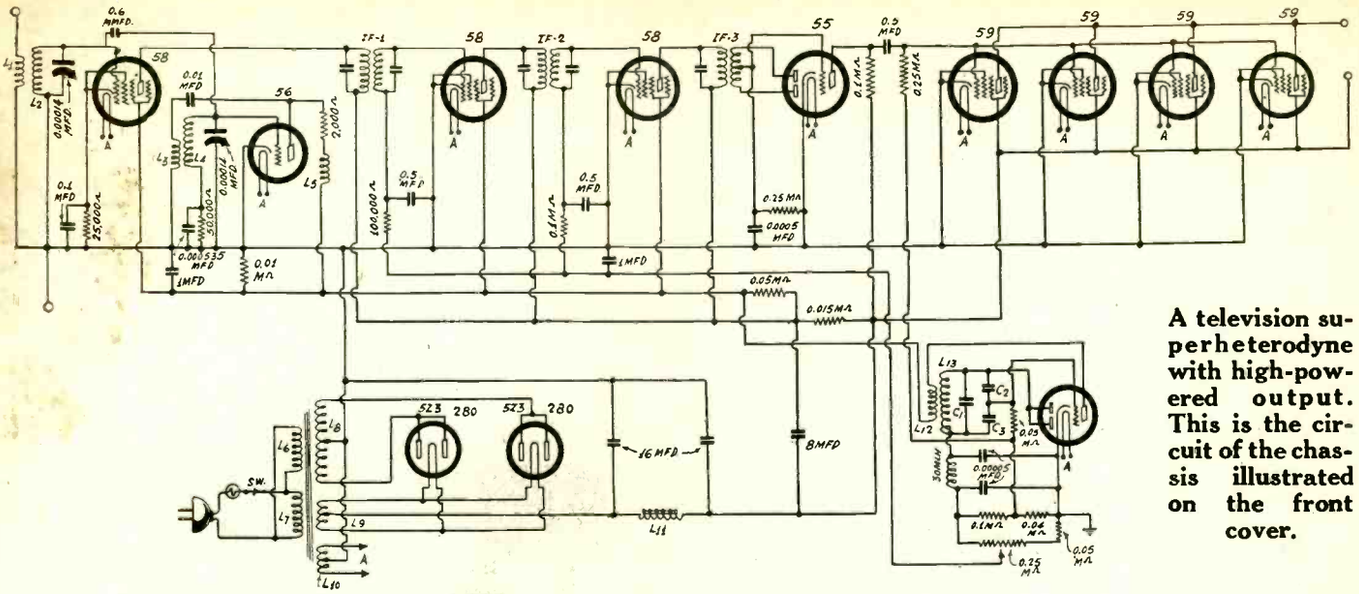
Many would have use for a wavemeter covering a specialized band, such as the broadcast band, hence could use a coil permanently in place, even a commercial shielded coil, with proper tuning capacity. The same circuit system may be followed.

Those who would experience difficulty in obtaining the transformer for the line could use the transformer they have, and even might include a tube as rectifier, instead of the copper oxide device, for the wavemeter principle is independent of these matters.

However, if the B voltage is high, then a resistor should be put across the total, and only around 25 to 50 volts picked up actually, by tapping off from the resistor. Two small resistors may be used approximately proportioned to the total voltage, compared to the desired voltage. Thus, if 300 volts output are obtained, and 50 volts are to be used, the resistance apportionment would be 6 to 1, so 600,000 and 100,000 ohms could be used in series across the B rectifier output, the smaller resistor between juncture of the two and ground, and the B feed for the tube taken from this joint.

If there is any choice as to earphones, select the type of the highest impedance. It is not pretended that the 'phones are or will be matched to the tube impedance, but this is not necessary, as considerations of maximum power do not enter.

(*Continued on next page*)



A television superheterodyne with high-powered output. This is the circuit of the chassis illustrated on the front cover.

Television Receiver With a Large Output

The three methods in use in television reception today for scanning are the disc with neon lamp, the disc with Kerr cell, and the oscillographic tube. For the neon lamp method a large power output is necessary, and the circuit shown was built for such use. The Kerr cell does not require a large power output but instead a high voltage at very little current. The oscillogram relies on a still higher voltage.

The circuit shown is a superheterodyne, with the 56 oscillator coupled to the 58 modulator by a small condenser from grid to grid. The intermediate band in the television spectrum is covered, and the tuning is from just above 1,500 kc to nearly 4,000 kc.

Transformers Unpeaked

Doubly-tuned intermediate transformers of the 450 kc type were used, and adjusted to give maximum band-pass filter effect, that is, as broad a top to the tuning curve as was consistent with circumstances. Two i-f stages preceded the 55 detector, which was resistance-capacity coupled to four 59 tubes in parallel as output. The 59's were worked as pentodes.

A novelty in the circuit is the presence of a C bias supply. This is an oscillator, also, and should generate a frequency considerably higher than the highest one to which the set's local oscillator will have to tune. If the C bias oscillator had too low a frequency its harmonics would interfere with reception.

The objects of the C bias supply are to preserve the audio fidelity, improve the regulation and conserve B voltage.

A single rectifier of the 280 or 5Z3 type would not be sufficient, theerfore two 5Z3 tubes are connected for full-wave operation, the cathode (filament) being common, and the joined plates of one tube constituting a single anode, the joined plates of the other tube the other anode.

It has been the experience of televisionists that a husky signal is necessary if the picture is to be telar, and details preserved.

Crater Lamp Preferred

Of course, there has to be sufficient illumination, and the lamp should take care of this, hence a crater type lamp is preferred, because of the localized illumination, instead of the spreadout or diffusion with the other type of neon lamp. Providing a strong signal augments the lamp brilliance, as the unmodulated illumination from the lamp may be regarded as a drag upon the picture, for there is so much light with no picture in it that for illuminated portions of the picture there is a relative loss of contrast. A high-powered output tends to correct for this.

So that the regulation will be excellent, the B filter choke should have a low resistance, yet the inductance should be high. It amuonted to 37 henries, although nearly a quarter of an ampere of B current was flowing through it.

The front cover illustration shows three cases, one being the choke, another the filament transformer, the other the power transformer for B supply (high-voltage and 5-volt windings).

An excellent quality of picture is obatinable from a circuit of this type, provided the other adjuncts are right ,including scanning disc and lamp. Even with a little sunlight in the room the picture is fairly visible, but of course in total darkness of the room the results are much better.

If there is any hum in the output it can be seen on the screen, for the scanning mechanism is a frequency meter. Three lines will be in view, since there are 20 pictures a second and the hum frequency is 60 cycles. A little hum, therefore, has quite an effect on the picture.

FINE WAVEMETER

(*Continued from preceding page*)

The circuit diagram shows the 'phones bypassed as to radio frequencies, but the small condenser is not very effective on lower radio frequencies, e.g., intermediate frequencies, but it may be said that omission of the condenser entirely does not change the result much. Any calibration of the wavemeter should be made on the basis of that condenser in or out, and no change should be made in this respect after calibration, as the condenser has an equivalent parallel effect on the grid circuit, although small.

The photographic illustrations show the cabinet view and also the chassis removed from cabinet.

PAINFUL TO SAY WJZ

A toothache is no fun. But a toothache was especially provoking to Jimmy Wallington because he had to announce "WJZ, New York" through an evening of steady assignments.

Not once did Wallington have a chance to announce "WEAF, New York," which would have been a relief.

"Try saying WJZ, especially if you have a sore tooth, stuffed with cotton.

Data for Inductances for Shiepe's Wavemeter

If the frequency range is assumed to be from 100 to 26,000 kc, with 280 mfd. used for the two lowest frequency ranges (double condenser connected in parallel), and 140 mmfd. for the four other ranges (one section of condenser not used), the plug-in method may be retained by putting small honeycomb coils inside the forms for the low frequency instances, and winding on the outside of the forms for the other instances. Hence six coil forms would be required.

For the lowest frequency band, 100 to 300 kc, the inductance for 280 mmfd. tuning should be 9 millihenries, and a coil of approximately this value is obtainable commercially as an 800-turn honeycomb, 1-inch outside diameter, which will fit inside the form. Simply solder wires to coil form pins and join these to the honeycomb extremes.

Also a commercial honeycomb is obtainable of approximately the value of 1 millihenry, needed for the next band, 300 to 900 kc, still with 280 mmfd. capacity. This is a 300-turn coil.

The rest of the coils are wound on the outside of a 1¼-inch diameter plug-in form, which is also a commercial product.

For 900 to 2,340 kc, using 140 mmfd., the inductance should be 230 microhenries, obtainable by winding 80 turns of No. 32 enamel wire. This size wire, some readers report, is difficult to obtain, but any experiencing difficulty should communicate with the Trade Editor of RADIO WORLD.

For 2,000 to 5,200 kc, using 140 mmfd., the inductance should be 44 microhenries, provided by winding 44 turns of No. 22 enamel wire. The appearance of the same figure, 44, is correct both for the inductance and the number of turns, it so happens.

For 5,000 to 13,000 kc, same capacity, wind 14¾ turns of No. 18 enamel wire to attain 7 microhenries inductance.

For 10,000 to 26,000 kc coverage, inductance required for same capacity, 1.8 microhenries; winding data, 6⅓ turns of No. 18 enamel wire.

There is sufficient overlap provided by the above inductance values.

Radio University

A QUESTION and Answer Department. Only questions from Radio University members are answered. Such membership is obtained by sending subscription order direct to RADIO WORLD for one year (52 issues) at $6, without any other premium.

RADIO WORLD, 145 WEST 45th STREET, NEW YORK, N. Y.

Adjustable I-F Coils

IS IT all right to use intermediate transformers that have a coil system wherein the mutual inductance may be altered, that is, coupling changed by turning a set-screw? I have encountered oscillation in receivers I have built, in the i-f channel, and I was wondering if it would not be a good plan to use the variable-coupling type of transformers, and loosen the coupling until the oscillation disappears? —K. D.

Yes, it is entirely satisfactory to use this method. The result is that not only is oscillation squelched but the selectivity is increased, the consequent result of looser coupling. Transformers such as you describe have been put on the market recently, are used in quite a few receivers, and the reports on such use are entirely encouraging.

* * *

Overtaxed Speaker

SOME TIME AGO I built a superheterodyne, and it worked all right. Recently there has been a rattle in the speaker, and moreover the set seems to have lost sensitivity. The tone quality is bad, whereas formerly it was most excellent, and visitors used to compliment me upon it, and enjoy listening to the reproduction. At present I can not enjoy the set. It consists of ten tubes, the output being two 245's in push-pull, and the speaker and 8-inch diameter dynamic, total weight 3.5 lbs.—T. W. D.

No doubt you have been having a fine time working a high-powered set into a modestly-proportioned speaker, and the result is that the speaker finally collapsed under the strain. The wretched tone would indicate this condition, and the reduced sensitivity also is consistent with the same conclusion. For sets of this type it is advisable to have a high-powered speaker. In fact, it is only sensible to have a speaker of greater power-handling capacity than the maximum undistorted output of the power tubes in the set. The formula you have not respected. You should get your speaker repaired, or replace it with one in excellent condition, but either repair or replacement on equal basis will result in consequent damage to the speaker again, no telling when. A speaker of greater capabilities is highly recommended in your case.

* * *

Soldering

SOMEBODY TOLD ME that it was not correct to solder a joint and then blow on it to make it cool off more quickly, but that the joint would be more secure if left to cool in the natural manner. Sometimes I even wet the joint, as I have a lot of soldering to do (it is a business with me) and I save considerable time by this expedient. I also carry the solder over on the tip of the iron, that is, put the iron onto the end of the coil of solder, let some molten solder adhere to the iron, carry over the solder and make the joint. What about this?—H. S.

There is no objection to blowing on the joint, as you will get just as good a joint that way as waiting for the solder to cool, and you may even wet the joint, if you like. However, there have been serious objections raised to the carry-over method of soldering, particularly if you use self-fluxing solder, as the rosin-core type. Too much of the rosin is evaporated in the process, for one thing, and then the joint is not as clean as it would be otherwise, as the flux has a cleansing effect. It is suggested that the solder spool be unrolled sufficiently so that you can handily reach the joint with hot iron and solder, that you heat the joint first with the iron, and then apply the solder, with the iron still on the joint. That method makes for excellent results.

* * *

The Traditional Circuits

I HAVE NOTED simple short-wave circuits, but lack of originality seems to characterize them. Has anything been done about a frequency-stabilized regenerative detector? I note there is plenty of frequency stabilization in high-class test oscillators, but what about sets?—G. D.

What you assume to be lack of originality may simply be abundance of experience. It has been found by long experience that certain types of circuits work better than others, and in this studied day of radio the healthy tendency is to show something that works well, though it may have a very familiar look on paper. Nothing has been done, so far as we know, about frequency-stabilization of a regenerative detector, and the subject offers some difficulties, but in time no doubt they will be overcome. It was quite enterprising of you to think of frequency-stabilizating a regenerative detector. That would get rid of the detuning effect of regeneration, which would be a helpful contribution. The frequency-stabilization of test oscillators has been going on for years, but the simpler forms did not get much attention until nearly two years ago. The crystal as a stabilizer of course is well known, but applies to a single frequency. Circuiting and loading the tube so as to constitute it practically a pure resistance enables frequency stability consistent with variety tuning. That is the important recent development, due to several scientists, including Llewellyn, Dow, Argimbau and others.

* * *

A-C, D-C Sets

WHAT is the general rule about the universal sets (those that operate on either a-c or d-c)? Do they always work as well on d-c as on a-c?—F. F. W.

They generally work somewhat better on a-c than on d-c, but the d-c performance is satisfactory, and besides you must remember that universality has a decided advantage.

* * *

Resistors

WILL a metallized pigtail resistor hold its resistance fairly well? What is the comparison with a wire-wound resistor? Does the carbon resistor stand up as well as the others?—H. D.

The metallized resistor will hold its resistance value well, provided it is not overloaded much, that is, if it is used within its rated capacity. Thus a 1-watt resistor should not be used for 5-watt service. A wire-wound resistor will hold its resistance better, but costs much more. The carbon type changes its resistance value quite a bit, but is commercially very useful.

* * *

Heart-Beat Amplifier

IN THE CONSTRUCTION of a heart-beat amplifier, is it not a good idea to determine the frequency of the sound emitted by the beating of the heart, and then have a transformer-coupled circuit, transformer tuned to the frequency of this sound, to make the sound output much larger than otherwise? What do you suggest?—D. F. W.

It is not a good idea at all, for counting the actual beats of the heart is, if anything, one of the least considerations, and can be done satisfactorily with a stethoscope. What are desired to be heard are the incidental sounds, the gurglings, murmurs and seepages, as these indicate what, if anything, is the matter with the heart. These concomitant sounds may be of altogether different frequencies, and usually are much higher than the frequency of the sound of the heart's thump. Therefore, instead of being tuned, a heart-beat amplifier had better be as nearly perfect and linear an amplifier as it is possible to construct, and the gain should be high. Such an amplifier serves a multitude of purposes, as the medical profession knows, and which do not ordinarily occur to the medical layman who might nevertheless be a radio expert. Recordings of the beats and extraneous sounds afford a permanent basis of comparison of the progress of a patient's condition. Besides, in an operating room, speaker reception of heart beats would inform the surgeon of the anaesthetic effects and guide him importantly in his work, no doubt sparing many a life.

* * *

Series Heaters

IS IT ALL RIGHT to operate heaters in series in the automotive or d-c type tubes as in universal receivers? I thought that the expression "unipotential cathode" meant something, but the tubes are used with heater and cathodes at quite different potentials.—H. C. D.

The tubes are made for the special purpose of functioning well, despite the relatively large difference in voltage between cathode and heater. The precautions against such differences for the run of a-c type tubes, therefore, are not necessary with these special-purpose tubes. There are, no doubt, some sacrifices made, to attain "universal" operation, but the convenience and utility gained are certainly ratable.

13 TUBES REDUCED

E. T. Cunningham, Inc., and RCA Radiotron Company announced further list price reductions on 13 radio tubes.

The 01-A now lists for $.60.

Type	*Old Price*	*New Price*
01A	$ .70	$ .60
24A	1.40	1.20
26	.75	.65
27	.80	.70
35	1.50	1.30
36	1.80	1.50
37	1.40	1.20
38	1.60	1.45
39/44	1.80	1.50
45	.85	.75
47	1.50	1.30
71A	.85	.75
80	.80	.70

WEVD WANTS MORE POWER

Washington.

WEVD, New York City, has asked the Federal Radio Commission for an increase in power from 500 to 1,000 watts. Application was filed recently when WHN asked authorization to remove its transmitter from New York City across the East River to Astoria, L. I. Both applications probably will be passed upon in the immediate future.

WHOM CELEBRATES

WHOM, to which the Federal Radio Commission has given permission to operate on full time, celebrated this authorization in its new studios in the Hotel President, New York. Several noted stars of radio, the screen and the speaking stage offered an unusually long and excellent program.

A THOUGHT FOR THE WEEK

RADIO is building a dramatic technique of its own. Emotional appeal still has its place in the new scheme of things, for without emotion there isn't much to win and hold the attention of drama lovers. However, the new method has to do with several things of which the speaking stage of current times does not boast. For instance, use is made of a greater variety of properties than were dreamed of even in the good old days of noisy melodrama. As listeners cannot see the players—television may remedy that in time—or get causes and effects except through the sense of hearing, radio directors are put to it to suggest the things the eye cannot see. And they are doing their work so well that the new technique has grown steadily in importance and worth and has added vastly to the entertainment value of radio presentations.

RADIO WORLD

The First and Only National Radio Weekly

Eleventh Year

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

Ten Years Ago!

(Some of the things which interested RADIO WORLD readers in the issue of June 30, 1923.)

Charles Raymond described the duplex radio equipment of great power which had been installed in the S. S. "Leviathan," and the operator was shown at work on the boat.

Professor C. Francis Jenkins announced in a contribution sent from Washington, D. C., that "Radio movies are here," but it just happened that it was considerably later before an appreciable advance had been made in this branch of entertainment.

It was announced editorially in this issue that the public should be most careful in buying stocks of several new radio concerns whose chief concern, so it turned out later, was to sell stock rather than to manufacture sets. Some of the concerns mentioned passed out of the picture before they had made any definite impression on the radio market.

An illustration showed five blind boys in the New York Institution for the Blind at work on a set, which they completed later in a workmanlike manner.

The Department of Commerce announced that active broadcasters for that week totalled 579.

General George O. Squier, Chief Signal Officer of the Army, presided at the graduation exercises at Camp Alfred Vail, N. J., and presented certificates as signal officers to sixty-five graduates of West Point.

The National Association of Broadcasters made a country-wide appeal to song-writers and publishers to turn over their mechanical royalty money to the association. Then the Society of Authors, Composers and Publishers got busy and the whole picture was changed.

German scientists were reported as having devised a method of putting out of commission any airplane motor using electrical ignition by the magneto, with radio waves. An American inventor said he was ready to circumvent these scientists by a method to be announced when his patent should be granted by the U. S. Patent Office.

THREE ATTITUDES TO NEWSPAPERS

THERE has been hostility by newspapers toward radio for years, due no doubt to the belief that sponsors of radio programs are spending money advertising with a competitor. This has been the general feeling, although some newspapers own or operate radio stations, and their sentiments must be rather an impartial mixture. At newspaper and syndicate conventions the hostility evidences itself rather regularly, sometimes as a resolution to bar radio programs from the newspaper page, unless printed as paid advertisements. Usually little comes of this retaliatory gesture. Though a resolution may be adopted in the stuffy heat of a convention, the larger aspects, as dictated by reader preference, usually prevail.

The stations have been most considerate of the newspapers, not only because newspapers do print the programs, but because it seems chivalrous enough to be generous to those from whom you have won accounts on a competitive basis. That the radio does compete with the newspaper can not well be denied, and the argument that the one supplements the other, with citations of the most prolific mailers of checks to stations being also the largest newspaper advertisers, rather conceals the jealousy between the covers of comforting statistics.

The policy of the National Broadcasting Company has been one of diplomacy on the subject, and indeed the company has intimate business relations with newspapers. Contracts easily subdue wrath. And a suave policy permits no wrath to rise. What the stations owned or operated by this chain had to say about the effectiveness of radio as a means of advertising was exclusively on the non-comparative basis of radio alone, so there could be no offense taken by newspapers.

Now the Columbia Broadcasting System, which also has been invoking non-comparison, leaves the fold to invoke the invidious, with a brochure that sets forth the superior merits of radio advertising over newspaper advertising, as frank a paper as one who owned a newspaper would not want to read. This is merely the acknowledgment now of the feeling that has existed but remained publicly unuttered for years. The competition is now admitted, the superiority as well!

As if to stabilize the situation, by contributing a neutralizing agent, the Amalgamated chain is about ready to start, and its policy, under the leadership of Ed Wynn, is to create a partnership of effort between newspaper and radio, with the sponsors acting as liaison officers. Not only will there be simultaneous advertising in the newspapers by the sponsors putting on the programs, but the very brief and restricted "credit" announcement will refer to these advertisements by paper identity and even page and column.

And so, while NBC remains partial to radio, but neutral as to controversy, and CBS speaks right out in plain language, Amalgamated starts life decidedly pro-newspaper, which perhaps leaves the problem in status quo.

THE MEXICAN THORN

WITH the North American Radio Conference scheduled to start in Mexico City on July 10th, to effectuate radio peace in the upper half of this hemisphere, the recent rule of awkwardness attending international conference openings is respected. When the World Economic and Monetary Conference opened in London war debts, taboo by United States reservation from discussion at that conference, were on several speakers' lips, and when currency stabilization was almost ready for adoption it was discovered that the United States did not feel ready for it, and hence difficulties arose. So with the radio round table, where the famous international good-will is to be expressed (but not enacted, or we miss our guess), Mexican delegates may be expected to voice lofty reasons for the licensing of a new 500,000-watt station on a frequency causing interference in the United States.

The Mexican situation is the worst one that the United States, well favored though it is in the radio distribution, has to face. The high-powered stations, some licensed for greater power than that used by any station in the States, are not intended for Mexican purposes, except the revenue. Why programs in English, if Mexicans who don't understand English are to be the beneficiaries? And why do station owners, ousted from their license in the United States, or applicants denied their vast ambitions to great radiated power here, go to Mexico, and point directional aerials to the States? Obviously so that delegates to international conference shall realize the technological difficulties. Anything for which there is no defense is called technological these days.

Not only stations long since erected, or licenses newly granted, with station operation impending, are concerned, but very recent additions to stations, as well. It was only the other day that XEAF, with call letters easily confused with those used by a United States station, went on the air at Tia Juana. Though using only 2,000 watts, it occupied the choice 980 kc frequency of KDKA. And the manager of the new station in Mexico is an American.

Diplomacy of an order approximating that of a European politician, who dines his foreign delegates well, without any aversion to driving hard bargains in conferences the next day, will have to be exercised if the radio conference is to accomplish as much for the protesting foreign nations as they desire. Canada wants more waves, and probably deserves them. The United States may have to relinquish some. An allotment plan ought to be worked out, and we should be eager to be just. Radio wave disorganization in North America ought to be ended, and the conference faces a tough task that deserves earnest prayers.

REBIRTH OF CONFIDENCE

THE leaders of the radio trade are becoming quite active again, evidently an expression of confidence. Some increases in receipts help a great deal in stimulating enthusiasm. So everything is set for a home-made code for the industry under the recovery bill, with mixed feelings. On the one hand, plenty of confidence that business will improve under the partnership with Government. On the other hand, are expressions of doubt as to the legality of some aspects of the law, and some firm feeling that traditional policies of the Government are being flaunted. Still greater increase in business certainly will deal a blow to respect for traditions of that sort. Too much money was lost during the period of highest respect for traditions. And, besides, prosperity is a tradition with us, and why not respect that one?

The codified activities of the industry will result in wages fixed and production controlled, and even resale prices established and prohibition of sale below cost of production. Besides (not in the law, however), there will be a two-fold drive for business: first, a sales drive, then a Progress Week, with many broadcasting activities.

The manufacturers of black ink now ought to do more business with the radio manufacturers. Confidence in one's own business is the second requisite for success. The first one, by the way, is that the confidence shall not be misplaced.

Station Sparks

By Alice Remsen

The Keys

FOR GENE ARNOLD IN "HEALTH and HAPPINESS"

WJZ and network; Mondays and Thursdays, at Noon, EDST.

What in the world is better than health?
Certainly not a lot of wealth!
For wealth without health is a sorry thing,
And health is the one thing that wealth cannot bring.

What, then, is life without happiness?
Not very good I must confess!
Why, friendship and love, and health are the keys—
And Happiness comes with the finding of these.—A. R.

* * *

And if you listen in to Gene Arnold with his talks on health, his lovely little poems and bits of homely philosophy, you'll put yourself on the right track to happiness. You will also be soothed and delighted with the smooth harmony of the Commodore Male Quartet. Tune in to this delightful fifteen-minute period; relax and enjoy it!

* * *

The Radio Rialto

Victor Replaces Ed

You'll miss one of your favorite comedians from the air-waves this summer commencing July 7th. Ed Wynn is taking a vacation—a well-deserved one, too—but he'll be back in the Fall; meanwhile the program will carry on with another star—Victor Moore will probably be the favored one; not so boisterous as Ed, but quietly comical. . . . The Gulf Refining Company has not yet settled on the new program at this writing; it could not come to terms with Fred Allen, who was supposed to replace the gum-chewing ad libber, Will Rogers. Wish they'd take the dramatic program to which they listened with such avidity last season; it certainly would be much more dignified than a comedy program, and be interesting and educational, but I suppose they know their own business. . . . Six radio programs have been prepared by the Columbia Broadcasting System to be transmitted to Argentina and Brazil, in conjunction with the Pan-American Society. The first of these programs went on the air June 24th, from 9:15 to 9:45 p.m., with the United States Marine Band as the entertainment feature. The announcements going over the Columbia network in the United States will be in English, and simultaneously with these, special announcements in Spanish will be transmitted over the short wave unit to South America. . . .

ED HILL ON NEW SCHEDULE

Edwin C. Hill began a new schedule on Monday, July 19th. His program, "The Human Side of the News," is now heard over the WABC-Columbia network on Mondays, Wednesdays and Fridays from 10:30 to 10:45 p.m. EDST. . . . Al Jolson was heard on the air again on June 26th. He was master-of-ceremonies on the Paul Whiteman series, with no limitations as to script or time. . . . Duke Ellington made his debut at the Palladium Theatre in London on June 12th. The colored dandy made good with the stolid Britishers, who are just as crazy about jazz rhythm as we are. . . . Cab Calloway and his Cotton Club Orchestra will be heard from WLW, Cincinnati, for eight days, from July 8th to 15th inclusive, when Cab and the boys will be doing their stuff out at Castle Farms; an engagement at the Hippodrome in Cleveland will follow. . . .

Ralio and the N. V. A.

It may interest you to know that a number of radio notables have already joined the National Variety Artists organization and many more are expected to follow suit. Am hoping that a few from WLW will realize the immense value of such an association. . . . Margaret Padula, who used to be well known in vaudeville, is making good on radio via WMCA. . . . Nalda Nardi is still warbling over that same station; she seems to be a fixture. . . . Over at WINS Claire Russotto is still making good, and Joe Connolly is presenting "Irish Echoes". . . . Art Coogan and his orchestra are heard on WMCA and WOR. . . . The two-way ocean broadcast between Walter Lippman on this side of the ocean, and John Maynard Keynes, in England, was a great success; it was technically perfect, and very smoothly received at the listeners' end. The technical set-up was one of the most elaborate ever used in the history of broadcasting; the effect justified the means. . . . The sympathy of the entire radio-listening world goes out to Milton J. Cross, who lost his nine-year-old girl recently through an appendix operation. . . . WHOM, New York, started on full time schedule June 20th. It threw a party to celebrate. . . . Dick Denten, former vaudevillian, is now playing radio dates around New York and vicinity. Heard him over WRNY; the lad comes over well, accompanying himself on a guitar, which he has a nifty way of handling. His voice is a sweet baritone—and he can really carry a tune and read lyrics, which is somewhat of a novelty in these days of trick singing and trickier consonant gargling. . . .

MARY GOES OVER

Mary Cornelia Malone, who sings over WSM, Nashville, Tenn., has given many concerts throughout the States and Canada, receiving warm praise from musical critics wherever she has appeared, even in Cincinnati, that most musical city; Carl B. Adams, of the Cincinnati "Enquirer," declared that Miss Malone's soprano voice was a beautiful, well-tempered instrument of wide range, exquisite tonal quality and rare flexibility. Her radio listeners felt the same way about it, judging from the fan mail received by this charming young American vocalist. . . . The Boswell Sisters will spend the summer season at the Palladium Theatre and the Cafe de Paris in London; they completed a tour of eighteen cities in America before leaving for Europe on the S.S. Ile de France. . . . Did you hear Kate Smith warbling "My Heart at Thy Sweet Voice" on one of her recent programs? Wonder if she'll ever do it again! . . . Myrt and Marge have gone movie, and start work immediately on a picture written by Willard Mack. Byron Foy is the producer and the picture is scheduled for late summer release. . . . One of the best programs heard over WJJD, Chicago, is the Wastebasket program, consisting of homely philosophy, expounded by Francis Owen, formerly of KDKA and WEAF, with a background of colorful music. . . . Uncle Bob is still a popular feature of KYW, the Chicago "Herald and Examiner" station in Chicago. . . .

HOW IT HAPPENED

Do you know that if Don Hall, in a fit of temper, hadn't criticized the harmony of Grace Donaldson and Hortense Rose, there wouldn't be a Don Hall Rose Trio today? Don was courting Hortense six years ago in Cleveland when the two girls were known as "The Maids of Melody." He was waiting for them to finish their rehearsals one night. Finally he grew tired and shouted in to them: "For Pete's sake, won't you girls ever learn how to harmonize?" "If you think you're so good, smarty," called back the girls, "why dont you show us?" He did; they found that they harmonized together so smoothly that right then and there they determined to form a trio—and that's how the Don Hall Rose Trio was born, and now, just for that, they start the day for WJZ six mornings a week at 7:30 a.m., EDST. . . . If Jimmy Melton were not a singer he'd make an excellent chef; at least so his friends think when they tackle his latest culinary achievement, **poulet flambee a la broche** —try that in the tenor register. . . . Well, E. J., the Mastersingers are Steele Jamison, James Haupt, Chester Ewers, Harold Branch, Earl Waldo, Edward Wolter, Darl Bethman, Charles Pearson, Norman Horn, Harry Donaghy, Everett Clark, Charles Harrison, E. B. Sanchez, John Wainman, Jackson Kinsley and Frank Croxton; all good singers. Charles Baker is the director. . . . WSM, in Nashville, is known as the Shield Station. . . .

JUST A NIGHTMARE

I had a bit of a nightmare last night! Dreamed that an enormous microphone was hanging over my head; it kept getting larger and larger, and nearer and nearer, until it almost engulfed me; just as I was about to be smothered it turned into a bass horn out of which came a horde of saxophones, manned by the most frightful looking men with long beards. They started playing a horrible cacophonic medley of tunes punctuated here and there with a yell of "Stormy Weather"—then it seemed I was on top of the Empire State Building trying to broadcast a program, with Ted Husing, Graham McNamee, Dave Ross, George Hicks and Norman Brokenshire all trying to announce at one time. They wouldn't let me start to sing; then came a big wind and hurled me over a parapet; I was falling and singing at the top of my voice at the same time; I woke up before I hit bottom, vowing never to eat lobster salad again before going to bed; but that doesn't prevent me from taking a chance right now—so here goes!

PERSONALITIES

Don Bestor takes his fishing tackle to the roof of his hotel to practice casting.

* * *

When the "Bar X Days and Nights" program goes on the air, the Columbia studios look almost like a ranch, for Carson Robinson and his Buckaroos appear at the microphone in full cowboy regalia.

* * *

Nat Shilkret is planning a trip to Europe.

* * *

Lou Holtz once played semi-pro baseball in San Francisco with the Hanley Stars.

* * *

Archie Coates, CBS continuity writer and author of the new Columbia hobo script series, "Wayfaring Men," writes from experience. The authenticity of the atmosphere of his scripts need not be doubted. for he put in several months of riding the side-door pullmans and gulping mulligan from a can in some of the country's better known "jungles" before he settled lown to typewriter-pounding.

TERMS OF NEW LAW OUTLINED AT CONVENTION

Chicago.

A comprehensive presentation of the new "National Recovery Act," including government control of industry, new taxes and other legislation on which the RMA has acted for its members, was made by Paul B. Klugh, of Chicago, Legislative Committee chairman, at the Association's annual membership meeting held at the Stevens Hotel in this city. The opportunities as well as the obligations of the radio industry under the new "industry control" plan of President Roosevelt were clearly and forcefully outlined by Mr. Klugh.

"Dynamite and teeth are in the administration's legislation for government control of industry," Mr. Klugh declared, presenting the plan for preparation of a voluntary "code" for the radio industry to be presented later at Washington. He emphasized that the anti-trust law suspension provision of the new act would be of incalculable benefit to the industry and prevent the "ruthless 10 per cent." from further operating to injure responsible manufacturers.

Mr. Klugh recited how the RMA had made recommendation to Congress on the industry legislation and also on its new tax features. Bond Geddes, executive vice-president and general manager of the RMA, appeared personally before the House Ways and Means Committee and before the Senate Finance Committee, presenting the legislative recommendations of the RMA after approval by Chairman Klugh.

Industry Control Plan Based

The "industry control" plan of the Roosevelt Administration is basic and broad, Mr. Klugh told the RMA convention.

"The broad purpose of the bill," said Chairman Klugh, "is to increase employment. They propose to do that through limiting the hours of labor.

"The second main provision is, while increasing employment, to raise the standard of wages, to get away from sweatshop wages such as are paid to girls at as low as five cents an hour in some instances. I know that reputable radio manufacturers pay a good many times that as a minimum wage. The broad basis of the bill in Congress is to increase earning power.

"They propose to increase earning power through the establishing of a 'code' and irrespective of what your ideas are as to whether this bill is constitutional, you are confronted with a bill that has dynamite in it and has teeth in it. No matter how small or large you are, you are going to be under this. Manufacturers look to trade associations to adopt a voluntary code as a most feasible and, I think, the nicest way to do it.

"Under that plan an association must be formed along certain lines, particularly designed not to oppress or exclude the small or weak manufacturer. The association membership must be open to all. I think the Radio Manufacturers' Association can qualify in the first rank. To make doubly sure the board of directors has passed a resolution whereby an invitation will again be extended to everybody in the industry to come into this association and told the necessity for their having membership.

President May Amend Code

"The bill provides that the President, which means the government, reserves the right to revise or amend or change the code. If an industry cannot or does not organize voluntarily the government can write the code for that industry and enforce it. If that fails, there is a licensing provision which will force industry to do what the bill contemplates.

"Labor is represented, but the labor provisions at this time are unsettled.

"They also provide in the bill that, aside from the minimum wage, you can fix prices notwithstanding the anti-trust laws.

"They do not propose to have the ruthless 10 per cent. ruin the business of the 90 per cent. The time has passed when sweatshops and gyps and the producers who indulged in destructive practices can go on and kill legitimate industry.

"The bill, therefore, gives any industry the right to fix price and that price, as I understand, must be a fair, legitimate and just price.

"The bill runs for a period of two years, but the framers expressed the opinion unanimously that if the law is a success it will go on for a long time. My personal opinion is that if this law is a success there is no one in this room who will live to see the time when we do not operate under a plan of this kind.

Production Control Contemplated

"The bill contemplates production control. It is not clear as to how they propose to do it, but it is contemplated. They do not propose to have over-production. Neither do they propose that foreign competition shall come in because of the increased cost of labor.

"The general tendency of the bill," continued Mr. Klugh, "is not to oppress small companies, but there is no intention that harum-scarum, poorly organized, inefficient, small companies shall survive."

Mr. Klugh presented and the convention unanimously adopted a resolution authorizing the Association's board of directors to do anything required under the Industrial Recovery Act, in cooperation with the government.

Prices to be Fixed in Recovery Plan

Washington.

In final drafting of the industry control law, the Radio Manufacturers' Association worked effectively to defeat an amendment by Senator Borah, of Idaho, which would have prohibited price-fixing by the Government in the "codes" of industries. Senator Borah's amendment specifically prohibited price fixing.

All set manufacturers were telegraphed by Chairman Paul B. Klugh, of the RMA Legislative Committee, to wire protests to their Senators and Congressmen against the Borah amendment. Protests also were sent by Bond Geddes, RMA legislative representative at Washington, from Chicago to Senator Harrison, of Mississippi, Democratic leader, and Senator McNary, of Oregon, Republican leader.

The Borah amendment in the conference between the Senate and House was revised to prohibit merely "monopolies or monopolistic practices." The Borah prohibition against price-fixing was stricken out and the new law now is continued to afford the valuable price-fixing privileges to trade associations, for their respective industries.

The Federal Radio Commission is to be continued, not being affected by President Roosevelt's plan for reorganizing the Government departments and independent bureaus. The RMA and other radio interests, notably the National Association of Broadcasters, urged that the Commission be not abolished, transferred to the Department of Commerce or otherwise disturbed.

SINGS FROM MEMORY

Mildred Bailey always sings from memory and looks over the mike at a far corner of the studio ceiling until her number is finished.

INDUSTRY AT WORK ON CODE FOR NEW DEAL

Chicago.

Featuring the ninth annual convention of the Radio Manufacturers' Association at the Stevens Hotel was consideration of operations of the radio industry under President Roosevelt's industrial recovery program. A special RMA committee to begin work toward a voluntary "code" for the radio industry under the new plan for government "industry control" was created without a dissenting vote at the RMA membership meeting. The Association's board of directors was empowered to "do anything that may be required by the industrial recovery act in cooperation with the federal government."

The committee of leading national radio manufacturers appointed to work with the government in administering the new law and cooperate with the federal industrial administrator consists of W. Roy McCanne, chairman, president of the Stromberg-Carlson Company, Rochester, N. Y.; Paul B. Klugh, of Chicago, vice president of Zenith Radio Corporation; Arthur T. Murray, of Springfield, Mass., president of the United American Bosch Corporation, and S. W. Muldowny, of New York, chairman of the National Union Radio Corporation. The committee immediately prepared to compile industry data in anticipation of early passage by Congress of the new legislation.

Williams Re-Elected President

Fred D. Williams, of the P. R. Mallory Company, of Indianapolis, Ind., was unanimously re-elected president of the RMA. The board of directors also was re-elected. Leslie F. Muter, of the Muter Company, of Chicago, was elected treasurer; Bond Geddes was re-elected executive vice president-general manager and secretary, and John W. Van Allen, of Buffalo, N. Y., general counsel.

A nation-wide Radio Prosperity Campaign next fall, including outstanding broadcasting during a "Radio Progress Week" in October, received wide support. With the cooperation of the two broadcast networks and other broadcast interests, jobbers and dealers, a radio promotion campaign over several months will be carried through. In October will be staged "Radio Progress Week." Earl Whitehorne, of New York, long identified with radio interests, will be director of the prosperity campaign.

The RMA annual meeting was attended by nearly 90 per cent. of the membership.

Following the convention a "radio family" informal dinner was held in the north ball room of the Stevens Hotel and attended by nearly 200 members, guests and friends. The guest of honor was Thad H. Brown, vice-chairman of the Federal Radio Commission, who spoke on the close interests of radio manufacturers in developing broadcasting with the Commission. President Williams was presented with a silver service in appreciation of his work during the past year.

Throckmorton and Moss Honored

New members elected to the RMA board are George K. Throckmorton and Arthur Moss, both of New York, the former representing the Tube Division, and the latter the Parts, Cabinet and Accessory Division.

The RMA board includes the following, elected for three-year terms: J. Clarke Coit, Powel Crosley, A. Atwater Kent, Paul B. Klugh and George K. Throckmorton; for two-year terms: E. T. Cunningham, W. Roy McCanne, W. S. Symington, A. S. Wells.

NEW MODEL SHIELDED TEST OSCILLATOR!

AN improved modulated test oscillator, fundamental frequencies, 50 to 150 kc, enabling lining up of intermediate frequency amplifiers, t-r-f and oscillator circuits, is now ready. It is shielded in a metal box 9½" wide x 6¼" deep x 4½" high, with beautiful Japanese finish. The test oscillator is obtainable in two models, one for a-c operation, the other for battery operation. The same cabinet is used for both.

The a-c model not only is shielded but has the line blocked, that is, radio frequencies generated by the oscillator cannot be communicated to the tested set by way of the a-c line. This is a necessary counterpart to shielding, and a special circuit had to be devised to solve the problem.

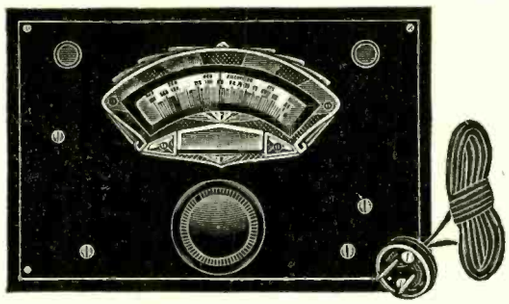
The modulation in the a-c model is the a-c line frequency, 60 cycles, effected by using the line voltage on the plate of the tube. In the cabinet there is a very high resistance between the shield cabinet and the a-c, a double preventive of line-shorting and application of a-c line voltage to the user.

The oscillator is equipped with an output post. No ground connection need be used, as the circuit is sufficiently grounded through the power transformer capacity to prevent body capacity effects in tuning.

The frequencies are more accurately read than normal use requires, being never more than 2% off, and usually not more than 1% off, many readings being right on the dot (no discernible difference). The frequency stability is of a high order from 100 to 50 kc, and somewhat less from 100 to 150 kc. Zero beats are guaranteed at all frequencies.

The oscillator was designed by Herman Bernard and is manufactured under the supervision of graduates of the Massachusetts Institute of Technology.

Either model FREE with two-year subscription for Radio World (104 issues) $12.00



The test oscillator has a frequency-calibrated dial, 150 to 50 kc, with 1 kc separation between 50 and 80 kc and 2 kc separation between 80 and 150 kc. Intermediate frequencies are imprinted on the upper tier. Broadcast frequencies are obtainable on tenth harmonics (500 to 1,500 kc).

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

THE a-c model is completely self-operated and requires a 56 tube. The battery model requires external 22.5-volt small B battery and 1.5-volt dry cell, besides a 230 tube. The use of 1.5 volts instead of 2 volts on the filament increases the plate impedance and the operating stability. The battery model is modulated by a high-pitched note. Zero beats are not obtainable with the battery model.

Directions for Use

Remove the four screws and the slip cover, insert the 56 tube in its socket, restore the cover and screws, connect the a-c attachment plug to the wall socket, and the a-c test oscillator is ready for service.

For testing some particular set, follow the directions given by the designer or manufacturer. In the absence of such directions, use the following method.

Mentally affix a cipher to the registered frequencies on the lower tier (so 50 is read as 500, and 150 as 1,500), and set the dial for any desired broadcast frequency. Connect a wire from output post of test oscillator to antenna post of set. Leave aerial on for zero beats, off otherwise. At resonance the hum will be heard. Off resonance it will not be heard. For testing intermediate frequencies, connect the wire to plate of the first detector socket. The first detector tube may be left in place and bared wire pushed into the plate spring. The intermediates then are tuned for strongest hum response. If an output meter is used, tune for greatest needle deflection.

The battery model is connected to voltage sources as marked on oscillator outleads and is used the same way.

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PUSH-PULL SUPER DIAMOND: Construction and trouble-shooting article and double-page picture diagram. In Radio World of March 18, 1933. 15c a copy. Radio World, 145 W. 45th St., New York City.

THE FORD MODEL—"A" Car and Model "AA" Truck—Construction, Operation and Repair—Revised New Edition. Ford Car authority. Victor W. Page. 708 pages, 318 illustrations. Price $2.50. Radio World, 145 W. 45th St., New York.

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

TROUBLE SHOOTER'S MANUAL, Nos. I and II

Having assembled 2,000 diagrams of commercial receivers, power amplifiers, converters, etc., in 1,200 pages of Volume No. 1 of his Perpetual Trouble Shooter's Manual, John F. Rider, noted radio engineer, has prepared Volume No. 2 on an even more detailed scale, covering all the latest receivers. Volume No. 2 does not duplicate diagrams in Volume No. 1, but contains only new, additional diagrams, and a new all-inclusive information on the circuits covered.

Volume No. 2—Perpetual Trouble Shooter's Manual, by John F. Rider, Shipping weight 6 lbs. Order Cat. RM-VT @.....$5.00
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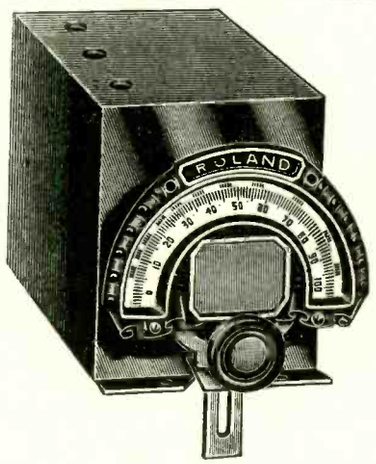
Two-winding coils, UX base. Cat. SWA (four coils).....$1.20
Three-winding coils, 6-pin base (tickler interwound with part of secondary) Cat. SWB @.....$1.40
UX sockets for use as coil receptacle, Cat. 5X, @ 10c each. Forms, four for 60c, either UX or 6-pin. Six-spring sockets. Cat. SZ. @..... 11c each.

SCREEN GRID COIL CO., 143 W. 45th Street, New York City



0.0005 mfd. Scovill tuning condenser, brass plates, shaft at both ends so condenser takes 0-100 or 100-0 dials and two can be used with drum dial; sectional shields built in, trimmers affixed; total enclosed in additional shield as illustrated. Access to trimmers with screwdriver. Side holes for bringing out leads to caps of screen grid tubes. Cat. SCSHC @....$1.98
Same as above, with ghost type dial (travelling light). Cat. SCSHC-DL @.....$2.89

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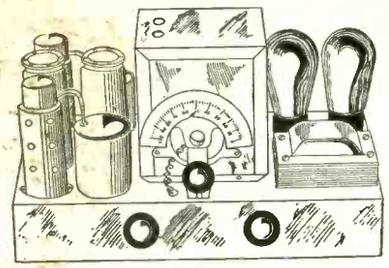
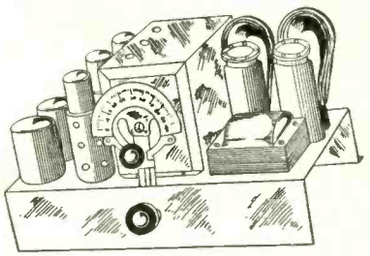


BLUEPRINTS, COILS and CHASSIS

FOR THE TUNED R-F

DIAMOND OF THE AIR



FOUR-TUBE DIAMOND

Extremely fine performance, including fetching tone quality, marks the Four-Tube A-C 1933 Diamond of the Air, blueprint of which is now available (half-scale). Many have been surprised that so much can be accomplished on a t-r-f set that costs so little to build. The circuit uses a two-gang 0.00035 mfd. condenser. Special coils are required. The chassis is metal, 13.75 x 6.75 x 2.5 inches.

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The Five-Tube A-C 1933 Diamond of the Air provides greater sensitivity than the four-tube model, also somewhat more selectivity, as a three-gang condenser is used. An infallible method of permanently suppressing oscillation is introduced, so that besides having a sensitive and selective set one will have a stable receiver. The tone is most excellent. Send $4.00 for 34 weeks subscription (34 issues) and get the blueprint, three shielded coils and drilled metal chassis free. Chassis is 13.75 x 9 x 3 inches. Order Cat. PRE-D-5-COMB.

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We do not pay postage on resistance meter. Average postage 17c.

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The standby of the service man is John F. Rider's "Perpetual Trouble Shooter's Manual," of which Vols. 1 and 2 have been published.

Vol. 1 consists of 2,000 diagrams of commercial receivers, power amplifiers, converters, etc. Total pages, 1200.

Vol. 2 contains additional diagrams on the same basis as above, but in Vol. 2 there is no duplication of any of the diagrams printed in Vol. 1.

To get Vol. 1 free, send $9.00 for 1½-year subscription (78 weeks) and order Cat. PRE-RM-1.

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RADIO WORLD

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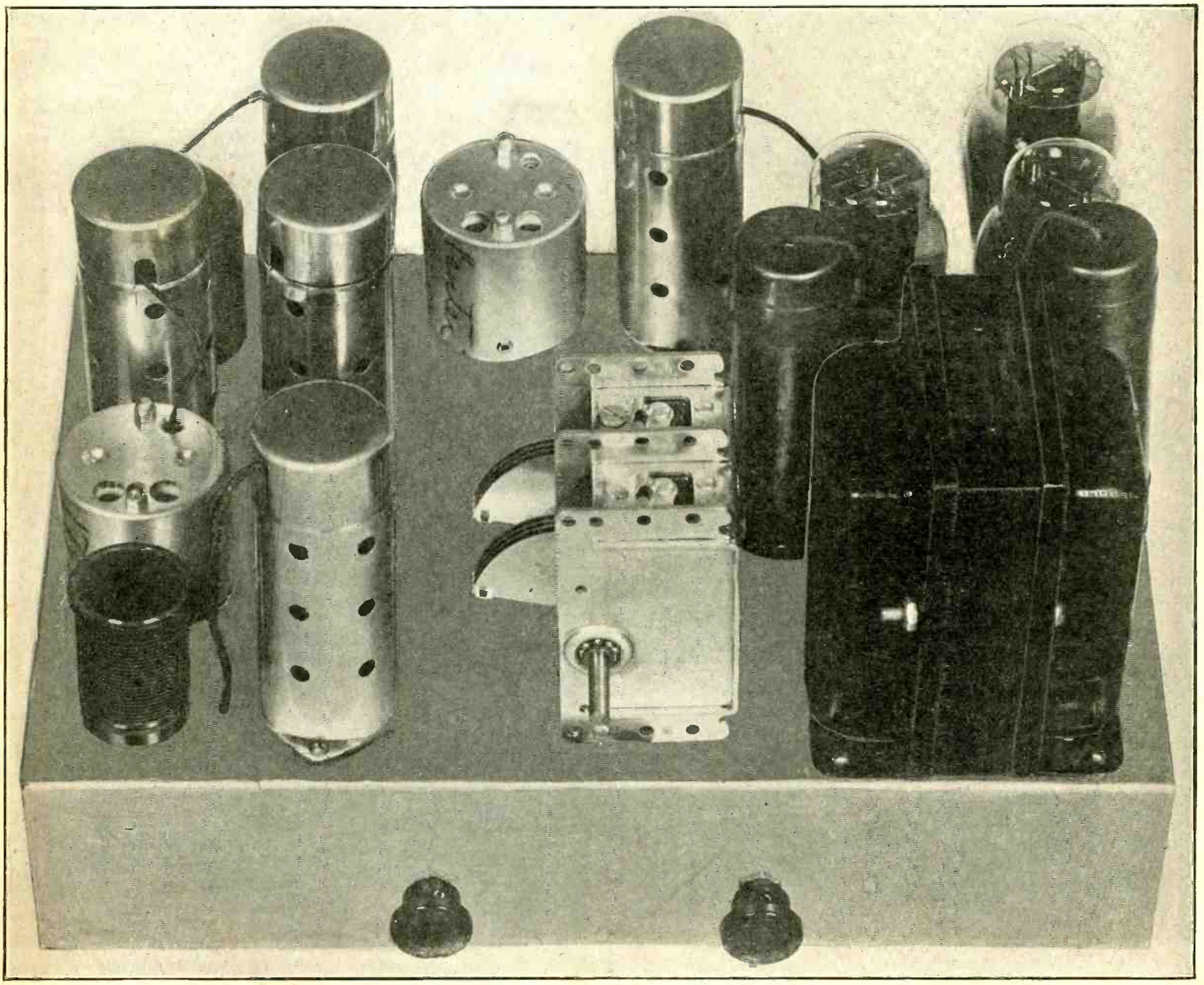
The First and Only National Radio Weekly

Twelfth Year *589th Consecutite Issue*

Scanning Like Human Eye and Brain Achieved for Television

1,520 kc I. F. in Short-Wave Set

JULY 8th 1933 **15¢ Per Copy**



A short-wave set, using plug-in coils and an intermediate frequency of 465 kc. The oscillator coil is in foreground, the modulator coil hidden behind the front tube shield. See page 6.

PUSH-PULL DIAMOND

A dual-range receiver, 1550—535 kc, 1525—4200 kc, using a perfected superheterodyne circuit, frequency-stabilized oscillator and electron coupling between modulator and oscillator. Ten tuned circuits, four variable. Two stages of t-r-f, tuned modulator, tuned oscillator, with switch for wave-changing. Output 15 watts from 2A3's in push-pull. Full-wave second detector, with 56 driver of output. 52 mfd. of B filter capacity. Automatic volume control of two i-f tubes. Automatic inter-channel noise suppression. Selectivity enough to blot out strong locals 10 kc removed from distant station. No squeals whatever.

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Super Diamond, including speaker, tubes and everything else, except cabinet. Lined up and padded by experts. Licensed. **$41.27**

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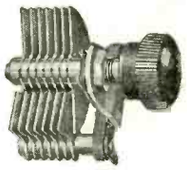
Two-winding coils, UX base. Cat. SWA (four coils) $1.20
Three-winding coils, 6-pin base (tickler interwound with part of secondary) Cat. SWB @ $1.40
UX sockets for use as coil receptacle. Cat. 5X. @ 10c each. Forms, four for 60c, either UX or 6-pin. Six-spring sockets. Cat. SZ. @..... 11c each.

SCREEN GRID COIL CO., 143 W. 45th Street, New York City

FREE with a $1.00 8-weeks Subscription



NEW STAR MIDGET CONDENSERS

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Any two condensers free with $2 for 17-week subscription.

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Any six condensers free with $6 for one-year subscription (52 weeks).

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Designed by J. E. ANDERSON

FOREIGN RECEPTION ON 6-INCH AERIAL

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UX, with insulator 10c
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DIRECT RADIO COMPANY
145 WEST 45th STREET, N. Y. CITY

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All the receiver tubes, and some others, under the following groups: Detectors and Amplifiers, Power Amplifiers, Rectifiers, Phototubes. Regulators. Two full pages, also page of descriptive text. In Radio World of April 1, 1933. 15c a copy, or send $1.00 for trial subscription of 8 weeks, including April 1. Radio World, 145 W. 45th St., New York City.

NEW MODEL SHIELDED TEST OSCILLATOR!

Either 50-150 kc Fundamental Model, a-c or battery; or 500 to 1,500 kc Fundamental Model, (broadcast band) a-c or battery, available.

Either model FREE with two-year subscription for Radio World (104 issues) $12.00

AN improved modulated test oscillator, fundamental frequencies, 50 to 150 kc, enabling lining up of intermediate frequency amplifiers, t-r-f and oscillator circuits, is now ready. It is shielded in a metal box 9⅛" wide x 6¼" deep x 4½" high, with beautiful Japanese finish. The test oscillator is obtainable in two models, one for a-c operation, the other for battery operation. The same cabinet is used for both.

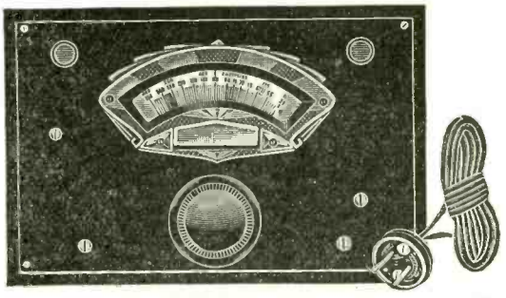
The a-c model not only is shielded but has the line blocked, that is, radio frequencies generated by the oscillator cannot be communicated to the tested set by way of the a-c line. This is a necessary counterpart to shielding, and a special circuit had to be devised to solve the problem.

The modulation in the a-c model is the a-c line frequency, 60 cycles, effected by using the line voltage on the plate of the tube. In the cabinet there is a very high resistance between the shield cabinet and the a-c, a double preventive of line-shorting and application of a-c line voltage to the user.

The oscillator is equipped with an output post. No ground connection need be used, as the circuit is sufficiently grounded through the power transformer capacity to prevent body capacity effects in tuning.

The frequencies are more accurately read than normal use requires, being never more than 2% off, and usually not more than 1% off, many readings being right on the dot (no discernible difference). The frequency stability is of a high order from 100 to 50 kc, and somewhat less from 100 to 150 kc. Zero beats are guaranteed at all frequencies.

The oscillator was designed by Herman Bernard and is manufactured under the supervision of graduates of the Massachusetts Institute of Technology.



The test oscillator has a frequency-calibrated dial, 150 to 50 kc, with 1 kc separation between 50 and 80 kc and 2 kc separation between 80 and 150 kc. Intermediate frequencies are imprinted on the upper tier. Broadcast frequencies are obtainable on tenth harmonics (500 to 1,500 kc).

RADIO WORLD

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

THE a-c model is completely self-operated and requires a 56 tube. The battery model requires external 22.5-volt small B battery and 1.5-volt dry cell, besides a 230 tube. The use of 1.5 volts instead of 2 volts on the filament increases the plate impedance and the operating stability.
The battery model is modulated by a high-pitched note. Zero beats are not obtainable with the battery model.

Directions for Use

Remove the four screws and the slip cover, insert the 56 tube in its socket, restore the cover and screws, connect the a-c attachment plug to the wall socket, and the a-c test oscillator is ready for service.

For testing some particular set, follow the directions given by the designer or manufacturer. In the absence of such directions, use the following method.

Mentally affix a cipher to the registered frequencies on the lower tier (so 50 is read as 500, and 150 as 1,500), and set the dial for any desired broadcast frequency. Connect a wire from output post of test oscillator to antenna post of set. Leave aerial on for zero beats, off otherwise. At resonance the hum will be heard. Off resonance it will not be heard. For testing intermediate frequencies, connect the wire to plate of the first detector socket. The first detector tube may be left in place and bared wire pushed into the plate spring. The intermediates then are tuned for strongest hum response. If an output meter is used, tune for greatest needle deflection.

The battery model is connected to voltage sources as marked on oscillator outleads and is used the same way.

ROLAND BURKE HENNESSY
Editor

HERMAN BERNARD
Managing Editor

RADIO WORLD

J. MURRAY BARRON
Advertising Manager

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TWELFTH YEAR

Vol. XXIII | JULY 8th, 1933 | No. 17. Whole No. 589

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REFLEXING TO-DAY

Operating Economy with the Newer Tubes

A COPYRIGHT pamphlet entitled "Technical Discussion on Reflex Circuit Considerations" (Laboratory Series No. UL-6) has been prepared by RCA Radiotron Co., Inc., and E. T. Cunningham, Inc., and is reprinted herewith by special permission:

Reflex Circuits in the Past

Some years ago reflex circuits received considerable attention and extensive application. Because of the relatively high price of tubes, the high order of sensitivity required to receive weak or distant broadcast stations, and the heavy drain on batteries by the tubes then available, any circuit combination which gave greater sensitivity for a given number of tubes was considered meritorious. Consequently, reflex circuit-arrangements were used extensively since they answered many of the design problems encountered at that time.

Later the reflex circuit was dropped, disappearing from use almost entirely up to the present time. The reasons for its loss of popularity were primarily the poor stability obtainable with the available triodes, the poor quality of output, and the introduction of cheaper and more efficient tube types which permitted the use of more tubes in the set without excessive cost or excessive battery drain. Furthermore, the growing demand for a single-control receiver which would give approximately maximum sensitivity at any dial setting, did much to push the erratic and complicated reflex receiver of that time into temporary discard.

Reasons for Renewed Interest

The spontaneous public approval accorded the introduction of the "pocket size" compact receivers had led radio engineers to an almost frantic search for new circuits and new methods which would give improved performance without an increase in the size or cost of the set. The number of parts and tubes which can be put in the chassis space available in these small receivers is now, and has been, at the saturation point.

PRACTICALITY OF REFLEX, USING THE 2B7 OR 6B7

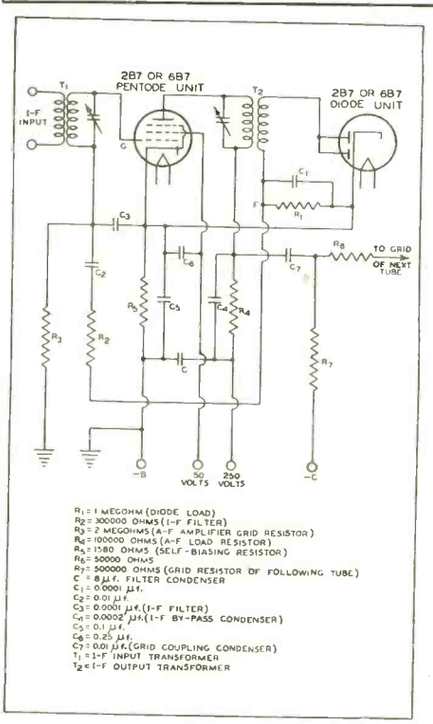
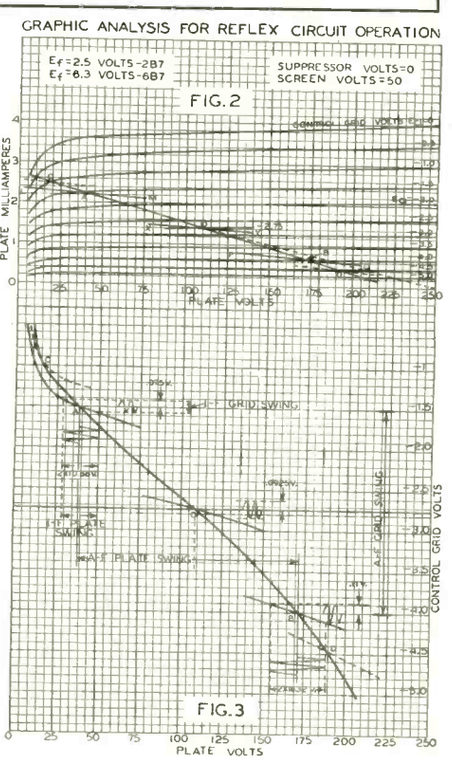


FIG. 1
A fundamental reflex circuit. A pentode and a diode are used. Since the two tubes are in the 2B7 and 6B7, either of these types may replace the two separate envelope tubes diagrammed.



FIGS. 2 and 3
A typical family of plate current curves for a pentode amplifier. The plate supply is 250 volts, the screen voltage 50 volts. The 2B7 or 6B7 tube is in mind. Fig. 3 delineates the grid swing.

The use of duplex tubes has aided considerably the performance capabilities without an increase in chassis size.

In automobile sets the problem is to get the best performance possible with the smallest drain on the car's battery. Consequently, the next logical step is to make some of the tubes perform additional functions. Reflexing may be the answer to these problems.

With reflex arrangements, higher gains are attainable with a given number of tubes than with a straight circuit. The size of the chassis is not usually increased by the use of reflex circuits, while the weight and current consumption remain the same.

While fewer tubes are used with a reflex circuit to secure the same overall gain, the cost of circuit elements is slightly higher for a reflex arrangement, since filters must be provided to isolate the reflexed frequencies. The increased cost and complication of the circuit may offset the saving in tube costs over a straight circuit. Consequently, the principal advantages of the reflex circuit may be its economy of space and reduced power consumption.

Fundamental Principles

In Fig. 1 is shown a fundamental reflex circuit, employing a pentode and a diode. The pentode is reflexed so that it amplifies both r-f and a-f voltages. Using a duplex tube, such as the 6B7, the two tubes shown can be replaced by a single tube.

In operation, the incoming i-f signal is passed through the i-f input transformer (T_1) and amplified by the tube in the usual way. The plate circuit of the i-f amplifier also includes the a-f load (R_4), but a by-pass condenser (C_4) around this makes the impedance for i-f relatively low. Thus the i-f current flows through the condenser practically unaffected. The diode detector is coupled to the i-f amplifier through the i-f output transformer (T_2). Rectification, and consequently detection, of the signal takes place in the diode, producing an a-f output. The a-f output is fed through an i-f filter back to the control grid. This filter consists of the resistor R_2 and condenser C_3. It prevents any i-f component from being fed back to the control grid of the pentode. In passing to the control grid of the pentode, the a-f signal must pass through the i-f input-transformer secondary, but since this has relatively low impedance to a-f, the a-f signal is unaffected. The a-f signal is then amplified by the pentode, producing an a-f voltage across the a-f load (R_4) in the plate circuit of the pentode. Although the primary of the i-f output transformer is in the plate circuit, it has little effect on the a-f plate current due to its relatively low impedance to a-f. Thus it is possible to develop an a-f voltage across the a-f load (R_4), which can be fed to another stage of a-f amplification or to an output tube.

From this elementary discussion of a typical reflex circuit, it will be seen that the operation of the circuit depends upon its ability to separate the reflexed frequency from the other frequency. Naturally, it will be simpler to design circuits for frequencies which differ widely. For this reason, the reflexing of a-f voltages through an i-f amplifier is perhaps the simplest. However, it is possible, although considerably more difficult, to reflex i-f through an r-f amplifier.

Operating Considerations

In Fig. 2 is shown a typical family of plate characteristic curves for a pentode amplifier. The plate supply voltage for the tube is 250 volts, and the screen voltage is 50 volts. An a-f load line, A-O-B, representing an effective a-f load

Operating Curves for 2 B7 and 6 B7

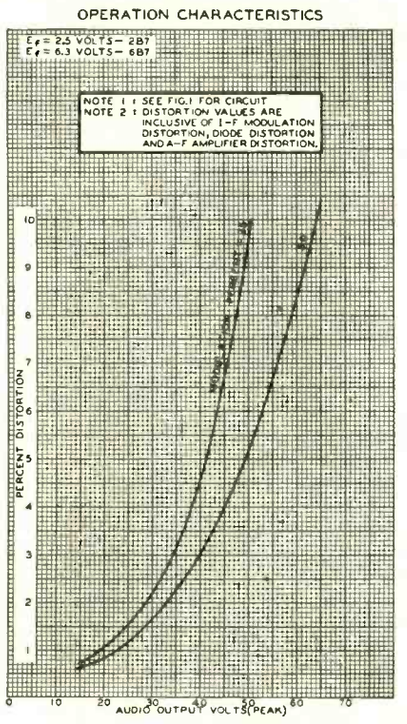


FIG. 4
Percentage distortion curves for the 2B7 and 6B7

of 83,400 ohms, is shown on the characteristics. The static center of the a-f swing is the point O, showing that a bias of —2.75 volts is required. The amplitudes of the a-f swing may be, for example, OA and OB.

Since the amplitudes of the a-f swing are much larger than the amplitudes of the i-f swing, due to the amplification of the system, the dynamic center of the i-f swing will be moved up and down along the a-f load line. The location of the dynamic center of the swing at any instant will depend upon the instantaneous value of the a-f voltage applied to the grid of the tube.

An i-f load impedance of 313,000 ohms is represented by the load lines, L-A-M and P-B-Q, at the extreme ends of the a-f swing. The i-f load with no a-f signal on the grid of the tube is represented by the line X-O-Y.

If the characteristics of the tube were absolutely linear over the entire range of the a-f and i-f swings, the tube would be ideal for reflex amplification. Since the characteristics are not absolutely linear, some distortion is introduced, and the selection of the proper load becomes important if stable operation is to be obtained.

Slight Distortion

It is apparent from the curves that the a-f voltage is distorted but slightly by the curvature of the characteristics. The dynamic center of the i-f voltage swing, however, is carried back and forth along the a-f load by the a-f grid voltage. Consequently, the i-f plate-voltage amplitude is subjected to considerable change with respect to the i-f grid-voltage amplitude. Hence the i-f voltage is distorted. An appreciable part of this distortion is eliminated by the tuned i-f circuit, but the percentage of modulation of the i-f signal is also changed.

When an unmodulated i-f signal voltage is applied to the input of the circuit shown in Fig 1, a d-c voltage is developed across the load resistance (R_1) of the diode. The point F (Fig. 1) becomes negative with respect to the cathode. An increase or decrease in the i-f amplitude due to modulation increases or decreases the negative potential at the point F. The changes in potential occur at the modulating frequency (a-f). The a-f voltage is directly effective at the grid of the reflexed tube through the coupling connection R_2 and C_2. The changes in potential at the grid and at F are identical in sign with respect to the cathode.

It is evident that when the modulation increases the amplitude of the i-f signal, the dynamic center of the i-f swing is shifted by the a-f voltage towards the point B. Similarly, when the carrier is modulated downward (decreased i-f amplitude), the a-f voltage shifts the dynamic center of the i-f swing towards the point A.

Modulation Decrease

The spacing of the grid voltage lines (Fig. 2) increases towards A and decreases towards B with respect to that at the point O at the central portion of the plate characteristics. This causes a decrease in the percentage of modulation of the i-f signal, since the small amplitudes are amplified more than at point O and the large amplitudes are amplified less. This decrease in the percentage modulation has a stabilizing effect on the system, while the gain and output are reduced slightly.

If the output of the iode detector were connected to the grid of the reflexed tube in the opposite phase, there would be an increase in the percentage of modulation. This effect tends to be accumulative and motorboating may result.

Consider the normal stable circuit arrangement with the loads shown in Fig. 1. Suppose a small, modulated i-f signal is applied to the input and its amplitude is gradually increased by means of a gain control operating on the preceding amplifier stages. When the positive a-f voltage swings the grid appreciably beyond the point A, the i-f amplitude no longer receives increased amplification as compared with that of the point O, due to the curvature of the characteristics near the point C. The amplification rapidly decreases beyond the point A, causing a further decrease in i-f amplitude to the detector, which in turn causes a more positive grid voltage on the reflex tube. The effect is accumulative so that an unstable motorboating action may result.

Stability Results

Stable operation is obtained, if the change in the i-f amplification over the operating range of the a-f grid voltage values produces a distortion of the modulated i-f which, when rectified by the diode, causes a considerably larger change in the a-f amplitude at the lower end of the grid swing than at the upper end (Fig. 3.) Even though the characteristic at the upper end tends to produce an increase in percentage of modulation, the characteristic at the lower end counteracts this effect.

In general, for stable operation in reflex circuits, the i-f voltage amplification over the operating range must either be constant, or tend to oppose the changing amplitude of the input carrier-voltage.

The limiting conditions for stable operation, therefore, depend upon the a-f load, the i-f load, the plate voltage, the screen voltage, and the grid-bias voltage. It is necessary to use a somewhat lower screen

voltage than that normally used in i-f amplifiers in order to obtain high a-f voltage-amplification. The control-grid bias must be selected so that the tube operates near the central part of the plate characteristics in order to obtain maximum output and stable operation. High output requires high plate voltages, particularly when resistance-coupling is employed.

The i-f plate-load impedance and the a-f load impedance should not be too high. Low impedances give better stability, but, also, low voltage-amplification.

While it is possible to provide volume control on the reflexed tube, it is generally more satisfactory to use a volume control operating on preceding tubes.

Analysis of Fig. 1 Circuit

The 100,000-ohm load resistance (R_4 in Fig. 1) and a bias voltage of —2.75 volts place the static center for the a-f plate-voltage swing at a favorable point (O in Fig 2) on the plate characteristics for a plate supply of 250 volts and screen voltage of 50 volts. The grid resistor (R_7) in parallel with load resistor (R_4) constitute the a-f load (a-f R_p) of 83,400 ohms. This load is represented by the line A-O-B in Fig. 2.

The i-f output transformer (T_2) has a primary to secondary voltage ratio (N_e) of 1.7 to 1. The parallel resonance impedance of the primary (Z_{pr}) is 400,000 ohms. The secondary of T_2 is loaded by the diode. The diode impedance (Z_d) at the 175-kc. i.f. is approximately one-half of R_1, or 500,000 ohms. The resistance and reactance of the secondary T_2 are negligible in comparison with this diode load. Therefore, the total i-f plate load impedance is the parallel value of Z_{pr} and the reflected diode impedance, or 313,000 ohms.

The points A and B mark the limits of the assumed a-f plate-voltage swing on the dynamic a-f characteristic in Fig. 3 (Fig. 3 is obtained by projecting instantaneous values of grid voltage and plate voltage from the load line A-O-B in Fig. 2). The amplitude of the fundamental a-f plate-voltage swing is 67 volts. This corresponds to a grid voltage swing of 1.25 volts, giving a voltage amplification of $67/1.25 = 53.5$.

Since the voltage produced across the diode load (R_1), modified by the voltage ratio of the network comprised of R_2, R_3, C_2 and C_3 gives the a-f grid voltage swing, the voltage across R_1 over the frequency range for which C_2 and C_3 are negligible must be equal to

$$\frac{1.25 \times R_2 + R_3 = 1.44 \text{ volts}}{R_3}$$

For a diode efficiency of 90%, the amplitude of the i-f modulation on the secondary of T_2 is $1.44/0.9 = 1.6$ volts.

Voltage Variation

With 20% modulation, the i-f signal voltage on the secondary of T_2 is $1.6/0.20 = 8$ volts. The voltage on the primary of T_2 is the voltage in the secondary times the step-down ratio of the transformer $= 8 \times 1.7 = 13.6$ volts. Since this voltage is 20% modulated, it varies between 16.32 volts and 10.88 volts.

Since the d-c voltage across the diode load (R_1) increases with increasing i-f voltage, the maximum value of a modulated wave causes the highest voltage, while the minimum causes the lowest voltage. The d-c voltage change across R_1 produces the instantaneous a-f grid voltage on the tube. Consequently, when the modulated i-f voltage swing is 16.32 volts the dynamic center is at B, when it is 10.88 volts the dynamic center is at A.

It will be seen by inspection of Fig. 2 and Fig. 3 that the i-f voltage amplification for a given i-f amplitude depends upon the instantaneous grid voltage. The voltage amplification is low at highly negative values of grid voltage and increases gradually as the negative grid voltage decreases towards point A. For negative grid voltages less than that at point A, the voltage amplification begins to decrease rapidly, until at C it is considerably lower than at A. The decrease in voltage amplification at the point C is due to curvature of the plate characteristics for low plate voltages.

Amplification Considered

The voltage amplification at the points A and B is found from the i-f load lines on the dynamic characteristics (Fig. 3) and equals the ratio of the peak-to-peak plate-voltage swing to the peak-to-peak grid-voltage swing. At point A, the voltage amplification is $(2 \times 10.88) / (2 \times 0.075) = 145$. At B it is $(2 \times 16.32) / (2 \times 0.11) = 148.2$.

As brought out in the discussion on the theory of operation of a reflex amplifier, stable operation can exist only when the i-f voltage amplification is constant or tends to oppose the changing amplitude of the input carrier-voltage.

Under the conditions obtaining at points A and B, the percentage modulation of the i-f signal is increased, due to the difference in voltage amplification at these points. Due to the distortion of the a-f amplitudes, the a-f grid voltage is not sinusoidal as assumed for the construction of Fig. 3. The point B actually should be more distant from O than point A, and not as shown. This is a more stable condition than that shown in Fig. 3.

With a slightly larger amplitude of i-f input, the stabilizing effect of the unequal a-f amplitudes no longer predominates and the system becomes unstable. Larger i-f amplitudes cause the points A and B to move away from O into regions of increasing instability until the tube draws grid current. As a result of grid current, the point O is shifted to a more negative value, restabilizing the system for an instant. The rapid reoccurrence of this phenomenon is usually termed "motorboating."

Modulation Percentages

For smaller a-f plate-voltage swings the voltage amplification in the direction of point A becomes greater than that in the direction of point B, producing slight demodulation. This condition adjusts itself instantly, so that stable operation is obtained.

Higher percentages of modulation have smaller i-f grid voltages for the same audio output. Therefore, larger audio-output voltages can be obtained without exceeding the i-f grid voltage swings which mark the end of stable operation. The following table shows the results of experiments illustrating this:

% modulation of i-f signal	Peak a-f output voltages for stable operation
10	45.3
20	64.0
30	79.0
50	105.0
80	116.0

The values for 50 and 80 per cent modulation show that the entire a-f dynamic characteristic (Fig. 3) is used. These values represent the maximum possible voltage-output obtainable without causing the tube to draw grid current.

The calculation shows that the i-f amplification is 145 and the a-f amplification is 53.5. Due to the step-down ratio of T_2, the overall i-f gain is $145/1.7 = 85.4$. The gain of the entire circuit of Fig. 1 with an i-f signal of 20% modulation is $67/0.0925 = 725$. For 30% modulation the overall voltage amplification is 1090, and for 100% it is 3625.

Harmonic analysis shows a distortion of 2.7% for the a-f amplifier alone, with a peak plate-voltage swing of 64 volts. The measured overall distortion is shown versus the peak a-f output in Fig. 4. The measured overall distortion is considerably higher than the calculated value for the a-f amplifier alone, since it contains distortion due to the change in percentage modulation of the i-f signal, and also distortion due to the diode detector.

General Comments on Design

There shoud be no audio-frequency coupling between the plate circuit of the pentode (Fig. 1) and the diode-detector circuit, if audio feed-back and audio rectification are to be avoided. The capacity between the i-f output-transformer-primary winding and secondary winding should be low in order to eliminate audio-frequency coupling.

There should be no i-f coupling between the plate circuit of the pentode, or the diode circuit, and the grid circuit of the pentode, since i-f feed-back will cause oscillation or degeneration.

In resistance-coupled circuits, the plate-supply voltage should be at least 5 times as high as the screen grid voltage. The audio load should be determined for low distortion and be such that the least negative required peak grid-voltage value does not occur at too low a plate voltage.

The reflexed a-f voltage must be returned to the control grid of the reflex tube in the proper phase. In resistance-coupled circuits such as that shown in Fig. 1, the correct phase relation automatically obtains. In transformer coupled circuits, the polarity of the a-f transformer must be correct.

For an i-f signal of given percentage modulation there may be a limiting amplitude beyond which instability results.

The plate-load impedances for i-f and a-f conditions have critical values which determine the limits for stable operation.

If the volume is controlled only by varying the a-f voltage fed back to the reflex tube, rectification of the i-f in the plate circuit of the reflex tube will, at low volume levels and high i-f input voltage, introduce some a-f voltages which may be appreciably distorted. For this reason it is generally advisable to control the volume on some other tube in the set.

Self-bias is recommended, since the operation with correct loads will remain satisfactory for considerable variation in plate-supply voltage.

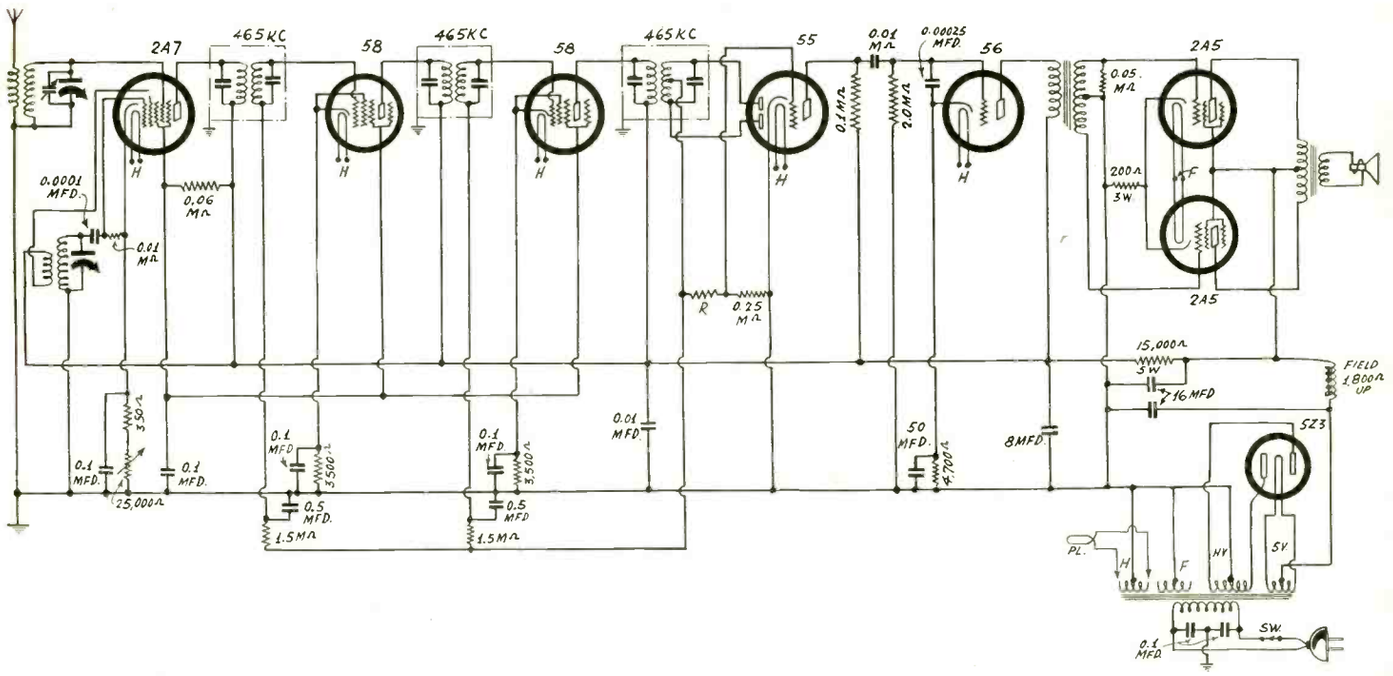
Conclusions

It has been the purpose of this article to point out some of the difficulties normally encountered in the design of reflex receivers. Limiting conditions for the extreme range of the tube's performance capabilities have been discussed in order to present ways of analyzing and designing circuits. It is quite probable that in the design of a broadcast receiver some of these limits may never be approached.

With the tube types now available, it is possible to design reflex receivers having sensitivity capabilities comparable with those of a straight receiver employing a larger number of tubes. The stability and output quality of the reflex receiver can be made to compare favorably with that of receivers employing straight circuits.

A SELF-CONTAINED SHORT-WAVE SET WITH HUM ELIMINATED

By M. G. Woodward



The eight-tube short-wave superheterodyne from which hum has been eliminated. The two condensers across the same potentials, low side of 15,000-ohm series resistor and ground, are 0.01 mfd. and 8 mfd. Of these the 8 mfd. reduces hum and the 0.01 mfd. bypasses radio frequencies. Otherwise for the higher radio frequencies the impedance of the intended bypassing might be entirely too large. Plug-in coils are used.

THE construction of an a-c-operated short-wave receiver, with total receiver and power supply on one chassis, naturally brings up the subject of hum, to which short-wave sets seems to be subjected more than are broadcast receivers. The fact may be accepted even though the reason for it is not altogether clear.

In the diagramed circuit, four methods were employed to reduce the hum effectively, and a fifth incidental method that might yield a slight extra reduction.

An adequate filter in the B supply is taken for granted, and this consists of the field coil of a dynamic speaker used as B choke, with 16 mfd. next to the rectifier and 16 mfd. more at the end of this filter. Adding more capacity doesn't do any good at these positions, and indeed many would be satisfied that the hum was low enough. However, extra methods were utilized, and since they are not peculiar to this circuit, they may be tried (with confidence of their value being proved) on other receivers.

The Four Methods

First, a resistor was introduced in series with the tuner B feed, shown as 15,000 ohms, and at the low voltage side of this resistor an 8 mfd. condenser was placed. This further reduced the inherent hum, already low to begin with, and removed the existence of slight tunable hum.

Second, and in line with the use of the same resistor, the B voltage to the tuner tubes was kept low, around 100 volts, and the screen voltage whatever results from the series 60,000-ohm resistor. If you haven't 60,000 ohms you may use 50,000 ohms. The actual screen voltage will be between 40 and 50 volts, although it will read less than that, screen to ground, on most meters used by experimenters.

Third, the output tubes were of the heater type, so that the hum otherwise introduced into a filament, hence into the tube itself, is not amplified.

Fourth, a resistor of 50,000 ohms was connected between grid of one output tube and ground. Either tube may be selected, and in some instances the hum reduction is greater when the connection is made to one grid rather than to another, so try both. If both have resistors simultaneously in both, then the resistance had better be 100,000 ohms from each grid to ground. However, one resistor suffices, hence one of half that value is shown.

The Fifth and Incidental Method

The fifth, and incidental, method was discovered by accident. In using a potentiometer as the total resistance load on the diodes of the 55, the hum rose when one got near the extreme voltage (left-hand side of the load resistor, reading R and 0.25 meg. as one resistor in the diagram). Since the resistor is 0.25 meg., a potentiometer of equal value may be put in the circuit, arm to pointer, and the slider moved until this hum-increase point is reached, then the resistance measured between the arm and the left-hand end of the resistor in diagram, and when a fixed resistor of 250,000 ohms is used, then R is additional, and of the value determined by the experiment. The value is not so critical that this method does not apply.

A sixth aid is the filter in the power transformer primary, consisting of two 0.1 mfd. condensers, although there primarily for another purpose, that of keeping radio frequencies from getting to the rectifier by way of the a-c line input. If the power transformer is of the type without static shield, a terrific tunable hum may be experienced on any receiver (broadcast waves or otherwise), and the two condensers will get rid of this, if the cause is the stated one.

Drain Kept Down

Because of the low B voltages in the tuner, and the biasing that is around 5 volts, the B current drain is small, and the constructor should not be surprised if the total drain is only around 90 milliamperes.

Taking up the circuit in the order of the signal function, the mixing is done in the single envelope of the 2A7, with the modulator negatively biased by the drop in the 350-ohm resistor, plus any extra drop due to the 25,000-ohm rheostat (or potentiometer used as rheostat).

The oscilator portion is of the grid current type, with stopping condenser and grid leak, the value of leak having been determined experimentally at 10,000 ohms. This may seem like a low value, but it must be remembered that circumstances dictate the value of the leak. It should be as high as practical, yet should not cause blocking, and at the high frequencies blocking did occur even when the leak was 15,000 ohms. So while 10,000 ohms or more may be used, the maximum must be less than 15,000 ohms, and any who are assiduously experimental may try out various values between these two, or others may accept the 10,000-ohm value as final. This resistor is marked 0.01 meg. in the diagram.

Electron Coupling

Coupling between oscillator and modulator is effectuated in the cathode circuit, which is common to the two separate tubes in the one envelope, the pentode modulator and the triode oscillator. This is therefore electron coupling.

The connection for the 2A7 are, looking at bottom of socket, heaters toward you, go-

LIST OF PARTS

Coils

Two sets of standard short-wave plug-in coils for 0.00014 mfd. tuning: four coils to a set, total eight coils.
Two doubly-tuned intermediate-frequency transformers, 465 kc.
One doubly-tuned intermediate transformer, 465 kc, with center-tapped secondary.
One power transformer.
One dynamic speaker; field coil total 1,800 ohms or more; any existing tap on field may be ignored; output transformer for push-pull pentodes.

Condensers

One two-gang 0.00014 mfd. tuning condenser.
One 0.0001 mfd. grid condenser.
One 0.00025 mfd. fixed condenser.
Two 0.01 mfd. condensers.
Seven 0.1 mfd. bypass condensers, 200 volts minimum rating.
Four 8 mfd. electrolytic condensers (two in two pairs to constitute two 16 mfd.)
One 8 mfd. electrolytic condenser to be used separately.
One 50 mfd., 30-volt electrolytic condenser.

Resistors

One 200-ohm B-watt resistor (or two 400-ohm 1-watt resistors in parallel will do).
One 350-ohm pigtail resistor
Two 3,500-ohm pigtail resistors.
One 4,700-ohm pigtail resistor.
One 15,000-ohm, 5-watt resistor.
One 0.05 meg. pigtail resistor (50,000 ohms).
One 0.1 meg. pigtail resistor (100,000 ohms).
One 0.25 meg. pigtail resistor (250,000 ohms).
Two 1.5 meg. pigtail resistors (1,500,000 ohms).
One 2.0 meg. pigtail resistor (2,000,000 ohms).
One pigtail resistor, marked R in diagram, suggested around 100,000 ohms.
One 25,000-ohm potentiometer with a-c switch attached (used as rheostat). Reverse the connections to the rheostat if the volume control works in the wrong direction.

Other Requirements

One chassis.
Five tube shields and bases.
One seven-hole medium socket, five six-hole sockets, two five-hole sockets and one four-hole socket. (The extra five-hole socket is for speaker plug, although actually only four connections need be used).
One a-c cable and plug.
One vernier dial, escutcheon and pilot lamp.
One antenna-ground binding post assembly.
Four grid clips.
Tubes: one 2A7, two 58's, one 55, one 56, one 5Z3 and two 2A5's.

ing right to left: one heater, other heater, plate, screen, oscillator plate, oscillator grid, cathode. The control grid of the modulator is the cap of the tube.

While the control grid is shown as negatively biased by cathode resistor drop, those partial to grid leak detection in the modulator may use 0.0001 mfd. and 75,000 ohms, connecting grid return then to grounded B minus, and shifting the volume control to an intermediate tube, as well as increasing the resistance, approximately doubling it. That is, there would be 50,000 ohms of rheostat at maximum in series with 3,500 ohms of fixed biasing resistance.

The coils used in the mixer are of the standard plug-in variety in conjunction with the 0.00014 mfd. tuning capacities. Both coils are the same as to number of base pins (four) and as to inductance for a single band, and the question arises how the difference in frequencies is struck between the modulator and the oscillator.

This is done by including a seven-plate junior condenser in parallel with the section tuning the antenna secondary. Since we desire the oscillator frequency to be higher, the modulator frequency will be lower, and to lower it extra capacity, as found in the manual trimmer, provides the result.

For the first band of tuning this capacity has to be relatively large, although it must be admitted that 50 mmfd. will more than take care of it. For the next band the capacity has to be much less, and for the next two bands it is scarcely necessary to move this manual trimmer's knob, but the condenser may be left at minimum, because the percentage of difference in frequencies is so small.

Percentage Differences

Even at 5,000 kc, the percentage of difference is only 10 per cent., approximately, so at 10,000 kc it is 5 per cent. and at 20,000 kc it is 2.5 percent. As we shall tune to around 30,000 kc, the difference finally becomes a little more than 1.6 per cent.

Some arguments may be raised against this small difference in relative frequencies at the higher frequencies, but the only remedy would be to use a still higher intermediate frequency than 465 kc, and one would soon get into the broadcast band, where there is trouble ahead, due to likelihood of interference by direct pickup, in the intermediate amplifier, from broadcast stations, so one would select perhaps 1,520 kc, which would render the coil problem somewhat serious for those not yet thoroughly versed in radio. On the other hand, the splendid short-wave supers with intermediate frequencies in the four hundreds may be cited, and also the excellent results obtained.

The intermediate transformers are of the doubly-tuned type, but if you have singly-tuned transformers, these may be used, and in fact may yield even a little more selectivity, for there is an inescapable band-pass filter effect in the double-tuned variety.

While the 55 is shown worked as a full-wave detector, it may be worked as a half-wave detector if you haven't the transformer with center-tapped secondary.

40% Off

Simply then connect one side of secondary to joined anodes, other extreme of secondary to one side of the load resistor, other side of which resistor goes to ground. R then might have to be somewhat higher than for the full-wave circuit, but this could be verified experimentally, following the directions previously given. As a generalized value, R may be recommended tried at 100,000 ohms, even though less than the full rectified voltage (40 per cent. of it in such instance) would be applied to the triode of the 55.

While this seems like a great deal off, the actual result in quantity of sound is not much, as the 56 gives more volume on strongest signals when less than the full voltage is taken off the 55 rectifiers.

If 4,700 ohms are used in the 56 cathode leg, the negative bias will be around 8 volts, although on meters less sensitive than 1,000 ohms per volt, the reading may be around 5 volts or so. Nevertheless the actual voltage is around 8 volts, and the current is a bit under 2 milliamperes. It is therefore not necessary to filter the a-c from the primary of the push-pull input transformer.

I-F Filter Condenser

The 0.1 meg. resistor in the 55 plate circuit is higher than usually recommended, but the output signal voltage is raised a bit thereby. The 2.0 meg. leak helps improve the sensitivity, and if slight hum increase is tolerable, this resistor may be raised even to 5 meg.

Across the grid resistor is a condenser of 0.00025 mfd., in a position that has much less effect on reducing the high audio frequencies than if this unit were across the diode load resistance (R plus 0.35 meg). The purpose of the condenser is to serve as an i-f filter. If the intermediate amplifier tends to be a bit squealy at maximum gain this condenser corrects for the condition.

The quality is improved by a large bypass condenser across the 56 biasing resistor, yet none is shown across the 200 ohms biasing the push-pull stage. This is due to the absence of signal from the smaller resistor.

The 0.05 meg. resistor as a hum-reducer has been discussed. There remains only the consideration of the power transformer, rectifier and speaker.

Optional Connections

The power transformer may be of the so-called 90 ma type (where the plate drain at d-c values is used as the transformer rating), otherwise a 50-watt transformer (if primary input is used as rating). The windings need not be exactly as shown. Perhaps there is only one 2.5-volt winding. It may be used nevertheless, provided it will stand around 10 amperes or so. The rectifier windings are the high-voltage supply (normally around 350 volts a-c between B minus and one side), and 5 volts. If the 5-volt winding is not center-tapped, use either side of the filament for the B feed.

The circuit is equipped with automatic volume control of the two intermediate tubes, but if desired this control may be extended to include the modulator, by making the modulator grid return to the 55 diode load resistance, as done in the other instances, through a high resistance bypassed by a large capacity, instead of directly to ground as diagramed. In case the change is made, separate the primary from the secondary, so that the primary is directly grounded. This refers to the modulator coil (extreme upper left).

Coil Connections

The intermediate amplifier is peaked in the usual way, by putting the oscillator voltage on the plate of the 2A7, with modulator and oscillator coils out, then resort restoring the circuit, and on a very weak signal received later, relining the intermediates carefully and slightly for maximum quantity of sound or greatest deflection of the needle, if output meter is used.

It has been stated that standard plug-in coils may be used. If machine wound, as they naturally would be, the windings are in the same direction, and the connections for modulator, top to bottom, would be: (secondary) grid and ground, (primary) ground and aerial. Oscillator coil: top to bottom (secondary), ground; B plus, plate. The connections to base pins will have to be traced out, but for commercial types in mind the code is: coil's positive filament to antenna or plate: coil's plate to ground or B plus; coil's grid is grid in both instances; coil's negative filament is ground for both. "Grid" in the case of oscillator represents the coil side of the 0.0001 mfd. grid condenser.

[Other Illustration on Front Cover]

3,000 AT STUDIO

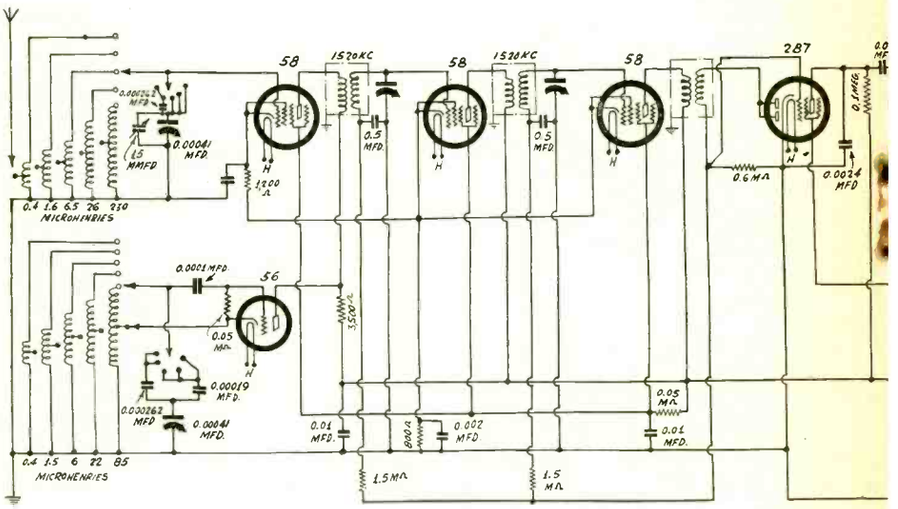
More than 3,000 persons attended a recent broadcast of the Pontiac program, thronging the grand ballroom of the Waldorf-Astoria Hotel in New York City to applaud the comedy of Stoopnagle and Budd and the music and songs of the Kostelanetz Orchestra and Chorus, William O'Neal and Jeannie Lang. The special presentation was arranged to accommodate some of the many requests for personal attendance at the programs, and standing room only, with plenty of standees, was the order of the evening. After the program, the Colonel and Budd put on a special performance for their enthusiastic audience. A surging mob of autograph-seekers kept Stoopnagle, Budd, Announcer Louis Dean and the other principals busy with pens and pencils for a good part of the night after the performance.

HIGHER

TREND IN THAT DIRECTIO

DICTED—COIL DATA FO

By F. W.



A short-wave receiver, using an intermediate frequency around 1,520 kc. are electron-coupled. Automatic volume control is included. The i-f coi

IN the superheterodyne intended primarily for short waves, the intermediate frequency should be as high as practical, and while good results are obtained with 450, 465 kc, etc., no doubt the trend will be to frequencies higher than the broadcast band, just as the intermediate frequencies of broadcast superheterodynes were increased from 30 kc to the four hundreds.

Many will desire to be in the vanguard of such experimentation, and therefore some details will be given to guide them, although the engineering of the circuit diagramed herewith has not been completed by the author. The intermediate and audio amplifiers, and the B supply, have been completed, but there remains some work to be done on the mixer coils.

The inductance values may be stated on the basis of specified capacities. Suppose that a two-gang 0.00041 mfd. condenser is used. The frequency ratio will slightly exceed 3 to 1, but for overlap assurance the ratio will not be deemed to be greater than stated.

Different Frequency Ratios

Let us look for a moment at the highest frequency band. Suppose it ends at 30,000 kc (30 megacycles). Then if the same ratio prevails the low frequency tuning would be at 10 megacycles, a difference of 20 mgc. At the low frequency short-wave band the difference would be that between 1,540 kc and 4,620 kc, or 3,080 kc. It is clearly advisable to reduce the frequency ratio as the frequencies tuned in become higher and higher, band for band, so that no disparity like 20 and 3 mgc. will exist. As an arbitrary selection in the right direction, the 3-to-1 ratio may prevail for the first and second 2-to-1 for the two other short-wave bands. short-wave bands (lower frequencies), and

The fifth band represented in the coil system may be the broadcast band. although this would be simply an auxiliary service, in such a set, and the predominating consideration would be short waves.

As the frequencies become higher the difference between the modulator and the oscillator frequencies becomes less, that is, the two come closer to being the same, even with 1,520 kc or thereabouts as the intermediate frequency. So while series capacity padding would be required for two or three of the low frequency bands, a parallel manual condenser across the modulator will take care of frequency adjustment for the higher frequencies, where there would be no padding condenser, although for all save the highest frequency there would be some inductive compensation.

40 Mmfd. Minimum

The series padding condenser is selected on the basis of the low frequency tuning, the oscillator inductance on the basis of the high frequency tuning. Therefore to compute the coils it is necessary to know or assign the minimum capacity. This has been selected as 40 mmfd. for each of the two circuits, modulator and oscillator.

In broadcast practice we find the series padding condenser has little effect on the high frequencies of tuning, for a particular band, and in general if the series capacity is large the effect on the high frequencies is small.

Now let us consider the broadcast band.

The modulator input coil has an inductance of 230 microhenries, tuned by 0.00041 mfd., while the oscillator has an inductance of 85 microhenries, and is tuned by a circuit consisting of 0.00041 mfd. and 0.00019 mfd., making the net result 0.00013 mfd. The tap on the modulator coil is at about one-eighth the total number of turns, whether honeycomb coils are used, as will be likely, or solenoids. The oscillator tap is at about one-quarter the total number of turns, and is not critical. Now, we find the first short-wave band is covered by a modulator coil of 26 microhenries inductance, tapped at one-quarter the number of turns. The companion oscillator coil has an inductance of 22 microhenries, and the padding condenser is the same as before, 0.00019 mfd., resulting in a net effective capacity of 0.00013 mfd. The tap is at one-quarter the total number of turns.

The inductance for the next band is 6.5 microhenries for the modulator, 6 microhenries for the oscillator; for the next band, the values are 1.6 microhenries for the modulator and 1.5 for the oscillator, while for the last band both coils have the same inductance, 0.4 microhenries. The taps on all these coils are at center. The series capacity for reducing the ratio to 2 to 1 should be 0.000262 mfd., but a commercial value of 0.00025 mfd. may be used.

The best way to wind these coils has not been determined experimentally by the author and therefore no details are given, although honeycomb coils are now being used for the lower frequencies, and perhaps solenoids will be used for the higher ones, by winding the solenoids, with their few required turns, on the small diameter hub or form on which the honeycombs are wound.

The idea suggested is that the honeycombs be wound on a ⅜-inch diameter dowel, placed one above the other, with the lowest frequency (largest) coil on top, etc.,

Listeners' Int

Indication that the intelligence of radio audiences is probably higher than the intelligence of the whole population, and that radio programs are probably pitched at too low an intellectual level, is given in a report published by Professor Frank N. Freeman, educational psychologist at the University of Chicago, who recently conducted an intelligence test by radio over an NBC chain.

Professor Freeman received 2,500 responses to his broadcast, in the form of answers to the examination questions. Three-quarters of the entire group made scores "representing superior ability," Professor Freeman reports.

The test, based on Army and school intelligence tests, had the "average adult ability" represented by the score 24. Dr. Freeman found that the average score of the whole group taking the radio test, ages 20 and above, was 32.

"This average is six points above average ability, and three points above the score of 29, which represents superior ability," he states. "In fact, three-quarters of the entire group made a score that was practically as high as the score of 29. Twenty-five per cent of the group made a score of 32 or above, which represents very superior ability.

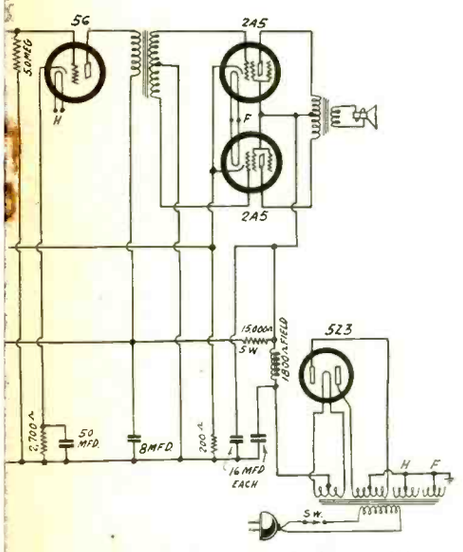
"The range of ages of persons taking the test was from 6 to 80. I was surprised at the large number of papers sent in by older persons, and also at the high scores made by these older persons. As some psychologists think that mental ability decreases sharply in the later years, this is encouraging to some of us who are approaching those years. The average score of persons above fifty is exactly the same as that of the whole group of adults. Furthermore, the average score of seventeen persons who are 70 years of age or over is within one point of the average of the whole group. There is only a fraction of a point difference between the scores made by men and women."

When these scores are interpreted in terms

I. F. DUE

N FOR SHORT WAVES PRE-
)R PRELIMINARY CIRCUIT

C. Hedges



The 58 modulator and 56 oscillator feeding the 2B7 diode is not tuned.

leaving the winding of the two highest frequency coils on the hub as solenoids.

The data given are not intended for use in connection with total shielding, although some shielding evidently will be necessary, as for instance a shield partition between the two coils, but not too close to either of them. Such shielding would change the inductance only a little. Total close shielding would reduce it sharply.

In fact, one result of shielding was that in tuning in around 20 and 30 meters there was stoppage of oscillation below numerical 70 on the dial (higher frequencies than represented by 70) when the shield was on the oscillator coil, but oscillation prevailed when the shield was removed. The oscillator then was a tuned grid feedback type, the usual inductive plate winding, but the Hartley proved a more reliable oscillator, and therefore is shown.

The intermediate coils are easily wound or obtained. If 1-inch diameter forms are used, 127 turns of No. 32 enamel wire may be put on, with primaries wound over the secondaries, primaries consisting of 30 turns of any fine wire, with insulating fabric between the two windings. The condensers tuning them may be regular shaft-type midgets, with or without knobs, two such condensers are on a side wall of the chassis and the third on the rear wall. Knobs greatly facilitate adjustment.

It was found on hooking up the circuit that there was audio-frequency feedback, but this was cured by using a 0.1-meg. resistor in the plate circuit of the 2B7, and putting a condenser of 0.00024 mfd. from plate to ground. Naturally, for this to be effective the feedback had to be at a high audio frequency, as indeed it was. As a further stroke in the same direction, the 2B7 resistor may be made somewhat lower than 0.1 meg.

Some radio-frequency oscillation in the intermediate amplifier was encountered, but this was found due to too low a screen voltage, which was corrected by lowering the limiting resistor for screens to the specified value, 0.05 meg. It was not clear why the lower screen voltage should cause oscillation, but it did just that.

Lining Up Intermediates

The problem of lining up the intermediate frequency without an oscillator will arise, but as it is supposed one has local stations at or near 1,450 to 1,500 kc, select the highest frequency among these, and, with oscillator tube removed from set, line up the intermediates by putting the aerial at plate of the modulator. The locals can be tuned in, if of high enough frequency. Of course the intermediate frequency will be too low, but you will know approximately where to line up, instead of being very far off, and when the set is restored the two intermediate condensers may be shifted to a bit less capacity and when a weak short-wave station is tuned in may be relined for loudest reception of that station. The displacement of the condenser for the higher frequency will amount to only one degree, or at most a few degrees, so do not make the intermediate frequency too high.

Making a Test Oscillator

Some sort of oscillator is needed for the rest of the adjustments, and a broadcast-band oscillator will suit the requirements. It may be a simple regenerative one-tube set of the grid-leak condenser type, with standard broadcast coil used for constant feedback, and the oscillator calibrated against a broadcast receiver, and if need be a curve drawn to ascertain frequencies not directly obtained.

This test oscillator may be used on short waves by its harmonics, which will yield, say, 1,060 to 3,200 kc for the second harmonics, 1,590 to 4,800 kc for the third harmonics, etc. If instead of covering the whole short-wave band, simply a 2-to-1 frequency ratio is desired, as that is sufficient for a harmonic oscillator, then a 50 mmfd. condenser junior may be used with an inductance of 1.7 millihenries, which will reach the lowest broadcast frequency at the low frequency end and twice that frequency at the high end of the test oscillator, or a range of about 530 to 1,060 kc.

The receiver uses the switching system, and for such purposes an excellent switch must be used. However, a few are obtainable on the market, and they may be judged in general by the positiveness and reliability of their contacts, for when this consideration is met the other requirements usually are attended to by the manufacturer in good fashion.

It may well be imagined that the audio gain is very high. The reason is to boost the sensitivity particularly on the weaker stations, as the signal strength from weak, distant stations, including foreign ones, otherwise would not be great enough. It is not to be compared with the signal strength from broadcasting stations, except the very remote ones.

The 2B7 has a very high gain pentode as the amplifier in the same envelope as the diode. The connection for the diode is that of half-wave detection, as the both diode plates are then paralleled, and the tube will better stand any heavy voltage delivered to the detector. The 2B7 feeds into a 56, which is the driver for the push-pull output stage, and while a large bypass capacity is shown across the biasing resistor of the 56 audio amplifier, if there is audio instability this condenser should be omitted.

The I. F. as a Signal Frequency

There are, as intimated, various problems connected with such a circuit, some of which have been specified, and the remedies given. However, one problem not mentioned is that due to the intermediate frequency being somewhere around 1,520 kc, so a signal frequency of the same value would result in a squeal, not in what might be termed reception. Therefore it is advisable to have the broadcast band go from its low frequency extreme to no higher than 1,500 kc, and then have the first short-wave band begin at 1,540 kc or thereabouts, thus skipping the intermediate frequency, and some surrounding frequencies, excluding them from the possibility of reception.

If this is not desired, a wave trap may be put permanently in the antenna circuit to kill off virtually all response at 1,520 kc, or if there is nothing usually receivable on this frequency, remedies may be ignored, as only a single squeal will result, and one squeal in a super is not so bad.

lligence Rated

of the well-known age-intelligence ratios, used for persons under 18, they come out as follows: Average intelligence for age 17, average score should be 23 points; for 16 years, 22 points, for 15 years, 21 points, for 14 years, 18 points, for 13 years, 16 points, and for 12 years 13 points.

Eight persons taking the test scored a perfect 40, one of them a thirteen-year-old girl. Each question of the test required a one-word answer. A typical question is this, in a section on "opposites" in which the listener was asked to write the fourth word of a series: "Handle is to hammer as knob is to . . . . . ." the correct answer being "door." Through comparing the test results in a number of ways Dr. Freeman was able to assure himself that the answers were honestly written, and not looked up.

"It seems to be a common opinion that the average intelligence of the radio audiences is only as high as that of the thirteen- or fourteen-year-old child. If this opinion is wrong the programs are pitched too low.

"Our results suggest that the intelligence of the radio audience is above the average although, of course, they do not prove it."

Occupations listed by those who responded to the test indicate that 26% of them were in some profession, whereas in the whole population, according to the U. S. census, only 3.4% are in the professions. Commercial occupations were listed by 39% of those who reported, whereas only 16% of the whole population are in commercial work.

"I am quite sure that there is a large group of highly intelligent radio listeners, and that it is advisable to keep this group in mind in planning programs." Dr. Freeman concludes.

A Federal Government pamphlet a few years ago listed the average intelligence of a radio listener as that of a thirteen-year-old person.

Educational specialists, not connected with the government, took complex topics as samples and prepared talks on the 13-year plane to show what should be done.

ANTENNA REMEDIES

SQUEAL ELIMINATION, LEVELLING OF CHARACTERISTIC, AND IMPROVING SELECTIVITY

By Thomas Parks

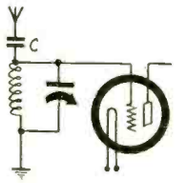


FIG. 1
C is an antenna series condenser, feeding directly to the secondary.

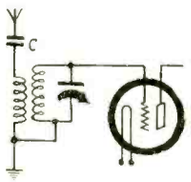


FIG. 2
Here a primary is used, and C has smaller detuning effects.

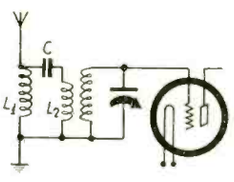


FIG. 3
L1 is a large inductance, C is a small condenser in this case.

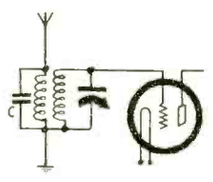


FIG. 4
C tunes the primary to a lower frequency than the set's lowest.

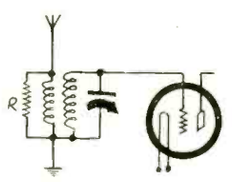


FIG. 5
R is a resistor to stop oscillation. It may be thousands of ohms.

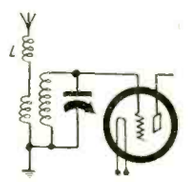


FIG. 6
The series choke L does no good. It only reduces input by choking.

THE antenna stage is more or less of a perplexing problem, in that the selectivity is greatly influenced by the method of circuiting and treatment, the antenna itself may have a detuning effect difficult to compensate for, and even occillation is governed to some extent by the antenna input.

Some form of coupling is necessary between aerial and coil, and usually this consists of the antenna capacity feeding the primary of a transformer with carrier voleage. However, the antenna may be coupled to the grid of a tuned circuit by a small condenser, omitting the primary, as in Fig. 1, although if there is gang tuning it will be almost impossible to track the subsequent sections, as the effect of the antenna capacity across the tuned winding is large enough to be of importance on the higher frequencies. For instance, if the first stage is peaked at a low frequency with the subsequent stages the first section will tune off, beginning at around 1,000 kc. so that at 1,500 kc it would be very seriously off, perhaps 50 kc.

In a two-tuned-circuit system this would be all right, if a manual trimming condenser were put across the second section of the tuning condenser.

Reduced Carrier Input

The series condenser should be small, and in that sense 50 mmfd. is rather large, though satisfactory as a rule. The detuning trouble would not be reduced enough unless the series capacity were around 10 mmfd.

Putting in a series condenser of such low value as even 50 mmfd. (low in the comparison to the antenna capacity itself), greatly reduces the input voltage, but at about the same rate it increases the selectivity. In fact, it is the simplest way to increase selectivity, if the method is consistent with a sufficient quantity of sound in the final output. In high-powered sets, including of course superheterodynes, the method well may be used.

Because it increases selectivity ahead of the modulator it is also a method of reducing squeals in supers where such squeals are caused by insufficient selectivity ahead of the modulator.

The receiver will normally have a former, that is, primary and secondary, and then the detuning effect is decreased by inserting the series condenser, because the equivalent capacity across the primary is the net capacity resulting from the prime antenna capacity (say, 0.0002 mfd.) and the series condenser (0.00005 mfd.), and the inductive coupling reflects little capacity in the next winding. Thus also the condition present in the following circuits in the set is more closely approximated, where the capacity across a primary is small.

Levelling Effect

In some instances, with receivers that have effective automatic volume control, the series condenser reduces the quantity of sound at the output very little. When noticed it is plainest regarding the lower radio frequencies, considering the broadcast band.

The series condenser in the primary circuit is illustrated in Fig. 2.

Sometimes the rising characteristic of tuned radio frequency amplification (greater amplification at higher frequencies) is sought to be overcome, and a rather even response attained. This may be at least approximated by using a large r-f choke coil as L_1 in Fig. 3, and coupling to the primary again through a similar small condenser as before. If the condenser is large the tuning of the tuned circuit is upset and perhaps nullified. Honeycomb coils of hundreds of turns (though only about 1 inch total diameter) normally would be used.

Another way to give the lower frequencies a break is to have a large enough primary, and tune it with a condenser, so that, aerial capacity considered, the primary would resonate at some frequency a little lower than the lowest frequency tuned in by the set itself.

Both these methods of favoring the lower radio frequencies make the set seem less selective at these lower frequencies, though actually the selectivity is not reduced but the voltage input increased, while the actual reduction in selectivity takes place at the higher frequencies, because of the equivalent increased resistance in the tuned circuits at such higher frequencies. Moreover, another treatment of the antenna circuit consists in the introduction of a resistor in parallel with the primary. Though this is a parallel resistance of some thousands of ohms, or perhaps even tens of thousands of ohms, in any instance it is equivalent to a much smaller series resistance in the tuned circuit, and there is a formula for determining the equivalent series resistance.

Of course such resistance reduces selectivity, but if a receiver oscillates at the r-f level, the extra resistance will be of benefit, instead of otherwise, since absence of oscillation is consistent with fine reception, and presence of oscillation is inimical to any decent reception. If there is any cross-modulation, however, the antenna resistor remedy can not be applied to correct squealing, without increasing the crossmodulation. Thus with 24 or even perhaps 35 tubes in the first stage the remedy would be inapplicable, but with triodes, and the later remote cut-off tubes, it could be used.

The stabilization by the parallel resistor requires that a variable be used or various fixed values tried, until the one is found that stops oscillation. The variable would be measured and a fixed resitsor of that value introduced. The resistor should be as high as practical, consistent with attainment of the desired result.

Series Choke

Series chokes have been shown from time to time, but they are of small use in correcting troubles in receivers. They reduce the input too much, without any compensating advantage. Thus if the choke L in Fig. 6 is large enough it would stop all radio frequencies from entering the receiver, in the range of frequencies a particular receiver is intended to cover.

It is obvious that various troubles therefore can be cured at the antenna stage. The reduced input due to a small series condenser can well be stood by nearly all of the latest type receivers having six or more tubes. Often a problem arising in servicing a set can be cured right at the antenna stage, by using some of the remedies herewith proposed.

EXPERIENCE

Reports on Short-Wave Sets

A GOOD MANY experimenters are building short-wave sets, and as I have built several, I would like to report my experience, as a guide to those who might like to follow me and thus perhaps save themselves a good deal of time, labor and some money.

Having tried both superheterodyne and tuned radio frequency-regenerative sets, I am bound to report that I have been able to do at least as well with the regenerative type, with about half the number of tubes required for a super.

Good results were obtained from supers, too, but as the sensitivity can not be developer very far for short waves without running into the noise level, the advantage of a superheterodyne for broadcast use does not seem to me to apply to short waves. As for selectivity, while a superheterodyne may surpass a regenerative set, all the required selectivity is obtained the simpler way. Besides, the superheterodyne's selectivity is nonuniform to a more considerable degree because of the popularity of low intermediate frequencies, where the difference between the oscillator and modulator (signal) frequencies soon becomes too insignificant to be worthy of attention.

My set, that is, the one I prefer, has a stage of t-r-f, a regenerative detector (57 tube), a 56 driver audio stage, and push-pull 2A3's as output. Greater sensitivity can be attained with pentodes in the output (47, 2A5 or 59), but I have intimated that it seems the better part of wisdom not to press the sensitivity to the utmost.

The t-r-f stage should be shielded, as should the detector stage, but the usual small shields should be avoided. Also it is good practice to make the shielding all-inclusive, so that there is a shield bottom piece for the chassis, and if possible a total shield enclosure for the top of the chassis, besides the individual coil and tube shielding there. By taking these precautions there is little, if any, danger of encountering radio-frequency oscillation. On the very shortest waves this oscillation otherwise might be present.

If a super is to be used for short waves, the double-tuned intermediate transformers will be all right, but for still greater selectivity to the point of sideband-cutting the transformers with only one winding tuned will be preferable. Next to the modulator the plate circuit should be tuned, rather than the following grid circuit, provided the coupling is one-to-one, or at least not step-down. In subsequent stages the grid circuits are tuned, and only two stages may be used, as the utmost, for the usual intermediate frequencies. That is, there are three intermediate coils.

I have tried a high intermediate frequency, which in theory should be preferable for a short-wave superheterodyne (1,520 kc as a starter), and at first with even one stage there was terrific oscillation and primaries had to be reduced to 20 turns wound over the secondaries. When two stages were tried the primaries had to be reduced to 12 turns. I believe that high-intermediate-frequency superheterodynes have possibilities, and when the i-f amplifier is stabilized there is no more noise than if the i-f were much lower, say, 450 kc or thereabouts. I can not quite see any advantage in a short-wave superheterodyne if the intermediate frequency is as low as 175 kc.

ADAM BRADWORTH,
San Antonio, Tex.

* * *

His Portable a Success

CONSTRUCTORS should notice that now there are two different kinds of seven-hole sockets, one of the medium size, as for the 59 and 53 (the new twin Class B amplifier tube) and the other of the small size, for the 2A7, 6A7, 2B7 and 6B7. The tubes and sockets are not interchangeable, although a socket has just come out, for tester construction, that takes both of the seven-pin types in the same receptable, by a special arrangement.

J. J. WORK,
Spokane, Wash.

Studio Notes

Who said that One-Eye Connolly had "retired"?

He crashed the gate at NBC Times Square Studio to see Ed Wynn's last broadcast for the season, and Graham McNamee was the unwitting accomplice.

McNamee arrived at the studio with a suit case.

"Carry your bag, Mr. McNamee? No charge," a man offered. McNamee handed over the bag and they went on up.

Once safely inside the studio the volunteer red cap deposited the bag on the floor and refused to carry it further. He thereupon introduced himself to McNamee. Much amused by the deception, the announcer took the world's champion gate-crasher back stage, introduced him to Ed Wynn and later fixed him up in a box seat for the show.

* * *

Russell Johns, lyric baritone heard weekly over a network, was born in Chillicothe, Ohio, also the home town of Clyde Beatty, the animal trainer. The two were boyhood chums and classmates in school. Johns says he cannot understand how Beatty came to go into lion-taming unless it was their eighth grade teacher who "inspired" him.

* * *

Frederic William Wile, Columbia political analyst at Washington, expresses a preference for the boisterous "Of Thee I Sing, Baby," from the political satire of that name. Colonel Stoopnagle registers a fondness for "Without a Song," which may be his actual preference or just a humorous implication. Edwin C. Hill and the Street Singer are both rooters for "Ol' Man River." Will Osborne is swept away by the strains of "Stormy Weather." Mildred Bailey, Columbia's glorifier of the blues, votes appropriately for "St. Louis Blues." Irvin S. Cobb reported "Swing Low, Sweet Chariot" is his choice. Freddie Rich's favorite is a selection from a bygone musical comedy hit, "Oh, Kay," entitled "Someone to Watch Over Me." Andre Kostelanetz declares allegiance to "Dancing in the Dark." Gypsy Nina votes for "Honey, Take a Look at Me." The "Night and Day" pluggers include Fred Feibel, organist, Gertrude Niesen and Irving Kaufman.

World Field Day a Success

Hartford, Conn.

An international experiment in emergency amateur radio communication was performed recently when members of the American Radio Relay League, the Radio Society of Great Britain, the Reseau Belge, the Nederlandsche Vereeniging voor Internationaal Radioamateurisme, and other national amateur radio societies held an international field day.

Taking complete portable radio stations into the field, hundreds of them in every state and province of the United States and Canada alone, these amateurs set up their equipment and established reliable inter-communication in a manner to do credit to any organized communications system.

Certain of the operators contacted as many as fifty other stations. Nearly all were using very low power, from one to fifty watts. Even the highest power is less than one-thousandth of the amount used by high-powered broadcasting stations. A great proportion of the equipment was designed to be capable of operation without power from the electric lines; in time of emergency this feature would be invaluable.

The great bulk of the work occurred on the amateur 3,500-4,000 kilocycle band, said F. E. Handy, communications manager of the American Radio Relay League, at the national headquarters here, although there was nearly equal interest in the newly developed 56-60 megacycle, or five meter, band. The most sensational work was accomplished in the neighborhood of 7,000 kc, or 40 meters.

Amateurs Thriving; Books Selling Well

Hartford, Conn.

In keeping with the unparalleled growth of amateur radio during the past four years, the sales records of the newly announced publications of the American Radio Relay League, "The Radio Amateur's License Manual," and "Hints & Kinks for the Radio Amateur," uphold the record-breaking tradition established by previous books in their series.

Announced approximately one month ago, the "License Manual" has already sold over 2,000 copies. The market for this publication, which covers the entire field of obtaining any one of the several kinds of amateur licenses issued by the Federal Radio Commission, consists of new amateurs and those seeking to enter amateur radiotelephony on restricted bands.

Strictly Commercial

R. L. Watkins Co., sponsor of Lyons tooth powder, is all set for its new broadcasting contract with National Broadcasting Co. Practically the same program will be used as under the old contract just expiring. The new deal starts early this month.

* * *

NBC has received a protest from St. Louis regarding a certain program, as local medical men do not like the idea as presented commercially, and it is probable that Station KSD in St. Louis has dropped this program for good.

* * *

A big new beer program for NBC is about ready to be signed and it is said to represent the biggest money venture of its kind since the beer barons have been able to go after business via the ether.

* * *

Columbia Broadcasting System recently signed a substantial contract with the Household Finance Corporation, the programs to be broadcast from Chicago.

* * *

The new Amalgamated Broadcasting System is said to be signing 'em up so fast that the other chains are taking sharp notice of what is going on. ABS was not considered a very important business proposition when Ed Wynn and his associates first announced their plans.

New Pick-up Tube Puts Television Well Forward

Chicago.

A SCANNING system that brings television near to commercial practicality, with reproduction on a par with that of home movies, was described before the Institute of Radio Engineers at its convention here by Dr. Vladimir K. Zworykin, of the RCA-Victor Company's laboratories, Camden, N. J. Dr. Zworykin, noted television specialist, spent eight years on the system while with Westinghouse Electric & Manufacturing Co. and the past two years on it while with RCA-Victor.

He explained that the main feature of transmitting under the new system is the pickup equipment for converting the image into radio signals without the use of mechanical or moving parts, adding that this involves a new system that greatly increases the output.

Image Retention Increased

Whereas disc systems, using good optical methods, deliver only 60 electrons during the period the picture point is active on the photo-electric cell, the Zworykin method produces 420,000 electrons, due to the 7,000 times greater duration. He explained this duration has been achieved in practice, but that it is theoretically possible to increase the present result ten-fold by still longer retention of the image by the cell.

However, in the new method the ordinary photo-electric cell is not used, but a mica sheet in a cathode ray oscillograph tube is treated in a secret manner to constitute 3,000,000 photo-electric cells, and the picture acts on the cell structure all the time.

The transmitting device is called the iconoscope, meaning "image observer."

The receiving device is also a cathode ray tube, but with a fluorescent screen instead of the cell structure, and is called a kinescope, or "motion observer."

At present the image is 4 square inches and the pictures are divided into 250 elements per scanning inch, or a total of 250 x 4, equalling 1,000 elements. The size of the spot or crater of the beam should be 1/125th of an inch, or 0.008 inch.

The two counterparts of the system have been likened to the human optical system, representing the pick-up and transmitter, and the human brain, representing the receiver, while the greatly increased rentitivity has been referred to as "memory." The photo-cell arrangement is in some respects more sensitive than the human eye, because it responds to higher frequencies, including ultra-violet and infra-red, which are in the human eye's invisible spectrum.

New Tubes Under Way

The intention is to develop the system for use on a high carrier frequency, around 50 megacycles (6 meters) to avoid interference with existing radio transmissions, and also meet television requirements for a wide modulation band width to insure picture quality.

In connection with this new tubes are being developed, much smaller in size than those in broadcast sets, so that 50 megacycles may be amplified even at radio frequencies, at present impossible with the standard tubes. The iconoscope, or transmitting system, makes possible satisfactory amplification, because of the high quantity of output, whereas under present methods the signal hasn't much more vigor than the inherent noises in an amplifier, so that amplification is limited.

The kinescope, or receiving system, was announced four years ago and at that time it was predicted a tube scanning method would be the one actually to be generally used when television reached a stage near enough to perfection to warrant commercialization. Since then various improvements have been made, but the system of reception remains the same in principle, while the transmitting improvement yields more light, and thus tends to overcome one of the objections raised by others to the oscillographic scanner, that there was not enough light to permit magnification to projection size, as otherwise the size of the picture was limited to the size of the fluorescent screen, or the lamp would have to be several times larger than the picture.

Another objection raised to the oscillographic scanner has been that it produces saw-tooth instead of sine-wave scanning, that is, distorts somewhat, but one of the recent improvements is said to concern that factor. A third objection was that the voltages required were very large and might be considered dangerous to life, but that has been given attention, also.

Much Is Kept Secret

While the fundamental theory and principles have been revealed, much concerning the combination transmission-reception system as developed by Dr. Zworykin is being kept secret. However, it seems a clear inference that the transmitter comprises a pickup system consisting of a cathode ray tube in which there is a movie camera lens and that the action is as fast and as clear as that in the movies, the rentitivity resulting in the equivalent of a complete picture in one twenty-fourth of a second, as in the movies, while at the receiving end persistence of vision creates the illusion of motion.

The image cast on the multi-photo-electric screen of the pickup system is transformed into electrical impulses, and these are emitted at the radio transmission frequency, around 50 megacycles. Hence it is assumed that there are introduced into the tube the following: vision frequencies, a polarizing voltage and a radio-frequency of the intended frequency of carrier frequency, so that the tube is also a modulator.

Dr. Zworykin's Explanation

Dr. Zworykin explained to the convention:

"The main feature of the iconoscope is a transmitting or pick-up equipment which converts the image into radio signals also without requiring the use of moving mechanical parts. This involves a special new principle, which gives more electrical output for transmission. In ordinary television systems every point of the picture acts on a photo-electric cell for a very short duration of time. This time is of the order of one 1,500,000th part of a second, or one second divided by 1,500,000. This duration is only obtained in the case of very good pictures.

"During this period a photo-cell of the highest sensitivity will deliver only sixty electrons to the amplifiers, an amount so small that good amplification is impossible. In the iconoscope the picture acts on a photo-electric cell all the time, and there is provision in the structure which collects the energy of the light, or, so to speak, memorizes it, and then transmits it, point by point, twenty-four times per second.

"This involves a new principle of storing electrical energy, which may be called the 'electrical memory'

"Thus it can be seen that the amount of energy stored or 'memorized' in the new photo-cell is, as compared with the old system, in the ratio of one divided by twenty-four as against one divided by 1,500,000, a 'memory' 70,000 times greater. At present, however, we are able to obtain only 10 per cent efficiency, or 7,000 times increase of output from the picture possible with the disc-scanner under identical conditions.

Electric Switch

"The means which makes this possible is the use of the cathode ray beam, which acts as a sort of electrical switch, connecting the 3,000,000 individual photo-cells in the iconoscope with the radio transmitter. At the present time the development is at such a point that it can perform substantially in the same manner as a motion picture camera, which also exposes twenty-four images per second."

New Tubes Developed for Ultra Frequencies

Chicago.

Special tubes have been developed for high radio-frequency work, including the ultra frequencies. They were described at the convention of the Institute of Radio Engineers by G. M. Rose, Jr., and B. J. Thompson, of the RCA Radiotron Company, Inc. The tubes are triodes, quadrodes and pentodes. Using standard circuits, screen-grid tubes provided amplification to 60 centimeters, or a wavelength of about 23.6 inches.

The tubes have been worked successfully in tuned radio frequency amplification at around 6 meters, where t.r.f. hitherto had not been possible, except with very special tubes rather experimental in nature. The new tubes will be much smaller than the ones now used in broadcast sets, and the capacity between the elements will be a small fraction of that existing in present tubes. Nevertheless, the mutual conductance and amplification factor will be high, and the per-stage gain at around 100 centimeters, in a t.r.f. system, would be around 4, although perhaps only one t.r.f. stage would be practical for the present. At the lower frequencies, around 50 megacycles (6 meters), two stages could be worked, perhaps more.

The triodes are used principally as oscillators and the screen grid tubes as amplifiers and detectors. The triode at 120 volts on the plate draws 3 milliamperes in a 30-centimeter oscillator.

Dr. Vladimir Zworykin's electrical scanning system will use such tubes as adjuncts for amplification, and possibly oscillation.

Radio University

A ***QUESTION and Answer Department. Only questions from Radio University members are answered. Such membership is obtained by sending subscription order direct to RADIO WORLD for one year (52 issues) at $6, without any other premium.***

RADIO WORLD, 145 WEST 45th STREET, NEW YORK, N. Y.

Ohm's Law

WILL YOU GIVE, once more, a concise statement of Ohm's law for direct current? I would like to have this before me in brief form. I am a schoolboy.—E. L.

Ohm's law relates current, voltage and resistance. The current in amperes is equal to the voltage in volts divided by the resistance in ohms. The voltage in volts equals the resistance in ohms multiplied by the current in amperes. The resistance in ohms equals the voltage in volts divided by the current in amperes. Where fractional values are treated it is usual to express them in their decimal forms, that is, one-tenth ampere would be 0.1 ampere, and one one-thousandth of an ampere as 0.0001 ampere. One of the first things one should learn about electricity is Ohm's law for direct currents. If you will work out a few examples you will soon become familiar with the three forms of the law and then will need no printed reminder.

* * *

Where to Put Volume Control

IS THERE any decided advantage in one form of volume control as against another? I have been used to putting the control ahead of the detector, but I find more and more circuits have the control in the audio amplifier.—P. O.

The type of volume control and its placement will depend considerably on receiver design. Thus, if the detector (or second detector in superheterodynes) is fully protected from danger of overload, it is permissible to put the control in the audio channel, although this should be done in a manner not to constitute change in volume a control of tone as well. One advantage of such location is the avoidance of detuning effects, otherwise inevitably present. However, in a superheterodyne these would not be serious in the intermediate amplifier. Grid bias variants have shown detuning to as much as 20 kc for the controlled circuit near the high frequency end of the broadcast band. Theoretically at least, the volume control should be a gain control and an input control, because the amount of gain should be cut down to reduce the noise, and the amount of signal input cut down to prevent cross-modulation and overloads of other types. So compound controls are sometimes used. There is no altogether satisfactory volume control, so far as we know, and most engineers must feel mildly stumped when they come to the control feature. Perhaps the day will come when constant output tubes will be developed, so that one may make a permanent setting, and the volume will come up to that in nearly all instances, at least will not exceed the predetermined value. A close approximation to this could be made with the present duo-diode tubes, using the rectifier for auxiliary biasing of each tube (automatic volume control), and the amplifier section (whether triode, quadrode or pentode) for gain. However, the circuit would be awkward, and no doubt the constant output tube will see the light of day some time.

* * *

Radio and Electricity

DO YOU BELIEVE that radio has made any vitally important addition to the knowledge of electricity, and is that knowledge in a definite form now?—T. H.

Radio can not be said to have contributed anything vital to the fundamental knowledge of electricity, as the electron theory, that lifted knowledge of electricity from a hazy plane to one of sense and nuderstanding, was known long before radio became practical. At present other aspects of electricity are yielding to human research, and we know the electron, positron, neutron and, according to Compton, may expect some new divisibility. Knowledge of electricity is still in a formative state, though much advanced over that of half a century ago, when pupils were taught that electricity was a fluid, because it flowed through a circuit. Now we know that electricity is the phenomenon of electron action, and that the electron, or negative particle, is in a state of orbital motion. Thus the old idea of flow of electricity is supplanted by the realization of the bombardment of atoms and the drift of electrons. These electrons are agitated by electromotive force, i.e., voltage, and the intensity of the bombardment, the constitution of the mass, and other considerations, affect the net drift. The electron theory can not be regarded as a theory any more. Radio is a branch of physics, as is electricity, but physical branches intertwine so much that demarcation is not so easy. Radio's great contribution may be regarded as one toward the means of using electricity, rather than vital contribution to the understanding of electricity. The phenomenon of tuning was derived exclusively from radio, though now used in various branches of electrical work. The vacuum tube still remains the supreme radio contribution to electrical use. These matters are largely ones of opinion, hence debatable.

* * *

Wire for Short Waves

FOR SHORT-WAVE wiring, is it desirable to use extra-heavy wire for grid and plate leads, rather than thinner wire? Is it a fact that losses should be kept as low as possible, despite regeneration?—T. H. D.

It is not necessary to use awkwardly thick wire for the leads you mention. No. 18 or equivalent is sufficient. Especially is this true since the coils themselves hardly would be wound of coarser wire. It is assumed that you refer to frequencies no higher than 30 megacycles. For ultra frequencies thicker wire should be used, say, No. 14, 12, or even ⅜-inch diameter hollow copper tubing. The circuit losses should be kept as low as possible, and regeneration should not be relied on to come to the rescue, because, strangely enough, the results are better with a low-loss circuit, using regeneration, than with the other type, where regeneration is also included. This does not seem consistent, since regeneration may be expressed as a state of negative resistance, and it would seem therefore that all r-f resistance has been overcome. Another consideration is that in short-wave reception the frequency range to be covered is enormously wide, and the so-called regenerative circuit may become non-regenerative at the higher frequencies unless due precaution is taken to constitute the circuit losses as low as practical. As a general rule, the simplest regenerative circuits work best, and that means circuits with the fewest parts and most sensible layout. A great deal more depends on the layout than most short-wave enthusiasts realize.

* * *

Directional Aerial?

I HAVE a roof aerial, about 10 feet above the tin, and it is 40 feet long. Also I live on the second floor of a six-story house in New York City, so the lead-in, straight up and down, is 36 feet, and the horizontal portion, from window to set, is three feet. Is this aerial essentially directional, since it points in a certain directon on the roof? The lead-in is taken from the high end (the aerial slants about 20 degrees, and the 10-foot height is the lowest point).—M. H.

The aerial is not essentially directional, particularly as the principal component of the aerial is the downlead, which picks up more than does the horizontal portion on the roof. Vertical antennas are not directional.

* * *

The 6A7 Tube

PLEASE give me some directions for use of the 6A7 pentagrid tube in an automobile receiver.—I. D.

This tube has the usual 6.3-volt heater, uses a seven-hole socket, and is connected as is its a-c counterpart for 2.5 volts, the 2A7. The overhead grid should be biased minus 3 volts. This is the modulator control grid, numerically 4. Up to 250 volts may be used on the plate and 100 volts on the screen. The plate resistance is very high, 0.3 meg., and therefore if an intermediate frequency transformer is used that has only one winding tuned, that winding preferably should be in the plate circuit of the modulator.

* * *

Wants Infallible Remedies

MY SET hums too much. There are a 30-henry choke in the B filter and two 8 mfd. at each end. Also, when the set is turned on the wet electrolytic condensers make a boiling sound. This disappears as soon as the signal is audible. The set fades on distant stations. There is some squealing at the high frequency end. Please give me unfailing correctives.—A. W.

The hum may be reduced by putting 8 mfd. more next to the rectifier. The B voltage at the output will go up a little also. The electrolytic condensers "boil" because the voltage is too high at the start. You probably have a heater type output tube (or two such tubes), so the B current does not drain the rectifier at once, only after the heaters have warmed up. Put a bleeder reistor from rectifier filament to B minus, around 15,000 ohms, 15 watts. Then the B current will be large at the start, consequent B voltage lower, and condensers won't "boil." Fading on distant stations is to be expected, and automatic volume control would not be a complete cure by any means. Squealing can be corrected by using parallel resistance in tuned circuits, thousands of ohms, or series resistance, tens of ohms. Infallibility is easy to ask but hard to achieve.

A THOUGHT FOR THE WEEK

MONTAGUE GLASS, of Potash and Perlmutter fame, has joined the literary folk of the air. He will be in good company, for he follows Booth Tarkington, Octavus Roy Cohen and Zona Gale, who already have been able to prove that there is room and opportunity at the microphone for our distinctly American writers. Mr. Glass has made a fortune from his Potash and Perlmutter stories and plays. At one time these two characters were outstanding on our stage and in our periodicals and there is no reason why Abe and Mawruss should not come to life again through the medium of radio. They are first cousins of the Goldbergs, albeit they are low comedy types and their philosophy is boisterous rather than deep throated—but their humanity is easily understood by all races.

Station Sparks

By Alice Remsen

The Recipe

FOR LITTLE JACK LITTLE, WABC

9:00 *a. m.—Monday, Tuesday, Wednesday, Thursday and Friday.*

A little bit of laughter, a great big pinch of fun;
A cheery smile to keep the blues away.
A pint or two of happiness, a pound or two of sun,
And quite a bit of appetite for play.
A little sense of humor; sincerity, of course;
Three drops of kindness, just to make it jell;
A grain or two of wisdom, an ounce or two of force,
A touch of personality as well.
A measure full of harmony, a tune to make it sweet;
A charming voice to sing a lyric gay;
Mix well into the microphone, turn on a little heat,
And cook for fifteen minutes every day.
—A. R.

THERE IS THE RECIPE, or so it seems to me, of Little Jack Little's fifteen minute programs, which charm the listeners of the WABC-Columbia network. If you have never heard Little Jack, you've missed a treat. Tune in some morning!

* * *

The Radio Rialto

ALONG THE LINE

Let's take a stroll down the Radio Rialto. . . . Ran into Grace Donaldson, of the Don Hall Trio this week; she informs me that this pleasant little act opens on a new series very shortly; a commercial program, fifteen minutes three times weekly, sponsored by Molay, which is, I believe a shaving cream. Station and time are not yet decided upon at this writing; will let you know that later. . . . Grace also informed me that Otis Maddox, who made such a hit in the Middle West, over WLW, with his hill-billy songs, is in town, making records for Victor. . . . Popped into the Santly Brothers, to get a copy of their new publication, "Under a Blanket of Blue," and met up with that cute little trick, Peggy Healy, who chants the vocal choruses with Paul Whiteman; she's a pint-sized child, with a most intriguing smile, and a way of wrinkling up her nose like a friendly puppy; very sweet. Did you hear her with the great Paul on that two-hour Kraft Cheese broadcast over WEAF, on which Al Jolson did his stuff, and Deems Taylor prated of music and such? . . . Louis Conrad happened in before I left, and we reminisced of the time when he and I warbled together over WJZ on the Matinee Gems program; Louis expects to have his own band again soon; in the meantime he is singing with the Meyer Davis outfit at the Hotel St. Regis. . . .

RUDY VALLEE OF THE N. V. A.

Cannot resist telling you that I had the very great pleasure of proposing the one and only Rudy Vallee for membership in the National Variety Artists, Inc.; the organization is very proud of the fact that Mr. Vallee has joined us, and continues to extend a cordial invitation to all radio artists. . . . My dear pal, Ivy Scott, joined last week, as did Uncle Don Carney a couple of weeks ago. Get aboard children; we need every one of you. . . . Do you remember Hilda Clifton, who played piano for me over WEAF a few years ago? Well, the indefatigable Hilda is conducting an orchestra this season at one of those swell resorts up in the Catskills; what a clever girl she is; plays piano and organ like nobody's business, makes swell arrangements, writes original stuff and, what's more, she can cook! . . . Ann Brae, who has done lots of radio work on all the prominent metropolitan stations, has teamed up with that swell singer and pianist, Rae Zelda. The two girls, who bill themselves as "The Jingle Belles in Rhyme and Rhythm," may be heard every Wednesday at 10:15 a.m. on WOR, in a clever program of harmony and pattern. . . .

AT THE GOOD OLD NBC

On a recent morning, bright and early, I hied me to Studio D, at the NBC. There I rehearsed with Dave Grupp and his boys for the Morning Parade, a network program, under the direction of the tall and slender Harold Hackett. It was an enjoyable experience, for I met up with many of my old friends. Was surprised to find Edythe Handman on the bill, teamed up with a chap named Freddie Farber. They make an excellent combination, doing harmony, comedy patter, piano and guitar. . . . Then there was George Bennett, who possesses a warm and resilient baritone voice; he did some work with Berna Deane, soprano, one of the prettiest girls I've seen in a long time. . . . A funny incident happened during the course of the program. A colored lad, named Joshua, did a couple of songs, accompanying himself on the guitar. He eased up to the microphone, placed his foot on a chair and started; his foot tapped out the tempo, the chair wiggled and wiggled closer and closer to the microphone, imperilling the equilibrium of that sacred piece of mechanism; every once in a while Ben Grauer, the announcer, would dart forward and rescue the chair, but Joshua still tapped, and the chair still wiggled, and the noise of the tapping still penetrated above his singing. Ben tried holding Joshua's foot still, but it was no good. After the program was over Joshua mourned, "Dawgone it, Mr. Grauer, when you hol' mah foot I jes can't play!" . . . So many people have written and told me how much they like the Casa Loma Orchestra playing from the Glen Island Casino. I like it myself; think it's one of the most pleasing dance orchestras on the air; the special arrangements of popular tunes are particularly intriguing. . . .

WHEN AND WHERE

Yes, Rubinoff was born in Russia. Grodna is the specific place. . . . Rudy Vallee's birthday is July 28th, and he was born in 1901. . . . The Phantom Gypsy is Lou Raderman. . . . Jerry Kilgore, NBC announcer at KFI, San Francisco, was born in Toronto, Canada. . . . Madge Tucker, the Lady Next Door, was born in Centralia, Ill., and attended schools in St. Louis and Chicago. . . . Oliver Smith, NBC's Painter of Songs, was born in Flucom, Mo., in 1896. . . . Nick Nichols, sketcher of movie stars, and the idol of youngsters who draw cartoons on nursery walls, is very popular with the young listeners of WJJD, Chicago . . . Billy Sunshine, one-man entertainer at WJJD, handles a mean paddle and wrested the ping-pong championship from Bubb Pickard in three sets. . . .

You may now hear a new series of summer programs on WABC, featuring "The Road Reporter," under the sponsorship of the Shell Eastern Petroleum Products, Inc., of New York City. This program will be presented over the Eastern chain of WABC-Columbia network. "The Road Reporter" will chat about places and events of interest to motorists and travelers, introducing dramatizations of thrilling stories from real life. Tuesday and Thursday evenings from 7.30 to 7.45 EDST. . . . Stoopnagle and Budd just love to work, so they will spend their vacation making a personal-appearance tour. . . . Vera Van, a new song personality from California, has been signed by Columbia for a series of sustaining programs. She may be heard on Saturday at 8.15 p.m., Sundays at 5.45 p.m., and Thursdays at 8.45 p.m. . . . David Ross will spend the summer in a secluded spot in Connecticut; he will commute to New York for his Old Gold and Poet's Gold programs. . . . Burns and Allen are on their way to the Coast to make another picture, stopping off here and there to make personal appearances. . . . Ted Husing, Columbia's ace sports-announcer, has begun a new series of sports comment program, heard over the WABC-Columbia network each Monday at 6.45 p.m., under the title of "Sportraits." Rather a nifty title, what! . . .

3 A WEEK FOR MILDRED BAILEY

Mildred Bailey has an augmented schedule, which I think the portly songstress deserves; instead of two-a-week, she'll now be heard on a three-a-week basis. Mondays, Wednesdays and Fridays, at 7.00 p.m., which is a star spot. She will be supported as usual by Freddie Rich's Orchestra and the Four Eton Boys. . . . Jane Froman and Howard Marsh will be co-starred on a new series of twice-weekly broadcasts over the Columbia network under the sponsorship of the Frigidaire Corporation. The first program will be heard from 10.30 to 10.45 p.m. EDST, Friday, July 14th. Subsequent programs will be broadcast on Wednesdays and Fridays at the same time. . . . And now I think it's time to call it a day, drink a nice ice cold bottle of—well, what do you think?

DIRECTED SHORT WAVES

The first of six radio programs, specially prepared for reception in South America, was put on the air by the Columbia Broadcasting System and transmitted to the Argentine and Brazil by the short-wave facilities of the Radio Corporation of America. The first program, arranged by CBS in conjunction with the Pan-American Society, was heard from 9:15 to 9:45 p.m., E.D.S.T., June 24th, with the United States Marine Band as the entertainment feature. Announcements, heard only at the opening and closing of the program, were given in English on the Columbia network in the United States, with simultaneous announcements in Spanish transmitted over the short-wave unit to South America. The broadcast was directed to the Argentine. The July 1st broadcast will be directed to Brazil, and subsequent programs to both countries simultaneously.

BALL GAME ON AIR THURSDAY

Baseball's "game of the century," in which a team of National League stars will battle an all-star American League team, will be described over the WABC-Columbia network Thursday, July 6th, beginning at 2:00 p.m., E.D.S.T., with Pat Flanagan and Johnny O'Hara, Chicago sports announcers, alternating at the microphone. The "Game of the Century" will be played in Chicago as organized baseball's contribution to A Century of Progress, and proceeds of the game will go to retired players of both leagues who are in need of financial assistance. The broadcast over Columbia will be sponsored by the Prima Brewing Company of Chicago, but since it is a charity event, the network will turn over to the retired diamond men all but the actual cost of making the pick-up. The line-ups of the two all-star teams will be based on the votes of newspaper readers in a country-wide poll.

TRADE UNITES FOR SALES BY DUAL PROGRAM

A highly organized campaign to find a new prosperity for the radio industry will be staged this Summer and Fall under the leadership and stimulus of Radio Manufacturers Association, Inc. It will consist of two parts: an intensive sales drive during the month of September, and a week of special broadcasting from October 2d to 7th, which will be known as Radio Progress Week. The organizing of the industry for cooperation in this program will begin immediately.

Earl Whitehorne, of New York, has been engaged as director of the Radio Prosperity Campaign and Radio Progress Week. The major features of the plan as detailed by Mr. Whitehorne follow:

"The radio industry, of course, has been bowed down with hard times. Sales curves disappeared in the cellar, cut-price competition destroyed profits, dealers became disheartened and public interest in the radio reached a low ebb; but the business tide is turned; general prices are rising, and public gloom is changing to confidence and optimism. Men and women are now talking about the things they want to buy, and the spending will start soon. It is this reawakening market that this campaign is to capitalize.

Many Still Unsold

"There are now approximately 6,750,000 homes using radio sets that are obsolete, and 13,000,000 homes that have no radio at all, but the radio industry cannot expect to sit back and let the returning prosperity pour new business into its lap. For every other industry is going to be out after these same dollars from the family budget. Automobiles, refrigerators, travel, clothes, and other strong personal appeals will be scrambling for attention, and John and Mary are going to buy first the thing that they have come to desire the most.

"So the radio industry is entering a season of better business with an intense competition to fight, and it is not a competition between radio manufacturers or radio distributors or dealers as in the past four years of sweat and tears. It will now be a competition with other industries that will be out energetically selling the home market. Therefore the radio industry must organize to throw its united strength into the market place, first and strongest, so that radio will be the thing that John and Mary will buy.

Owners to Be Canvassed

"The Radio Prosperity Campaign will have two objectives. First, to canvass every radio owner and put his set into condition, by installing new tubes, parts or accessories, or to replace it with a new set. Second, to convass all prospects for new receivers. Through July local committees will be organized in all cities, so that manufacturers, distributors, dealers and service men will be prepared and ready to play their part in the concerted sales drive through the month of September. The cooperation of all branches of industry in all communities will be sought, and since every manufacturer, distributor and dealer has his eye in this awakening market and plans to do his utmost anyway to increase his sales, the RMA is confident that the industry will respond enthusiastically to secure the benefit that will come from massing the strength of the industry."

TRADIOGRAMS

By J. Murray Barron

It would not necessarily follow that all advertised products are superior to non-advertised ones. What is generally called advertising covers mostly publications, newspapers, billboards and radio broadcasts. However, constantly to keep one's name before the public through advertising requires public approval, and this in turn can only be achieved through merit. Therefore it follows that it is generally safer to buy nationally advertised goods. It seems the bigger the organization the more readily it appreciates the great value of advertising and the keeping of its name before the public. Possibly that may be one reason for the bigness.

* * *

One of the latest innovations in the retail radio stores is the testing outfit that has been installed at Thor's Radio Store, at 167 Greenwich Street, New York City. It is now possible to have even the latest tubes thoroughly tested. This outfit is the only one of its kind now in downtown New York.

* * *

RCA Victor Co., Inc., is wide awake to the great possibilities of the summer business and is breaking into a special summer campaign to aid the dealer, featuring three specials, the RCA-Victor auto radio, the five-tube superheterodyne and the combination radio-phonograph.

* * *

In the New York metropolitan section nightly good catches are reported on DX reception. This covers not only the United States, but other points on this continent and includes the broadcast band. However, there are also records during the earlier hours of foreign short-wave reception. Folk one might not suspect of being real fans are often deeply interested and they do considerable experimenting to improve their receivers and conditions over which they have control. To those who take noises and peculiar conditions for granted, it might be well to look more deeply into the matter, for a little attention here and there may repay the trouble in added reception. The local radio retail storekeeper should not attempt to take it for granted that certain types of customers would not be interested in short-wave reception, as many big business men are ardent short-wave fans.

* * *

E. F. Johnson Co., Waseca, Minn., manufacturers of radio transmitting equipment, is now represented in New York City by Howard F. Smith, 142 Liberty Street. This line includes tube sockets, feeders, spreaders, antenna insulators and stand-off insulators. Those out of town may address the company direct.

* * *

The Fanning Radio Labs., 377 Eighty-seventh Street, Brooklyn, N. Y., have in preparation a limited edition of an attractive and interesting bulletin on short-wave kits, receivers, ac-dc sets and also the new manual by Don Wallace, the winner of the Hoover Cup.

* * *

Universal Microphone Co., Inglewood, Cal., announces it has gone into production of its new hearing aid device, which will be marketed solely through radio channels, including service outlets. These new Universal devices have been created primarily for home and office use.

* * *

Drake Mfg. Co., 452 North Ashland Avenue, Chicago, has an attractive and solidly-constructed jewel light assembly. This may be used for many purposes in radio: receivers, amplifiers, remote control, etc. Those desiring more information may write direct.

COUNSEL OF RMA QUESTIONS LAW

Chicago.

Revolutionary changes now faced in industrial competition were pointed out to Radio Manufacturers' Association members at their annual convention, by John W. Van Allen, of Buffalo, N. Y., general counsel of the association.

Government control of industry is to be substituted for the anti-trust laws and involves many sweeping and fundamental problems and changed conditions, Mr. Van Allen said. He added:

"Whether we have arrived at the period when we must be governed in all respects by the government itself, or whether people shall continue to govern as they have done in the past, or whether the departure upon which it is proposed we embark, is a manifestation of the way in which people desire to govern by extended powers to officers of the federal government, is a question fraught with the deepest significance."

Mr. Van Allen said that he looked with "great apprehension on the plan to license private business" and continue it only "by favor of a politically-minded public official."

NEW OHMITE BULLETIN

The Ohmite Mfg. Co., 636 North Albany Avenue, Chicago, Ill., has issued a new eight-page Ohmite resistor and rheostat bulletin that is free.

Literature Wanted

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

Earl T. Reaves, R.F.D. No. 5, Box 412, Watsonville. Calif.
Irving Anderson, Jr., Box 1027, Wallace, Idaho
Radio House, 131 Manchester St., Christchurch, New ealand
L. F. Rodgers, P. O. Box 154, GooseCreek, Texas
F. D. Enwright, 43 High St., Manchester, N. H.
John McNulty, 54 O'Connor St., Wellsville, N. Y.
W. B. Johnson, 1309 E. 31st St., Savannah, Ga.
F. W. Foust, Radio Sales Service, Ashtabula, Ohio
George Oldenbittle, 2954 School St., Chicago, Ill.
Paul C. McDaniel, Faucett, Mo.
E. W. Nelson, 81 Hereford, Hartwell, Cincinnati, Ohio
Max Stamm, 1527 Louden St., Philadelphia, Pa.
Edmund J. Ryan, Franklin Park, Mass.
Harry Tice, 23 Oak St., Newburgh, N. Y.
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Serge Krauss, 906 Lumbard St., Napoleon, Ohio
A. B. Rice, Tekamah, Nebr.
Jos. Belick, Box 133, 63 Front St., Coplay, Penna.
N. Peterson, P. O. Box 182, Riverside, Calif.
J. M. Kaar, 125 Princeton Road, Menlo Park, Calif.
M. Stakan, Y.M.C.A., Lincoln, Nebr.
Charles J. O'Gara, 674 Wulnut St., Fall River, Mass.
Chas. M. Showalter, Jr., 332 Lawrence St., Sandusky, Ohio.
Fred E. Rebhun, 1002 Fairmount Ave., Tarentum, Pa.
W. Grundman, 384 Richelieu, Quebec City, Canada.
Henry E. Greer, San Rafael, Calif.
C. C. Clayton, 310 State Line Ave., Texarkana, Ark.
Geo. L. Heyer, Arcade Radio Shop, 1310 First Ave., Seattle, Wash.
Hector Graham, 2903 Floyd Ave., Richmond, Va.
Glenn Neely, Dolgeville, N. Y.
Wm. C. Gruner, Dri-Kap Mfg. Co., 1315 So. Michigan Ave., Chicago, Ill.
Paul J. Jachim, 3941 Wellington Ave., Chicago, Ill.
Clarence Harris, R. R. A. Camby, Ind.
A. J. Young, Bluefield, W. Va.
H. W. Hendricks, Columbus Junction, R. 2, Iowa.
O. W. Wendelburgh, care The Union Trust Co., Cleveland, Ohio.
A. R. Lebsack, Otis, Kans.
H. Walter Witt, care Linz Bros., Dallas, Tex.
E. H. Oliver, P. O. Box No. 178, Vinton, Va.
George J. Hucks, 1289 Church St., San Francisco, Calif.
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Super Diamond parts in stock.

FOUR-TUBE MODEL

The four-tube model is similar, except that there is one stage of t-r-f, and a two-gang condenser is used. Tubes required, one 58, one 57, one 47 and one '80. Complete kit, including 8" Rola dynamic speaker (less tubes, less cabinet). Cat. D4CK $13.58

Kit of four Eveready-Raytheon tubes for this circiut. Cat. 4D.TK $3.89

FOUNDATION UNIT, consisting of drilled metal plated subpanel 13¾ x 2½ x 7"; two-gang 0.00035 mfd. SFL condenser; full shield; two shields for 58-57; center-tapped 200-turn honeycomb coil; five sockets (one for speaker plug); two 8 mfd. electrolytics; set of two shielded coils; 20-100 mmfd. Hammarlund equalizer for antenna series condenser. Cat. D4FU $5.48

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[If dial is desired for other circuits state whether condenser closes to the left or to the right.]

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