1933

MODERN RADIO

EDITED BY ROBERT S. KRUSE

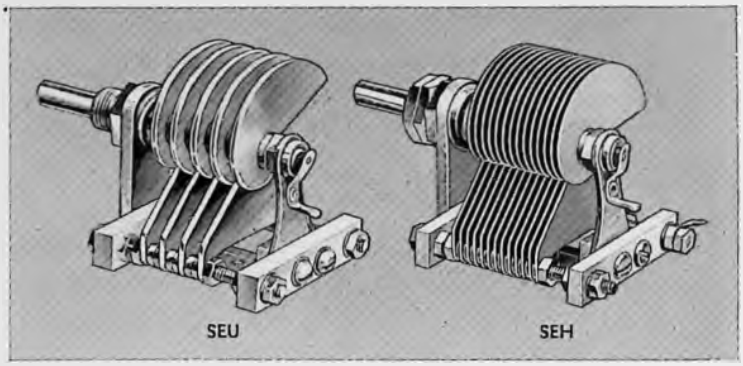
CONTENTS

January Number 19 20 cents

Standard NATIONAL MIDGET

PARTS FOR HIGH & ULTRA H.F. WORK

NATIONAL Company makes a full line of variable condensers, coil forms, coil and tube sockets, H.F. chokes, dials and accessories for H.F. work — also complete receivers and converters, including the AGS (finest Short-Wave Communications Receiver made). Send for FREE Catalogue MR-1.



NATIONAL MIDGETS FIT YOUR EVERY REQUIREMENT

Whatever the MIDGET CONDENSER you need for high-frequency work, there is a NATIONAL Midget that fills the bill.

We made and patented the first 270° Straight Frequency Line (Equicycle) Plate Midget in 1928. Everyone knows how much easier tuning this gives, how it spreads out the stations over 50° more dial space. This isn't a boast—it merely indicates the experience behind the NATIONAL Line of Midget Condensers. NATIONAL Midgets are up to the minute in design and performance. As each new H.F. development or improved material has become available, it has been incorporated in NATIONAL Condensers.

NO SHORTED TURNS IN NATIONAL MIDGETS

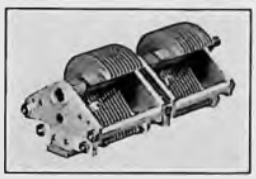
Years ago we recognized that efficient H.F. Condensers should have no shorted turns, and years ago we began making all NATIONAL H.F. Condensers without shorted turns. In fact we had ceased even to mention this feature, but we mention it again because it is a basic feature of NATIONAL H.F. Condenser design. All two-bearing NATIONAL Midgets have the insulated front bearing —result—no shorted turns. Naturally the single bearing types can have no shorted turns anyway.

EXCLUSIVE CONSTANT-IMPEDANCE PIGTAIL

Constant-impedance pigtail, a patented NATIONAL feature, is only one of many advantages that make NATIONAL Midgets such consistent and invariable performers. This exclusive and electrically perfect connection to the rotor eliminates the noise, crackle, and varying impedance (A.C. inductance) of the brush type of contact.

OTHER ADVANTAGES OF NATIONAL MIDGETS

Isolantite, acknowledged high-efficiency dielectric, is used for insulating NATIONAL Midgets—reducing dielectric losses to a minimum; assuring uniform condenser performance at maximum level under all conditions of humidity and temperature. Aluminum plates; thick, polished all over, with wide polished rounded edges, are used in the NATIONAL SEU Ultra-High-Frequency Midgets. Here—where rigidity and extreme stability are essential, where surface losses begin to count, we have chosen a suitable material fabricated in such a way as to give best possible performance. Equally thick plates (and thick plates are needed to give wide round edges) of any other metal, would run up cost and increase weight. In aircraft work this is most important, and there also the non-resonant characteristics of aluminum plates prevent any possibility of microphonic feed-back from plate vibration.



2 SE

THE NATIONAL 2-SE MIDGET WITH GANGED ISOLATED ROTOR

For high-frequency T.R.F. and super-heterodyne work. Heavy, rigid, permanent, precise in mechanical construction; constant in electrical performance. Rotors are effectively insulated AND isolated from each other. Equipped with standard NATIONAL 270° straight-line-frequency (Equicycle) plates. ALL CAPACITIES from 50 to 350 mmf. PER SECTION. Standard model has equal capacity each section and is furnished for clockwise rotation unless otherwise specified in order. On special order, the 2-SE will be furnished with different capacity sections, at a slight advance in price.

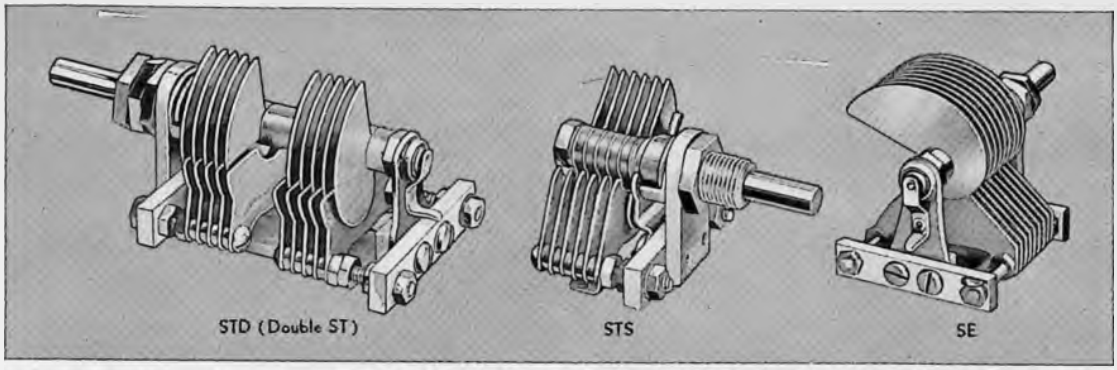
LIST PRICES—STANDARD MODEL—TYPE 2-SE

Type 2-SE, 50 to 99 mmf. each section..... $5.50
Type 2-SE, 100 to 350 mmf. each section..... 6.50

High and Ultra High Frequency

Receiving
Transmitting
Neutralizing
Instrument

CONDENSERS



Complete Specifications and Prices
STANDARD NATIONAL H.F. and ULTRA H.F. MIDGET CONDENSERS

Catalog Type No.	Capacity in Mfds.	Air Gap	Number of Bearings	Plate Shape	Rotor Plates	Stator Plates	Depth Behind Panel	List* Price
SE– 50	50	.026	2	270° S.F.L.	6	5	2¼"	$3.00
75	75	.026	2		8	7	2¼"	3.25
100	100	.026	2		10	10	2¼"	3.50
150	150	.026	2		15	14	2¾"	3.75
SEH– 200	200	.0175	2		14	13	2¼"	3.75
250	250	.0175	2		16	16	2¾"	4.00
300	300	.0175	2		20	19	2¾"	4.00
335	335	.0175	2		22	21	2¼"	4.25
SEU– 15	15	.055	2		3	3	2¼"	2.50
20	20	.055	2		4	4	2⅜"	2.75
25	25	.055	2		5	4	2¼"	2.75
ST– 50	50	.026	2	180° S.W.L.	6	5	2¼"	$1.80
75	75	.026	2		8	7	2¼"	2.00
100	100	.026	2		10	10	2¼"	2.25
150	150	.026	2		15	14	2¾"	2.50
STH– 200	200	.0175	2		14	13	2¼"	2.75
250	250	.0175	2		16	16	2¾"	3.00
300	300	.0175	2		20	19	2¾"	3.25
335	335	.0175	2		22	21	2¾"	3.50
STN– 18	18–3000v.	.065	1		4	3	1⅝"	2.00
STS– 15	15	.0175	1		2	1	1$\frac{3}{16}$"	1.40
25	25	.0175	1		2	2	1$\frac{3}{16}$"	1.50
50	50	.0175	1		4	3	1$\frac{3}{16}$"	1.60
STD– 50	50 per sec.	.026	2	180° S.W.L.	6 per sec.	5 per sec.	2¾"	$3.50
STHD–100	100 per sec.	.0175	2	180° S.W.L.	7 per sec.	7 per sec.	2¾"	4.50
SS– 50	50	.026	2	180° S.C.L.	5	4	2¼"	1.80
75	75	.026	2		7	6	2¼"	2.00
100	100	.026	2		9	8	2⅛"	2.25
150	150	.026	2		12	12	2¾"	2.50
SSH– 200	200	.0175	2		11	10	2¼"	2.75
250	250	.0175	2		13	13	2¼"	3.00
300	300	.0175	2		16	15	2¾"	3.25
350	350	.0175	2		18	18	2¾"	3.50
SSN– 18	18	.065	1		3	3	1$\frac{3}{16}$"	2.00
SSS– 20	20	.0175	1		1	2	1$\frac{3}{16}$"	1.40
30	30	.0175	1		2	2	1$\frac{3}{16}$"	1.50
50	50	.0175	1		3	3	1$\frac{3}{16}$"	1.60
SSD– 50	50 per sec.	.026	2	180° S.C.L.	5 per sec.	4 per sec.	2¾"	3.50
SSHD– 100	100 per sec.	.0175	2	180° S.C.L.	5 per sec.	5 per sec.	2¾"	4.50
150	150 per sec.	.0175	2		8 per sec.	8 per sec.	2¾"	5.00

* *Usual trade discounts apply.*

1. All shafts ¼" diameter.
2. Standard direction of rotation clockwise. Specify if desired counter-clockwise.

On special order any of above may be had with shaft extending through rear bearing for ganging.

NATIONAL CO., INC.
61 Sherman Street, MALDEN, MASSACHUSETTS

THE U. S. FOREST SERVICE RADIO EQUIPMENT

By Frank W. Prince*

• • •

The larger set, which is known as the Forest Service Radiophone, or Semi-Portable, weighs, complete with all accessories, slightly under 50 pounds. The equipment is divided between two boxes, one of which carries the radio proper, while the other box carries the batteries, head set, key, antenna, equipment, and

The C. W. and phone transmitter and receiver. Microphone on set cover with cord plugged into pinjacks, and additional jack and transformer tap providing for plugging in a phone line for remote pickup. The receiver tuning controls are at lower right, filament switches and meter jack at center and sending controls at left. At the top an antenna lamp, next a send-receive switch, then jacks for headset and key, a 2-point power-level switch and finally the cord and plug to connect to the battery box.

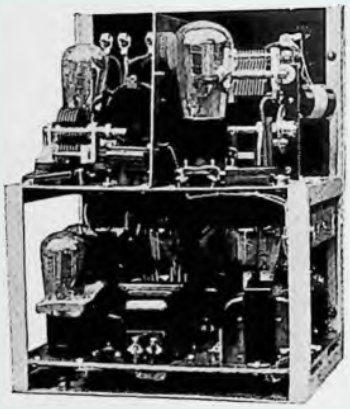
voltmeter. The set uses a total of six tubes, as follows:

A 30 crystal-controlled oscillator, a 33 RF amplifier, a pair of 33's in parallel, as modulators, a 30 detector, 30 first audio, and one of the modulators is used as second audio in the receive position.

The other box contains four standard dry cells in series parallel for filament supply, four Burgess 5308 45-v. B batteries, and a 22½-v. C battery.

The sets are very rigidly constructed on aluminum frames, with considerable aluminum and dural being used in the assembly. After being tuned-up, the tank condensers are locked so that there is no danger of their getting out of tune. The only step necessary to place a set in operation after installing the antenna is to set the filament voltage by means of a pin type voltmeter which plugs into the panel, and to manipulate a transmit-receiver switch and tune the receiver. The receiver has a total of three controls—tuning, regeneration, and audio gain control. This audio gain control is very essential in the set, due to the high gain of the receiver.

The microphone is coupled through a special winding on the second audio transformer directly to the grids of the two 33's in parallel, and connected this way, furnishes ample excitation for the modulator. The modulated amplifier is coupled to the modulators through an impedance matching transformer, and operates at 15 ma. and 180 v. when the batteries are fresh. The batteries are used until the terminal voltage is approxi-



Rear view of the c.w. and phone transmitter-receiver. Transmitting equipment and audio input transformer on upper deck; receiver and remaining audio equipment (also used for modulation) on lower deck.

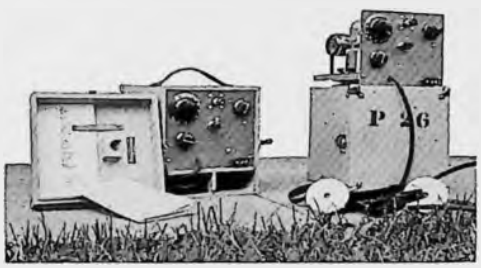
mately 155 to 160, and are good to operate the transmitter at least 50 hours, and the receiver 100 hours or more. The Forest Service finds that the sets, installed at lookouts where four or five contacts of ten or fifteen minutes duration daily are made, will run the entire fire season of about three months on two sets of batteries.

The sets are rated at 25 miles. With

* Technician, Spokane Radio Company, Inc., 528 First Ave., Spokane, Washington.

forty of these sets in use this summer in all parts of the Northwest, they have proven that they can handle this distance very easily. They are being operated on 3,385 kc., and it is almost a daily occurrence to hear these sets satisfactorily at a distance of around 200 miles. On a number of occasions two-way conversations have been carried on with two of these sets at distances, this great, and even greater.

The antenna as normally used with these sets is described in *Radio News* for September, and consists of two one-eighth wave radiators, with a quarter wave loading coil in the center. The loading coil is tapped for a single wire feed, so that the antenna can be set up with any length feeder, and will function as a Hertz antenna. They are usually installed with an average height of 7 to 15 feet from ground. For permanent locations, or where room is available, the standard half-wave antenna,



The 12-pound portable c.w. transmitter-receiver in and out of its case. '30 tubes are used. When receiving one is a dector, the other two are audio amplifiers. When transmitting the detector is idle, one tube is an oscillator and the third one is a monitor oscillating at double frequency and tuned over a short range by the upper right knob. Antenna terminal at upper center, send-receive switch at center, tuning controls at left.

139 feet long, is used instead, as the efficiency is somewhat better. These sets can be unpacked, the regulation antenna installed, and on the air in an average time of less than ten minutes, and no particular experience is required to operate them, as they are very simple and practically fool-proof.

One of these sets was deliberately dropped 15 feet from the roof of the Forest Service laboratory, and two tubes were broken. Upon replacement of these tubes, the set checked perfectly. Also, this summer one Forestry official had the misfortune to drive his car over a bank, and the car dropped and rolled approximately 300 feet down hill. Two people were killed in the accident, but an SP set that was in the car was put back on the air by replacing one tube and the flash-light lamp, which is used for a test indicator.

The little set is known as the Portable, and is strictly a CW set. It uses a 30 oscillator with a small padding condenser in the tank, so that it is tuned by means of a screw driver. This little set weighs less than 12 pounds, complete with all accessories. To bring this weight down it was necessary to obtain a special B battery from Burgess. This battery delivers 144 volts, and weighs 4.1 pounds. It is considerably lighter than any of the PL batteries.

A novel feature of this set is the monitor. A second 30 tube oscillates at double the frequency of the transmitter, with a limited frequency control on the panel. In operation, the operator holds the key down and tunes this monitor dial to obtain a beat note. He can then listen to his own keying and check any troubles that may develop. This scheme has been proven quite essential when the sets are used by Forestry men that have very little code training. In the receive position a third 30 tube is used for a detector, while the other two tubes mentioned above function as audio amplifiers.

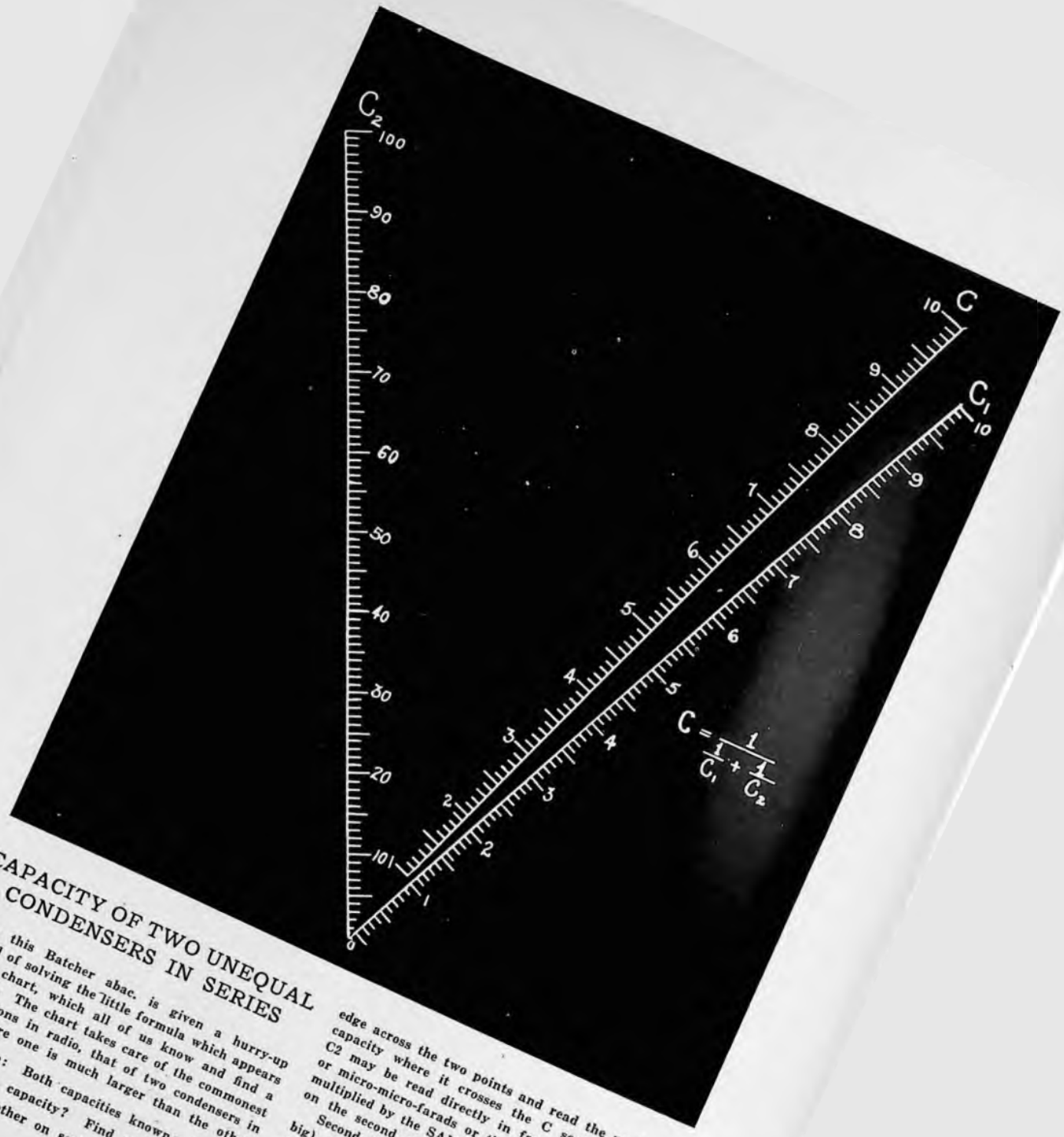
These little sets have been operated over distances of from 50 to 200 miles quite regularly on about 3,445 kc.

POLICE RADIO RESULTS

In one of the many reports of the Federal Radio Commission one finds that in one month, and in but 50 cities, police radio did this:

Calls sent	155,656
Arrests	12,676
Property recovered	* $386,953
Radio cars used	2,255
Square miles served	28,190
Population served	32,585,000

* Not counting 260 automobiles.



CAPACITY OF TWO UNEQUAL CONDENSERS IN SERIES

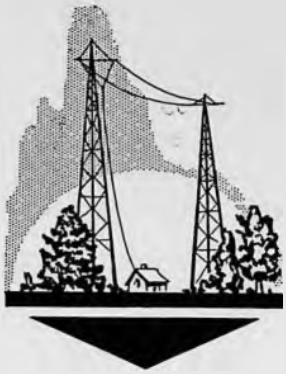
In this Batcher abac. is given a hurry-up method of solving the little formula which appears on the chart, which all of us know and find a nuisance. The chart takes care of the commonest combinations in radio, that of two condensers in series where one is much larger than the other.

First Use: Both capacities known: What is the resulting capacity? Find one capacity on scale C1, the other on scale C2; lay a straight-edge across the two points and read the resulting capacity where it crosses the C scale. C1 and C2 may be read directly in farads, micro-farads or micro-micro-farads or the three scales may be multiplied by the SAME constant. See also notes on the second parallel resistance chart.

Second Use: Knowing one capacity C1 (too big), and wanting to reduce it to a smaller value (also known), what capacity must be used in series? Find the existing capacity on the C1 or C2 scale, find the desired capacity on the C scale. A line through them will strike the other scale at a point showing the necessary series capacity.

The 1933 Transmitter

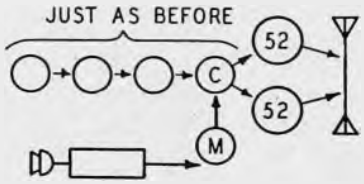
Part 3 of the Series—"Bringing the amateur Receiver & Transmitter up to date."*



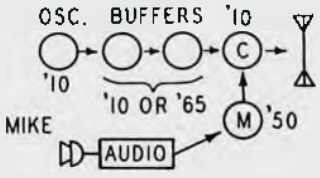
By Robert S. Kruse

The 1933 transmitter can be discussed very simply, no matter whether it uses voice or key modulation. In both cases we have a crystal-controlled oscillator, some buffers, and a final amplifier controlled by voice or key. We have thrown into the ashcan the wasteful old "Class B final r.f. amplifier"—sometimes miscalled a "linear amplifier," because it ate too many bias batteries for supper and when using voice gave us only one-quarter of the carrier power we were entitled to. Let it rest with the Radiola RC, the side-bar buggy, and the brontosaurus—none of 'em give us our money's worth for 1933.

Now let's go.



The expensive 1932 final r.f. amplifier. Theoretically producing 37½ antenna watts—seldom properly modulated.



The 1933 set—one-quarter as costly, one-tenth as dangerous, twenty times as likely to be well adjusted and in most stations out-performing the 1932 sort, though the carrier-power is but one-half or one-third as great. Even in large amateur stations this principle of modulating the LAST tube produces the most miles-per-dollar. Details in November "Modern Radio."

* November and December issues with Parts 1 and 2 at 20c each.

Better Oscillators

Merely replacing a '10 crystal oscillator by some other sort of tube (47, 46 or whatnot) is so small—and so painfully obvious—an "improvement" that time can't be wasted on it now.

A much more important thing is that so many crystal-controlled stations seem to have such horriferous frequency drifts REGARDLESS of the sort of tube used. In the cases where the station has been carefully examined it was pretty consistently found that the oscillator used 350 to 450 volts on the plate and a triode buffer which was neutralized—last Tuesday. With intermittent operation a crystal simply WILL NOT come anywhere within gunshot of being stable under such treatment. The first move is to cut the crystal plate voltage to 200 volts—not over 250 at the utmost—and then to get busy on making the buffer buff—and amplify.

Better Buffers

I don't know who started this thing of using neutralized triodes as buffers—but probably he did it when the 865 cost the same as a Chevrolet—delivered, and didn't last as long. That's all water over the dam now. The 1933 865 is reasonably priced and lasts—andlastsandlasts.

For Pity's Sake, Why?

If the set is a small one there is another perfectly good buffer—the plain

224 which can now be bought for $5 a dozen. Run it with 250 volts plate, 90 volts screen and about 9 volts grid bias PLUS a 30,000 to 100,000 ohm gridleak and you'll be surprised at the nimble way in which it will push an output tube of any sort below the 50-watt class. Please DON'T put an enormous r.f. input into the grid and then apply an enormous bias battery to it. Remember the gain of the stage is around 50, and about 5 volts of r.f. input is all that's really needed. This means that the pickoff clip on the plate coil of the oscillator gets pushed way down toward the filament end—and that is just what the oscillator likes.

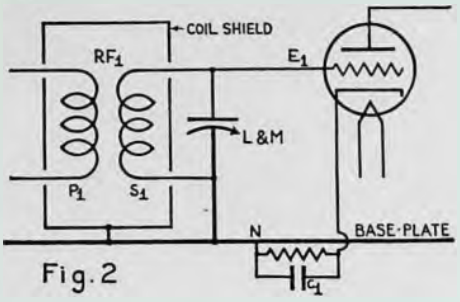


Fig. 2

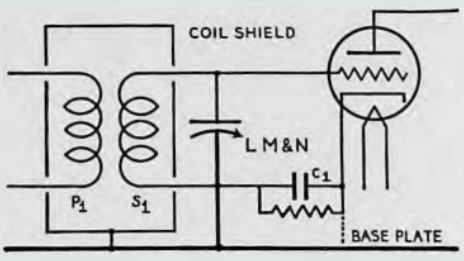


Fig. 3

The screen-grid buffer (or for that matter the neutralized triode buffer) work under conditions much like those of an r.f. amplifier in a receiver, which should suggest the proper precautions as to shielding, bypassing and choking. Receiver diagrams like the above use tuned grid circuits—and this is perfectly practical in a transmitter, or one may remember the precautions while converting the circuit to the usual transmitter arrangement—tuned plate with grid tapped off through a stopping condenser and then biased through a choke and battery—or better a leak as shown in November "Modern Radio."

Similarly, the 865, when pushing a good load, works very nicely indeed with a grid bias in the vicinity of 45 plus a little insurance in the form of a 20,000 ohm gridleak. The plate voltage is 500 and the screen about 125.

In neither case is there any apparent reason for using 5 to 10 times normal bias and then running the grid tap way up on the oscillator tank so as to get enough power with which to ruin the batteries.

One other thing—if a second buffer is used the 224 is out of the picture, but the 865 is IT when used as just described. In that case for uniformity the first buffer had better be an 865 also but it may as well run with all voltages reduced about one-half.

Dodging Trouble

Until one has thrown out the neutralized triode and replaced it with screen-grid tubes one simply can't imagine the beauty and ease of handling that results —and the decrease in crystal mortality, frequency drift and general grief. Motto for 1933—OUT WITH NEUTRALIZATION.

This, of course, includes eliminating the neutralized Class C tube-to-be-modulated—for what is the joy of having the buffers stable if the biggest r.f. tube in the place is instable? Even if the thing does not actually oscillate we have shown in the December issue (page 8) how accidental errors in neutralization may damage the performance without the knowledge of the operator. In this connection see also page 3 of the same issue. Here we have no time for retelling the story—it is all summed up in Fig. 5 and the accompanying table.

Better Frequency Changers

In the plain buffers there may be some excuse for "high C" tank circuits, but I don't know what it may be. Usually one has power to waste and perhaps the use of a wasteful tank therefore does no harm.

In a frequency-doubler very definite harm results—the output goes down to beat the band when the tuning capacity is increased above .00005 (that number has FOUR zeros in it) microfarads.

About the maximum that's bearable is .0001. The real way to do the thing is to use a .00005 midget air condenser for tuning, and put lots of turns on the coil. The reasonableness of this will be seen by remembering that a HIGH-C circuit is generally used to remove harmonics—and in this case the harmonic is all we want.

Any tube that is a good straight buffer will also do for a doubler or quadrupler. Better put the frequency-changer right after the crystal tube, then all chance of blow-ups for the crystal are avoided. A screengrid tube is very nice, but remember that a frequency-changing tube will ordinarily push another tube of the SAME size, but it can hardly be expected to push a larger one as can the ordinary buffer.

Better Final Amplifiers

The story of the better final amplifier for the phone was told in our November leading article—and what a response there has been to that article. The issue has barely been mailed and we already know of many stations that have found the battery-less information to be useful.

For c.w.—use the same arrangement there described and then KEY IN THE CENTERTAP—that is cut the filament

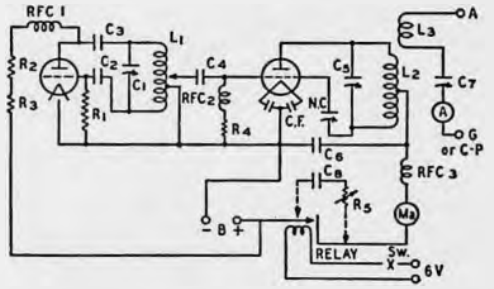


Fig. 4. A nice way not to key. In this case the thumping caused by breaking the B+ of the amplifier tube has been reduced by the filter C8 and R5, but a better device is to break the lead C.F. and (in case it is needed) to put the "thump filter" there. Try one or two microfarads in series with a rheostat of 1,000 ohms maximum, adjusting to get weak thumps at both make and break.

of the final r.f. amplifier loose from everything else when the key is up, but leave the grid return connected to B—. This old reliable keying scheme has been criticized in the past because with BATTERY BIAS IT THUMPS. Try it with the battery-less bias and be pleasantly surprised. Generally the final tube uses a separate filament transformer and the

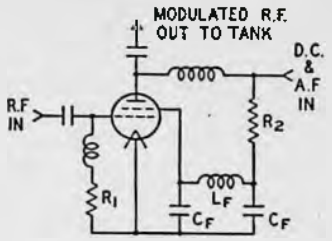


Fig. 5. Circuit for modulating a '65 or '60 tetrode. Details and constants appear in the table.

TETRODE MODULATION CONSTANTS

Voltages are for the "resting" condition.

R.F. Tube	Plate Volts	Ma.	R1	R2	Screen Volts
865	500	60	10,000 or 75 volts	25,000	+125
860	2,000	100	10,000 or 200 volts	100,000	+300

LF is any r.f. choke effective at working wave. CF, CF of mica and .0005 each (no more).

Circuit Notes: The modulating system may be of any sort suited to modulating the ordinary '10 or the ordinary '52 respectively. Systems using transformer coupling between the audio tube (modulator) and the r.f. tube are preferable. The usual rules apply as follows: If resistance-capacity coupling is used instead the proper dropping resistor is one which will cause the r.f. tube to work at the tabulated voltage (audio system at one and one-half or two times this voltage meanwhile) and to feed it a.d.c. input (watts) equal to twice the audio output watts rating of the modulator. Measure the voltages with a "1,000 ohms per volt meter." Where plate supply voltage is limited so that the r.f. tube receives less than 80% of the voltage tabulated change R2 so that the screen voltage is reduced in the same proportion.

scheme is simple. If it happens to use the same filament voltage as the buffers then the tube is a small one anyway and an additional filament transformer can be bought for a maximum of $5 and a minimum of 37c.

Auf Wiedersehen!

Details on all of this are on the fire —wait for the next few issues, or do

your own setting-up meanwhile. Oh yes—a little deep thought might meanwhile be put on the curve sheet which shows how the same sort of tube distorts when used Class A, Class A prime (see our July, August and November issues) and Class B. The rather awful Class B curve isn't as bad as some—but can be improved—even though you'd not suspect it to hear some of those on the air. More on that later.

The New Tubes

In the transmitter one needs not merely high-grade audio but lots of it—which is to say watts as well as fidelity. Whenever fidelity comes up the push-pull triode is still king and one should understand that any other audio output stage (modulator) is being used for just one possible reason—because one can't pay for the real thing. Off-hand it seems that Class B audio offers the best economy, simply because it produces the most audio watts output for a certain type of tube. However, its wandering plate current demands a plate supply with excellent voltage regulation. In a transmitter this supply MUST NOT be used to supply the oscillator and buffers or there will certainly be frequency b-minus line (which is perfectly possible with Class A) nor can it be taken from a resistor ANYWHERE IN THE B modulation. Thus in some transmitters the use of Class B audio might compel one to buy another plate supply which would be queer economy. In any case a conversion to Class B will probably call for a larger last condenser in the plate-supply filter so as to take care of the plate-current surges which were not present with the older Class A system. If this condenser is smaller than about 6 microfarads the percentage modulation will frequently be unsatisfactory. The provision of proper bias for the Classs B Stage is another problem. It can't very well be taken from resistance-drop in the

OPERATION OF PUSH-PULL PAIRS OF MODULATOR TUBES, ASSUMING 100% MODULATION OF CARRIER WITH 90% OF AUDIO CAPACITY OF TUBES IN USE

Tubes	Class of Operation	Plate Volts	Carrier Watts (Note 1)	% Distortion at Full Load	% With Audio Level Down (Note 2)	Plate Supply (Note 3)	Bias Volts	Bias Method (Note 4)	Bias Ohms for Method 1
'45	A	250	3.4	2.5	1	N	56	1, 2 or 3	750
'45	A prime	350	8.0	3	1	N	85	2 or 3	1,000
'46	B	425	22.0	6%	10 to 15	S	0	0	...
'10	B	500	27.0	6%	10 to 15%	S	60	3	N.G.
845	A	1,000	23.0	2.5	1	N	147	1, 2 or 3	1,000
'50	A	425	13.0	2.5	1	N	84	1, 2 or 3	750
'50	A prime	500	27.0	3	1	N	130	2 or 3	...
845	A prime	1,000	90.0	3	1	N	215		...
'59	A (triode)	250	7.2	3	1	N	28	1, 2 or 3	500
'59	A (pentode)	250	11.3	6	3	N	18	1, 2 or 3	700
'59	A prime (triode)	250	25.2	3	1	N	28	1, 2 or 3	500
'59	B	350	40.0	5	6 to 8	S	0	0	0

Note 1—Assuming that the tube is loaded 90%, that its output modulates twice as many watts of d.c. entering the plate circuit of the Class C tube (r.f. amplifier being modulated) and that the Class C tube has a plate-circuit efficiency of 60%. These figures are conservative.

Note 2—Audio input voltage 20% of that in the previous column, roughly equivalent to soft speech sounds.

Note 3—N means normal plate supply. S means separate special plate supply with 6 microfarad final capacity to take care of plate-current surges. This is necessary for full performance from Class B system without disturbance to r.f. positions of circuit, or preceding audio stages.

Note 4—Bias method 1 is by means of a resistor between chassis (b minus) and the filament center-tap. Method 2 is by a voltage divider in the plate-supply system. Method 3 is by separate supply—batteries, generator or low-impedance C sub. Method 1 not recommended for Class A prime though O.K. if used carefully.

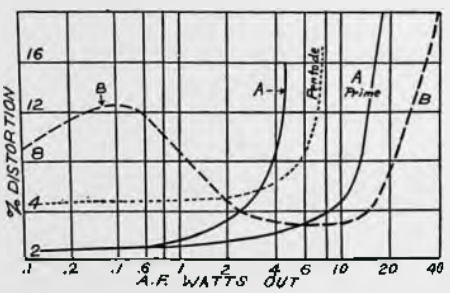


Fig. 6. Zenith's curves on the '59 tube's harmonic distortion when used in various ways. The R.C.A. figures differ slightly from this but it gives a good general picture of the probable performances of ANY audio output tube used in the three manners—i.e., "Class A, B or A prime."

SYSTEM without most careful filtering. One must accordingly resort either to the antiquated battery bias (which is costly in the long run) or else go to a separate rectifier-filter system with a low resistance shunted across it to prevent large voltage rises when the grid currents go up on the peak swings. Because of the necessity for a low resistance the device must consume more power than is nice and accordingly costs more than is pleasant. The real thing—manifestly—is a generator bias, since the resistance of a generator is very low. One can avoid a good deal of this refinement and still have a sort of near-Class-B such as is used in many broadcast receivers of this year's production—but one will decidedly NOT get out the number of watts named in the tube table.

Class A Prime

Most of the griefs of Class B can be avoided, by simply not attempting Class B at all but using tubes of such a size that the power can be obtained by less violent biasing and swinging—keeping within the limits in which the grid currents are small and the plate currents reasonably steady. This is a compromise between Class A and Class B and has been called "A prime," "Triple A" and "True Class A"—though the reason for the last name is not apparent. A comparison between the three schemes with common tubes goes about as follows:

From the table it will be seen that some tubes are especially attractive on account of their economy. Thus a carrier level around 25 watts with 100% of modulation can be had with a modulator system using the '46 in Class B, the '10 in Class B, the 845 in Class A, the '50 in Class A prime, the '59 in A prime or the '59 in Class B.

Comparison of modulators for a 25-watt carrier:

'46 Class B — a.c. filament, no bias needed, driver stage needed, special plate supply needed. Tube cheap. Distortion.

'10 Class B—a.c. filament, big bias needed, driver stage needed, special plate supply needed, tube fairly cheap. Distortion.

845 Class A—a.c. filament, can be auto-bias, no driver stage needed, no special plate supply needed, tube costly.

'50 Class A prime—a.c. filament, can be auto-biased, small driver stage needed, no special plate supply needed, tube fairly cheap.

'59 Class A prime—Indirectly heated to reduce hum, can be auto-biased, small driver stage needed, no special plate supply, tube fairly cheap.

'59 in Class B—Indirectly heated cathode to reduce hum, separate bias needed, driver stage necessary, special plate supply necessary, tube fairly cheap. Distortion high.

Now where Class B does not offer marked economies it should be rejected because of the greater distortion and other griefs previously mentioned.

One will notice immediately that the '59 Class B offers no advantage except a bit more output as compared to the '59 in A prime—hence one drops the Class B idea as concerns that tube. The Class B '46 and Class B '10 present about the same disadvantages, plus a good chance for plenty of hum—and they are discarded.

This leaves one considering the 845 Class A, the '50 Class A prime and the '59 Class A prime. The last presents all the advantages of the first, plus a lower hum, and a probably lower cost as the tube comes into more extensive use. The final choice therefore falls between the '50 Class A prime and the '59 A prime, with the latter as favorite. Details on this tube appear elsewhere in this issue of MODERN RADIO.

Next trip—The 1933 Antenna.

BUSINESS TOO GOOD

Cheer with us—because the "perpetual" Hatry set analyzer has again been postponed on account of a rush of business which is keeping L. W. H. from finding enough time to finish writing the story for this issue. Since it has been postponed once, and L. W. H. is an old newspaperman, you can imagine that the jam is a real one.

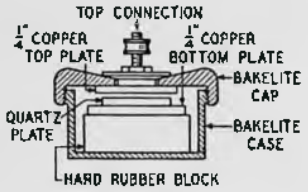
But in the February issue—by all the gods! !

Automatic Temperature Compensation for Crystals

By JOHN L. REINARTZ*

Having joined the great army of seekers after economy, even the small amount of current consumed by the heater for the maintenance of proper crystal temperature came under close scrutiny and had to follow other expenditures to the scrap pile. The story of how it was done may be interesting to some of you, so here goes.

It is not suggested that the device to be explained will take the place of heater control, it will however aid in the control of crystal frequency over that which obtains when the crystal is not temperature controlled.

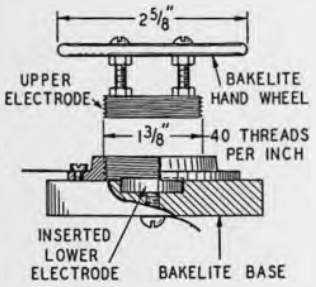


The self-compensating crystal holder that does the trick.

The idea is simply to compensate for the change in frequency due to temperature change by placing the crystal in a holder made of such material that the plate spacing changes with temperature so that this is accomplished. We go about it in the following manner: In place of the usual holder we substitute a bakelite case as from an old Baldwin ear phone, making use of the cap to allow for original adjustment of air gap between the bottom and top electrodes.

Instead of placing the lower electrode on the bottom of the receiver case we place it on top of material that changes with temperature to compensate for the frequency change due to this same temperature change. This can only be used on crystals of the Y cut, meaning crystals which have a frequency rise due to a rise in temperature. Such a crystal has a frequency change of 7 cycles per million per degree centigrade temperature rise. To compensate for this we will need some change in the air gap. Not knowing this amount we have to get at it by experimentation; we accomplish this by placing in the bottom of the receiver case enough peices of flat copper or brass so that we can adjust the air gap in the range that allows the crystal to oscillate. Next we adjust a receiver to dead beat with the crystal frequency, then we change the air gap over the crystal by giving the cap a twist in either direction enough to change the frequency by 1,000 cycles as noted by the proper key on the piano. Middle C is 256 cycles, the octaves above and below 128 and 516. Carefully measure the amount of movement of the cap necessary to accomplish this frequency change.

To aid in the understanding of the problem let us take a case of twenty-four threads to the inch. We find it necessary to turn this cap downward for three-sixteenths of an inch as measured along the outside circumference of the case. The case is two inches in diameter so we therefore moved downward .001245 inches for a change of 1,000



The Phelps type of Crystal holder shown here can be modified to be self-compensating, preferably by making the shell of bakelite and making it deeper to allow for insertion of the hard rubber block. The hand wheel may carry a scale, or be replaced by a bakelite dial.

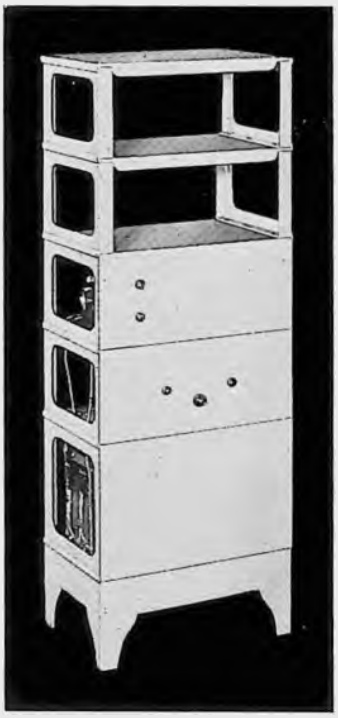
* Mansfield Center, Connecticut, also WCAC and WIXAM.

cycles. For the frequency range we are working in, namely the 3,500 kc. band, this should be at the rate of 7 cycles per degree per million cycles, a total frequency change of 24.5 cycles per degree centigrade. So we have to see what fraction of an inch change in the air gap will compensate for let us say 25 cycles. Then if .001245 inches change is equal to 1,000 cycles, one-fortieth or .0000311 inches change will do the work.

As we have a limited space in which to place the material which is to do the expanding we will have to use that material that has the greatest coefficient of expansion, hard rubber. Its coefficient of expansion is much greater than any other material that we could use and amounts to .000077 per degree centigrade. We now multiply .000077 by the thickness required to give us .0000311 inches expansion, this amounts to .404 inches or say .4 inches thickness. We therefore cut a piece of hard rubber to fit the inner diameter of the case and have it fit loosely. Carefully cut it to the required thickness of four-tenths of an inch and glue it down to the bottom of the case. Then we place over it a flat electrode of copper or brass which is glued down to the hard rubber. On this the crystal lies surrounded by a piece of stiff paper that has a hole cut in it in which the crystal lies to keep it from having too much room to move around in. The top electrode is of course mounted directly to the cover and provides the other connection to the circuit. The cap is now screwed down over the case and so adjusted that the air gap is within the range that allows the crystal to function. We make such minor changes to this air gap as are needed to start off with the proper frequency. This frequency should now hold quite closely for a considerable temperature change.

To be more exact we would also take into consideration the temperature coefficient of expansion of the copper or brass electrodes as they are part of the mounting. If the electrodes take on any appreciable thickness this should be done, figuring their expansion as added to the hard rubber. But as the bakelite case has an expansion factor which is nearly that of brass, and as its effect is in the opposite direction, they cancel out to some extent, the bakelite case having somewhat the better of it. It will therefore be possible to use as much as .5 inches of brass for electrodes to fill in if it should be necessary without overbalancing this factor.

A mounting such as has just been described has been in use at this station for over a year with splendid results, one such mounting contains a crystal that is used as a reference standard, checking weekly with WWV has shown errors in frequency of ten to twenty cycles at 5,000 kc.'s.



A wide variety of cast aluminum sectional frames, bases and panels is offered in widths of 15¼" and 19" by the Springfield Aluminum & Bronze Company, through T. F. Cushing of 345 Worthington St., Springfield, Mass. They assemble as shown. An assortment of cast aluminum cases is also made, with covers or recessed panels if desired. Machine work and engraving are done as desired by the customer.

Suggestion to Receiver Manufacturers

By Joseph M. Tasker

Manufacturers, in designing and constructing receiving sets, seem to give no thought to ease of repairs or replacement of parts, probably under the impression that these things are of no great importance. None the less they

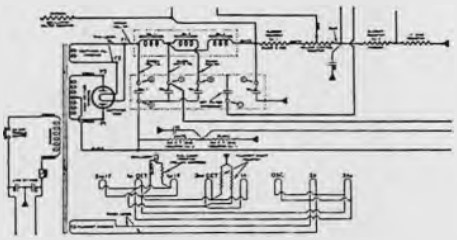
LET'S MAKE IT EMPHATIC!

ARE important, not only to the service man, but to the dealer, the jobber, and the manufacturer . . . which is to say, the whole industry.

Am I taking in too much territory? If so, let's make it emphatic by taking in some more and saying that frequently the follow-up is as careless as the original design—and just as costly to the manufacturer.

Now let's show why.

We will assume that the set has been sold and is back for service, which is no disgrace since there can't be any such



Part of a diagram—the rest is just as innocent of constants—which one large manufacturer furnishes as a guide (?) to service men. Just as you suspect, the color code is a secret one—but there's complete price list of parts and all you need to do is wait—and make the customer like it.

thing as a set which never needs service, certainly not at present prices. The serviceman, to work swiftly and economically must know all about the set—but—

"Service"—Eh!

First of all, a number of manufacturers, although they give diagrams, do not give any values (constants) for the parts, which, after all, is by far the most important part of a diagram (any decent service man can trace wiring). This is the case of one of the largest manufacturers in the business. He and the others are building up ill-will among service and sales people—and customers. It is easy to see why the man at the bench gets a headache in trying to keep repair costs down—and passes it along to the manager! As to the customer, when you take a receiver out for repairs the customer always asks, "When can I have it back?" But, if the service man finds a bad part and is given such poor manufacturer's follow-up as has just been

"WHEN CAN I HAVE IT BACK?"

mentioned, he neither has a replacement part, nor does he know the value and must substitute parts of other makes BY GUESS until the analyzer meters read right. How many service men and dealers have (or can afford) a complete set of all the possible parts and values? Not one in 50! This means looking up the part number and SENDING TO THE DISTRIBUTOR FOR IT. This takes from three days to three weeks. During this waiting time the customer is continually calling up and wanting to know "When can I have my radio back?" When he does get it back (no matter how little it costs or how good it sounds) he is "fit to be tied" and swears that the

next time he buys a radio receiver he will get one that the dealer guarantees can be repaired in 24 hours. The service man probably loses a customer and so does the manufacturer.

"Hay Wire"

Now, in regard to construction, just take the bottom off of any of the present day receivers and look at the tangled criss cross birdnest wiring, the resistors

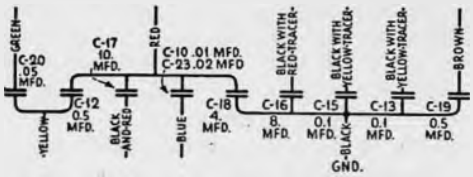
"WE LOOK FOR IT IN THE DIAGRAM"

placed on one strip and then faced TOWARD the casing and riveted about $\frac{1}{16}$ of an inch from it. How can I change a bad one? Find it first by violently removing the strip and soldering enough extra length into 20 wires so that you can see what you are doing, then maybe you will find the bad one. Ah! After only 35 minutes work we have found it —and it's open. You don't know the resistance value. Nobody knows but the manufacturer. The R. M. A. color code means nothing to him. We look it up on the diagram. It isn't given! Well, well, doesn't the manufacturer give us a pile of information?

The power transformers and choke coils are both in the same can and filled with compound. One has gone bad and you only have to wait three days (or weeks) for another from factory or jobber—or else melt out the compound and remove the good parts, if any. It is covered with tar and makes the whole receiver look and smell very bad and there's no place for it—whereas if the two parts were in individual cans, replacing either would cost just less and take much less time.

And then there are parts piled one on top of the other. All you have to do is remove the other nine parts, and there you have it! To change a PILOT LIGHT in a number of receivers you have to take the receiver out of the cabinet and partly disassemble it, which means to change a 15-cent part, will cost the customer almost 20 times that. And are they peeved?

Last but not least, today condensers are commonly placed together in one can filled with compound and they do not all have a common lead which means the same old story—either melt out all the condensers and take a chance of spoiling the others to get out the bad one, or put in a whole new can. The expense is practically the same in either case, due to the time involved in the former.



Here is the condenser pack used by one of the largest makers. It's all in the same tin can—and you are outside looking at the sealing compound.

All these things hurt the dealer and service man, especially now when prices have come down while the free service guarantee remains almost the same. On the other hand when the customer has to pay a big repair bill because a whole unit had to be changed he immediately is "set" against this make of receiver. When (or if) he buys a new one, he will not buy the same make.

You, Mr. Manufacturer, are in the end the biggest loser of the lot and perhaps that's fair enough—for you built these troubles into the set without thought of the dealer or service man.

Instead of taxing agencies being given further license to stifle industry, it perhaps is time for industry to interfere with incompetent government.

Henry Ford in "Christian Science Monitor".

A Useful Voltage Booster

By Richard F. Shea

One piece of apparatus that is almost indispensable in any up-to-date laboratory is a voltage booster, a device from which continuously variable voltage may be obtained so that voltages from 85 to 135 volts, and 170 to 270 volts may be obtained. Such a device is also of great utility in service shops, in order that proper line voltage may be applied to sets under test, or possibly a desired overload, in cases where excess heating is encountered. Therefore here are given details for the construction of such a device, with a suggestion of layout.

Figure 1 shows the wiring of this booster. The main thing is the auto-transformer, which is provided with a primary center tap, in order to obtain 220 volts, plus or minus, from the more customary 110-volt line. The details of this transformer are given below. It is to be noted that the secondary is provided with several taps, the center going to the high side of the primary, and that a heavy duty rheostat is connected across successive sections of the secondary by a tandem two-point switch, so arranged that the two blades are continually one tap apart. This may be accomplished by using two sections of switch, coupling them up mechanically, or by using two

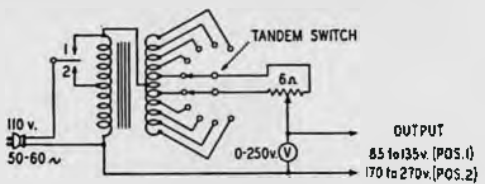


Fig. 1

rotating arms on the same set of taps, with the arms one tap apart. It must be remembered that these taps and switch blades will carry several amperes, so that the taps and switch blades need to be rugged and heavy, and to make a very positive contact.

Now for the auto-transformer. This is wound on a heavy core, approximately three inches in cross sectional area at the center. The primary has 220 turns of No. 21 enamel wire, centertapped, while the secondary has 240 turns of No. 18 wire, tapped every 20 turns. The insulation used on the secondary will more depend upon the method of bringing out the taps than anything else, as either enamel or cotton covering will have sufficient insulating properties for the winding, but cotton may be necessary if the winding itself is brought out, instead of soldering taps onto the winding. When the switch connects the input across the whole primary the secondary gives the lower voltage range, from about 85 to 135 volts, and when the switch is thrown to the other position the output voltage is about doubled. This is very handy as you often have 220-volt sets to test.

A transformer of this sort will handle up to about 175 watts, and thus is capable of supplying any standard set without trouble. The stunt of having the secondary potentiometer across one section only at a time has a real advantage over the use of a plain series resistance in either primary or secondary, as it provides continuously variable volt-

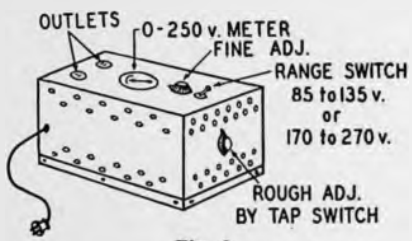


Fig. 2

age from tap to tap, one taking up exactly where the other left off, and thus expedites the use of this instrument.

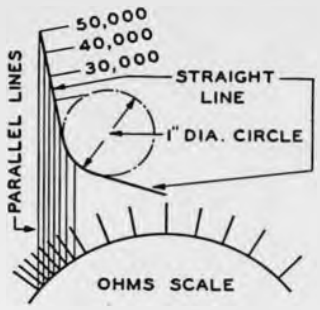
This 6-ohm potentiometer must be capable of handling at least 50 watts safely, and the use of asbestos insulated units, wound on a heat-radiating steel frame is recommended.

The switch for 110-220-volt change can be an ordinary toggle switch, or a knife or rotary snap switch. The small Weston a.c. 0-250 volt meter will usually be accurate for all ordinary purposes, and

(Continued on Page 26)

• METER TRICKS •

OHMMETER TRICK



This is a trick for "opening" the calibration of an ohmmeter at the crowded end of the scale. Although useful for any meter it is only accurate if carefully made and if the meter is of high accuracy. Make as above: First drawing a very careful reproduction of the scale on your meter being careful to avoid errors of dimension; if you have a draftsman friend have him do it. Then draw above the scale the arbitrary curve of straight lines and a corner circle as shown. Connect the arbitrary curve to the scale divisions by PARALLEL lines. The new calibration points on the new curve will be widely spaced and easily read between points. The parallel lines must of necessity be carefully drawn. This idea was first shown the writer by a serviceman in Hartford.

The Milliammeter as a Voltmeter: A series resistor must be used with a milliammeter if it is to be used as a voltmeter. This resistor will have so many ohms for each volt that is to be accounted for. Since a 1 ma. meter needs 1000 ohms for each volt, larger meters will need proportionately less: e.g., 50 ma., divide 1000 by 50 to get ohms per volt, and so on.

The Milliammeter as Ohmmeter: An ohmmeter is basically a voltmeter, i.e., a milliammeter with added series resistance. The series resistance needed is figured as for changing the ma. to a voltmeter, the battery voltage being the basis. But this resistor also determines the resistance range of the ohmmeter and in this way: The base resistance required for the battery voltage used will show in the center of the scale, the maximum resistance that can be read reliably will be 10 times this base resistance and the minimum resistance a tenth of it. E. g., 1 ma. meter, 4.5-volt battery, 4500 ohm resistor and an ohmmeter range of 45,000 ohms down to 450 ohms dependably; higher resistance and lower ones with unreliability. Another example—If need a 0 to 100 ohm meter 10 ohms will be at the center of the scale and the resistance of the meter PLUS the "base", or series resistance, must also be 10 ohms. The meter's current range by ohm's law must be $I = E/R$, that is, $I = 1.5/10 = .15$ amp. $= 150$ ma. The meter maker should tell you its resistance, add enough more to total 10 ohms. To lower the range of an ohmmeter: Decrease resistance and voltage or by ohms law increase the current through the resistor being tested. The latter offers the simplest way out for self-contained ohmmeters since their resistor is difficult to break into. To lower the range the total ohmmeter self-resistance must be lowered in proportion to the new scale wanted; if a tenth of original scale then the total final resistance must be a tenth of the original, e.g., 50,000 ohm ohmmeter shows 4500 ohms at dead center of scale and uses 4.5 volts, hence self-resistance is 4500 ohms. Needed 5000 ohms maximum as well, a tenth of 50,000. The self-resistance is now also a tenth or 450 ohms. Parallel the meter with a sufficiently low resistor so that the total of the meter and the external shunt are 450 ohms and so use the parallel resistor rule figuring 4500 ohms and an unknown resistor to equal 450 ohms when paralleled. Or figure this way: A tenth of the current divided between the two paralleled resistors passes through 4500 ohms and nine tenths through the shunt; hence the required shunt is one ninth of 4500 (9 times less resistance gives 9 times the current) or 500 ohms and 500 ohms shunt with 4500 ohms equals 450 ohms. Obviously the final result is a shunted meter taking 10 ma. instead of 1 from the battery, passing about 10 times as much current through the resistor being tested and giving throughout the ohmmeter's range just a tenth of its scale in resistance values.

GENERAL PURPOSE TRIODES

As Detectors and Amplifiers

TYPE	W X 12	50	112	199	201A	226	227	230	237	240
Bulb	T-10	S-12	S-14	T-8	S-14	S-14	S-14	S-12	S-12	S-14
Base	4 Pin	5 Pin	4 Pin	4 Pin	4 Pin	4 Pin	5 Pin	4 Pin	5 Pin	4 Pin
Pin No. 1	Grid	Grid	Grid	Grid	Grid	Grid	Grid	Grid	Grid	Grid
" No. 2	Plate	Plate	Plate	Plate	Plate	Plate	Plate	Plate	Plate	Plate
" No. 3	Fil. +	Fil. + or −	Fil. +	Fil. +	Fil. +	Fil. + or −	Fil. + or −	Fil. +	Fil. + or −	Fil. +
" No. 4	Fil. −	"	Fil −	Fil. −	Fil. −	"	"	Fil. −	"	Fil. −
" No. 5	None	Cathode	None	None	None	None	Cathode	None	Cathode	None
Filament V	1.1	2.5	5.0	3 to 3.3	5.0	1.5	2.5	2.0	6.3	5.0
Filament A	0.25	1.0	0.25	.06 to .063	0.25	1.05	1.75	0.06	0.3	0.25
Plate V. (Max.	135	250	180	90	135	180	180	90	180	180
Plate Mils	8	5	7.6	2.5	3	0.2	5	1.8	4.7	0.2
Grid Bias	− 10.5	− 13.5	− 13.5	− 4.5	− 9	− 14.5	− 13.5	− 4.5	− 13.5	− 3.0
Mu	0.6	13.5	8.5	6.6	8	8.3	9	9.3	9	30
Plate Resistance	15,000	9,500	5,000	15,500	10,000	7,300	9,000	13,000	10,000	150,000
Mutual Cond	410	1,450	1,700	425	800	1,150	1,000	700	900	200
Plate Load	18,000	37,000	10,000	15,500	20,000	10,500	18,700	15,000	20,000	250,000
Audio M. Watts	35	300	260	7	55	180	165	16	165	.....

CONDITIONS FOR BIAS DETECTION

Plate V	135	250	135	90	135	Not	250	90	135	180
Plate Mils	0.2*	0.2*	0.2*	0.2*	0.2*	So	0.2*	0.2*	0.2*	Small
Grid Bias	− 18	− 20	− 15	− 10.5	− 13.5	Used	− 30	− 7.5	− 15.5	− 4.5

The tubes in this table will operate as transformer-coupled grid-leak detectors, using ¼ to 5 megohm leaks and condensers of .0001 to .00025 microfarad capacity for broadcast reception (500 to 1500 ke., or .00005 for short waves. The plate voltage should not exceed 45 except for the 26 and 27 which may use 135 volts.

* The "no signal" current as read on a D. C. meter. This current increases with signal strength and may rise to 10 or even 20 times the value given.

REVIEWS

CQ, "The Commercial Radio Operator's Magazine," does a commendable job in each month recounting the work and problems of the members of the American Radio Telegraphist's Association—the men who work the transoceanic, ship-to-shore and broadcast stations on which all radio depends. Whether you know that life well, or whether it is all news to you—take our advice and send for a sample copy—or go ahead and subscribe for a year at $1.50, you will be pleasantly surprised twelve times then. The office of publication is at 20 Irving Place, New York, N. Y.

"World Wide Shortwave Reception"

World Wide Short Wave Reception, by James Millen, published by a National Company, Malden, Mass.

Though frankly a commercial booklet this 24-page publication is full of first-rate information for any amateur, whether he listens to shortwave broadcasts, or operates a station of his own. There seem to be no advertising exaggerations of any sort to mar the effect of a most attractive publication and—as far as we can tell—it is free for the asking. We advise you to ask.

"The Amplifier"

The Amplifier, whose cover carries the statement "The Amateur—First, Last, Always," is published at 600 Belmont Street, Portland, Oregon, with the purpose just mentioned, especially as it applies to the transmitting radio amateurs of the Seventh District, as a token of which it is distributed free of charge to all "sevens" asking for it. The rest of us must pay—50c a year. Isn't that proof of a friendly attitude? Well—so is the magazine.

Photocells and Their Application, Zworykin & Wilson, 300 pp., 180 illustrations, published by John Wiley & Sons, New York. Available through MODERN RADIO's Book Department at $3.00.

Like radio, photoelectricity began with Heinrich Hertz—and that in 1887. It is, if you please, related to radio by common parentage and may well intrigue the

(Please turn to Page 26)

A very simple single-control tuning arrangement for superheterodynes

By Harry A. Brooks*

The problem is to tune two bands of frequencies, so that there is a constant difference between the members of each pair of simultaneously tuned frequencies.

In the broadcast band, we will have to discard the lower oscillator setting, as there are no standard S. L. F. condensers having a greater ratio than 1500/500. The lower setting can be used for narrower bands, if desired.

Our oscillator frequency then, will equal the signal frequency plus the intermediate frequency.

If any two numbers are increased by the same amount, the ratio of the resultant numbers is less than that of the original numbers.

Any S. L. F. condenser may be used to tune a narrower band of frequencies, if its extent of rotation be reduced.

We will take a 270° condenser and gang it up with a 180° S. L. F. on the same shaft. The 180° will, of course, cover the band 550 to 1,500 kilocycles, a ratio of 2.7272 to 1; while the 270° will cover a band ⅔ as wide, or 2 1515 to 1.

We also know that the difference between the highest and lowest frequencies remains the same, no matter what the oscillator frequency may be.

Now, as the ratio is 2.1515 to 1, the number 1 must represent the lower frequency and subtracting that from 2.1515 leaves 1.1515 representing that part of the ratio equal to the difference, or 950 kilocycles. Dividing 950 by 1.1515 gives us 825,000 kilocycles as the lower frequency. Adding 950 gives 1,775 kilocycles as the higher frequency. A 270° condenser of 250 mmf. capacity will be about right and will require approximately 150 mh. to tune to 825 kilocycles. Our intermediate frequency will be 825 — 550 = 275 kilocycles.

By turning the oscillator condenser on the shaft we may select any intermediate frequency up to 750 kilocycles, using the same inductance.

The method described is theoretically correct, and, if followed carefully, should give exact tracking and not just an approximation.

A little thought will show how it may be extended to other tuning ranges and used for amateur bands as well as the 550/1500 kilocycle band.

* 617 Western Avenue, Glendale, California.

WESTERN ELECTRIC FREQUENCY MONITOR

The Western Electric broadcast-station frequency monitor works on a different principle from the General Radio device. The crystal-controlled oscillator of the monitor (accurately temperature controlled, of course) is on the SAME frequency as that on which the station is supposed to work. When the station wanders the result is a beat between the station and the monitor-oscillator, the two frequencies are fed to a detector and each time a beat-cycle occurs it operates a relay in the plate circuit of the detector.

The number of relay-operations per second is of course proportional to the beat-frequency—that is the station error. The relay has contacts which at each stroke of the armature charge a condenser and discharge it through a d.c. milliameter whose deflection is proportional to the number of these discharges per second—which of course is in turn proportional to the frequency error. Thus the milliameter can be calibrated in cycles-off-frequency. The information is from Mr. R. C. Higgy of WEAO, of the Ohio State University, Columbus.

In the General Radio device the idea is somewhat different. The monitor-oscillator is put off the station frequency by 100 (?) cycles and the station frequency combined with it and fed through a detector as before. However, the indicating instrument is a frequency meter, which stands at center-scale when fed 100 cycles—which is the normal difference. The two halves of the scale therefore are calibrated in cycles "above frequence" and "below frequency."

The Birth of a Notion

The late John Fizzlesnoot was ordained to the life of an inventor from birth. Both Mars and Luna were in the ascendent and the numerology of his complexes was exceedingly uniform in inclination.

The evidence of his bent became overwhelming at the age of 15, when he invented the combination corkscrew remover and crystal detector which he so greatly improved in the following two years that under his guiding genius it

Family Living Three Doors from Fizzlesnoot's.

came into universal use as a self-cleaning steering wheel and drove thousands of automobile mechanics to wiping their hands on the door handles instead.

The years until his maturity were spent in sharpening the tools of his intelligence in the leading schools of this country and Europe. It was not until 1930 that the fruit of the mature master mind ripened. Then the Fizzlesnoot name crashed the first page, and the first

Theatre About Three Miles from Fizzlesnoot's.

great Fizzlesnoot invention caused a complete upheaval in a major industry. It was in this year that he perfected the perfect soap. Let Dr. Fizzlesnoot himself state the facts:

"For centuries," he explained, "hair hygiene has demanded a soap that will not get into the eyes. At the age of 6 I dedicated myself to the development of such a soap." Strange expressions flitted over the great inventor's face and he smiled his rare smile. "Ah—youth! How easily you solve complex problems! I instantly decided that if the soap did not burn the eyes it would not matter if it did get into them—and that quick decision misled me for years. I easily devised such a soap—but my development displeased mothers. A soap so mild that sensitive eyes enjoyed it must be ineffective. Even infants in their tubs refused to eat soap without a kick. A

Roast Beef Served at Fizzlesnoot's.

half-wit should have seen these salient facts." The Doctor smiled again, as he said, "But eye didn't." There was a twinkle in his I.

Undaunted at the failure of Fizzlesoap, the Doctor's gigantic intellect turned its tremendous energy on the fundamental considerations of soap and out of his labor there arrived the ideal soap, now known as Snootsoap, which positively cannot be made to get into an eye. This utter and unprecedented invention revolutionized the soap industry and brought to it the great style advantages previously enjoyed by radio, automobiles and women's hats.

For two months the hard-earned reward of gold rolled toward the inventor and it seemed that his toiling was at an end, Then the lightning struck—RCA already had a patent on it!

(Maybe Part 2 follows)

AVERAGE PER-STAGE GAINS OF TUNED R.F. AMPLIFIERS WORKING IN 550-1500 K.C. RANGE

226 or 227, loss stabilized, 6 to 7.

226 or 227, neutralized, 10.

224 (depending on design), 30 to 50.

These gains are for a plate voltage of 180, and are exceeded at 250 volts, but fall off rapidly below 150 volts. Other triodes and tetrodes perform similarly. R.F. pentodes slightly exceed 224 performance.

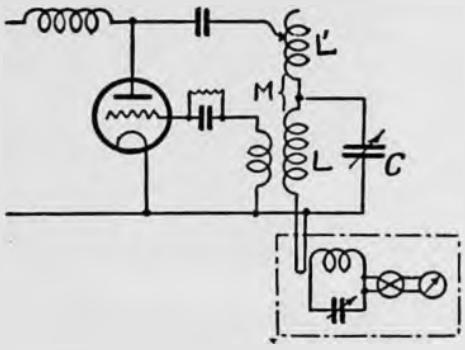
At short waves the 224 and similar tubes fall off gradually to a "low" near 10 meters, then rise slightly at about 5 meters. The 58 does not have this dip and slopes down more slowly.

At long waves (including intermediate frequencies) gains run from 50 to 120 per stage.

MODERN RADIO QUIZ-MATIC

This is another double-barreled quiz-matic—a trick one.

Part 1.—In the Kusonose harmonic eliminator shown LC is tuned to the working frequency, then the slider on L' is moved until the smallest second harmonic current is shown by the wavemeter (dashed rectangle) which is tuned to that harmonic. The adjustment of L' is fairly sharp (within ½ turn) and can reduce the second harmonic as much as 90%, which is better than a tuned trap will do at the same place. Now then—what is the action of the circuit?



Part 2.—Almost any antenna that isn't a loop, and isn't grounded at a high-current point must be called a "Hertz antenna." If you don't feel that way about it—just let it pass for the moment. Now then—we have a straight wire 1½ wavelengths long which we intend to use as a Hertzian antenna, and we intend to feed it by means of a single-wire feeder tapped directly on the antenna. Where is the tap to be located, need the feeder have any special length, and how can we tell when the thing is properly adjusted. You are supposed ot have a transmitter with some adjustment of frequency, the usual meters and lamps—BUT THE ANTENNA IS NOT VISIBLE FROM THE TRANSMITTER.

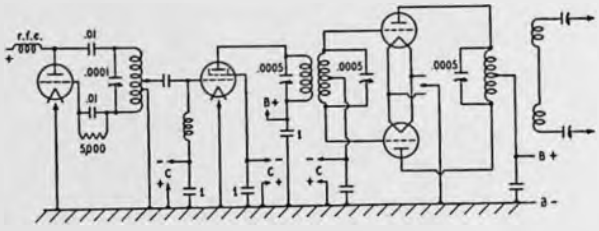
Island (Pioneer Instrument Co. and W2BRB) and to Leavenworth Wheeler of Yuma, Arizona (W5AHI and W5ZZT). Second prizes to Herb. Walleze (W8BQ for a lot of years), J. C. Lisk (W8EQ), G. F. Lampkin, Cincinnati, and Richard Howe (W2OAI). Crowding them closely were an astonishing crowd of others of whom we will list the first dozen, taken alphabetically. David Atkins, Piedmont, Cal., B. A. Currie, Los Angeles, T. J. Copeland, Port Arthur (W4AZM), Cyril Fossey, Salt Lake City (KDYL), E. Kahlert, Hollis, N. Y., H. A. Kline, Seattle (W7TS), E. W. Logan, Jr., Little Rock (KLRA), E. K. Miller, Bartlesville, Okla., E. W. Ruland, Natick, Mass., C. T. Stevens, Oakland, Cal., C. H. Vincent, Detroit (W8RD), Jack Wagenfeller, Philadelphia (W3GS), H. F. Washburn, Mt. Vernon, N. Y. (W2CL). Will the rest please pardon us for omitting their names and come again?

And now for the circuit itself—shown again herewith. Nobody spotted all the errors, which is no wonder, as there are many. Taken in the approximate order of their awfulness:

1—All sorts of r.f. returns are cheerfully dumped into the chassis instead of being returned to the proper filament directly. (Center-taps are indicated as usual in M. R. by an arrow pointing at the fil.) The 1 mike bypasses are "the bunque"—use .01 mica.

2—The buffer screen should show +D instead of —C. The tuning condenser should not exceed .0001 and a choke in the B+ lead does no harm. Resistance bias will increase stability.

3—Final amplifier needs grid resistors (100 ohms) for parasitic supression, but it does NOT need to be capacity fed, which would introduce more equipment. The grid tuning condenser is far too large and in fact can be thrown away entirely (only Glaser got this), and the Plate tuning condenser reduced to .0002 or .0001 with better output. Neutralization is NOT always necessary—many old broadcasting stations used similar circuits stabilized by the output load or a grid-coil ballast. However, neutralization is best. Second harmonic would be reduced materially if the plate-tank condenser were of the two-section sort with the rotor connected back to the filaments through mica stopping condensers.



As usual—a year's subscription for the most to-the-point answer, 6 months to the next four. Our judgment to be final.

November Winners

The November contest was so close that two first prizes go to Ed. Glaser of Bellmore, Long

And of course resistance bias—.

4—The oscillator tuning condenser should have a capacity between .0035 and .0007, plate stopping condenser not over .0005 and grid condenser not over .0001. The leak should be 10,000 to 15,000 ohms for a '10 or on up to 50,000 for a '45. (Why did almost everyone assume a '10?)

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How?—What?—Why?—Who?—When?

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

B—Additional questions, each..... .25

C—Schematic diagrams of battery-driven receivers up to 6 tubes, transmitters up to 5 tubes, antennas (other than beam types), switching schemes, metering, and power circuits of reasonable simplicity..... .75

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.

COMING!

THE SET ANALYZER THAT NEVER GOES OUT OF DATE.

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MODERN RADIO

PAGE	$40.00
½ PAGE	25.00
¼ PAGE	15.00
⅛ PAGE	10.00

RATE CARD ON REQUEST

(Continued from Page 19)

radio man from sentimental reasons alone.

Your reviewer knows little of this art, and is pleased that Zworykin & Wilson make no false assumption that the reader has previous knowledge. They start at the beginning, they explain clearly step-by-step right down to the present commercial state of the photo-electric devices. I found it enchanting reading. You will, too.

(Continued from Page 16)

a more accurate instrument can be plugged into one of the outlets, if desired.

Figure 2 shows a suggested layout of such a device which has been found very handy. The whole is contained inside a metal case, provided with proper ventilation holes. The voltmeter, knob for the potentiometer, switch for 110-220-volt shift and two female outlets are provided in the top. The control for the tandem selector switch, or rough control, projects from the end. This provides a handy, not too heavy unit, which can readily be transported as desired.

RADIO-ACOUSTIC RANGING

From a letter of Louis R. Huber we quote:

"Are you familiar with radio-acoustic ranging, or, as it is abbreviated, 'R.-A. R.'? If not, here is a brief description: The ship steams along at sea and at certain times throws overboard TNT bombs. The concussion from the explosion of the bomb travels through sea water at the rate of about 0.8 of a mile a second and, when it reaches the magnetophone (which is a piano unit inside a brass or aluminum cylinder, suspended several fathoms under water) at each shore station, is there amplified, and sends a dash by radio to the ship's receiver. The time of the bomb's throwing, the time of its explosion, and the time of arrival at each shore station is recorded on a moving tape; or rather the last three are; the first interval is clocked with a stop watch. By a simple computation the ship's position is determined with considerable accuracy, since the exact position of each magnetophone is known."

THE 59 UPO TUBE

7-Prong Big-brother to the 89

The 59, first introduced by Zenith, is intended to do the work of the fine old 45, also of the 46, 47 and 50 tube—with the 89 thrown in for good measure. To do this it must—like the 89—be able to work as a Class A triode, a Class A prime triode, a Class A pentode or a Class B triode. By referring to the detailed story on pages 10 and 11 of the August issue we see that the 89 triple-grid tube does this by using various grid connections, but is not big enough for Class A triode work, giving off less output than the 171 or 171A. To make the 59 bigger was necessary—though we doubt the wisdom of removing the top cap (input grid) and instead using a SEVENTH (!!!!) prong directly opposite the filament prongs.

However, let us "Look at the record."

General Data

Filament—2 amperes at 2.5 volts.
Plate—30-35 Ma. at 250 volts.
Base—New 7-prong type.
Output Class A equals 45 with higher gain.
Output Class A prime equals 45 Class A prime or Class A '50 with higher gain.*
Output as pentode exceeds 47 with slightly lower gain.
Output Class B exceeds 46 with improved gain for the two stages (driver and output stage).

* See "Modern Radio" for July.

The 59 as a Class A Triode

Grids No. 2 and 3 tied to plate, input to No. 1 (pin 7).
Plate 26 Ma. at 250 volts.
Grid No. 1 biased minus 28.
Mu 6.0.
Plate resistance 2400 ohms.
Mutual 2600 micromhos.
Power output 2 watts (per tube).
Power output A prime 14 watts per pair.
Lead resistance 5,000 ohms.
(When using autobias 500 ohms is correct for either Class A pairs or Class A prime pairs.)

The 59 as a Class A Pentode

Grid—No. 3 tied to cathode, No. 2 used as screen, input to No. 1 (pin 7).
Plate—35 Ma. at 250 volts.
Screen—10 Ma. at 250 volts.
Grid No. 1 biased minus 18 volts.
Load resistance 7,000 ohms.
Amplification factor 100.
Plate resistance 4,000 ohms.
Power output 3 watts per tube, 6.3 per pair.

The 59 as a Class B Triode

(Class A prime recommended instead)
Grid No. 3 tied to plate, input to grids No. 2 and 3 tied together.
Plate current, small until grids are swung.
Output per pair, 18 watts at 5% distortion, 22 watts at 8%.
Distortion at low volume rises to 12% or more as in most Class B systems, minimum distortion 3% in region from 3 to 10 watts output—too high for home use.

See page 10, this issue, for '59 curves, also see page 6, August "Modern Radio."

Short Circuits

• • •

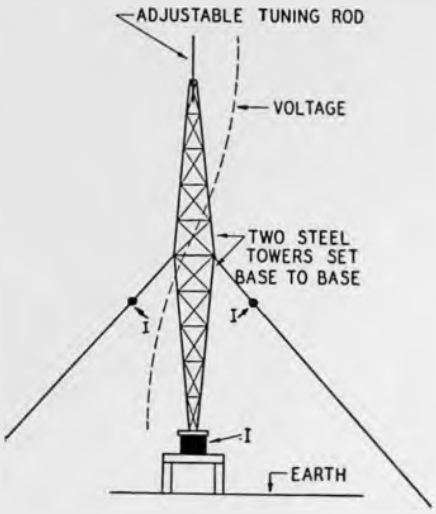
And—not in an F. R. C. report—we also hear that the New York police cars now go five times as far each week as in the good pre-radio days.

"BUT NOT FORGOTTEN"

Zeh Bouck says, "But why stop so soon?" and continues:

Sync spark gaps
CR3's
Greetings by radio (maybe)
Oscillation transformers
Bunnell
E. I. Co.
Electrolytic interrupters
Three-inch spark coils
Zinc gaps
Murdock
2PI (!)
William B. Duck
Modern Electrics
Slapp-Eastham
200 meters
Radio Broadcast
Loose couplers
VT1's
Loading coils (sky-scraper design)
Bus-bar wiring
Microphones, "property Bell Telephone Co."
Detector test buzzers
Honey-comb coils and duo-laterals
"Practical Wireless Telegraphy" by Bucher
WJY
Reflex circuits
The Eveready Hour
Cat-whiskers
Sliding variable condensers (abt 75% power factor)
Morse

This really appeared in a Massachusetts paper: LOST my job, forced to sell beautiful gent's one-quarter carat diamond ring, handsome setting, cost $115, sell for $35 cash or exchange for Browning automatic shotgun.

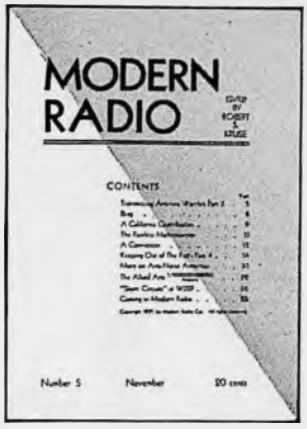


878 FEET STRAIGHT UP

WSM, of Nashville, now has the world's tallest antenna—878 feet! It is of the vertical half-wave type, the tower itself acting as the antenna in the fashion first used at WABC. The intention is to produce a strong ground wave and a weak sky wave—hardly the thing for DX freak records—but ideal for steady coverage. The sketch is not to scale but only schematic. I, I, I is insulation.

Richmond Times-Dispatch says that Buster Keaton's face is the only frozen asset that produces dividends.

Christmas Special



KRUSE! PHELPS! BATCHER! HATRY!—

Four well-known engineers, edit this "Modern Radio" magazine, make it the accurate, helpful and informative sheet it is.

Shorn of padding, concise in treatment, "Modern Radio" is as modern as its name. The busy man finds this compact, easily read, and well-filled journal the answer to his needs. Easy to carry, easy to read and of exceptional reliability, "Modern Radio" is the answer to your need for a magazine that gives a lot for a little time from its reader.

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Garvin Electric Co., Atlanta

ILLINOIS
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Chicago Radio Apparatus Co., Chicago

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Radio Electric Service Co., Inc., Baltimore

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H. Jappe Co., Boston
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Sager Electrical Supply Co., Boston

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Radio Specialties Co., Detroit

MINNESOTA
Lew Bonn Co., St. Paul

MISSOURI
Burstein-Appleby Co., Kansas City
Stone Electric Co., St. Louis
Walter Ashe Radio Co., St. Louis

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Kaltman & Kennybertz, Newark

NEW YORK
Blan, the Radio Man, Inc., New York City
Gross Radio Co., New York City
Leeds Radio, New York City
Roy C. Stage, Syracuse
Sun Radio, New York City

OHIO
Klodag Radio Sales, Kent
Northern Ohio Sales, Cleveland

OREGON
Northwest Radio Supply Co., Inc., Portland
Guy B. Paine Co., Portland
Wedel Co., Inc., Portland

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