1932

MODERN RADIO

EDITED BY ROBERT S. KRUSE

CONTENTS

October Number 16 20 cents

Use these **NATIONAL** Parts

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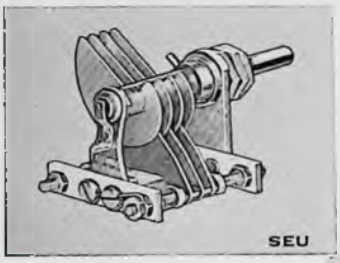
When you build a short-wave receiver or transmitter—get the maximum efficiency and performance with these NATIONAL parts, designed for short-wave use. NATIONAL Company, pioneer in the radio field and in the manufacture of electrical apparatus since 1914, has developed a full line of parts for ultra short-wave use in its Research Laboratories. Some of these are shown below. The full NATIONAL Company line of the famous Velvet Vernier Dials, Variable Condensers for Receiving and Transmitting Use, Transformers—RF, Audio and Power, Tube Shields, SW-58 and SW-3 Short-Wave Receivers, NC-5 Short-Wave Converter, Ultra High Frequency Receiver HFR (5 meters), Ultra High Frequency Converter HFC, Communications Type Receivers AGS and 58C, MB-32 DeLuxe Broadcast Tuner, Speaker Amplifier and Power Supplies, are all shown in the new NATIONAL 16-page Bulletin No. 200, sent free on receipt of coupon below.



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For short-wave work only. Heavy double-spaced, rounded edge 270° plates, insulated front bearing, constant low impedance pigtail, Isolantite insulation, single hole panel or base mounting. Any capacity up to 25 mmf. For ultra short-wave tuning or neutralizing in low power transmitters.

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NATIONAL SOCKETS

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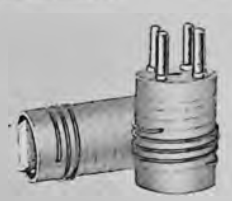
A 4" solid German-silver precision dial with the original and matchless Velvet Vernier mechanism and a real vernier permitting accurate reading to 1/10 division. Has 3-point attachment for easy and accurate mounting.



R-39 COIL FORMS

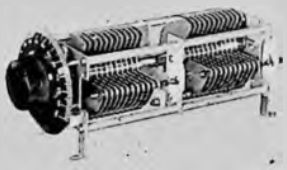
MIDGET R-39 COIL FORMS

Made of improved R-39, low-loss ultra HF material. Have best form factor for ultra S-W work and lowest power-factor, insure stability, maintain calibration. Also available in larger size with either 4, 5 or 6-prong for regular short-wave use.

#100 R. F. CHOKE

TYPE TMP
Transmitting Condenser

Split-stator type, for medium power push-pull transmitters. Fine for 5-meter work — give extremely accurate balance between both sides of tank coil. Heavy polished plates, rounded edges, self-aligning conical bearings, rigid frame construction, 3000 and 6000 volts.



T M P

COUPON

National Co., Inc.,
61 Sherman Street,
Malden, Mass.

Please send me your new Bulletin No. 200, giving full particulars and prices of NATIONAL Short-Wave and other parts and apparatus. (Write your name and address in margin below and mail today.)

MR-9-32

Reception of Television Images in an Airplane

By Harry R. Lubcke*

Fig. 1. The author before the receiver in the plane.

In order to test a newly developed self-synchronized receiver under conditions much less favorable than met in practice, it was taken aloft in an airplane and the reception of images attempted. In spite of rapidly changing field strength, varying airplane power source residual electrical interference and irregular mechanical shock, recognizable images were repeatedly received and proper synchronization maintained.

The receiver is shown as it was installed in the airplane in Figure 1. Besides the cathode-ray tube, which can be seen at the top center, it comprises of a 6¾ meters (44,500 kc) receiver, a low frequency source, a high frequency source, a power unit and a selecting amplifier. It is entirely 110-volt a.c. operated. The selecting amplifier functions to supply the high and low frequency scanning sources with synchronizing pulses derived from the incoming signal, thus providing synchronization regardless of the power network on which the receiver operates. It was this feature that made reception in an airplane possible.

A 10-passenger, tri-motored Fokker airplane of the Western Air Express was used for the flights. The mail compartment was used to house a 200 watt, 24-volt d.c. to 115-volt a.c. dynamotor to provide alternating current power for the receiver, rather than to rebuild it for battery operation. The electrical system of the plane included a 12-volt, 60 a.h. storage battery and a 50 ampere generator driven by the center motor, to which another 12-volt battery was added to give the required 24 volts.

The regular ultra-high frequency television transmitter of the Don Lee Broadcasting System, W6XAO, Figure 2, was used to transmit the images. This station is located in the Don Lee Building in metropolitan Los Angeles, and has been transmitting television images of 80 lines repeated 15 times per second on

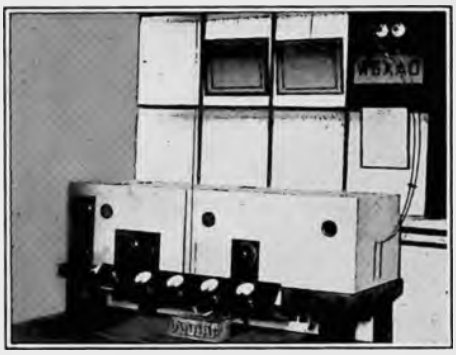


Fig. 2. W6XAO, 6¾ meters, 150 watt, 80 lines, 15 pictures per second. The 3-phase rectifier supplying 2,750 volt d.c. is not shown.

a nightly schedule since December 23, 1931. It operates on the ultra-high frequency of 44,500 kilocycles with a power of 150 watts. One hundred per cent. modulation is obtained. The modulated radio frequency energy is carried to the roof of the building by a two wire feeder, one termination of which is shown in the photograph.

Preliminary Tests

Some time before the final flights were scheduled a test flight was made to determine the distribution of the field

* Director of Television, Don Lee Broadcasting System, Los Angeles, Calif.

strength over the country. A portable battery-operated 44,500 kc. receiver was used with a portable cathode-ray oscilloscope to obtain this data. The results of this work are shown in Figure 3, in the form of a field strength contour map for an elevation of 3,000 feet. The figures on the contour lines give the signal strength measured in volts output of the portable receiver. The field strength in microvolts per meter is approximately four times the figures given. With the conditions existing above the city indicated by the test flight, the alternating current cabinet receiver was checked and taken out to the airport for installation in the plane. Two front seats in the cabin were removed and it was installed as shown in the photograph. The windows were darkened with black cloth, and the dynamotor and auxiliary battery were installed in the mail compartment directly ahead of the cabin. This accomplished, the plane was wheeled out of the hangar, and into the clear, with respect to the direction of W6XAO, and the receiver was snapped on. After warming up, the signal of W6XAO was received; not with sufficient strength to give an image, but enough to give an aural signal which served to check the operation of the radio frequency receiver and associated equipment. With the blank field visible on the screen, giving evidence that the scanning sources were operating satisfactorily, we were ready for a flight.

The Test Flight

After gaining altitude, the receiver was snapped on, and after the tube warm-up period, an interference we had not experienced on the previous flight appeared on the screen. It took the form of bright dancing horizontal lines about an inch long. Notwithstanding, about a half minute later the image began to appear and soon came in with great intensity. It did not stay in, however, but faded continually over a great range of signal strengths. Although it was a fair day, occasional clouds cause the air to be very bumpy, and the plane rocked and dropped almost incessantly.

In the darkened plane, the constant bumping, the vibration, and the roar of the motors conspired to create a feeling of continual confusion, in which no receiver, television or otherwise, could be expected to operate. This did not affect the receiver in the least; nor did the variation of signal strength do much damage. After a few minutes' experience it was possible to keep a tolerably good image on the screen by adjusting the volume control on the receiver. The synchronization of the image was not greatly affected by the fading. Cruising around within ten miles of the station

Fig. 3. The W6XAO field at 3,000 foot elevation.

verified the field strength distribution, as determined several days previously, and showed ample signal for an image up to eight miles away. The charging generator was suspected as the source of interference, and when shut off the bright lines disappeared. This accomplished, the plane was brought down and we were ready for the reporters and photographers of the press.

The Demonstration

After a five to ten minute demonstration the first group of passengers was brought down and a second group taken up. On this flight a better image was secured through the expedient of setting the receiver controls and allowing the image to fade and return at will. Most satisfactory operation was observed, in

that the image repeatedly came back intact and in frame, signifying proper performance of the synchronizing system in spite of continual signal variations from zero to overload.

Check Tests

The following day, with the flights over, the receiver was operated at a location in a reinforced concrete building having a field strength corresponding to five miles away and 3,000 feet in the air. The image was clear, constant and steady; checking its previous operation at this location. It was possible to simulate the fading noted in the plane by varying the output of the radio frequency receiver, indicating that this behavior was a characteristic of flight. It is interesting to note that this location was in the building under the W6XAO antenna, but such that the waves had to penetrate six floors of reinforced concrete building to reach the receiver.

Several facts on the behavior of ultra-high frequency television waves were unearthed. The field strength map of Figure 3 shows a pattern similar to that obtained with a directional antenna pointed for maximum signal to the northeast. This was caused by an antenna stay wire of the broadcasting station KHJ occupying a position about one wavelength away from the W6XAO vertical-doublet. This wire, erected before ultra-high frequency television was thought of, was cut into short lengths by the insertion of insulators in approved fashion, but into lengths corresponding too closely to 6¾ meters, for any good purpose. The combination gave a maximum along the line passing through the two antennas in both directions; but, in this case a grounded steel tower intervened another wavelength away which absorbed the southwest maximum. This condition is scheduled for correction in the near future; although it is not entirely unfortunate, in that it directs a strong signal to the city of Pasadena.

Many previous ground tests had proved that both the earth and steel buildings cast shadows, the latter about half as effectively as the former for a given volume of material. The ordinary wood frame or stucco house does not present a shadow of any consequence, but they may give rise to standing waves when close to the transmitter because of their pipework. A hill, or a large steel building casts a definite shadow, but one which ceases at a sufficient distance behind it. Several typical cases show that the waves converge to give normal volume at a distance on the order of 60 wavelengths behind the furthest extremity of the obstacle, for the 6¾ meter waves.

In the airplane flight the effect of obstacles was almost entirely removed, of course, except for one very near obstacle, the plane itself. It is believed that this was a contributing factor to the rapidly changing field strength observed. The antenna being in the wing and extending from near one wing tip to the other; the metal containing motors, cabin, or tail were always between the antenna and the station, and constantly changing position with respect to it as the plane flew on its course, or was rocked or dropped by the bumpy air.

Another factor was the speed of the plane through the field strength pattern of the transmitter. Flying at a speed of 120 miles per hour, two miles were covered in a minute, and assuming a square law variation of signal strength with distance, the field strength experienced at a point two miles away from the transmitter was reduced to one-fourth its value a minute later at a distance of four miles.

The writer acknowledges, in concluding, the excellent cooperation of Western Air Express, Inc., through the personages of J. H. White, R. C. Fell, M. Bell, and Pilot Allen Barrie; and the loyal and effective work of F. M. Kennedy, J. G. Turner, T. H. Denton, and P. C. Tait of the W6XAO Don Lee Television staff.

READ IT OUT LOUD

An electron is about 1/10,000,000,000,000 of an inch across, and a current of one ampere, lasting for only a second represents about 6,000,000,000,000,000,000 electrons, each of which weighs about 9 / 10,000,000,000,000,000,000,000,000 of a gram.

Screen Grid & Pentode Bias-Type Detectors, Also Special Detectors

(FOR TRIODE DETECTORS SEE PAGE 2 OF THE POCKETBOOK)

(FOR GRIDLEAK DETECTION SEE NOTE BELOW)

Type	224, 224A	32	36	57	58‡	35‡	39‡	44‡	551‡	55 and 85 Diode-Triode See r.f. table for constants also Note 2 below.
Bias	—5	—6	—6	—6	—10	—7	—7	—7	—7	
Plate V.	250	135	135	250	250	250	180	90	250	
Plate Ma.	0.1 to 4.0*	0.2 up	0.1 up	0.1 up	.....	.....	.....	.....	.....	
Screen V.	20 to 45	67.5	67.5	100	100	90	90	90	90	
Load	¼ Meg.†	100,000	¼ meg.†	¼ meg.†	I.F.T.	I.F.T.	I.F.T.	I.F.T.	I.F.T.	
Suppressor	.....	.....	.....	to cathode	to cathode	.....	to cathode	to cathode	.....	

* First value correct for no signal, second for strong signal.

† Or 500 Hy. with ¼ meg. shunt.

‡ As first "detector" in superheterodyne with oscillator input of 1 volt less than the bias (peak value).

NOTE 1. Gridleak detection possible with any of these tubes except the 55, 85, and variable mu types. Use about ⅓ of the plate and screen voltage given in the R.F. table, no grid bias and a gridleak of ¼ to 5 megs. Grid condenser .0001 to .00025 for broadcast, .000050 to .0001 for short waves.

NOTE 2. The 55 and 85 have one cathode, two small plates, a grid and one large plate, and are used as second detectors in superheterodynes. A push-pull i.f. transformer feeds the two small plates A and B which, with the cathode, give full-wave rectification. The resulting mixture of d.c. and audio is passed through a load resistor and the resulting voltage is applied to the grid. The grid and the large plate then act as an audio amplifier. The resistor-voltage (which depends on the carrier level) can also be filtered and fed back to the r.f. stages for automatic volume control.

REAL TRANSMISSION NEWS

• • •

The claims of publicity men representing broadcasting stations show very clearly that in the 550-1,500 kc. region there exists a lack of appreciation of the transmission possibilities in this band—not to speak of any ability to predict performance in advance of construction.

The odd contrast between such a foggy condition and the relatively precise and complete information in the short-wave and long-wave regions led Mr. J. F. Byrne, Assistant Professor of Electrical Engineering at the Ohio State University to undertake a rather formidable

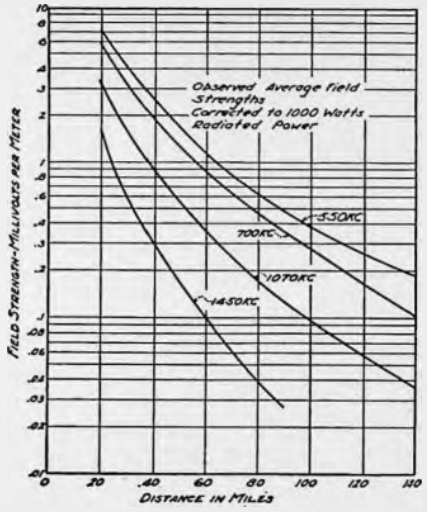


Fig. 1. A striking lesson to broadcast-station operators—and to the Federal Radio Commission. This picture will shift with soil conductivity and with absorbing obstructions, but always the 550 kc. curve will be far above the 1,450 kc. one—especially in returns-per-dollar.

program of measurements with a view to establishing something in the way of a definite basis for determining what powers and frequencies are needed to deliver a commercially satisfactory signal into the desired service area. The complete work appears as a bulletin, cited at the end of this abstract, but the purpose here is to review briefly the most interesting portions of Professor Byrne's work.

At the beginning a field-strength survey was made in and about Ohio, on nine stations scattered through the 550-1,500 kc. band. These field strengths were then reduced to a common basis of 1 kilowatt of RADIATED power. From this latter information it was possible to graph Figure 1, which should be studied prayerfully by station executives. It shows most of what ails our present method of channel assignments and must convince anyone that "—**the different frequencies in the broadcast band cannot be treated as equivalent, and that frequencies above 1,000 kc. are uneconomical for large coverage and high power.**"

It must be remembered that Figure 1 is purely a matter of measurement, not of theory; it was not taken from a for-

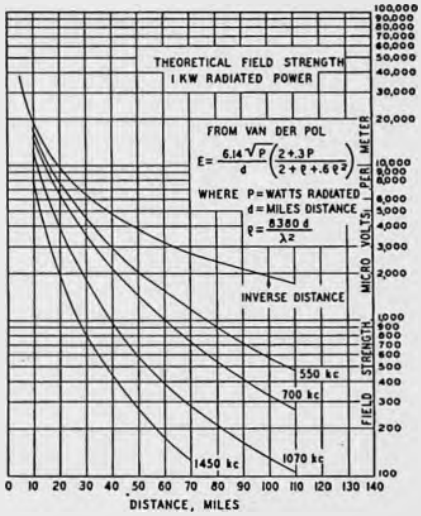


Fig. 2. Transmission as calculated by Sommerfeld's equation which appears on the chart. The equation takes the form shown when the soil conductivity is assumed to be 10-to-the-minus-thirteenth (in electrostatic units) and the antenna is assumed to be a perfect vertical quarter-wave antenna. For other soil conductivities the value of rho shown is corrected by multiplying by 10-to-the-minus-thirteenth (average Ohio value) and dividing by the conductivity measured in the region being tested. Special antennas, such as the KDKA antenna, which is designed to weaken the ground wave and strengthen the sky wave, cause further modification which can be allowed for from a knowledge of the antenna's characteristics.

mula but from the ether of Ohio. The words "of Ohio" are important—for the same chart does not apply directly to other regions. It is well known that the

resistance of the soil influences transmission. Obviously, therefore, a most valuable contribution would be made IF it were possible to discover how this chart must be modified to allow for varying soil conductivity. As a hopeful step in that direction, Professor Byrne has first made his chart in a region of tolerably uniform soil (northwestern Ohio) and secondly has tested its agreement with the Sommerfeld transmission theory in which soil conductivity appears as a factor. Figure 2 shows a graph somewhat like that of Figure 1, but based on calculation in accordance with the Sommerfeld equation which takes the form shown on the chart if the soil conductivity is assumed to be 10-to-the-minus-thirteenth e.s.u, remembering that the conductivity is the reciprocal of the resistivity and that the ordinary ohm $= 1/9 \times 10^{11}$ electrostatic resistance units. The fact that Figure 2 has a strong resemblance to Figure 1 encourages hope that one may be able to devise a scheme of performance-pre-

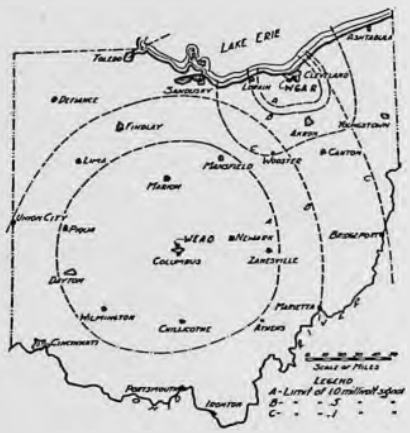


Fig. 3. A case in point. WEAO at 750 kc. and 500 watts as compared to WGAR with ⅔ the power, but the unfavorable frequency of 1,450 kc.

dictions based on one of these two charts plus a few soil-resistance measurements, which, of course, can be carried out vastly more cheaply than can any experiments based on temporary transmitting stations.

This job is not yet done, however. Figure 1 is a composite of transmissions in a number of directions, also the 1,450 kc. curves of the two figures differ materially, and one does not yet know which of several causes this is due to—hence predictions are not too safe. By way of clearing up this haziness more measurements are planned along one straight line, chosen so as to pass through an especially uniform region. While the field-strength measurement device is transported along this line the station will transmit at various frequencies from 550 kc. to 7,000 kc. so that very complete data for all frequencies of transmission along that straight line will exist. If the data so obtained will give a graph agreeing closely with the Sommerfeld equation (using the soil-conductivity factor for that region) one will be justified in believing that the prediction scheme outlined above will be quite usable—certainly a vast improvement on guesswork, and a considerable improvement on most of the schemes of prediction now available. For that matter, the Ohio observations, just as they stand, are in themselves a good advance and may well be used until the future work shows just what correction factors are to be used.

Certain precautions are, of course, to be kept in mind.

First of all, the curves relate to stations radiating 1,000 watts from a quarter-wave vertical antenna. As the wavelength is increased it becomes more costly to provide an antenna of that type, or any antenna of adequate size. This is an argument against the lower frequencies (longer waves) but a glance at a few of the tables will show that it is of small weight as compared to the staggering advantages of the 550 kc. end of the band.

Secondly, noises of a natural origin (so-called "static") are in general more severe at 550 kc. than at 1,500 kc. Thus at 60 miles the 550 kc. station lays down a signal TEN TIMES as strong as that of the 1,500 kc. station, but if the static is twice as bad at 550 kc., the advantage reduces to five times—for, after all, we are not interested so much in signal strength as in signal-noise ratio. If there were NO noise, almost any signal would answer.

PUTTING IT INTO DOLLARS PER SQUARE MILE OF SERVICE AREA

(Assuming $50,000 annual charge for 1 kw. transmitter)

ANNUAL CHARGES AND SERVICE AREAS FOR DIFFERENT SERVICE AREAS

Frequency	5 mv	2 mv	1 mv	0.5 mv	0.1 mv
550	$ 25.50	$ 7.85	$ 4.00	$ 2.06	$0.49
700	32.90	10.45	5.08	2.69	0.81
1070	70.50	23.60	10.60	5.88	1.70
1450	131.60	49.00	30.10	15.50	4.42

A COMPARISON OF TRANSMISSION EFFECTIVENESS

Minimum Field Strength in mv. at Edge of Service Area	Power at 550 kc.	Powe at 1,450 kc. to Produce Same Result
5	1 kilowatt	36 kilowatts
2	1 kilowatt	95 kilowatts
1	1 kilowatt	147 kilowatts
½	1 kilowatt	319 kilowatts
1/5	1 kilowatt	600 kilowatts

SERVICE AREAS COMPARED

SERVICE RADII FOR 1 KW. RADIATED POWER (MI.)

Frequency	5 mv	2 mv	1 mv	0.5 mv	0.1 mv
550	25	45	63	88	180
700	22	39	56	77	140
1070	15	26	37	52	97
1450	11	18	23	32	60

SERVICE AREAS FOR 1 KW. RADIATED POWER (SQ. MI.)

Frequency	5 mv	2 mv	1 mv	0.5 mv	0.1 mv
550	1960	6350	12500	24300	102000
700	1520	4780	9850	18600	61500
1070	710	2120	4300	8500	29500
1450	380	1020	1660	3220	11300

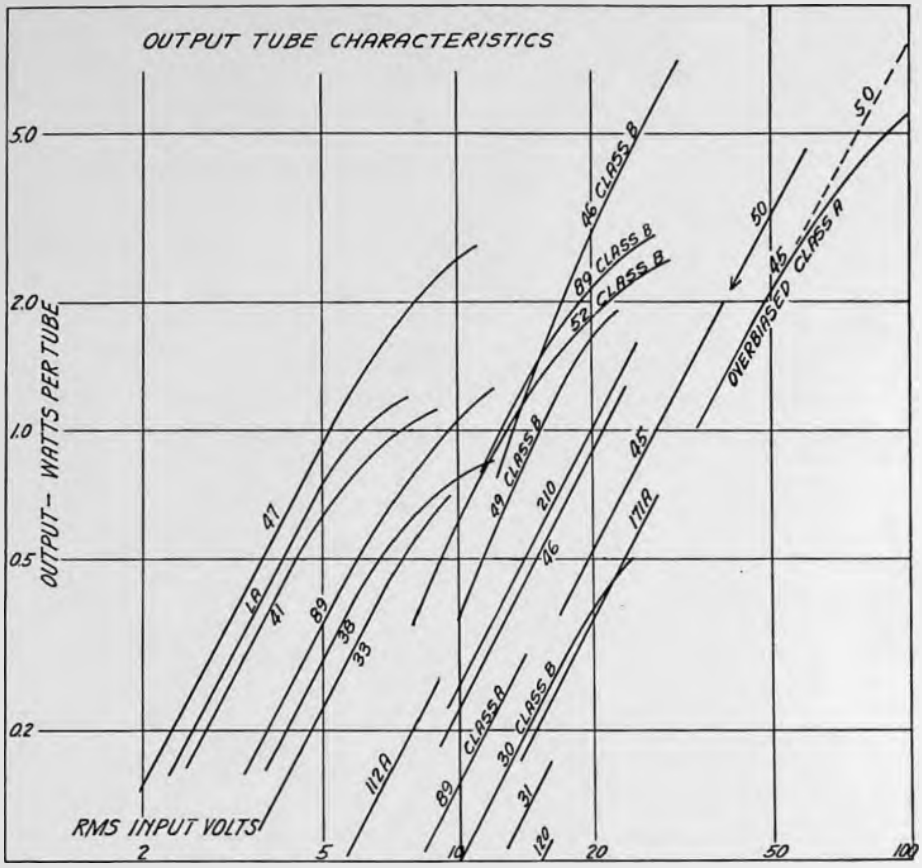
Again—the region of transmission must be considered. In cities, man-made electrical noise necessitates a field-strength of 2 millivolts per meter, (or even 10 millivolts per meter in business areas) where as in the country a mere ½ millivolt per meter will answer nicely.

Finally, the data are all as to daylight transmission, and while we are yet insufficiently informed as to broadcast-frequency fading, we do know that the tendency is for the fading to start nearer home for the higher frequencies—perhaps 25 miles at 1,500 kc. as opposed to two or three times that distance for the low-frequency edge of the broadcast band. This matter is now being studied systematically by various observers, but there is needed some static and noise study similar to that which has been done by commercial and government laboratories at shortwaves, and by the late Dr. L. W. Austin at long waves.

This can be but the merest outline of the subject. For a more complete, and very interesting, discussion the reader is referred to the original paper, which may be obtained from the Engineering Experiment Station, the Ohio State University, Columbus, Ohio. The price is 25 cents and the paper is entitled "Bulletin 71, Radio Transmission Characteristics of Ohio at Broadcast Frequencies". To this reviewer it seems that the survey of Ohio is somewhat of a by-product and the paper might well have been called, "An Engineering Basis for Broadcast-Channel Allocation". Not —of course—that this would materially change or improve matters under a governmental control scheme, which is so little interested in radio that it spends time in quizzing proposed candidates for the Federal Radio Commission on their political affiliations! So far we in this country have shown a boundless ability to put more things into politics—but a complete helplessness in again making them business matters.

R. S. K.

POWER TUBES AT A GLANCE



PERFORMANCE OF AUDIO OUTPUT TUBES WHEN OPERATING WITH MAXIMUM RATED VOLTAGE AND MOST FAVORABLE LOAD

By use of this chart one of several suitable stages for any loudspeaker or small radiophone transmitter may be chosen and the final exact choice made on the basis of cost, recalling that the curves show the best possibility for each tube and that other conditions will give lower, shorter or crookeder curves. For any sort of a push-pull pair figure 2 to 2.3 times the output shown.

The curves show the performance of single Class A tubes also single Class B tubes. The striking difference in the two sorts shows clearly why the Class B tubes cannot be used singly without excessive distortion. The "overbiased Class A" curve is also for one tube, which is seen to give good performance up to about 4 watts and then to curve off. A push-pull overbiased Class A pair would, therefore, go up to about 8 watts as detailed on page 18, "Modern Radio" for July.* A similar "Class A Prime" stage using the 50 tube gives a curve lying parallel to the Class A 50 curve on the chart and extending up to

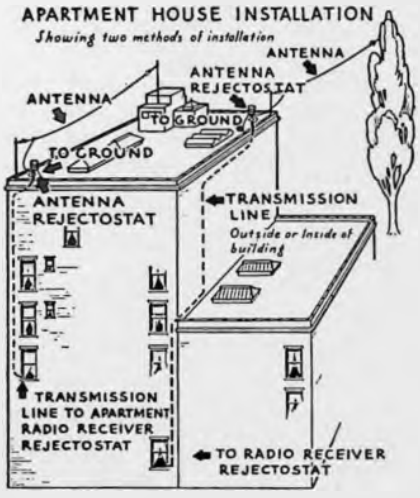
(Continued on next page.)

* Copies at 20 cents.

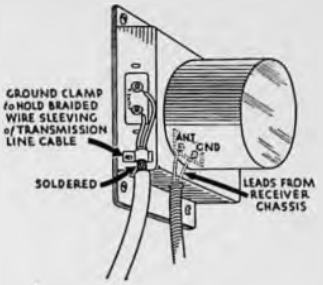
BACKING US UP

In our first issue we ran a story on "Anti-Noise Antennas", and sold every single copy. In the January issue we printed a revised story—and there isn't a copy left. Thus we know that there is a lot of interest in this anti-noise antenna matter and are reprinting the entire yarn, plus some new material, in "Modern Radio's" Pocket Book, which has just appeared.

Meanwhile a commercial form of the anti-noise antenna idea has appeared. It is due to Kolster Radio, Inc., of 67 Broad Street, New York, N. Y., and is called "Rejectostat". The catalogue says that it produces "98% Freedom from Man-Made Static". The promise seems over-optimistic since quiet reception is possible only when the antenna can be placed in a region of comparative freedom from man-made electrical disturbances—and such a place isn't always available. However, the Kolster device is correct in principle and if used intelligently must certainly result in improved reception. In this instance the transformers at both the antenna and the



receiver are of the primary-secondary type, rather than a single winding used as an auto-transformer. The transmission line is of the two-wire type, the wires being twisted together and surrounded by the shield which is grounded. This has some advantages over the use of a one-wire line in which the shield itself is used as a return path. The illustrations herewith explain the idea well enough. Included in the equipment are shields to place over the top of the screen-grid tubes to complete shielding against local noise-pickup at that point. Naturally this does no good in a cheap-John midget with exposed condensers



and grid leads—but we pray those things will soon pass out anyway. For the respectable receiver and the good serviceman the Kolster device is really something.

(Continued from Page 11.)

20 watts before curvature sets in, i.e., the same performance as a 46 Class B pair with slightly lower power-sensitivity and somewhat higher fidelity. Such a stage is described in "Modern Radio" for August.*

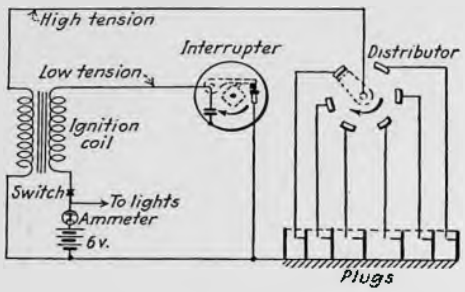
The farther a curve is to the right, the lower the "power-sensitivity" that is the more a.c. (audio) volts must be applied to its grid. In general "A prime" push-pull stages produce 2 or 3 times the output of Class A at about 80% the power sensitivity and (with proper design) equal purity, while Class B stages (push-pull) produce about up to 10 times the Class A output, but the driving power (a.c. grid input) required is increased to an extent ordinarily requiring another audio stage, as Class B tubes draw grid current whereas Class A do not and Class A prime draw but little.

The dashed curve showing the performance of a single "A prime" 50 tube has been added to a chart otherwise due to Dr. P. T. Weeks of Raytheon Production Corporation.

Curing Noises In Auto Radio*

By F. W. Schor

Check the entire ignition system of the car. This includes cleaning the spark plugs and if any are badly burned, replacing them. The breaker points should also be filed clean or replaced. Very often an obstinate case of noise is found to be due to an excessively wide gap between the distributor rotor and its brush contacts. Remove the rotor arm



and place it on a flat steel block. Hammer it until it is long enough to leave a gap of about .004 of an inch. Do not build it up with solder, as this will soon burn away. It is important to avoid any actual mechanical contact between the distributor and its brushes as this will not only affect the timing but may also damage the distributor itself.

In connecting to the 6-volt supply, it is always preferable to connect directly to the hot side of the A battery rather than to the ammeter. This may not be quite so convenient but it allows appreciably less ignition interference to feed from the primary ignition circuit through the battery to the set. A small choke coil consisting of 12 to 20 turns of No. 18 wire on a ½" or ¾" form in series with the hot "A" lead often helps to eliminate noise.

High Tension Shielding

Where the coil is mounted on the instrument panel, it is often necessary to shield the high tension lead from it through the engine compartment. Slip a piece of hollow copper braid over the lead and ground the braid with a short pigtail at the dash. Adding the shield over the wire is preferable, in my opinion, to using new wire with the braid already tightly woven on it.

Very often meter lines and pipe lines coming through the engine bulkhead carry interference from the motor compartment to the car interior where it is either picked up directly by the speaker and remote control leads or transmitted through the body of the driver to the antenna. The remedy is to bond all such pipe lines and rods to the dash, using a heavy copper braid, soldering all connections. Cases have even been encountered where it was necessary to bond the dashboard to the engine block. Bonding leads should always be as short as possible. Always use heavy conductors.

Where the primary circuit of the ignition system runs for some length through the passenger compartment a by-pass condenser from either side of the ammeter to the instrument board will reduce interference.

Since most cars use auto-transformer ignition coils, reversing the low-tension leads may produce less high-frequency voltage across the A-supply and further reduce the interference feeding into the receiver.

Special Car Kinks

It is assumed that standard suppression equipment has already been installed.

AUBURN. Set mounts in engine compartment. By-pass battery terminal to instrument board. Ground cable shields to lock cable.

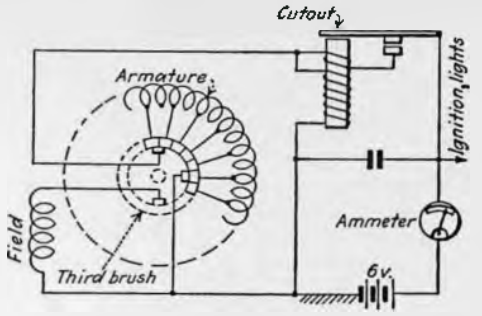
BUICK. Plug resistors mount under cover plate of engine. By-pass from instrument board to either side of ammeter. (Determine best terminal by trial.) Make a copper screen housing from the spark plug housing over the

* From "Radio Retailing", August, 1932.

distributor, enclosing all the high tension leads in between. Bond to the motor block at both ends. Use a switch in the dome light circuit to disconnect it during operation of the receiver. A small choke coil similar to that used on the A battery can also be used in series.

CADILLAC. By-pass either terminal of ammeter to instrument board. Usually a very quiet car.

CHEVROLET. Try reversing primary leads to coil. No by-pass at coil necessary. By-pass either terminal of ammeter to instrument board. Use a switch or choke coil in the dome light circuit. Shield entire primary circuit



and bond separately to bulkead. Shield high-tension leads from coil to distributor and bond at both ends. Lengthen distributor rotor. If interference is carried to roof-antenna through the body of the driver or passenger it may be necessary to line the toe-board with copper sheet thoroughly bonded to the bulkhead.

CHRYSLER. By-pass either terminal of ammeter to instrument board. Shield high-tension lead from coil to distributor and bond shield to bulkhead. Also shield low-tension lead between coil and breaker. Separate this lead from the high-tension wires. A switch or choke in the dome light circuit may also be necessary.

DODGE. By-pass either side of ammeter to instrument board. Shield low-tension lead from coil to distributor and bond to engine block. Also shield high-tension line from coil to distributor and bond to bulkhead. A switch or choke coil may also be necessary in the dome light lead.

ESSEX. No by-pass required on coil. By-pass to left terminal of junction box. Shield primary circuit from coil to breaker and bond. Use a shielded antenna lead-in.

FORD. No by-pass required on coil. By-pass from left terminal of junction box to bulkhead. Remove coil from bulkhead and bolt on side of engine block. This can be done by enlarging the hole in the coil bracket and requires no additional parts. Run shielded leads from the terminal block on the dash to the coil. A by-pass from either low-tension coil terminal to the block should stop any remaining interference.

HUDSON. No by-pass required on coil. By-pass light wire terminal to instrument board. Shield low-tension lead between coil and breaker and bond to bulkhead or engine block.

NASH. By-pass either side of ammeter to instrument board. If radiation into antenna is strong shield the bulkhead with copper sheet or screening and bond on both sides to the engine block. Also bond the instrument panel direct to the bulkhead.

OAKLAND. By-pass either terminal of ammeter to instrument board. Shield high-tension wire from coil to distributor and bond shield to bulkhead. Shield low-tension lead from coil to breaker. Use shielded antenna lead down windshield column. A switch or choke coil may also be necessary in the dome light circuit. If there is still interference, house the complete distributor in a copper-screen shield bonded to the engine block.

OLDSMOBILE. By-pass either side of ammeter to instrument board. Shield low and high-tension leads from coil to distributor and bond. It may also be necessary to use a switch or choke in the dome light lead.

PACKARD. By-pass from coil bracket to switch wire terminal. By-pass from either side of ammeter to instrument panel. Shield low-tension lead between coil and breaker and bond to bulkhead. In extreme cases, it is necessary to move the coil. Proceed as follows: Remove the switch from the coil, connect the wires inside and cover with

(Please turn to Page 14.)

National's AGS Receiver

The National AGS receiver is a superheterodyne with a tuning range from 15 to 125 meters (2,400 to 20,000 kc.) due to coils which are plugged in from the front of the heavy aluminum panel which is of standard 19" x 8¾" size and serves as the backbone of the set. Calibration curves and a log-chart are carried on this panel, as is the single "Velvet Vernier" tuning control and the four secondary controls which, from left to right, control the beatnote (second)

oscillator, the switching from manual to automatic volume control, the manual volume control itself, and a headset-or-speaker switch. An r.f. stage provides pre-selection for image suppression, two i.f. stages provide the major gain of the set, all three tubes being controlled by the a.v.c. tube. The tubes used are 1-238, 4-237s, 4-236s.

CURING AUTO NOISES

(Continued from Page 13.)

a metal disc soldered to the edge, using insulation between the wires and the metal disc. Mount the coil horizontally to the bottom of the radiator brace. Remount switch. Use a shielded lead from the switch to the coil and bond to the bulkhead.

PLYMOUTH. By-pass either side of ammeter to instrument board. Shield and bond both low and high-tension wires from coil to distributor. It may be necessary to use a switch or choke in the dome light lead to reduce antenna interference.

PONTIAC. By-pass either side of ammeter to instrument board. Shield high-tension lead from coil to distributor. Remove low-tension lead from secondary manifold, shield and bond to engine block or bulkhead.

STUDEBAKER. By-pass switch wire of coil to coil-bracket. By-pass either side of ammeter to instrument board. Shield secondary lead from coil to distributor and bond to bulkhead.

The author wishes to thank Eugene V. Larrabee of the American Auto-Radio Company of Chicago for his valued assistance.

Allied Art

THE SPATARI CODE

A GIFT OF FRIENDSHIP

One of the biggest bars to speaking a foreign language, including artificial languages, is that of pronunciation; one dislikes to display a "foreign accent", it seems always to have been the feeling that there wasn't any way around this obstruction, nor around the awful chore of learning a new grammar—probably just as insane as English grammar—and a new scheme of spelling, which fortunately could not possibly be as fearful as English spelling.

There IS an International Language

Professor Carlo Spatari of Astoria, N. Y., proposes to avoid these difficulties; making practical use of the old saying that "Music is the true international language", by using the NAMES OF THE MUSICAL NOTES OR THE ACTUAL SOUNDS as code-characters. With inconsiderable exceptions all speakers of a European language use the same names for the musical notes AND PRONOUNCE THEM ALIKE! Thus there are seven syllables that are ready-made and it will be a poor business if we can't make a useful code of them when Morse needed but two—dot and dash.

What Sort of Code?

Right at the off go one must decide whether to make code letters or code words. It is instantly evident that the code word is the thing, for then we can make do-re mean the same thing in every language; the two notes can be played or sung or NAMED into a microphone and will convey the same sense to an Englishman and an Italian, because each will work with his own translation book, which does NOT show the other man's language at all but only HIS. language and the musical notes. Do not be alarmed at the mention of a dictionary, it will not be used much or long.

The Simplifications

Most of our ideas can be expressed with about 2,000 words, though some of us may use as many as 6,000. In turn, some of these commonest words will be found rather needless—we drop them out of telegrams and we certainly would expect to drop them out of a Spatari music-message.

The grammar can be calmly omitted with surprisingly small damage to most thoughts in SIMPLE language intended to give news-facts. Languages do have things in common, and (in the main) these are the only essentials, so that the problem is handled by a few "endings" which denote essential points of grammar such as tense and number.

It is apparent that one will not convey fine shades of meaning, and that words must be used with their dictionary meanings—one cannot translate literally such an expression as "beat it"—unless one actually means "strike it". These losses are small, to the native slang and idioms are indispensable, but to any foreigner these things are a damned nuisance—no less. To the German it is easy to understand what is meant by "Der hat einen Bock geschossen"—but it conveys nothing to the American when dictionary-translated into "He has shot a billy-goat". The American has no way of knowing that this SHOULD be translated into "He's made a fool of himself". Avoidance of such things are merely the ordinary limitation of conversation between people who do not know the same language equally well.

Among Professor Spatari's suggestions are that it may be advisable to use a radio-phonograph combination and record the received message, discounting the different time in the different countries of the world by playing it back later, which also permits slow word-for-word dictionary work.

Useless Information

Richmond Hill, Long Island, New York, is as flat as the buggy market. It was named by homesick English immigrants without regard to scenery.

MODERN RADIO INDEX

• • •

From No. 1 (July, 1931) to No. 12 (June, 1932) inclusive

IMPORTANT NOTICE

Issues No. 1 (July, 1931) to No. 7 (January, 1932) are completely sold out, except for a few copies of Numbers 4 and 5 which are available at 25 cents for a time, as are Numbers 8 to 13, inclusive.

Later issues are for the present available at the regular price of 20 cents.

We Go Eclipsing

"Modern Radio's" eclipse expedition was marvelously fortunate. While most of New England lay under a thick cloud blanket, ponderous expeditions with truckloads of equipment saw nothing, millions of private lookers stared hopefully at a gray sky, and even the radio contact with a plane above the clouds failed to work—we sat on a New Hampshire hill and saw the whole show—almost two solid hours of it.

Radio Results

Before the eclipse date of August 31, we had concluded that most of the radio preparations were wasted effort—why should a short night show anything whatever that wasn't more easily observed in any ordinary night? Therefore, we only arranged for a "listening watch" on various bands, since ANY transmission effect of real importance is bound to have some effect that can be heard, while no great effort is wasted if nothing happens. We heard just what was expected—an upswing in static at the actual totality, lasting for a few seconds, exactly as in any ordinary sunset. The effect was strongest at 5 meters, observed by Associate Editor Perry O. Briggs. That's that.

The Changing Sky

This left us free to see, enjoy and remember. From the first notching of the sun's disc until complete totality, the bulk of an hour elapsed. During the first three-quarters of this time, the light faded so gradually that the day appeared normally bright. At 75 per cent. totality the birds began to rush about and complain, as it was now perceptibly darker than a normal clear day. Ten minutes before the totality two sky-effects appeared. The clear portion became striped in light and dark blue, the stripes being about five degrees wide, the effect being very definite and seen by three of us. At the same time the sun was surrounded by a double rainbow ring, the inner one being of about four times the sun's diameter and the outer one of seven diameters and with the colors reversed in sequence as in an ordinary double rainbow. The apparently clear space was accordingly probably slightly hazy. The light now failed more rapidly and there was some mooing of cows and barking of dogs, also nighthawks appeared and went to hunting.

Totality Arrives

The sun now narrowed down to a brilliant narrow crescent with its horns pointing to our right. This crescent narrowed rapidly and the light faded very swiftly, catching the birds unprepared, so that they settled on the ground in the pasture-land about us.

An instant later the tall mountains of the moon reached clear across the light and we saw the remaining sunlight

(Continued on Page 23.)

Still More Tubes—42, 48, 69, 49, 52, 71, Sub-midget

• • •

THE 49, A 2-VOLT CLASS B TUBE

The 49 appears to be due to Everready-Raytheon and is simply a 2-volt battery version of the same idea as the 46, which was fully discussed on pages 12 to 14 of "Modern Radio" No. 11 (May). Also see "Modern Radio Serviceman's Pocket Book", page 4. In our estimation here is a Class B tube that can hold up its head and dare anyone to deny its right to exist—for whatever one may think about Class B fidelity—there's no arguing that it is easy on a B battery. A push-pull Class B pair of 49 tubes have a "resting" plate current of 8 Ma., as against 40 Ma. for a 171 pair—and you may recall that it was the 171 which put the B battery out of business originally.

General Constants of ER-49

Filament volts, 2.0.
Filament current, 0.12.
Bulb, S-14 (227 type).
Length, 4 and 11/16".
Diameter, 1 and 13/16".
Base, ordinary 5-prong.

The 49 as a Class B Triode

(Driver stage to use 231 or Class A ER-49. Higher sensitivity but 30% less output obtained with 230 driver. Transformer to have 1½ times as many primary as secondary turns, counting whole secondary. Both grids tied together.)
Plate, 4 Ma. at 180 volts.
Peak plate current with signal, 50 Ma.
Output per pair, 3.5 watts.
Load R per tube, 3,000.
Load R per pair, 12,000.
Bias volts, 0.

The 49 as a Class A Triode

(Outer grid tied to plate.)
Plate, 5.7 Ma. at 135 volts.
Inner grid biased, minus 20 volts.
Amplification (mu), 4.5.
Plate resistance, 4,000.
Mutual conductance, 1,125 micromhos.
Power output, 170 milliwatts.

THE 52 TUBE FOR 110-VOLT D.C. OR FOR CLASS B WORK

Another Everready-Raytheon tube is the ER-52 which can be thought of as the 89 triode-pentode-triode with a grid and a base pin left out—or else you can call it a 6-volt version of the 49 just described above—or maybe you had rather say that it is a small 46.

General Constants of the ER-52

Filament, 0.3 amps at 6.3 volts d.c. or a.c.
Base, again regular 5-prong.
Bulb S-14, 227 style.

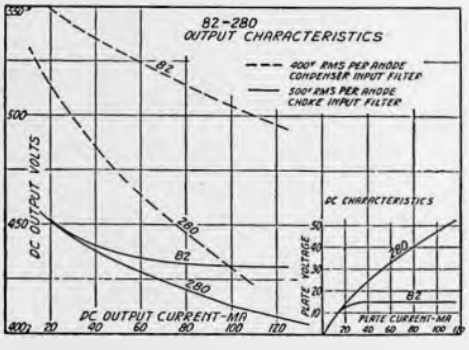
The 52 as a Class B Triode

(Driver stage to be a 237 or an 85 "duplex-diode-triode" as described on page 10 of "Modern Radio", No. 14, August, or on pages 3 and 5 of "Modern Radio Serviceman's Pocket Book". Both grids of output tubes tied together.)
Plate, 6 Ma. per pair at 180 volts.
Peak plate current, 60 Ma. each.
Output per pair, 3 watts.
Load R, as for the 49.
Bias volts, 0.

The 52 as a Class A Triode—Low Voltage

(Outer grid tied to plate.)
Plate 42 Ma. at 100 volts.
Inner grid biased to 0.
Output, 1 watt if driven by an 85.
1.9 watts for push-pull pair driven by a 171.
Load resistance, 2,000 to 2,500 per tube.

This serves splendidly to point out that we need a good clear definition of "Class A" and "Class B". R. C. A. runs a 46 tube with zero grid bias and because the mu is high says the result is "Class B operation". Here we have a tube with zero bias, and the grid, therefore, swinging positive, yet it is called "Class A". The fuzziness is in our definitions—the ER-52 idea is O. K.



One-glance comparison between the 280 full-wave rectifier and the mercury-containing equivalent, i. e., the 82. Our thanks to Dr. Weeks of Everready-Raytheon for summing it up graphically.

THE R. C. A. 48

R. C. A. is rumored to be about ready with a similar tube. The differences are interesting and novel.

THE 69

The 69 is a 2-grid detector—and in short is seemingly the Wunderlich tube, for details of which please see either page 10 of "Modern Radio" No. 11 (May)

(Please turn to Page 22.)

(Continued from Page 20.)

or the "Modern Radio Serviceman's Pocket Book", page 7. These things come with 5 and 6 prong bases and various filaments.

THE 42 AGAIN

This month's mystery story is about the R. C. A. 842. R. C. A. tells us it has been "released" and sends one of the very beautifully prepared "Technical Information" booklets to go with the letter. Yes, but—wasn't the 42 released years and years ago?

Anyway, the tube continues to be the same good tube it has always been—a low mu 210 that can be summarized as follows—all omitted data being as for the 210, both considered for audio output—modulation included.

The 250 data is for lagniappe—or weren't you ever down South?

Tube	210	842	250
Mu	8	3	3.8
Mutual	1,600	1,200	2,100
Bias Volts	—40	—100	—77
Plate Volts	425	425	425
Plate Current	10-18	28	55
Class A Watts	1.6	3	4

THE 71 RECTIFIER

Hytron has a baby halfwave mercury-vapor type rectifier called the 71. It uses 2½-volt filament supply.

SUB-MIDGET TUBES

Very tiny tubes—less than 99 size—are being made at Newark for sub-midget receivers. For instance in the rectifier the getter capsule is used as a plate! More later.

★

COMING !

How to Use the New Tubes in Amateur Reception and Transmission

NOVEMBER "MODERN RADIO"

★

(Continued from Page 18.)

through the valleys of the moon in brilliant fragments of various shapes—the so-called "Bailey's Beads"—though they resemble beads much less than bits of broken glass intensively heated. This lasted but a few seconds—and the sun was gone.

The Great Corona

On that instant the corona bloomed forth all about the moon's edge, so brilliantly that we wondered at not having been able to see it sooner. The inner corona, supposed to consist of actual flaming gases or of a cloud of incandescent solid bits boiled out from the sun, seemed to us to reach out at least a half-diameter and to be brilliantly white—just plain white—and, indeed, it gave so much light that with no help from the sun we could easily see the colors and shapes of trees on a hill two miles away, and make out the colors of a white house, an unpainted house, a brown barn and a red barn, all about one-quarter mile distant. Certainly it was no night. On the upper left side, located at about the point a rifleman would call "half past ten o'clock" was a bulge in the corona, tipped with sparkling beads of red and blue, and directly opposite was another, but smaller bulge, which was white like the rest. The intensity of the whole affair was far above that of 1925, probably because this was midsummer instead of midwinter, and we were nearer to the sun.

The filmy outer corona, whose mother-of-pearl streamers we had seen out to four or five times the sun's diameter in 1925, was this time much brighter, almost white, but also much shorter—perhaps cut off by unseen haze.

—And Day Again

For 55 seconds—that seemed much shorter—the strange display stood so while a chill breeze blew—then the sparkling "beads" burst out at the right, the corona vanished magically, light poured down on the earth—and the eclipse of 1932 was over. The remaining hour of the moon's retreat was a slow anti-climax and of little interest.

"MODERN RADIO'S" ANSWER FACTORY

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A—Letter with one question..... $ .50
No charge for small incidental pencil sketches.

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D—Matters such as given under C, where all constants are desired ... 2.00

E—a.c. or d.c. socket-power receiver circuits without constants..... 1.50

F—Same as E but with all constants 3.00

G—Transmitter diagrams of greater complexity, bibliographies, operating instructions, analysis of complex operating difficulties in apparatus, and other questions not covered by the above will be estimated on receipt of a clear and complete statement of the problem.

NOTES

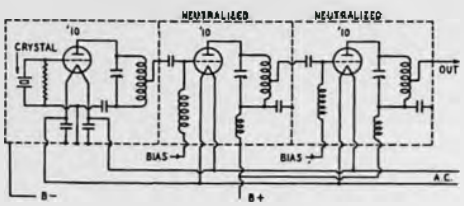
1. Keep a copy of your letter, including diagrams, numbering questions 1, 2, 3, 4 and lettering diagrams a, b, c, d.

2. The right is reserved to return remittances for any questions which it is impossible to answer.

3. No attention will be paid to radiograms, telegrams or letters (other than those under class G) which are not accompanied by a remittance. Please use money order—loose cash may not arrive.

4. Address letters, "Modern Radio", 101 Allyn Street, Hartford, Connecticut.

MODERN RADIO QUIZMATIC



Oh, very well—here's a Quizmatic that is NOT about receivers, although a good serviceman ought to be able to guess the answer.

In this transmitter diagram the neutralizing circuits have been omitted for simplicity, and because they have nothing to do with the question. Something else is very wrong—several things. What are they?

For the best answer, a year's subscription or subscription extension. For the next four, six months. The editors do the judging and may print the contributions. "Best" means "to the point"; we are not interested in rhetoric or art.

AUGUST QUIZMATIC WINNERS

First place tied for by Paul E. Griffith of Iowa City and S. J. Stansfield of Highland Park, Michigan.

Both receive a year's subscription extention. They were just a neutron apart and the only reason for putting one first in the listing is the S follows G in the alphabet.

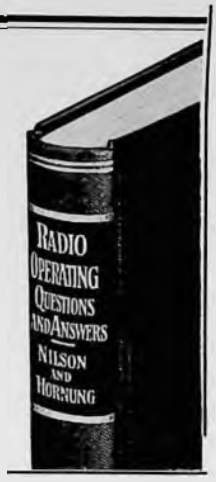
Honorable mention and six month's subscription, or extension, to J. W. Peckham, Binghampton, N. Y.; Clarence R. Rogness, Winona, Minnesota; J. M. Sharp, Santa Paula, California.

Wish we could use something cheap like diamond in place of tourmaline.

Blah! For ten years one radio manufacturer has claimed fine reproduction due to a complete tonal range—this year he claims twice as great a range.

If you want to advance in radio . . .

. . . it will pay you to send now for this new book, for 10 days' free examination.



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WHAT'S NEW

A BIT SPOOKY

In the "Christian Science Monitor" for September 2, the genial Volney D. Hurd tells of an amazing bit of re-recording. It appears that the old mechanically recorded records of Enrico Caruso were better than was suspected when they were played with the old mechanical phonograph—in fact they recorded Caruso very well indeed—it was the orchestra that was weak. Now Victor has been doing an amazing thing. Caruso is being lifted from his old records and being transplanted to a new electrically recorded disc on which is laid, in exact time, an electrically recorded accompaniment played by an orchestra conducted by Nathaniel Shilkret. While the feat is worthy, and the records will be of intense interest, we have even greater interest in wondering what went through the conductor's mind as he played for the absent singer—for Shilkret conducted for some of those records when the singer was not yet absent.

FOR A.C.!

Just when we have learned thoroughly that electrolytic condensers must never, never be reversed as to polarity, along comes a new type which is so dry that electrolysis is almost absent and they can actually be used for intermittent a.c. loads, such as motor-starting. It is, of course, well known that a number of types of single-phase a.c. motors can be started to better advantage, if a very large capacity is available to connect to one phase. Paper will do the job but has a disadvantage in size and cost. The new type of electrolytic, offered by Solar Manufacturing Corporation, 599 Broadway, New York, N. Y., would seem to be worth careful attention.

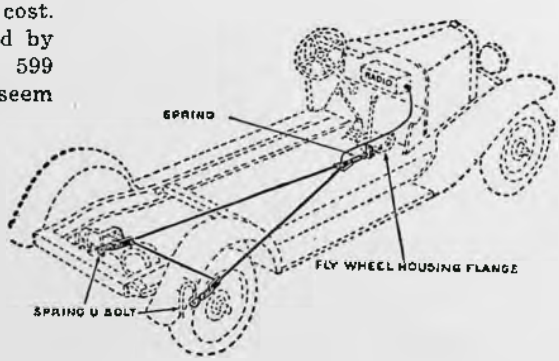
HEAVY—BUT SOLID

For those who can digest some pretty solid food we earnestly recommend a careful reading of "Circuit Relations in Radiating Systems" by P. S. Carter. This was given as a talk at the Pittsburgh convention of the Institute of Radio Engineers and is presumably to appear in Proceedings—may have when this is printed. The article alone costs 50 cents —Institute of Radio Engineers, 33 West 39th Street, New York City.

UNDERNEATH

Automobile roof antennas are not so hot. If exposed they are a nuisance. If concealed, their installation is a job for a professional body repairman, or else the roof cloth will look as if a pair of terriers had worried it. In either case the thing tends to be noisy because of pickup from the dome light and from the engine itself.

Several years ago W. F. Cotter of Bosch, devised a sub-running-board sheet metal antenna which was so good that it is widely imitated. The pickup of such an antenna increases as the antenna is *lowered*. 1932 running boards are both short and low—hence the antenna must retreat to the frame to avoid being scraped off. The drawing herewith shows a good type, due to M. H. Fleron Company, Trenton, N. J. The price is $4.00.



THE "SUB-CAR" ANTENNA

Short Circuits

Lots of bargains turn out to be mere wind in the sales.

We wonder why nobody ever thought of keeping pet propellors in the home acquarium.

Also, we grieve over the passing of the electrolytic charger and B eliminator: They never reached the full of their possibilities. Nobody ever thought of lighting up the jars with colored bulbs; and somehow ingenuity slipped in failing to develop gold-fish and flora aquaria suitable for making them more decorative.

A Sierra Madre (Calif.) resident has succeeded in raising in his garden a 15-foot sunflower and it is believed that the fair-minded Kansan will concede that it soon will be large enough for transplanting.—"Christian Science Monitor".

Depression or no depression, we understand the Heaviside layer is going up again this winter.

"Not many can do this," said the magician as he turned his Ford into a fire hydrant.—"Tickler", U. S. Naval V. C. R., 11th District.

If all radio set advertisers are right, then we submit that the Lord did a very poor job in the human ear.

We got this one from an insurance counsel:

Smart Alec Question: "What would you do if you had all the money in the world?"

Smart Alec Answer: "Pay my debts—as far as that much money would go."

The Ohm should have been provided in assorted sizes or maybe in stripes an' colors. Well, that's not so far fetched. We've seen 'em checked. (Heh, Heh.)

The idea of the 6-pin base is that it permits you to connect several socket terminals together so as to get the effect of a 5 or 4 pin base. Unfortunately an output pentode can't be converted into a 45 by a similar process.

WHERE TO BUY "MODERN RADIO"

ARIZONA
Nielsen Radio & Sporting Goods Co., Phoenix

CALIFORNIA
Associated Radio Buyers, Oakland
Jack Broadly, San Francisco
Coast Electric Co., San Diego
I. S. Cohen's Sons, Inc., San Francisco
El Cajon Radio Exchange, San Diego
Electric Supply Co., Oakland
High Frequency Engineering Lab., Los Angeles
Inter-City Radio Stores Co., Long Beach
Offenbach Electric Co., San Francisco
Radio Doc., Los Angeles
Radio Manufacturer's Supply Co., Los Angeles
Radio Supply Co., Los Angeles
Radio Technical Labs., Long Beach
Sea Cliff Radio & Elec. Co., San Francisco
San Francisco Radio Exchange, San Francisco
Warner Bros., San Francisco
Warner Bros., Oakland
Wenger-Brill Co., Oakland
Western Wholesale Radio, Inc., Los Angeles
Zach Radio Supply Co., San Francisco

CONNECTICUT
Hatry & Young, Inc., Hartford
S. S. Kresge Co., New Haven

ILLINOIS
Abbott's Sweet Shoppe, Berwyn
Chicago Radio Apparatus Co., Chicago

MARYLAND
Radio Electric Service Co., Inc., Baltimore

MASSACHUSETTS
T. F. Cushing, Springfield
Neisner Bros., Boston
Sager Electrical Supply Co., Boston

MICHIGAN
Radio Specialties Co., Detroit

MINNESOTA
Lew Bonn Co., St. Paul

NEW JERSEY
Kaltman & Kennyhertz, Newark

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Blan, the Radio Man, Inc., New York City
Jerry's Place, New York City
Leeds Radio, New York City
Roy C. Stage, Syracuse
Sun Radio, New York City

OREGON
Northwest Radio Supply Co., Inc., Portland
Wedel Co., Inc., Portland

PENNSYLVANIA
Cameradio Co., Pittsburgh
Hall's, Harrisburg
M. & H. Sporting Goods Co., Philadelphia
Radio Electric Service Co., Inc., Philadelphia

RHODE ISLAND
City Hall Hardware Co., Providence
W. T. Grant Co., Providence

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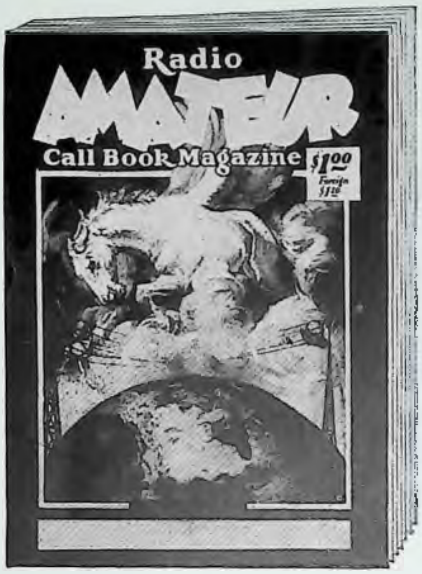

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