THE TIME SIGNAL

IN THIS ISSUE: The 4-Tube Pathfinder, by Sidney E. Finkelstein; Coils for Short Waves, by J. E. Anderson; How to Make a Loop, by Herbert E. Hayden; New Style Terminal Strip, by Herbert Irwin.
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City ................................................. State ........................................
THE PATHFINDER

By Sidney E. Finkelstein
Associate, Institute of Radio Engineers

Part I.

The stability of a set that otherwise might be hard to handle is enhanced by the use of the toroidal coil, which is growing in popularity and which, when Winter comes, will be among the coils in commercial ascendancy. These coils, as is well known, have a very limited magnetic field, therefore, the chances of stray inductive coupling, which induces over-oscillation, are reduced almost to zero. Another favorable point is the mounting ease. And to that the attractive appearance of the toroid and you have a combination of reasons that compels you to give this form of inductance serious attention.

Early Experiments

When experimenters were pottering around with toroidal coils, before the present stage of efficient development, they found that type to have too high a resistance and, incidentally, distributed capacity in comparison with the inductive value. But by closely winding the turns at the inside and by other means already popular in the manufacture of such coils, the erstwhile evils have been eliminated, leaving the coil one which may be freely introduced in any type of circuit.

The toroidal winding was used in the circuit shown in Fig. 1 with fine success. This receiver is capable both of extremely distant reception and very fine volume. There are a stage of tuned radio frequency amplification, a specially sensitized detector stage, one stage of transformer coupled audio, and a final stage of transformer audio that is volume-controlled. The device used to control the volume is a high maximum resistance potentiometer.

Load Carefully Apportioned

On the radio side you have all the amplification that it is advisable to crowd into two tubes. The conventional tuned RF stage is followed by a detector input that utilizes some of the radio component of the detector plate output for sensitizing purposes, through the fixed condenser C4. This should be of very low capacity, say 0.001 mfd., and not the 0.01 or 0.002 mfd. instrument usually found in an equivalent position. While it serves a by-pass purpose it turns some of this salvaged radio current back to the grid of the detector tube, instead of just passing it around the batteries.

Simple Filament Wiring

The three ampiplifier tubes—one radio and two audio—are controlled, as to filament heating, by a 34-ampere ballast, R3, as the tubes are, like the detector, 201A-301A. The detector tube filament is governed by a rheostat, R1, which should be 30 ohms, instead of the more customary 20, because it is used as a volume regulator, but need be varied only when the set is tuned suddenly from a low wave to a high one, say from WRNY, 298 meters, to WEAF, 492 meters. Just a trifling in innumerable instances where this set is constructed only the switch need be manipulated to turn the set on and off as a unit, and the detector rheostat, once set, is left that way.

The tap N on the toroidal coil is used for connection to A+, the detector grid return.

The set, in actual operation, found its way about the air with such sureness that I called it the Pathfinder and the name has stuck in my family ever since. This was only ten days ago, to be sure, as any one familiar with the radio trade will notice that some brand-new apparatus is included in the receiver. These include the Erla audio-transformers and vernier dials.

Novice Can Make It

Anybody can wire the set, even the absolute newcomer in radio. The panel layout is shown in a photograph and the other views bring out very clearly the placement of the parts. The RF tube is at left rear, the detector tube is the one nearest the back of the panel, while the two without a volume control are found in alignment with the RF-tube, and make that alignment read, left to right, as one stands at the front of the panel, RF, first AF and second AF.

The photographs were taken after the set was partly dissembled, so that the wiring would not obscure the view.

Strong Amplification

The potentiometer should not be omitted, because the audio transformers amplify so strongly it is well to have some easy adjustment at hand to cut down volume on some of the local stations. Nearly every one living in or near a large city finds considerable disparity in volume, as among the several stations, hence a blasting effect may be introduced in any receiver by too close a station, and it is hard to get rid of this simply by manipulating the radio input, e.g., vary a rheostat setting. Then again, when a far-distant station is being received, one desires all the volume possible, consistent with clarity, and that is when the strong amplification is needed. One might have three stages of audio coupling and use two without a volume control, plugging in the third stage for extra volume, but that would mean an extra tube, and the

SIDNEY E. FINKELSTEIN

THE AUTHOR shows the rear view of the set and points to the interstage coupler, L3L4.

FIG. 1, the wiring diagram of the Erla Pathfinder, constructed by Sidney E. Finkelstein.


Vol. VIII, No. 6. Whole No. 187. October 31, 1925 15c per copy, $8.00 a year

www.americanradiohistory.com
Pathfinder Easy to Wire

TOP VIEW. The sockets are RF, left rear; detector, center foreground; first AF, center rear; second AF, right rear.

potentiometer-control method, combined with two high amplification transformers, is a more satisfactory and economical solution.

It appears that the panel has on it only the switch, rheostat knob, jack, potentiometer knob and two dials. The potentiometer is the Centralkah 500,000-ohm type (0.5 neg.). As for the other items, the grid leak and grid condenser are a unit, known as the Daren Leckandenser, also something new. The leak is 2 megohms (2,000,000 ohms). It is of the fixed type.

C4 should be a very high-class condenser. The Sangamo is excellent to use here.

To wire the set, consult the photographs and the wiring diagram, study them carefully, then drill the panel, which should be 7x21", and mount the panel parts. The photographs show the Erla SLW condensers.

The Wiring

First connect A minus to one side of the ballast R1 and to one side of the rheostat R1. Connect the other side of the ballast to the three amplifier sockets' F— posts. These are tubes 1, 3 and 4. outside the set.

LIST OF PARTS

Two circloid coils, L1, L2, L3.4. Two .0035 mf. variable condensers, C1, C2.

Two vernier dials.

Four sockets.

One grid condenser, .0025 mf. (or less) C1.

One grid leak, 2 megohms, R2.

One .0005 mf. fixed condenser, C4.

Two audio transformers.

One single-circuit jack.

One 2x2" socket, 1/2".00025 baseboard.

One A battery switch.

One 30-ohm rheostat.

One 3/4-ampere ballast resistor.

One 500,000-ohm potentiometer.

left to right in Fig. 1. Then join the other side of the rheostat to the F— post of the detector socket. Join A+ to one side of the battery switch S, the other side of this switch going to the F— post found on all four sockets. This completes the filament wiring.

Join F of the aerial transformer to the aerial and B to ground. G goes to grid post of the RF socket and to the stator plates of C1. The open end of L2, marked E, goes to A minus and to the rotor plates of C1.

When to Connect B—

P of the interstage coupler goes to the plate of the RF tube. The B post goes to B+ No. 1, 45 volts. G is connected to one side of the grid condenser and to the C2 stator plates, while F is connected to the rotor plates of C2 and to one side of the .0001 mf. fixed condenser, C4. The other side of C4 goes to the detector plate. A+ is connected to the tap N, which in other circuits is used for neutralization.

On most of the detector panels, already connected to C4, also goes to the P post of the first AFT, the B post of which goes to B+ No. 1, 45 volts. The G post of the first AFT goes to the grid post of the next socket, the F post of AFT to A minus. The P of the third socket gets its grid post from the other terminal of the potentialmeter, the other terminal of which goes to the F post of AFT and to A minus.

The arm of the potentiometer goes to grid of the last socket whose plate connects to one side of the jack J, the other side of the jack going to B+ No. 2.

This accounts for all the wiring, except the grid leak, which, because a unit is used, is automatically included, and except B—, which is connected to A— only when it is found the tuning is not satisfactory and interference is encountered.

(Part II, the conclusion, will be published next week)

Redistribution of Stations Favored on Population Plan

By Thomas Stevenson

WASHINGTON.

The great big problem with which the Fourth National Radio Conference, which opens November 9, will be confronted is the wavelength situation. The future policy of the Department of Commerce in handling the wavelength problem probably will depend on the conference recommendations. An effort will be made to have Congress incorporate the recommendations into legislation, but whether this succeeds or not Secretary Hoover will follow them as closely as possible.

There are three phases to the wavelength problem.

(1) Providing new wavelengths for additional stations which are either under construction or contemplated.

(2) Redistributing wavelengths in order to decrease interference.

(3) Low waves.

Little consideration can be given at the conference to disappointed applicants for wavelengths. Secretary Hoover has let it be known pretty generally that there are no wavelengths except in class A, and these are nearly exhausted. Stations which have been constructed recently have received warning that it would be at the risk of being unable to get a wavelength.

There is a feeling that the present allocation of wavelengths constitutes an injustice to certain cities and parts of the country. A notable example of this is Baltimore. This city is the eighth largest in the United States. It does not possess a class B station. There were no applicants until recently, but with the erection of a class B station in Baltimore, the city feels that it is entitled to a class B wavelength.

It is felt that there should be a redistribution of class B wavelengths and that they should be divided proportionately according to population among the largest cities where the best class of entertainment and instruction are available.

Suit of the best efforts of radio supervisors and the Department of Commerce, the present arrangement of stations results in interference. Complaints testify to this fact. There are too many stations for the existing other channels. If a wider separation between stations were provided it is believed interference of this type would be considerably lessened.

It is believed that the conference will go away with the present classification of stations. In the future, stations will be divided into two classes, the higher and lower power classes. No specific wavelength will be provided for either class. Stations will be assigned wavelengths wherever it is found they will work with the best results.

There has been a lot of talk of commanding the band between 150 and 200 meters for broadcast purposes. This band is now used by the amateurs. But until sets are produced which will tune that low, there seems little if any use of the band will be made.

One outstanding feature is that the conference probably will recommend a limitation of stations, and Secretary Hoover, in turn, may make such a suggestion to Congress. Plans on this point have not yet been finalized, but any plan under such a scheme each section of the country would be given a certain number of wavelengths, according to population.

If this plan were adopted, Secretary Hoover believes that future applicants for licenses should be called upon to show reason why they should be permitted to operate.

(From, 1925, by Stevenson, Radio Syndicate)
A Snap-Catch Terminal Strip

By Herbert Erwin

The wish for greater flexibility of use than is afforded by the general run of terminal strips is the demand of many fans. I base this assumption on the fact that I have often wished that I could more readily disconnect the battery leads from the terminal strip. To fill the gap several suggestions have been put into practice, some of them commercially, like the multi-plug. Confining ourselves, however, to the idea of a strip, we may use the snap catches that are usually sold to women for dressmaking purposes.

What You Need

The object of our endeavor will be to make a strip like that shown in Fig. 1. The little upright extensions of the base are rounded, so that when the head is pressed on the contact is firm, yet when it is desired to disconnect the wire all one need do is to lift up the head, since the rounded extension yields readily.

To make this outfit we need a hard rubber or Bakelite strip, say 7" long x 1½" wide, the snap catches and seven screws and seven nuts, about 6/32. The screws should be about 1/2" long. Also you will need seven lugs.

In Fig. 2 you see what the snap catches look like when bought by the dozen for a few cents. They come mounted on cardboard. In Fig. 3 is shown the more conventional purpose for which they are used.

The First Step

The first thing to do is to drill the strip, making seven holes ¾" apart at centers. Then at extreme right and left, on a central line, drill two more holes. These two will be for wood screws to mount the strip on the baseboard. Usually extension bushings are used, so that the under part of the strip is kept safely above the baseboard level. The drilling operation is shown in Fig. 4.

Now we come to an optional point. If only the battery leads are to be easily removable, seven snap catches are needed—one for each hole, granting that aerial and ground are included, as is the case of the seven holes are employed in the conventional manner. But you can make the leads from set to strip removable, too. Fig. 5 exemplifies this. The set lead is soldered to the lug, hence this snap head may be lifted off the base at will. In Fig. 5 the lug is mounted one way, while in Fig. 7 it is mounted upside down, so to speak, but you may select your own method.

The soldering operation necessary for the double-duty purpose—which object requires 14 snap-catches—is as follows:

(a), solder snap base, which looks like a collar button, to the flat head of a machine screw, as in Fig. 6; (b), insert screw in drilled hole on strip; (c), fasten down knurled locknut; (d), solder collar button to free end of screw; (e), solder lug to ring of snap catch; (f), solder set leads to lugs; (g), solder external leads to new circulgr heads of snaps. Be sure to solder. Any play may be taken up by extra nut or washers. Even cardboard washers will do.

These operations are for double duty service, but either set of leads may be made removable, instead of both.

Soldering Tips

In soldering take care to heat the catch sufficiently, that is, first hold the soldering iron against it, as the metal must be heated to the same temperature as the flowing solder before a joint can be made. If any difficulty is experienced in making a success of the soldering job, apply some solder to the catch first, timing it in this manner, and allow this to cool off. Then do the same thing to the head of the screw. The next operation will be to hold together, with the aid of the pliers, the two things that are to be soldered together. The solder that has been placed on both of them will be amply sufficient for the joint, and usually not even a speck of extra flux will have to be added.

Shielded Underground, Antenna Cuts Static

CHICAGO.

Elimination of atmospheres and interference caused by "man-made static" has been furthered within the last year or so through additional experiments with underground antenna for fixed radio receivers.

Experiments conducted over a number of years by several prominent radio men have developed that while an under-ground antenna does not down interference, including that caused by some of the electrical inventions of man, there is a drop in volume.

The underground "aerial" consists of a buried wire which has been carefully insulated so as to exclude dampness. Sometimes this wire is buried in the form of a spiral and at others it is laid in a long trench.

Greater success has attended the system when the insulated wire is encased in a metal shield, which, of course, is grounded, giving what is known as a condenser effect aerial. This shield tends to keep from the receiver a large part of the static and other interference, permitting clearer reception and at times louder signals.
How to Make a Simple Loop

By Herbert E. Hayden

Photographs by the Author

In compliance with the many requests received from RADIO WORLD readers, I built a simple loop and photographed

It may be used with any receiver, which requires a loop for picking up elec-
tro-magnetic energy, instead of the out-
door antenna. Since a great many of the
sets are at present equipped with .0005
mfd. variable condensers, this loop was
made for those condensers. How-
ever, those who have a .00035 mfd. vari-
able condenser will be able to use this
loop by adding three extra turns of wire.
This will be discussed later.

In Fig. 4 we have the completed oblong
loop, which stands three feet in overall
height. This includes the base, the loop,
the length of the stick holding the center
of the loop, and the loop proper, which
has 2 ft. arms.

Selecting the Material

The first thing to do is get all your
material together. You will need a small
vise. This can be purchased in the hard-
ware store for less than $1. You can
purchase a much cheaper one, but it will
not stand the strain and will crack. Now
get three dowel sticks, which are 2 ft.
each in length and about 3/4" in diameter.
See that the wood is tough and the type
that will not absorb moisture very easy.
A good wood to use is birch. This might
be difficult to obtain. If you have had
hard luck and cannot get it take the next
bet, white pine. This will suit the
purpose.

By treating it with several coats of
shellac, the wood will become a bit
tougher. Don’t do anything with the
wood until you have made all the neces-
sary slots and holes. Next get the base.
This may be of the same wood. It can
be circular or square. It is 2' in width
and 1 foot in circumference or square, whichever the case may be. The wire
with which the loop is wound is next
obtained. This is No. 20 double cotton
covered.

There are several tools required.
A small breast drill with some 3/4" drills,
a hack saw, which is 12" long and carries
a 12" saw, with about 9 teeth to the inch,
a 12" ruler and a counter sink 3/4" drill
comprise the list.

A 2" long machine screw with nut is
needed, too.

Making the Arms

Now take the dowel sticks. Screw one
of them in the vise. Get your ruler.
Measure off 11 3/4" from each end. This
means that in the center between the two
marks there will be a 1" box. Now mark
down 3/4" from the side circumference on
both sides. Now take your hack saw
and saw out this portion which is 1" in
length and 3/4" in depth. Fig. 2 (top)
gives you a clear view of the sawing out of
this portion. Do the same with other dowel
stick. Now take the two sticks, and see
if these square portions fit snugly. That
is, one is placed at an angle to the right
angles to the other, and they are both held
tight by these notches. Now take one stick
and again put it in the vise. Exactly in the
center of the notch drill a 3/4" hole. Do
the same with the other stick. Take them
both out. Fit it in through these holes. Now take the third
dowel stick. Eleven and three-quarter
inches from the end (either end) drill a
3/4" hole. Again take one of the dowel
sticks and place it in the vise.

Measuring Notches

Place the ruler on the side of the dowel
stick. Now, you can start marking the
slots right off the edge, as is shown in
Fig. 5, or you can start 1" from the edge
and make the slots. The latter is shown
in Fig. 1. Whichever manner you may
follow, make 14 marks, 3/4" from each
other. Now take your hack saw and make
small 3/4" gashes, where ever there is a
mark. This means that there will be 14
notches. Now on the other end of
the same dowel stick, do the same. Mark
off the 14 points, and then make the
gashes. There will then be 28 notches
in this dowel stick, 14 on each side of
the 1" center notch. Take this dowel out
of the vise and place the other one in. Make
14 notches on one end 14 on the other
end, in the same manner that the notches
for the other stick was made.

Now take the circular or square base
and exactly in the center drill a 3/4" hole.
This hole extends three-fourths of the
way through the block. In other words
the hole is 3/4" deep. Into this hole the
dowel stick which has no notches in it
is placed. Take the two sticks with the
notches and place them so that the center
notches fit. Now take the stick without
the notches, and place the center hole up
against the holes of these two sticks.
Run the screw through these three holes.
Take the nut and tighten it down. You
should now have a strong frame. Place
the center stick in the hole of the block.
Now take the wire. Run a wire around
either end of the three notches. Now run
the wire up vertically, and then through
the notch on the cross stick. In this man-
ner make 14 turns. Run the end of the
wire around the stick twice.

Garage a Radio Church,
General Waits for “Gas”

WASHINGTON.

In the autumn number of Cathedral Age,
published by the Washington Cathedral,
stories are told concerning actual members
of the congregation which “listen in” on
the services at the cathedral broadcast
on Sunday afternoon.

A Washington General, driving down a
dusty Maryland road a few Sundays ago,
was informed by the chauffeur that the
gasoline was getting low. They stopped
in front of a wayside garage and tooted
the horn in vain. Finally both walked
into the building.

As they stepped across the threshold
of the place they halted. Fifteen or twenty
men, some in working jumpers, others in
Sunday black’s, were standing silently
in a group with their hats in their hands.

Through the garage echoed a sonorous
voice, in prayer.

As the General stood there a man stepped
up and said in a low voice:

"We cannot serve you now, sir; the
bishop is praying."

He pointed to the loud-speaker on the seat of a rusty old Ford. Off came the
General’s hat, followed by that of the
chauffeur, and then the worshipers in
this radio church.

After the bishop had pronounced the
benediction the garage owner explained:

"You see, sir, there is no church within
ten miles of this place, so the neigh-
borhood men have gotten into the habit
of coming in here on Sundays to
hear the cathedral services. We never
sell while the garage is a church."

FIG. 1.

FIG. 2 (top): FIG. 3 (bottom).
Wind 14 Turns, Tune In!

FIG. 4 (top); Fig. 5 (center); Fig. 6 (bottom).

make, which is much simpler. This is shown in Fig. 9, bottom view. Here only two dowel sticks are used. The center one which had no notches in it is laid aside. This loop will work just as good as the one just described, with same capacity condenser. The only difference between the one just described so fully, and the above is that it takes the shape of a box, while the other takes the shape of a diamond. This is not to be confused with the box-shape loop, in which the windings are made on a 2" flat surface. This is then attached to dowel sticks, and unlike this one is not a direct portion of the stick proper. There are 14 turns on the diamond-shaped loop, using the same sized wire.

FIG. 7 (top); Fig. 8, Fig. 9 (bottom).

Eight New Stations
WASHINGTON.

Eight new class A broadcasting stations were licensed by the Department of Commerce and one station was transferred from class A to B. The new stations:

<table>
<thead>
<tr>
<th>Station</th>
<th>Owner</th>
<th>Location</th>
<th>M.</th>
<th>W.</th>
</tr>
</thead>
<tbody>
<tr>
<td>KFYD</td>
<td>N. Baker</td>
<td>Muscatine, Iowa</td>
<td>256</td>
<td>250</td>
</tr>
<tr>
<td>KSO</td>
<td>A. A. Berry Seed Co.</td>
<td>Clarinda, Ia</td>
<td>242</td>
<td>500</td>
</tr>
<tr>
<td>WGTB</td>
<td>Geo. H. Bowles Developments, Clearwater, Fla</td>
<td>266</td>
<td>500</td>
<td></td>
</tr>
<tr>
<td>WBT</td>
<td>Charlotte Chamber of Commerce, Charlotte, N. C.</td>
<td>275</td>
<td>250</td>
<td></td>
</tr>
<tr>
<td>WABT</td>
<td>First Universalist Church, Bangor, Me.</td>
<td>240</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>WMAL</td>
<td>M. A. Leese Optical Co.</td>
<td>Washington, D. C.</td>
<td>2126</td>
<td>15</td>
</tr>
<tr>
<td>WWAO</td>
<td>Michigan College of Mines, Houghton, Mich.</td>
<td>263</td>
<td>150</td>
<td></td>
</tr>
<tr>
<td>KFOJ</td>
<td>Moberly High School, Moberly, Mo.</td>
<td>242</td>
<td>10</td>
<td></td>
</tr>
</tbody>
</table>

Class A to Class B

WOQ—Unity School of Christianity, Kansas City, Mo. | 278| 1000|

What Station Is This?

Hook-Ups! A lot of them, some of which are sure to suit your purpose, appeared in RADIO WORLD dated Aug. 15. Get a copy, or start your subscription with that number. RADIO WORLD, 145 West 45th St., N. Y. C.

www.americanradiohistory.com
Winding Data for Short Waves

By J. E. Anderson
Consulting Engineer

A HIGH-FREQUENCY coil should be wound in the shape of a circular solenoid a little longer than its diameter, with heavy wire, with a minimum of solid insulation, and with the turns well spaced. It should be a circular solenoid because this shape gives a greater inductance to resistance ratio than any other form of winding; it should be little longer than its diameter because the distributed capacity is proportional to the diameter and independent of the length of the coil, and of utmost importance to keep the distributed capacity down to a minimum, it should be wound with heavy wire because the high frequency current travels only over the surface of a conductor, and a heavy wire presents a greater surface. It should be wound with as little solid insulation as possible because solid dielectrics increase the distributed capacity somewhat and very greatly increase the losses; and it should be wound with the turns separated because this reduces the distributed capacity and the losses.

Suitable wire sizes for high-frequency coils are from No. 20 to No. 12 copper, preferably bare, but if this is not available, then with single silk or cotton insulation. These sizes are rigid enough so that a coil wound with them will be nearly self-supporting, or if required very little solid support to give them adequate strength and permanence. The separation between any two adjacent turns may be equal to or less than that greater than the bare wire diameter of the conductor.

An Efficient Coil

A good high-frequency coil may be made in the following manner. On a circular cylinder of the proper diameter and requisite length cut iron from six to nine narrow grooves axially and at equal angular separations. The iron may be made of hardwood, with the convex surface polished a little. The grooves may be about 1/16" wide. Cut strips of this celluloid just wide enough to fit into the grooves, and adjust the depth of the grooves so that the celluloid extends above the surface of the cylinder just a trifle. Fasten the strips with glue or with small tacks. Then wind the wire over the cylinder, spacing carefully. Erect a good deal of tension on the wire and make sure that there are no kinks in it. When the correct number of turns has been wound on the cylinder fasten the terminals securely. Then paint over the celluloid strips with a solution of celluloid in amyl acetate. The celluloid solvent will soften the strips allowing the wire to sink into the celluloid a little, and the celluloid in solution will unite with the strips and securely bind the wire. When thoroughly dry carefully remove the coil from the cylinder and trim. This will make a coil which is practically self-supporting, and will be about as low-loss as it is possible to make it. Coils of large diameter and small wire require more celluloid strips than coils of small diameter and heavy wire. Coils of low inductance intended for the higher frequencies should be made of heavier wire, since the higher the frequency the more conducting surface is required.

The Ranges

If it is desired to cover the short wavelength range from about 200 to 20 meters it is not practicable to use a single coil or a combination of coils and condenser which gives a high capacity to inductance ratio. "A High Inductance to Capacity Ratio gives Louder Signals."

Coil Winding Table for High Frequencies

<table>
<thead>
<tr>
<th>Diameter Wire</th>
<th>Turns</th>
<th>D to A Ratio</th>
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<tbody>
<tr>
<td>3/16&quot;</td>
<td>14</td>
<td>1.28</td>
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<tr>
<td>3/16&quot;</td>
<td>14</td>
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<td>3/16&quot;</td>
<td>14</td>
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<td>20</td>
<td>0.60</td>
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<td>2/20&quot;</td>
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<td>0.55</td>
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<tr>
<td>2/16&quot;</td>
<td>16</td>
<td>0.52</td>
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<table>
<thead>
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<th>Diameter Wire</th>
<th>Turns</th>
<th>D to A Ratio</th>
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<tbody>
<tr>
<td>1/2&quot;</td>
<td>14</td>
<td>1.12</td>
</tr>
<tr>
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| [Key: L = inductance; D = diameter of form; A = axial length of winding] |

Setting capacity of 50 mfd. be assumed, again, the lower limit in this case will be about 75 meters. To go lower than this another coil will be required. The next coil should tune up to about 80 meters with the given condenser. This 5-meter overlapping is required to make sure that no such wavelength will be skipped. The required inductance in this set of coils will be 5.14 microhenries. If a minimum capacity of 25 mfd. be assumed, the lower tuning limit will be about 22 meters.

Using the .0005 Mfd.

If the maximum capacity in the circuit is 25 mfd., then with the inductance to tune up to 200 meters is 45 microhenries. Assuming a minimum capacity of 50 mfd, the lower limit will be about 90 meters. The next coil should tune up to about 95 meters. This re-
How to Cover the Wave Ranges

quires an inductance of 10.2 microhenries. The lower limit of this coil will be about 30 meters, with a maximum capacity of 20 mmfd. Another coil will be needed, and this should tune up to about 35 meters with the 250 mmfd condenser. The required inductance is about 1.2 microhenries. This coil will tune way below the 20 meter mark.

If the tuning condenser used is such that the maximum capacity is 125 mmfd, the required inductance to reach up to 200 meters is about 100 microhenries. If the minimum capacity is 20 mmfd, this coil will tune down to 53 meters. The next coil should reach up to about 55, requiring an inductance of 68 microhenries. The wavelength of this for 50 mmfd, in the circuit is 37 meters. The upper limit of the next coil should be about 40 meters. The required inductance is 3.6 microhenries. This coil will tune down below 20 meter provided the minimum capacity in the circuit is less than 3.1 micromicrofarads.

Although a minimum capacity of 50 mmfd was assumed in most cases above it will be much less than that, and if a slow motion attachment to the condenser is used it is practicable to tune much lower with a given coil than the lower limit given. This would require a fewer number of coils. This is particularly true of the last condenser. Let us obtain another series of coils for this condenser by the assumption of 25 mmfd minimum capacity. The first coil is the same as above, namely, 1.2 microhenries. In this case it will tune down to 90 meters. The next coil should tune up to 95 meters. This requires an inductance of 20 microhenries, and this coil will reach down to 42 meters. The next coil should reach up to 45 meters, requiring an inductance of 4.6 microhenries. This will just reach down to 20 meters.

Summing up, With a 500 mmfd condenser the required inductance is for 3.2 microhenries and the wavelength range is from 200 to 63 meters. With a 350 mmfd condenser the required inductance will be 32.2 and 5.14 microhenries with a combined range of from 200 to 22 meters, with overlapping of about five meters. With a condenser of 250 mmfd, capacity the required inductances will be 45, 10.2, and 1.2 microhenries with a combined range of from 200 to 20 meters, with ample overlapping. With a 125 mmfd condenser the inductances required are 90, 20, and 3.2 microhenries, with a combined range of from 200 to 20 meters. This last is on the assumption that the means were for each coil 25 mmfd. Instead of 50 as in the previous.

Below will be given the turns and diameters for a combined range of 90, 45, 32.2, 22.5, 20, 10.2, 5.14, 4.6, and 1.2 microhenries. In all these coils it is assumed that the spacing between turns is equal to the bare wire diameter of a particular wire used in the given coil. The turns are given to the nearest half turn. The diameter given is the outside diameter of the coil, that is, the distance from the center of the wire on one side of the coil to the center of the wire on the other. The difference between the diameter of the cylinder upon which the coil is wound and the true diameter of the coil is quite considerable when the diameter of the wire is large or when the diameter of the coil is small.

The SLF Dial Explained

As to Action and Purpose

For a long time it has been realized that radio users have one serious drawback: tuning is extremely difficult, especially at the lower wavelengths where the various stations are crowded together on the dial, while in the high wavelengths they lie far apart.

This is caused by the fact that broadcasting stations are spaced according to frequencies. Every station, in order not to interfere with its channel neighbor, needs a frequency band of 10,000 cycles (10 kilocycles) of its own. Now, in tuning at the lower dial settings a small change in condenser capacity will cause a great variation in the frequency to which a tuned circuit responds, while a considerable change in condenser capacity is needed for the same frequency variation at the higher dial settings.

Hence, with ordinary condensers, the readings of the dial will not correspond to the variation in frequency, and the matter works out in such a way that at the lower settings of the dial the stations are crowded.

This problem may become even more acute when space will have to be allotted to more stations, because this may be done by assigning to the new stations wavelengths below 200 meters, which means lower numbers on the dial.

As a result of the above considerations some manufacturers have created condensers with such characteristics that at the lower readings the variation in condenser capacity is but small, thus spacing the stations at these settings farther apart. The best form of condenser for this purpose is the straight-line-frequency condenser, which, when well made, actually does space the various stations evenly over the entire dial scale, a highly desirable feature. It is not always convenient to mount them in an existing radio set, either home-built or manufactured.

It was with these facts in mind that means were sought whereby any existing receiver, equipped with the prevalent type (semi-circular plate) condensers, could be made to separate stations evenly. Thus arose the straight-line-frequency dial, such as the Tune-rite.

The goal is achieved by having the condenser move as usual, with a regular, steady pace, while the dial that rotates it moves at a changing pace, very slowly at first, then eventually very rapidly. The mechanical means are employed to achieve the equivalent of an electrical result.

Equal spacing of the stations has its limitations. Theoretical perfection would mean the manufacture of a special dial for every different make of condenser, as a number of manufacturers have adopted some special shape of condenser plate in an attempt to eliminate some of the crowding of the stations on the dial at the lower wavelengths. The way the SLF dial is constructed will not serve all makes of semi-circular plate condensers and commercial receivers equally well, as it is in practice it will accomplish the purpose of a straight-line-frequency condenser at the low readings, where separation is essential, and bring stations together where they are separated too far.

The dial must be constructed as a vernier dial as a matter of course, and due to its peculiar vernier action with regard to the actual condenser, the settings change gradually from a ratio of 24 to 1 at low wavelengths to 22/23 to 1 at high wavelengths. Of course, the pointer moves uniformly.
By Lewis Winner Associate, Institute of Radio Engineers

**The Phonograph Cabinet Set**

[Part I of this article was published in the October 24. Part II, the conclusion, follows.]

_BUT_ in order to get the condenser in so that it should slide on the tubes you had to get a very small size condenser, is that true?

I quoted you one of the propositions that I hit up against. It is not easy to answer. Well, you see, Jack used condensers with an overall shaft extension of only 3/8", the height that the rotatory plates reached, when completely out of mesh, was only 3/8". All this depends on the type of condenser, so that the dimensions that I am giving to you is

"But suppose I have a condenser which has an overall shaft extension of 3 or 4", and an overall height of 3 1/2", then you will have made your shelf which holds the sockets, much wider. The sockets will be placed back further, and then your shelf will give you plenty of space all around, since you have 1/4" in the compartment.

"That means that one shelf instead of being 2 1/2", will be 3/8" and the other will be 6". Then this will give me the extra 3 1/2" compensation."

That's O.K. The coils in the top shelf will be placed in front of the sockets, in exact measurements. Then if I instead of going 2 1/2" from the left-hand edge goes 4 1/2" from this same edge. This will allow plenty of space for the coil L12. This coil will then go right opposite this socket and be 3/8" from the edge, since the diameter of the coil is 3/8", coil L1A placed between sockets 1 and 2. This is 4 1/2" long. The grid leak and condenser will then be placed on the socket, and not between, as I drew on the diagram. The other two condensers will also be in front.

"Say, the top one, as to the bottom shelf, we used small General Radio AFT. If you are going to use the large autoformers, those dimensions will not hold. That is you will have to place them on top of the shelf, instead of the bottom underneath the sockets. You see, we used the same transformers that were used in the other set. All that was done was to connect them up in the special AF fashion. This means that the sockets will be in the back and the AFT will be in front, with only the grid and fixed condenser on the bottom."

"Well that was certainly fine of you to catch me on that. I forgot that these big AF were going to be used.

Remember folks, Jack's set was built on the dimensions given last week, and these changes took effect only when I and then Bill called these special details to each other's attention, while this was being developed, my brother believed that a great many of you would have had the same trouble. I know I would. Nobody likes to have his brother tell him that and then find out that the condensers will hit the tubes or any thing to that effect. And especially when the thing else has gone smoothly. If you will look, at the picture diagram of the internal view of the set (side view shown last week), you will see that the top of the tube cleared the bottom of the condenser. This of course was due to the peculiar construction of Jack's set, in which nine tenths of the cases will not prevail."

"Now suppose, Bill, you tell your brother how to make the coils. Be specific, please, I requested."

Making the Coils

"All right, O.M., here goes. The first choice to be chosen is the antenna coupler, better known as the first radio-frequency transformer in the diagram, L1L2. L1, the primary of the first radio-frequency transformer (we'll operate on a form 3/5" in diameter and 4" in height. There are 10 turns. The beginning and the end of the windings are on the terminals on the form. The secondary, L2, is then wound. There is no space left between these two windings, but they are separate. There are 45 turns here. Again the beginning and the end of the windings go to the terminals on the form."

"Now that form goes aside and the other radio-frequency transformer is wound. This is also wound on a form 3/5" in diameter and 4" in height. The primary L3 is wound first. There are 8, not 10 turns here. The beginning and the end of this winding are on the terminal posts on the form."

The beginning and the end of this winding also go to the terminals on the form. All these windings are in the same direction. The wire used when winding these coils is No. 30, 26 gauge, covered.

Bill's description being finished, I carefully drew a diagram of the receiver, Fig. 1, and handed it to Herman."

"Now, please pay strict attention to each detail in the wiring of this set,” I admonished. "You will see here the parts lying on the upper shell, which contains the antenna coupler, L1L2, the second radio-frequency transformer, L3L4, the two sockets, the two fixed condensers, C3C5, the grid leak and the condenser."

The beginning and the end of the primary winding, L1, goes to the antenna binding post on the terminal strip. This lead may be flexible, as Jack has it in his set, or it may be rigid, as in this diagram. However, don't put any spaghetti on it. The end of this same winding goes to the ground binding post on this winding. This is for the secondary winding, L2, of this same transformer. The beginning of this winding goes to the rotor-plates of the variable condenser, C1. It also goes to the arm of the rheostat, R1 (the A—lead). This also goes to the ground binding post, which as I said before, goes to the end of the primary of this transformer. This winding as you will notice lies just adjacent to the ground winding, or the end winding of the primary. In other words, the low points are together. The end winding of this secondary goes to the stationary plates of the variable condenser, C1, and also the grid post on socket 1. The arm of the rheostat, R2, which also goes to one terminal of the fixed condenser, C3. The beginning of the primary winding of the second radio-frequency transformer goes to the plate post on socket 1. The end of this same winding goes to the left terminals of the fixed condenser, C3."

This means that the grid return is electrostatically coupled back to the plate. Care must be exercised. This C1 is G. If it isn't, K, otherwise you will blow out your tube. The F—post on socket 1 goes to the reference X. The F—post on this socket goes to the F+—posts on socket 2. The beginning of the secondary winding, L4, of the second radio-frequency transformer goes to the rotor-plates of the variable condenser, C2. This also goes to the arm of the rheostat, R2, which in turn goes to the one terminal of the fixed condenser, C5. Also see that this condenser is O K. The end winding of the secondary goes to the grid of the grid leak, L5, and to one terminal of the grid leak, R5. It also goes to the secondary of the variable plates of the condenser, C2. The plate post of this same socket, 2, goes to the top terminal of the double end jack, J1, this point is also the grid terminal of the large fixed condenser, C5. Again the filament and the B+—post are by-passed by this condenser, and the same care is taken here. Now, the end winding of the primary, L3, of this transformer goes to the B+—post on the terminal strip. The terminal on the jack touching, or nearest the frame goes to the B+—I post on the terminal strip. The resistance wire of rheostat, R2, goes to the F—post on the socket 2. The F+—post on the socket goes to the F+—post on socket 3. So far we have connected the B+—posts of 1, 2, and 3 sockets.

"The terminal nearest the top terminal of the double circuit jack goes to the F+—post on the first amplifier transformer. Note that this is not the autotransformer. The only remaining terminal of the jack goes to the F—end. This completes the wiring of the first two tubes. I will now discuss the wiring of the audio-frequency transformer."

The grid post on the audio-frequency transformer goes to the G post of socket 3. The F+—post on this same audio-frequency transformer goes to one terminal of the ballast resistor, R3. The other terminal also goes to the arm of rheostat, R1. The filament of the ballast resistor goes to the F—post on socket 3. This means that the resistance wire of rheostat, R3, which, of course goes to the F+—post of socket 4. Now comes the hooking up of the autotransformer."

**Auto-Transformer Virtues**

You will notice that there is only one winding on an auto-transformer. How you get the portion of the winding used as a primary and the entire winding as the secondary. It is much better than the two windings, with sub-divisions of amplification, but not quite so powerful. The coupling between the P and S is also close. We use L1, L2, L5, L6, C6 and C7 in the diagrams, and also the grid leaks, R4 and R6, to keep the plate voltage off the grid of the tube following. One thing to note here is that the impedance to the tube which follows is the voltage drop across the grid leak, and not the drop across the secondary of the transformer. Only by employing a large capacity and resistance can we obtain the full quality value. With the ordinary transformer the high and the low notes are not amplified equally, but the middle range is favored. The resistances best be taken from specifications given by J. E. Anderson in the Oct. 3 issue, which are very interesting.

Remember, to go on with the wiring of this portion of the circuit. The P post on socket 3 goes to the F post on the transformer, AF2. The G post on the transformer goes to one terminal of the fixed condenser, C6. The last terminal of the transformer, B, goes to the B terminal of the set. The terminal on the jack that was not connected goes to one terminal of the potentiometer (the resistance which will now be used to control the volume). The other terminal of this potentiometer, also 811, goes to the G post on socket 4. The other resistance wire post goes to the C—post. The other terminal of this resistance goes to the C—post. The other terminal of this resistance goes to the C—post. The other terminal of this resistance goes to the C—post.
How to Wire Up the Receiver

THE ELECTRICAL WIRING of the Phonograph Receiver, shown in a picture diagram.

LIST OF PARTS
Two radio-frequency transformers (L1L2, L3L4).
Two SLF Streamline variable condensers, .0005 mfd. (C1, C2).
Two .001 mfd. fixed condensers (C3, C5).
Two 20-ohm rheostats (R1, R2).
One .06025 grid condenser (C4).
One 2-megohm grid leak (R8).
Three ballast resistances (R3, R5, R7).
One low ratio AFT (AFT1).
One filament switch (AF1).
Two autoformers (AF2, AF3).
Two 1 mfd. fixed condenser (C6, C7).
One 5 megohm Centralab potentiometer (R4).
One .5 megohm fixed leak (R6).
Five sockets.
One double circuit jack (J1).
One filament switch (S).
Two 4" dials.
Three 2" dials.
One single circuit jack (J2).
One 12x18" panel.
One socket shelf, 11x6".
One socket shelf, 11x5½".
One dozen angle brackets.
Two strips of bakelite, 12" long.
One terminal strip, 12" long.
Accessories: Connecting wire, antenna wire, ground wire, lead-in wire, ground clamp, insulators, A, B and C batteries, phones, loud speaker, screws, nuts, plug and tubes, etc.

Without any obstructions, which otherwise will occur, e.g., if the wire is tinned. The only good thing about tinned wire is that it is easy to solder. But you are not kind of solderer you will be able to tin the wire at the juncture and make just as good a job.

Making Tests
"Now every portion of the receiver should be tested for complete or short circuits. This is easily done by the following process. Procure a pair of phones, and a 1½-volt battery. Connect one end of the phones to the battery. This will give you two leads. Put some long flexible leads on both the phone terminal and the battery terminal. Make sure that these leads are making contact. Now test the variable condensers for a short. Before doing this you will have to take a lead of the condenser off so that it is not in the circuit. Otherwise you will get a click anyhow due to the complete circuit made through the coil. See if you get a click, when you turn the condenser through a complete revolution. You shouldn't. See that the prongs of the sockets are making contact with posts on the socket proper. You probably will have to tighten the nut screws on the bottom a little, so that proper contact will be made. Push up all the prongs, so that when the tubes are inserted they will make contact with terminals of the tube. Test the transformers (audion) for complete circuits. That is, see if you get a click between the P and the S terminals. Test the fixed resistance for a short or an open. It will be difficult to tell if there is an open, as you will not get a click. The only way to test this type of an instrument is with a megometer. The fixed condensers are tested in the usual way. That is, the phone and the battery terminal is put across them. After a few moments' duration a faint click should be heard. If nothing is heard, then there is an open circuit. If at the very beginning you hear a loud click, the condenser is shorted, and you will have to get a new one.

Photographs of a receiver built along the same lines as the one described in the foregoing article will be published next week.

October 31, 1925  R A D I O  W O R L D  11
Completing the 3-in-1 Set

SOCKETS are arranged so that the two RF tubes and detector tube are in the rear, in alignment. These show up in front socket is at left, above, and the

THE front panel of the laboratory set was 161/4 x 9". The condenser Cl is mounted with shaft hole 8 5/8" from either side. Consider the panel and 3/8" down from the top. The drill should be more than 1/4" on a 1/4" shaft, so that no friction will take place between shaft and panel. If 1/4" drill is used, there will be a countersink on front and back of this shaft hole until you have widened it a little, or use an 1/8" pair of axes or a file to scrape off enough for complete clearance of the shaft. Then locate the condenser mounting hole or holes (using a template), and drill these, countersinking. The potentiometer shaft hole is on the same perpendicular plane as the condenser shaft hole, but is only 1/16" from the panel bottom. The radio-frequency rheostat is 4 3/4" from left of panel, 2 1/4" up from the bottom, and the detector rheostat is 4 3/4" from right of the panel and on the same horizontal line as the RF rheostat shaft. The filament switch, at left, and the telephone jack at right, are, like the potentiometer, 1 1/2" up from the bottom, but respectively 2 3/4" from left and right of the panel. Except for two mounting screws for the subpanel and a dial pointer, nothing else appears on the panel. These holes are 4 5/8" up and are 1" from panel left and right of panel respectively.

The Subpanel

The subpanel is 8 5/8" x 15". On one of the long sides, considered the front, cut away a piece 1 3/4" wide and 4 3/4" deep. This is to allow room for the condenser, but it will not apply in every case, since the make of condenser employed will determine the size of this cutaway. This can be decided quite readily, since the mounting holes for the subpanel are located on the front panel itself, and the condenser is mounted thereon, too, the location of the cutaway therefore being merely a matter of ocular attention.

Reading the front as that length with the cutaway on it, the second RF socket would be mounted behind the condenser. In the laboratory model the central socket is the largest you have, then they center of the width (7 1/4" from either side of the subpanel). The central points of the two other rear sockets was on the same left-to-right line, 2" from each end of the subpanel, respectively. The standard Navy socket flanges are about 1 3/4" inside diameter, 1 7/16" outside diameter, and holes were drilled to pass this outside diameter, so that the cups would stick up through the subpanel, the socket bases being mounted underneath. This required threaded drilling, to take a given small screw, so that two such holes and screws would be used to secure each socket to the subpanel. But most persons will not have the large drill or can. In the 1 7/16" socket holes, nor the means for making a threaded hole for the special socket mounting screws, hence will simply mount the sockets instead on top is the subpanel as if the subpanel were a baseboard, and will drill four small holes in the subpanel at each socket, just outside of where the socket binding posts are, so that the leads may be carried to the subpanel bottom, where all the wiring is done. Besides two holes must be drilled in the subpanel to mount the socket itself. The audio tube sockets are on a same front-to-back plane as the first and third RF sockets, and are placed with centers 2 9/16" back of the subpanel front. The binding posts are a 1/4" left, each 1" apart, with one exception, from each other, running from front to back and all with centers 1/4" from left or right.

Binding Posts

The battery binding posts are at right. Reading from front backward. The first is 2" back of the front. It is A+. Next comes A-, and then the B+ C-, C+, B- 22 1/2, B- 45 and B+ 90. On the other side the first post is for plate and the other B+- (speaker). The distance exception noted before is that the next post (ground) is 3" back of the B+ 90, and next to that need be only the aerial post. In the laboratory model two posts were used for the aerial, the primary L1 being tapped accordingly for long and short antenna, but experiments proved that this was unnecessary, so just a single aerial binding post need be used.

The location of the only remaining holes will depend on three things: (1) the type of grid leak used; (2) the size of the brass angle used in mounting the subpanel to the front panel; (3) the accommodation of the subpanel end of the three coil mountings; (4) the AFT. The brass right-angles used for affixing the front and subpanels in the laboratory model were 1/2 x 3/4" (measurements of the length of the arms), but it is a simple matter to locate the subpanel hole for these two angle irons by affixing both the irons to the front panel and looking where the remaining holes hit the subpanel. The grid leak, if fixed, should be about 2 megohms. Hence consideration (3), cited above, may be disregarded. But (4) of course have to be taken care of by the constructor much on his own initiative, since it depends on the type and make of audio transformers used.

Other Resistors

The rheostats R1 and R3 have been considered, but the other resistors, R2 and R4, had better be of the ballast type, although resistance strips may be pressed into service. R2 would be of the 6-volt, .25 amp. type, while R4 would be of the 6-volt .5 amp. type, if 201A tubes are used throughout. If dry-cell tubes are used, the 99 type or their equivalent is to be preferred to the 11 and 12, which are not made any more. However, there need be no fear whatever of using the 99 type, and if such be incorporated, either standard Navy sockets or special 99 sockets may be employed. I always favor standard sockets, because of the choice they afford, and if the R, C, A, and Cunningham do not make 99 type tubes for standard sockets, instead of using adapters, buy tubes of this kind in 6-volt standard stock such as DV3 and the 99 tubes made by some of the better independent tube manufacturers, such as Magnatron.

The .5 amp. ballast may be mounted on the switch.

The Polarity Question

Note in Fig. 1 that the aerial goes to the beginning of L1, the end to ground, the beginning of L2 to the secondary meter arm and the end of L2 to grid of tube (1). The beginning of L3 goes to plate of the first RF tube (1) and the end to B+ No. 1 (45 volts), the beginning of L4 to potentiometer arm and the end to grid of the second RF tube (2) and the end of tube (2) goes to the beginning of L5, the end to B+ No. 1, while the beginning of L6 goes to 15 minutes and the end to the coil side of the second detector C2. Thus the antenna coupler is connected "out of phase," the first tube turns the

(Continued on page 24)
How to Eliminate a Control

By Percy Warren

WHERE one stage of RF and a detector tube are used, with regeneration in either stage, the usual controls may be reduced to two, thus simplifying the connec-
tions. An excellent way of accomplishing this is to use a gear system. Thus the rotors, as well as the stators, are mechanically and electrically separate and if a positive grid return is desired for detector tube this can be done simply by connecting the terminal of the interstage coupling secondary to A+, which could not be done if the rotors were common to both condensers, for then the RF tube would have a positive grid return, which is inefficient.

There is another feature of this special attachment. If you will look at the diagram you will note that there is a special compensating device, attached to the condenser on the left. Here a piece of bakelite strip is attached to the variable plates. The bottom of this strip goes to a small cam. This cam is attached to a small arm. By moving this cam the movable plates of this condenser are moved. They are brought farther apart or nearer to the stator. The variable plates of the other condenser are not affected. In this way the plates of this condenser may be put ahead or behind the other variable condenser so that both condensers tune exactly in step.

Let us suppose that the secondary winding, L2, of the radio-frequency transformer contains 40 turns, and the secondary winding, L4, of the 3-circuit tuner has 45 turns. This means the variable condenser which shunts the RFT will be about 8 degrees ahead of dial that controls the second RFT. However we only have one dial here and we therefore adjust the plates of the condenser that has this device on it so that the same dial reading represents resonance for both. In other words the secondaries of both circuits are equalized. Of course any divergence of tuning, such as due to tube plate capacity, etc., is made up in the same way.

Drilling the Panel

The first thing that ought to be done when building this receiver is drilling the panel. By doing this you automatically place the panel parts and save a great deal of trouble. The panel is 7 x 24". The variable condenser is placed in the exact center. That is, the center hole is 3/4" from the top and bottom and 12" from each end. The holding holes are given in a special template provided with each condenser. Place this template over this 5/16" hole, and drill the others. This takes up all of the space in a square area. The center hole for rheostat R3 is placed 3/4" from the left-hand edge, and 2 1/2" from the top. The rheostat will not be in line with the condenser dial, which by the way is 3 1/2" in diameter. The center hole of the other rheostat, R2, is 3" from the hole drilled for R3 and 2 1/4" from the bottom, or on the same plane as R3. The diameters of the center holes are 5 1/16". The holding holes are placed 1/2" from the center of the center hole one on the left and one on the right. These are 3/4" in diameter. The single circuit jack, J2, is 1-1/2" from the left-hand edge, and 2" from the bottom. The diameter of this hole is 3/4". The filament switch is 12" from the left and the right-hand edge of the panel. It is 2" from the bottom. The diameter of this hole is also 3/4". The double-circuit jacket, J1, is placed 9" from the right-hand edge, and 2" from the bottom. The diameter of this hole is also 3/4". The hole for the shaft controlling the tickler coil is 3/4" from the top and bottom, and 3" from the right-hand edge of the panel. A small knob, rheostat size, is used. The only holes that remain to be drilled are the bracket holes. The bottom hole of the bracket on the left is 19/32" from the bottom. This is a 1/8" hole. The top hole is 5 1/32" from the bottom hole. They are both 3/4" from the left-hand edge. The diameter of this hole is 3/4". Now on the right-hand side the other bracket holes are placed. The bottom hole of this bracket is 19/32" from the bottom, 3/4" from the edge, and has a diameter of 3/4". The top hole is 5 1/32" from the bottom hole, is also 3/4" from the edge, and has a diameter of 3/4". This is all the drilling there is to be executed on the panel. The next substance to be drilled is the socket shelf.

Drilling the Socket Shelf

If you are going to use the gang socket type of shelf there will be little drilling to be done. You can tell the socket terminals, though they are not marked, by the fact that the grid is at rear left of the slot in the shell where the tube pin attaches. The slot at rear, the plate is at right rear, the F− at left front, F+ right front. Suppose you are going to use individual sockets. The shell is 23" long and (Continued on page 26)

FIG. 2, showing the back view of the set, with the Hanscom capacity unit in view.

FIG. 3, showing how the condenser mechanism works. Remove the looped pigtail to construct the set shown in Fig. 1, as the two tuned circuits have different grid returns.

FIG. 4, showing the template for the condenser unit. The hole at the bottom is for the compensating strip. There are three holes for the mounting of the condenser unit. This template is pasted on the panel.
WILL YOU please give me a diagram of a 2-tube reflex receiver, employing a regenerative detector. I wish to use a coil shunted by a condenser as a means of tuning the plate of the detector tube instead of the conventional tickler. —Q. Resona, Oakdale, Ill.

Fig. 223, shows the electrical diagram of such a receiver. The primary, L₁, is wound on tubing 3/16" in diameter and 4" high. There are 10 turns wound on this tubing. The secondary, L₂, is wound on the same tubing and contains 45 turns. The primary of the second radio-frequency transformer is wound on a tubing 3/16" in diameter and 4" high. There are 10 turns made here. The secondary is wound on the same tubing and contains 45 turns. The plate coil, L₃, is wound in a tubing 3" in diameter and 3" high. There are 35 turns wound. The wire used when winding all these coils was No. 22 double cotton covered type. The variable condenser, which tune the secondaries of these coils have a capacity of .0005 mfd. These are known as C₁ and C₂ on the diagram. The crystal detector is of the fixed type. The ratio of the first AFT is high, about 6 to 1, while the ratio of the second AFT is of a low ratio, about 3 to 1. The success of the receiver depends upon this. The capacities of C₃ and C₄ are 100 mfd. The both tubes are controlled by one rheostat and has a resistance of 10 ohms, with a current carrying capacity of ½ ampere. The type of tube used is the UV201A. The jack, J, is of the single circuit type. There are 67½ volts placed on the plates of both these tubes. A 6-volt A battery lights the filaments of the tubes.

I WOULD be pleased to know the following: (1) Could I use the UX120 tube in Herman Bernard's audio-amplifier? (2) Will a UX120 give more volume here? (3) Will the same tube give more volume in the transformer coupled amplifier? —George O. Snow, 3153 Donner Way, Sacramento, Cal.

(1) Yes, but the voltage that you will have to use will be tremendous. That is, you will have to use a very high B battery voltage, about 250 volts, to get any kind of satisfaction. (2) Yes. (3) Yes.

WHAT SET with 2 stages of AF do you recommend for use as a portable? There should be no more than 3 tubes used. —F. D. Love, Georgetown, Tex.

The Harkness will suit the bill. This is a two-tube set. An extra stage of audio-frequency amplification will make the sets very loud, and can be easily added by taking the output from the plate circuit of the first tube and coupling it to an AFT.

I HAVE the Goodman Spider-Web coils, which have an inside diameter of 14", and an outside diameter of 4", I am going to use a .0005 mfd, to shunt to the secondaries. These coils and condenser are to be used in the Diamond. Would you please give me the specifications? (1) What size wire shall I use for the primary and the secondary of the radio-frequency transformer? (2) How many turns are on the primary and the secondary of the 3-circuit tuner? (3) How many turns are on the tickler? (4) Would the straight-line frequency condenser be best? —H. K. Mansfield, Barber Block, 15th and Parnam St., Omaha, Neb.

(1) No. 22 double cotton covered wire is used. (2) There are 10 turns on the primary and 45 turns on the secondary. (3) There are 10 turns on the primary and 45 turns on the secondary. (4) There are 35 turns on the tickler.

(5) Yes.

How far in should the tickler be from the side of the outside tubing?—L. A. Y. C. ,
143 E. 63rd St., Los Angeles, Cal. (1) Magnet wire should not be used. (2) The primary contains 12 turns. (3) The secondary contains 50 turns. (4) None. (5) The primary contains 12 turns. (6) The secondary contains 50 turns. (7) The tickler contains 40 turns. (8) The tickler contains 1/4. (9) Yes. (10) The tickler coil should be 1/4" from the sides. The diameter of the tickler tubing is 2 1/4".

**WOULD YOU** please give me the diagram of a 1-tube regenerative set.—R. Elson, Beacon Point, Fla. Fig. 225, shows the electrical diagram. The primary, L1, is wound in a tubing 3/4" in diameter and contains 10 turns. The secondary is wound on the same tubing, and immediately adjoining the primary. There are 45 turns placed here. The wire used in winding the coil is of the No. 22 double cotton covered type. The condenser which is shunted across the secondary of this 3-circuit transformer is one having a capacity of .0005 mfd. The grid leak, R2, is one having a resist- ance of 2 megohms. The condenser, C2, is the grid condenser and has a value of .00025 mfd. The resistance of the rheo- stat is 10 ohms. This is provided the 201A type tube is used. The switch is present to make use of the higher and the lower winding. The tap is brought to the 224 turn. The tickler, L3, is wound on a tubing 2 1/4" in diameter and 2" high. It contains 35 turns. No. 22 DCC wire is used in winding.

**WILL YOU** please answer the following questions referring to Fig. 209, page 16, Oct. 3 issue of Radio World on the Diamond electrical diagram: (1) Please give winding specifications for radio frequency transformer and 3-circuit tuner using them with two 23-plate condensers. (2) What would be the difference in the windings using a straight line frequency condenser? (3) Would it pay to buy new straight line condensers or would satisfactory operation be obtained with the condensers I have? (4) What is the value of condenser C2? (5) What is the value of condenser C3? (6) What is the best amplifier voltage to use? (7) What is the best detector voltage to use? (8) What is the best battery voltage to use? (9) I have two 23-plate American Audio transformers. Will these be satisfactory for loud speaker opera- tion? (10) Is a grid leak advisable in this circuit? (11) What is the value should be placed in and where is it to be connected? (11) I have three 201A tubes for amplifiers and one 201B detector. Is it right all to right? (12) Should the lower end of coil L2 be connected to A negative as shown; will better results be obtained by connecting it to A positive? (13) Would the above arrangement cover a range of 2,000 miles in winter weather?—O. F. Barklage, 627 Grain Exchange Building, Omaha, Neb. (1) The winding specifications as given in Percy Warren's article in the present issue may be used for .0005 mfd. (commonly 23-plate condensers, either plate or double. (2) None. (3) You would be able to get the low wave stations with much more ease using SLF condensers, or retaining your present ones, putting an SLF dial on them. With the old type of condenser, the stations will be crowded together on the conventional dial. (4) C2, .00025 mfd. (5) C3, .001 mfd. (6) If you are going to use the 201A tube, and you refer for a certain amount of volume, then use 112" volts on the plate of the AF amplifier tubes. (7) If you use the UV200, use only 20% volts or less. When using a 201A tube use 45 volts on the plate. (8) The average voltage should be 100. (9) This, however, depends upon the amount of voltage applied to the plate of the amplifier tubes. (9) Yes. (10) Yes, when using a 201A or 200 tube. The value should be 2 megohms. (11) Yes (12) When using the 201A, use a positive grid return. When using the 200, use a negative return. (13) This depends upon a great many things such as location, manner in which the set is built, material that the set is built from, person who is tuning the set, etc. If everything is right you will get that dis- tance.

**WILL YOU** kindly inform me if any injury to the A battery will take place if the B- amplifier, is connected to the A positive and B- detector to the A-? (2) I have a pair of AFT. There is rust on the exposed surfaces. Will this impair the efficiency of this receiver any? (3) Can this be removed without injury to the plates?—Charles Reese, McCurdy Hotel Barber Shop, Evansville, Ind. (1) Yes, you will have short in the A battery. Connect the A+ to the B- of all the tubes. (2) No. (3) There is no necessity for removing this rust. It is very difficult to remove without injuring the plates.

**WHICH IS** really the better for DX, two stages of transformer AF or three stages of resistance AF. (2) When I'm receiving a station sometimes the set will break into oscillation. Why is it that the grid leak is sometimes connected across the condenser and sometimes in shunt to the filament? (4) How far apart should the RFT and the 3-circuit tuner be?—Hal. B. Brown, 3332 Abbey St., Oak- land, Cal. (1) AF amplification has next to nothing to do with the actual obtaining of distance. If the first portion of the set, in which the RF tubes and the detector tube, are situated detect the signal, then you will hear it. If, however, this signal is so weak that you can hardly hear it, then the AF amplification will amplify to audibility. If the signal is not rectified, you will not hear it, regardless of the amount of the AF amplification. (2) Use a variable grid leak. (3) If you use a double condenser and you wish to have positive bias on the detector tube, while the RF tube has a negative bias, you cannot do so, unless you put the leak to the plus filament side, instead of across the con- denser. (4) They should be about 6" apart. However, there is no definite rule about this. If you place them nearer to each other the magnetic field is greater.

**WHAT KIND OF** transformer should be employed in the AF stages in the receiver described by Capt. Peter V. O'Rourke in the Oct. 10 issue of Radio World? (2) I have an All-American 10-to-1 AFT. Can I use this?—Wm. Warner, 706 11th Ave., New York, City. (1) and (2) Since you have the high ratio type, use it in the first stage. Use 3/4 or 4-to-1 in the second.

I HAVE a .001 mfd. variable condenser, some 4" bakelite tubing, and some No. 20 DCC wire. I would like to construct an RFT. (1) How many turns should I place on this form, so that the condenser may be shunted across the secondary of this coil? (2) I have a .0005 mfd. variable condenser, and a commercial 3-circuit tuner. Should any change be made? (3) I have a Ballantine Vario-Transformer. I would like to know if this could be em-

(Concluded on page 30)
Radio Telephone from New York to London

How the Crystal Oscillator Works for Frequency Tests

In their quest for a frequency governor that will hold radio transmission constant engineers of the General Electric Company are putting the often times troublesome harmonics to work.

Every radio listener has been annoyed by wavering signals. The howl that punctuates an otherwise delightful concert is generally due to the encroachment of a second station which has taken to wandering from its assigned wavelength. Sometimes this departure from the true path is the result of a wind-blown antenna or it may be due to a deposit of ice or sleet on the antenna. Sometimes poor calibration of the transmitter is the cause. Whatever the cause the effect is distressing to the listener and embarrassing for the men who are responsible for the output of the offending station.

A Year's Work

For nearly a year the radio engineers have been delving into the mysteries of crystal quartz in an effort to adapt the peculiar properties of the mineral to the field of radio transmission. It was known that a particular type of quartz possessed what is known as the Piezo-electric effect, that is, that a given piece of crystal will oscillate at a constant frequency when electrical energy is applied to it. For sometime now the crystal has been used as a wavemeter to calibrate signals. The General Electric engineers have gone a step farther and have adopted the crystal as an oscillator to monitor the frequency of a transmitted signal. It is working so well that it is predicted that if all of the nearly 600 broadcasting stations of the country would adopt the crystal as a frequency guide the interference now experienced between stations on neighboring wavelengths would be practically abolished.

The Department of Commerce has spaced stations ten kilocycles apart. This distance is ample if all stations hold their frequency. The department permits a departure of 2,000 cycles from assigned frequency and regards a station that holds its frequency within 500 cycles as perfect.

The frequency of WGY, the Schenectady station of the General Electric Company, is now crystal controlled in fact it is the first broadcasting station in the country to use the crystal oscillator as a part of its equipment.

A Physical Difficulty

Before the crystal was found to meet all the demands of daily service months of research were necessary. Nearly all of the experimental broadcasting using the crystal oscillator was conducted on the 41.88 meter transmitter. Investigations were made on this wave without danger of interfering with the enjoyment of the listeners. However, before working...
**Multiplex Radio**

at 41.88 meters, the engineers have to find a way of getting crystal quartz thin enough for the high frequencies involved. Crystal quartz looks like frosted window glass. The thinner the quartz the higher its frequency and the lower the wavelength. For example, a 209.9 meter crystal is two millimeters thick. A 41.88 meter wave crystal representing a frequency of 7,160,000 cycles, must be four-tenths of a millimeter thick. That means that the quartz, of almost diamond hardness, first must be sawed roughly and then ground down with a slow process until it is a very thin, brittle wafer. It is so thin that it is impractical to handle. To meet this difficulty the engineer decided to put the harmonics to work.

A radio set, in generating a fundamental wavelength, generates simultaneously a number of other wavelengths which are fractions of the fundamental. These fractional wavelengths are known as harmonics. The English refer to them as overtones, the same name as is given to the same phenomena in music. Since a 41.88 meter crystal is too thin for practical use the engineer used a crystal ground to give a frequency of 209.9 meters wavelength. He then took the fifth harmonic of the wave, which is one-fifth of a 209.9 meter fundamental, and amplified this harmonic by means of vacuum tubes.

**The Clergy, As Ever, Sets Example**

THE CLERGY takes over the radio wiring reins. This photo shows the Rev. William H. Moger at work on his latest radio set in his laboratory. This is the popular Harkness Reflex. The Rev. Mr. Moger hasn't much time, but ever since radio broadcasting has become popular he has devoted many of his spare moments to developing radio sets, until he has become an expert. He has a complete working knowledge of all the radio sets from a simple 1-tube affair to the elaborate 8-tube Super-Heterodyne. When he started to build this set, it was a 2-tube affair, but now a third tube has been added, and he claims it to be a crackerjack, and his claims seem ever dares dispute. Note the ingenious manner in which the Rev. Mr. Moger holds the soldering iron, showing that he can do something which even some experienced builders cannot do well. (Fotograms).

**Test Your Tubes for DX, Says Standards Bureau**

WASHINGTON.

With ideal radio weather at hand the Radio Laboratory of the Bureau of Standards advises fans to have their tubes thoroughly tested if best results are to be obtained.

"Electron tubes in radio receiving sets eventually lose their sensitivity," says the Radio Laboratory. "This sometimes progresses to the point where the receiving set frequently operates very poorly or not at all, even though the tube filament is not burned out. If the tubes are of the thoriated tungsten (XL) filament type, they can usually be rejuvenated by a simple process and made to serve as well as new tubes. Most of the tubes now in use are of the thoriated type. The WD11 and WD12 type of tubes are not the only ones extensively used which can not be reactivated.

"The Bureau of Standards has found that the reactivation process is quite successful and frequently makes a wonderful difference in the results obtained with the receiving sets."
THE KEY TO THE AIR

Key

Abbreviations: EST, Eastern Standard Time; CST, Central Standard Time; MST, Mountain Standard Time.

How to tune in a desired station at just the right time: Station numbers are given in the list published herewith. See what time division the station is under (EST, CST, etc.) and then consult the table below to find the proper time to tune in. The table is divided into four sections: (1) Station numbers, (2) Time, (3) Frequency, (4) Zone.
Radio World Discontinues Advance Programs

When RADIO WORLD started to publish advance programs some years ago it did so as a matter of service to its readers. Since that time the size of our publication has diminished considerably. For instance, three years ago only a small percentage of the daily papers through which RADIO WORLD was published had the regular and advance programs. Today, every big Sunday newspaper publishes the advance programs for an entire week in advance of the radio sections in New York and throughout the country do the same thing. It is estimated now that nine-tenths of the daily newspapers, large and small, throughout the entire length and breadth of the United States publish programs daily. Even those papers publishing a half-week's worth of advance programs also repeat the day's program for the date of issue.

It is fair to assume that newspaper readers prefer to get their programs every day, embodying all additions and other amendments, which a weekly publication cannot include.

A message sent to thousands of RADIO WORLD's subscribers and newsstand purchasers indicates that our readers prefer to have the programs on which they depend in advance, but that we should take up to date service and news articles and illustrations. This is shown by a vote of five to two against the advance program idea.

Therefore, starting with next week's issue of RADIO WORLD the editors will carry on the expression with daily service to you. This does not mean that RADIO WORLD will decrease in size, but it does mean that instead of publishing useless radio programs, RADIO WORLD will devote more space to technical and news articles and illustrations. Remember that the size of the paper every day will not be curtailed.

KPO, San Francisco, Cal., 429 (EST)-7 AM to 7:45; 10 to 12 M; 1 PM to 2; 3:20 to 7:30.
KSD, St. Louis, Mo., 741.1 (EST)-7:15 to 12:30; 12:30 to 3:30.
KTHS, Hot Springs, Ark., 374.8 (EST)-12:30 to 10:30 AM to 11:30; 12:30 to 11:30.
KYW, Chicago, Ill. 5 (EST)-4:30 to 5:15; 6 to 11; 11:15 to 12:30.
CNRA, Moncton, New Brunswick, Canada, 312 (EST)-3:30 to 4:30 PM.
CNRR, Regina, Saskatchewan, Canada-4 PM to 6.
CNBO, Ottawa, Ontario, Canada, 435 (EST)-7 AM to 9:30.

THURSDAY, NOVEMBER 5

WAAM, Newark, N. J., 263 (EST)-11 AM to 12 M; 7 PM to 9.
WABW, Kuhio Hill N. Y., 316 (EST)-12:30 PM to 1:45.

(Closed on page 21)

WASS, Minneapolis, Minn., 435.8 (CST)-12 M to 11; 11:30 to 12 M.
WBBM, Chicago, Ill., 226 (EST)-8 PM to 9.
WOR, Kuhio Hill N. Y., 316 (EST)-3:30 to 4:30.
WBZ, Springfield, Mass., 333.6 (EST)-6 PM to 7:30.
WCAC, Pittsburgh, Pa., 641.3 (EST)-12:30 to 3:30 PM; 4:15 to 6:30.
WBBW, Zion, Ill., 344.6 (EST)-6 to 8.
WIP, Philadelphia, Pa., 683 (EST)-7 AM to 10.
WZLX, Boston, Mass., 405 (EST)-6:45 AM to 7.
WPKA, Cincinnati, Ohio, 370 (EST)-3 PM to 11:15 AM to 10:15; 10:15 to 12.
WGY, Schenectady, N. Y., 395.7 (EST)-7:30 AM.
WADH, Milwaukee, Wis., 275 (EST)-11 AM to 10:15; 11 to 10:15.
WJZ, Baltimore, Md., 541 (EST)-10 AM to 11:15 AM to 10:15; 10:15 to 12.
WOR, Newark, N. J., 405 (EST)-6:45 to 7.
WPG, Atlantic City, N. J., 299.7 (EST)-6:15 to 7.
WQJ, Chicago, Ill., 448 (EST)-11 AM to 12 M; 12 to 1.
WRC, Washington, D. C., 495 (EST)-9 AM to 12 M; 12 to 1.
WREX, Lansing, Michigan, 283.5 (EST) to 12 M.
WNYN, New York City, 285.2 (EST)-11:15 AM to 12 M.
WSB, Atlanta, Ga., 438.3 (CST)-12 M to 1 PM; 1 to 2 PM; 2 to 3 PM; 3 to 4 PM; 4 to 5 PM; 5 to 6 PM; 6 to 7 PM; 7 to 8 PM; 8 to 9 PM; 9 to 10 PM; 10 to 11 PM; 11 to 12 M.
WBSE, St. Louis, Mo., 273 (CST)-12 M to 1 PM; 1 to 2 PM.
WJW, Cleveland, Ohio, 1215 to 11:15 AM to 10:15; 10:15 to 12.
WJKY, Detroit, Mich., 484 (EST)-6 AM to 10.
WOR, Newark, N. J., 405 (EST)-6:45 to 7.
WAPK, Faro, N. D., 381 (EST)-7 to 9; 9 to 11 AM to 10:15; 10:15 to 12.
WRC, Washington, D. C., 495 (EST)-9 AM to 12 M; 12 to 1.
WREX, Lansing, Michigan, 283.5 (EST) to 12 M.
WNAV, New York City, 285.3 (EST)-11:15 AM to 12 M; 12 to 7.
WSB, Atlanta, Ga., 438.3 (CST)-12 M to 1 PM; 1 to 2 PM; 2 to 3 PM; 3 to 4 PM; 4 to 5 PM; 5 to 6 PM; 6 to 7 PM; 7 to 8 PM; 8 to 9 PM; 9 to 10 PM; 10 to 11 PM; 11 to 12 M.
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WNAV, New York City, 285.3 (EST)-11:15 AM to 12 M; 12 to 7.
WSB, Atlanta, Ga., 438.3 (CST)-12 M to 1 PM; 1 to 2 PM; 2 to 3 PM; 3 to 4 PM; 4 to 5 PM; 5 to 6 PM; 6 to 7 PM; 7 to 8 PM; 8 to 9 PM; 9 to 10 PM; 10 to 11 PM; 11 to 12 M.
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WREX, Lansing, Michigan, 283.5 (EST) to 12 M.
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WSB, Atlanta, Ga., 438.3 (CST)-12 M to 1 PM; 1 to 2 PM; 2 to 3 PM; 3 to 4 PM; 4 to 5 PM; 5 to 6 PM; 6 to 7 PM; 7 to 8 PM; 8 to 9 PM; 9 to 10 PM; 10 to 11 PM; 11 to 12 M.
WBSE, St. Louis, Mo., 273 (CST)-12 M to 1 PM; 1 to 2 PM.
WJW, Detroit, Mich., 484 (EST)-6 AM to 10.
WOR, Newark, N. J., 405 (EST)-6:45 to 7.

A THOUGHT FOR THE WEEK

The crisp Autumn days are here, the happiest of the year for radioists. Exit Mr. Static, Enter Miss Contentment. Net result, happiness to all!

Radio World's Blanton: "A radio set for every home."

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PUBLISHED EVERY WEDNESDAY
FROM PUBLICATION OFFICE
HENNISITY BROS. & CO., PUBLICATIONS CORPORATION
165 West 45th Street, New York, N. Y.

ROLAND BURKE HENNESSY, President
A. E. HENNESSY, Vice-President
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A radio set for every home.

The Doctor's Goat

The animal is captured when in the midst of DX reception the doctor gets a hurrying personal call.

Farmer's Keenness for Radio

Rises As His Profits Grow

[The Pennsylvania Department of Agriculture sounded out 343 farmers on their views on radio, set forth in the following report by Geo. F. Johnson.]

Purpose

The increasing farm popularity of radio has advanced to a point where the farmer's reception of market and weather reports, music, singing and other forms of entertainment has been influenced by the economic and social conditions surrounding the farmer. To get some idea of this influence on Pennsylvania, to gain as far as possible the farmers' own viewpoint and estimate of radio and radio programs, and to bring together suggestions for the improvement of these programs for farmers, has been the purpose of a questionnaire survey by the Pennsylvania Department of Agriculture.

The three counties in which this survey was made were:

Bradford, in Northern Pennsylvania, prominent in hay production, poultry raising and dairying.


Westmoreland in Western Pennsylvania, bordering Allegheny County in which Pittsburgh is located, a general farming section.

Farmers Find Radio Satisfactory

The survey revealed that farmers generally regard the radio as a satisfactory investment. The 343 surveys were taken in all three counties surveyed. Out of a total of 314 replies to the question, "Do you regard the results you receive as a satisfactory return for your expenditures for radio?" 302 or 96 per cent. said "yes" and only 12 or 4 per cent. said "no."

The Size of Farm Radio Sets

That the majority of farmers are not depending upon one tube or crystal sets for their radio information is evident. Approximately two-thirds of the 343 farmers replying to the question, "How many tubes in your set?" reported two or more tubes and of these 85 per cent. had four or more. The entire 343 sets, 57 per cent. are equipped with loud speakers which means that the entire farm family can enjoy the programs. A total of 107 sets were either one-tube or crystal, and, of course, not equipped with loud speakers.

Stations Farmers Hear Best

In answering the question, "What station do you hear best, and next best?" it was evident that the larger stations located within twenty-five miles or less were heard best. In Westmoreland County, the Pittsburgh stations, especially KDKA and WQ, were named with but very few exceptions. WGY was named by some in this county as their "next best" station. In Bucks County which adjoins Philadelphia County, the Philadelphia stations, especially WIP, WOO and WWI, and the New York station, WEAF, were most frequently named as "best" and "next best." In Bradford County, which is at a much greater distance from Pittsburgh and which is scattered list of stations was given. KDKA, WGY and WBZ (Springfield, Mass.), were named as stations in this order given. The same three, with WEAP of New York City, were also the "next best" stations.

Farm Families Use Radio in Daytime

The radio is not used on the farm merely for evening entertainment. More than 70 per cent. of the families covered by the survey use the radio in daytime. A total of 234 replies were made to the question, "Does your family use great variety of radio in daytime?" and of these 234 or 71 per cent. replied "yes."

Permanency of Radio Popularity

In order to gain some idea of the permanency of the radio popularity, the question was asked as much as when first installed?" Since only farmers having their radio sets for six months or more were in the survey, the answers are significant. A total of 307 farmers answered the question. Of these 188, or 61 per cent. said their radio was being used as much or more than when first installed, and 119, or 39 per cent. replied in the negative.

Farmers Interested in Many Features

If the farm population covered by the survey is at all representative, "have market reports, weather reports, cooking recipes and current news items. Of these, market reports, popular music, educational talks, market reports, weather reports, cooking recipes and current news items were checked in more than 75 per cent. of the replies.

Radio Market Reports

In an attempt to discover the kind of market reports which interest farmers, the questionnaires listed the following reports and farmers were asked to check those which were of value to them: stock, poultry, eggs, fruit, vegetables, potatoes, grain and feed. Out of 343 replies, 234 desired reports on eggs, 225 on poultry, 168 on grain, 160 on feed, 152 on live stock, 148 on potatoes, 126 on vegetables and 120 on fruit. In general, the kind of market reports desired, depends upon the type of farming practiced in the particular locality. For example, raising eggs and chickens is the leading farmer's enterprise in all three counties surveyed. (Bucks and Bradford Counties are both poultry centers.) For the general popularity of egg and poultry market reports. On the other hand, the live stock raising enterprises are less specialized in the counties surveyed than in other sections of the State, which accounts, no doubt, for less interest in live stock and fruit market reports.

About one-third of the farmers answering the questionnaire reported that radio market reports had either made or saved them money. Out of a total of 208 replies to the question, "Have market reports ever made or saved you money?" 104 said "yes" and 104 said "no." One hundred and thirty-five farmers (26 per cent.) did not state an answer to the question. Very few of those who said the reports had saved them money, explained the way in which it came about.

"When is the most convenient time to receive radio market reports?" This question brought forth a variety of replies ranging from morning to after 10 p. m. In general, it seems that the most convenient time was between 10 p. m. and 6 a. m. The largest number of 287 replies, 139 specified "evening" and 79 others stated various times between 7 and 9 p. m. Those reporting at noon numbered 39 and those between 6 and 7 p. m., 17. Only four wanted the reports after 9 p. m., and only six in the forenoon.

October 31, 1925
ground. Separate aerial and ground leads give more volume.

**Disposition of Parts**

Mount the parts on the panel. They are the two variable condensers, the coil, the rheostat and (if you use one) the A battery switch. No switch is necessary, but if you include one place it in the A plus lead. The idea of mounting the coil on the panel is in keeping with the non-baseboard idea. This necessitates a socket of the panel-mount type, so if you are planning to use the other type, get a baseboard 7" deep and about 1" shorter in width than the width of the panel. This is to allow the baseboard to pass through the front opening of the cabinet, if you are thinking of treating yourself to a cabinet. If you are not going to use a cabinet, and still desire to avoid a baseboard, attach two large iron rings to the ends of the panel, to support it when you stand the set on a table.

**Wiring**

Wire the filament first. A minus goes to one terminal of the rheostat. Be sure it is that terminal that is closer to the resistance wire. You will find an open wire between the winding and the other terminal of the rheostat, and this is the terminal that goes to the F minus post of the socket. Connect A plus to F plus on the socket. Join B minus and A plus.

Connect the aerial to the beginning of L1, the ground to the end. Connect the beginning of the secondary to the rotary plates of C1 and to the rotary plates of C2. This lead is joined nowhere else. Connect the tap to A plus. Connect the end of L2 to one side of the grid condenser C3 and the other side of the grid condenser to the G post of the socket. With some types of grid condensers it is possible to place the one hole over the socket post and screw down the nut. This is sufficient security and electrical contact, but be sure to screw down the nut firmly. The grid lead is connected across the grid condenser, which, if it has two clips on it, enables the cartridge type leak to fit in snugly. If your condenser has no clips you may use a single mounting, connecting its end to the grid condenser's two sides, and inserting the leak in the mounting. In an emergency solder a 1/4" piece of draw binding at right angles to the leak, at each metal tip of the leak, and solder the other end of the bus bar to the respective sides of the grid condenser.

The plate or P post of the socket goes to the spring of the jack J and also to the stator plates of the frame or right-angle of the jack is left unconnected for the moment.

Turn up the rheostat. If it lights the tube properly you may proceed. If it does not light it at all, check back on the filament wiring, for you have made a mistake, else the rheostat winding is broken. If the tube lights suddenly bright, then gets dimmer the more you turn the rheostat, reverse the leads to the rheostat terminals, so that where the battery now goes the F minus of socket will go instead. Now disconnect the A minus lead from the A battery, but leave A plus there. Connect the frame or right-angle of J to B plus, say 45 volts. Turn up the rheostat. The tube should not light. If it does, then check up your wiring, for there is a short circuit in the A or B wiring. If the tube does not light, then you may safely restore the A minus lead to its position on the battery, leaving the B plus where you have it, and prepare to tune in.

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RADIO WORLD, 145 West 45th St, New York City. (Phones: Bryant 0558-0559)

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Radio University

(Concluded from page 15)

played in the Diamond—C. Douglas Reid, care The Ritchie Co., Limited, Belleville, Ontario, Canada.

(1) There shall be 8 turns on the primary. Leave no space and wind the secondary, 35 turns. (2) No. (3) If you wish to use it, take out the RFT, and the condenser which is on the secondary, place the vario-transformer in its place, using the same terminal connections.

KINDLY LET me know if I can use the Bremer Tully 3-circuit tuner and con-

denser in the Diamond. (2) Can I use the Bremer-Tully RFT, with the condenser in the Diamond?—Charles Fischer, 337 Second Ave. Garfield, N. J.

(1) Yes. (2) Use .0003 mfd. condensers with B-T coils.

I BUILT the Powerful Reflex as described by H. E. Wright in the May 23 issue of Radio World and find that I get wonderful results. I had no effect on tuning. That is there is no regeneration present. (2) The set distorts. I am using a Sodin tube. (3) When I place a resistance across the first AFT, the volume is cut down at least 30%. (4) The base of the tubes get very hot. Is this anything? I am using two Bradleyats to control the filament, Bruno Coils, General Radio AFT, and low loss condensers. By Robert, 20 W Rd., Toronto, Ontario, Canada.

(1) Reverse the tickler leads. Place a .001 mfd. condenser across the tickler coil and increase the voltage of the detector tube. Test your tube. It may be lifeless, though it lights. (2) Place a 201A tube in the circuit. Also place a grid leak in the circuit. This is shunted across the grid con-
denser. (3) This is exactly what will happen. Use 1 megohm resistance. (4) This is nothing serious, so long as the rheostats do not get very hot. A proper value ballast will not hurt. See that you use the proper voltage A battery.

REFFERING TO: The Most Efficient 4-Tube 3-Control Set® as described by Capt. Peter V. O'Rourke in the March 21 issue of Radio World, a ground lead is not shown. (2) The diagram shows the plus side of the outside battery connected to the minus side of the A battery. Is this correct? I ask this because if the battery is connected this way I get a great deal of volume, but with a lot of noise. However, as soon as I reverse this battery the volume is reduced. The noise is cleared up. The set otherwise works great, but I would like to obtain the maximum volume possible, so please set me straight with this connection.—F. O. Smith, Hartsville, S. C.

(1) The ground lead goes to the end of the primary winding. This is not absolutely essential. (2) The manner in which the C battery is hooked up, is the correct way. Reduce the C voltage or omit the C battery. WILL YOU please tell me the number of turns that are on the coils of the 1-tube set as described by Percy Warren in the May 23 issue of Radio World.—Wm. J. Marin, 33 Second St., Providence, R. I.

All the turns are wound on the same form, 3/" in diameter and 3/8/" in long. For the antenna coil wind 10 turns. This is wound in the center of the form. The grid coil contains 50 turns. This is wound on either end. The plate coil contains 15 turns. Be sure and see that the Gnd. terminal and the F terminal are kept toget-
er. The plate terminal then joins the antenna terminal. No. 22 single cotton covered wire is used. The condensers that shunt the plate and the grid coils are of the .0005 mfd. capacity type.

LOUD SPEAKER RECEPTION from either coast on three tubes. Blueprint and instructions $1.50 Necessary low loss coil $1.25 Batteries $2.00 each S. A. TWITCHELL CO. 1960 Western Avenue Minneapolis, Minn.

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ANDERSON'S 8-TUBE SUPER HETERO-
DYNE, by J. E. Anderson; the 3-Tube Marconi Blanket Receiver, by Percy Warren; How to Make a Good Battery, by Percy Warren. RADIO WORLD, July 18, 1825. 15c a copy, or 10 for $1.00, for your subscription number. RADIO WORLD, 145 West 45th St., N. Y. C.

HOW TO BECOME AN AMATEUR OPER-
ATOR.—A comprehensive, illustrated article appeared in issue of June 27, 1925. 15c a copy, or 10 for $1.00. Includes subscription number. RADIO WORLD, 145 West 45th St., N. Y. C.
WARREN'S SET
(Concluded from page 27)
C3, grid condenser, and to C2 rotor plates. The other side of C3 goes to the grid post on socket No. 2. The arm of the rheostat, R3, goes to the A-post on the terminal strip. The resistance wire goes to the F+ post on socket 2. The tickler remains to be wired up. The beginning of this wiring goes to the plate post on socket 2. The end of this wiring goes to the top terminal of the double circuit jack J1. The bottom terminal goes to the B+ post on the terminal strip, normally 45 volts.
The inner terminal touching the upper terminal or plate connection, when the jack is out of the circuit, goes to the P-post of the first AFT. The other remaining jack post goes to the B+ post on the AFT. The grid post of socket 3 goes to the G post on the AFT. The F-post of this AFT goes to the C-post. This same connection goes to the F-post on the other AFT. The P post on AFT2 goes to the P post of socket 3. The B+ post goes to the B+3 post on the terminal strip. The G post on AFT2 goes to the grid post on socket 4. The F-post of both sockets go to the same connection that F-post of the other sockets. The plate post of socket 4 goes to the top terminal of J2. The bottom terminal of this same jack goes to B+3 post on the socket strip, usually 90 to 135 volts. Ballast resistors, R4 and R5, are placed in the negative A lead.
Put the grid leak R1 across the grid condenser.
Tuning the Set
This set is easy to tune. But suppose you have just finished the set and you get absolutely no signals, except the usual B battery click. First turn your tickler coil. See that if by turning this you hear a loud click when a certain point is reached. If you don't, then you have no regeneration. To cure this first reverse the leads of the tickler coil. If this doesn't help, add on more turns to the coil. Add on about five turns for a starter. You may easily get too much regeneration. In this case, reduce the number of tickler turns. The next thing to do is to put more voltage on the plate of the detector tube. Then try placing a 0.001 mfd fixed condenser across the outside J1 terminals. Instead of adding turns to the coil you may place a 0.005 mfd fixed condenser across the tickler leads themselves. This will automatically increase the fundamental frequency that this coil will respond to. In other words, it will be the same as if adding on trims of wire.
Now suppose you get broad tuning. This can easily be cured, provided you don't live within a quarter-mile of the stations.
A short antenna should be used. By

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