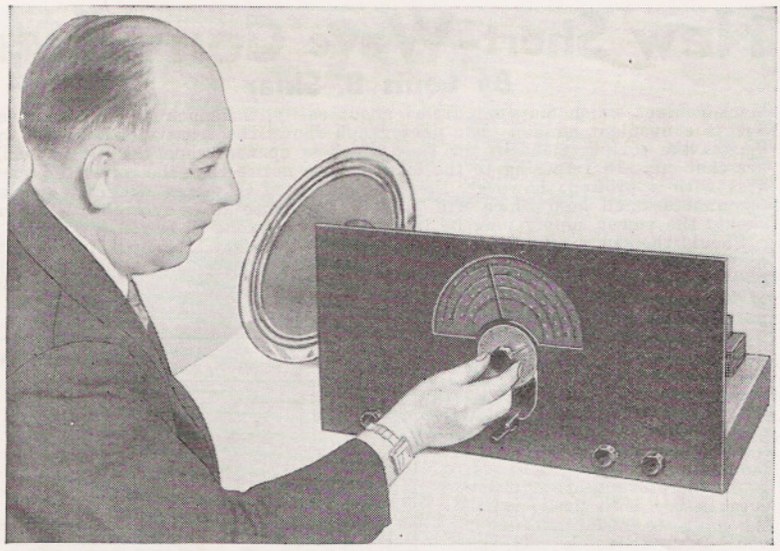


One of the important features of the Browning 35 "All-Wave" receiver is that continuous band-spread is available on all bands.

The • • "BROWNING 35" — All-Wave Receiver

By Glenn H. Browning

The Browning 35 receiver was especially designed to be readily assembled by the average short-wave experimenter and it provides "band-spread" on all bands. The set covers the complete range from 13.2 to 555 meters.

● FUNDAMENTALLY, the only real excuse for a radio receiver in kit form is that it should provide a better set for less money where the builder is willing to do his own assembling and wiring. The complete set market is surfeited with cheap and medium-priced sets built on a large production basis which give fair or indifferent results. Such receivers are usually worth about what they cost and are cheaper to buy than to try to build. But in the more exclusive field of really high-class radio receivers the market is far from being overcrowded. The few sets of this type which are available are expensive and beyond the reach of the average radio fan's pocketbook.

It was to meet the requirements of the radio experimenter who wants the finest results and who is willing to do some of the work himself to obtain them economically that the "Browning 35" was developed.

Low "Noise-Level" Boosts DX

In designing this receiver we have had constantly before us certain requirements which must be met:—

In the first place it should be a really fine modern receiver, which meant an *all-wave* superheterodyne incorporating a stage of *efficient* radio frequency amplification on *all* bands.

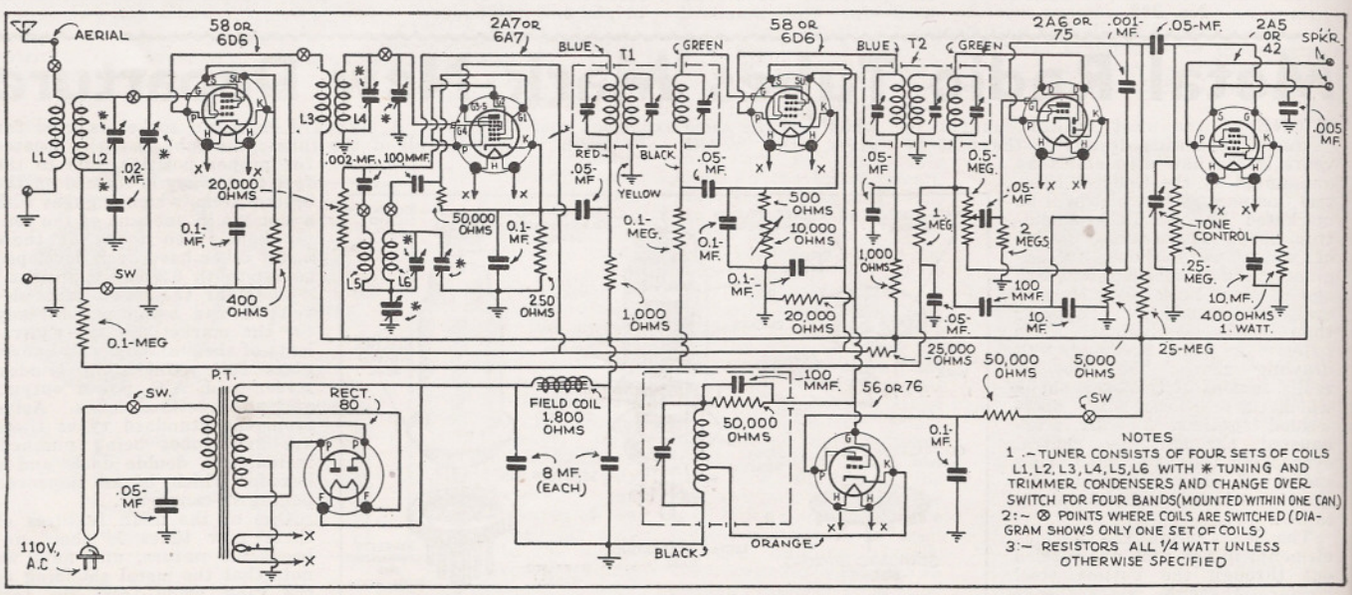
Secondly, it must have a satisfactory *quality-selectivity* compromise. It is a simple matter to design an ultra selective receiver with poor reproduction characteristics. Or, good reproduction is no problem if broad tuning is allowed. Combining these two requirements in the same set is a different story and requires the utmost care in circuit design.

Next this receiver must be capable of not only *good* long distance reception but of the very finest distance reception possible with present tubes and standard equipment. We have persisted in this requirement from the beginning, as much of the pleasure and fascination in an all-wave set lies in the satisfactory reception of *foreign* stations. To accomplish this result, (and we feel that we can safely say that it has been accomplished in the "Browning 35") one requirement stands out above all others, namely, a low *noise-level!* Adequate sensitivity is of course necessary but if carried too far this is often more of a liability than an asset. What we are after is good signal volume with the *least possible noise.*

In general, these are the features which distinguish the really fine radio receivers from the mediocre ones. Our final requirement, which was the most difficult of all to meet, was that this receiver should be so designed that it could be easily assembled by the *average* radio experimenter, with the assurance that when the job was completed it would retain all of these desirable characteristics.

This last requirement, which we confess seemed almost insurmountable at first, was finally accomplished by the use of a new piece of radio equipment —the TOBE SUPER-TUNER.

(*Continued on page* 174)



Wiring diagram for the Browning 35, showing the simple and straightforward arrangement of the various stages, including the beat oscillator.

The "Browning 35"—All-Wave Receiver

(*Continued from page* 154)

The Heart of the "35"

This tuner is the "heart" of the "Browning 35" around which the set is built. It contains in a single unit the 3-gang variable tuning condenser, with its vernier control; twelve tuning coils, three for each of the four separate frequency ranges, in separate shielded compartments; a trimming condenser for each one of these twelve coils, together with the variable and fixed padding and tracking condensers.

The SUPER TUNER also contains a silver-plated, multiple band, selector switch which passes through the shielded compartments with a coil-switching unit in each compartment. By means of the unique wiring arrangement of this switch the coils not in use are isolated and short-circuited. The individual parts of the unit are carefully arranged and spaced from the shielding walls to keep inductive losses and stray capacities at a minimum. Not only is the SUPER-TUNER completely assembled and wired at the factory, but the circuits and trimming condensers are also alined and preadjusted; the R.F. detector and oscillator circuits are all synchronized and ready to operate. Thus the complicated and critical part of the electrical and mechanical construction is eliminated and the remaining assembly and wiring work on the chassis can be done by anyone familiar with the use of soldering iron, pliers, and screwdriver.

Unique Construction Plans

Having solved the problem of how the amateur could construct such an advanced type of set by utilizing the SUPER-TUNER, our next concern was that the remaining assembly and wiring work should be made as clear and foolproof as possible. Accordingly five full-size drawings are furnished with each kit. The first shows a large schematic diagram of the circuit. Drawing No. 2 shows how to assemble the parts. No. 3 shows in detail all wiring on the chassis, including the filament and power supply, variable sensitivity and volume controls, switches, etc. Diagram No. 4 shows the connection of every fixed resistor and *no other wiring*. Diagram No. 5 shows how to mount and connect each fixed condenser and *no other wiring*, except the seven connections which are made last of all to the SUPER-TUNER.

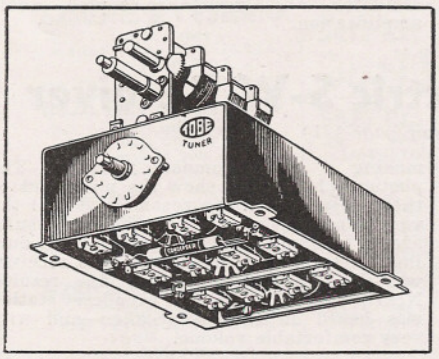
In building the set these diagrams are used in order. The parts (sockets, power transformer, variable resistor controls, switches, etc.) are first mounted as shown in Diagram No. 2. Then the general wiring is done from point to point exactly as shown in Diagram No. 3. The small fixed resistors are next connected to the sockets and special brackets provided for them in accordance with Diagram No. 4. Then the condensers are connected as in Diagram No. 5. Finally the SUPER-TUNER connections are made. The tuning unit should not even be mounted until all wiring and other work have been completed. This makes it easier to work on the chassis without danger of harming the tuning unit which must be handled with a reasonable amount of care to preserve its adjustment.

Circuit Includes Preselector

The superheterodyne circuit used in the "Browning 35" has several unique and advanced features, which are—in large part—responsible for the exceptionally fine performance it is giving on long distance reception.

In the first place the stage of tuned R.F. amplification or preselection, as it is sometimes called, which is used ahead of the 2A7 mixer tube on all bands really amplifies. If this part of the circuit is not very carefully designed it will prove more of a liability than an asset on the high frequencies, decreasing the sensitivity instead of improving it. Silver-plated wire is used in the high frequency tuning coils in both the R.F. and detector circuits, and

every precaution is taken to eliminate resonant circuit losses ahead of the mixer tube. It is this part of the circuit which must be depended on to eliminate "image" and "pseudo image" frequencies which are so annoying, even in many of the higher-priced receivers. Moreover, if a reasonably high order of amplification can be obtained in this preamplifier, and this is



View of Tobe Tuner

entirely practicable with the help of a 58 supercontrol tube and low-loss circuits, it permits the use of less intermediate frequency amplification which helps tremendously in reducing the noise-level of the entire receiver.

Tuning Range from 13.2 to 555 Meters

The "Browning 35" covers the whole short and long wave broadcast tuning range up to 555 meters, or the entire frequency spectrum between 22.6 and .54 megacycles. Its sensitivity throughout this wide range is better than one microvolt which means that the R.F. gain is greater than can be used except under the most favorable atmospheric conditions in a very "quiet" receiving location. It can be seen from the accompanying sensitivity curves that the response on any one band is almost uniform while the entire variation over all four bands is unusually small. The uniformity of these curves is a direct indication of the high efficiency of the all-wave tuning unit employed.

The receiver is absolutely *single-control*. The twelve trimming condensers and four tracking or padding condensers in the SUPER-TUNER unit make it possible to maintain accurate synchronism between the preselector, detector and oscillator circuits over the entire frequency range.

Band-Spread Over Entire Range

Tuning is done with a 40 to 1 ratio microvernier dial. Stations are logged by reference to two pointers, one on the main shaft of the tuning condenser and the other on the vernier shaft. The vernier dial has a 2½" diameter and covers 360°. Thus continuous *band-spread* is accomplished over the entire tuning range. The advantage of such tuning control can be seen by considering one individual band. Take, for instance, the highest frequency band which tunes from 22.6 megacycles (13.2 meters) to 8.8 megacycles (34 meters). On the large calibrated dial this band is 8½" long. While the long pointer on the main dial is covering this distance the vernier pointer makes 20 complete revolutions on its 2½" scale, covering actually 15¾". The 20-meter amateur phone band, which is only 100 kilocycles wide, covers 72° on the 2½" vernier dial!

Oscillator Is Electron-Coupled

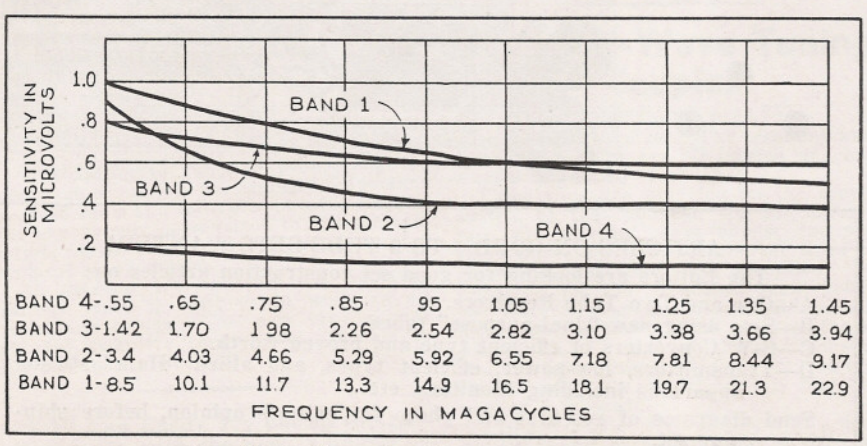
The beat frequency oscillator is combined with the first detector and electronically coupled to it in the 2A7 tube. This precludes any "locking-in" effects between the antenna or R.F. stage and the oscillator. Another feature of the oscillator circuit is the parallel voltage feed to the anode. This can be seen by reference to the accompanying schematic circuit diagram, where the 20,000-ohm resistor is shown in series with the power supply and in parallel with the plate inductance of the oscillator. This circuit arrangement tends to keep the R.F. output of the oscillator at a constant level over its tuning range and permits more efficient operation of the mixer.

Double Band-Pass Filter

Only one stage of intermediate frequency amplification is used. This was done deliberately in preference to using two or more stages, and not for the sake of economy. The 58 supercontrol tube, which is used here, has an amplification factor of 1280 and, when used with effective high impedance grid and plate coupling, is capable of delivering as much intermediate R.F. amplification as can be used under actual operating conditions.

It is common practice to make use of two or more intermediate stages of amplification operating at low efficiency, each slightly off resonance with the other, in order to obtain a selectivity and amplification curve which is not too sharply peaked. While this is good theory, from a practical standpoint the results are not always satisfactory. Tube capacities vary, their characteristics change and tuned circuits shift their peaks. An oscillator, together with an oscillograph, are necessary to properly readjust such an I.F. amplifier.

The "Browning 35" makes use of a double band-pass filter to accomplish this purpose. Six tuned circuits are employed in this one I.F. stage, two of these being link circuits which are conductively connected only to ground, and are consequently not affected by tube variations, etc. Three of these filter circuits are contained in each of the two I.F. transformers, the center one in each case being the independent link circuit. It is a simple matter to align these circuits at any time by merely adjusting the two outside circuit condensers in each transformer so that their circuits are in resonance with



Sensitivity Curve for "Browning 35" Receiver

the link circuit. This is done by listening to the noise level in the loudspeaker and simply adjusting the top and bottom tuning condensers in the transformers for loudest volume.

After much experimenting 456 kc. was chosen as the best intermediate frequency for the band-pass filter and the six circuits are preadjusted for this frequency at the factory. This adjustment is made on R.C.A. tubes, but regardless of tube variations the link circuits remain on 456 kc. and it is a simple matter to bring the others into resonance as described above.

Further advantages gained by the use of this band-pass I.F. filter in selectivity and quality of reproduction will be given next month together with a description of the remainder of the circuit which includes linear diode rectification in the final detector, automatic and manual volume control, sensitivity control, a beat frequency oscillator and resistance-coupled audio amplification.

Beginner's All-Electric S-W Receiver

(*Continued from page* 141)

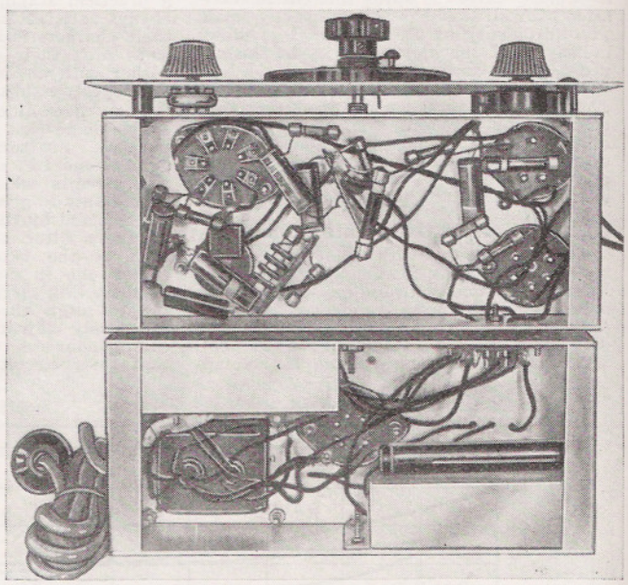
supply is used with other sets. However, for this set no taps were needed and the straight 15,000-ohm, 35-watt resistor was used. If a dynamic speaker is used the field coil can take the place of the second filter choke and should have a value of 1800 to 2000 ohms.

The chassis used for both the power supply and the R.F. and audio section are of aluminum and measure 4 x 9 x 1½ inches, making a really compact receiver. The photographs clearly show the placement of the various parts. We recommend that the very same layout be used, if best results are to be expected. The antenna used during the tests performed with this receiver was 75 feet long and gave fine results. Nearly every *foreign* S-W broadcast station was heard on the *loudspeaker*—and with very comfortable volume.

"3"-WINDING COIL DATA
6 pin base for use with .00014 mf. (140 mmf.) tuning condenser

Band W.L. 10-20 meters	Primary*	Secondary	Tickler	Dis. bet. Tick. & Sec.
	4T. No. 32 S.S.C. Interwound with sec. turns (tickler end.)	5T. No. 26 S.S.C. wound $\frac{3}{16}$" pitch bet. turns.	5T. No. 32 S.S.C.	3/32"
20-40	8T. No. 32 S.S.C. Interwound with sec. turns.	11T. No. 26 S.S.C. wound 3/32" pitch bet. turns.	7T. No. 32 S.S.C.	3/16"
40-80	15T. No. 32 S.S.C. Interwound with sec. turns.	23T. No. 26 S.S.C. wound 5/64" pitch bet. turns.	8T No. 30 S.S.C.	3/32"
80-200	31T. No. 32 S.S.C. Interwound with sec. turns.	50T. No. 30 S.S.C. wound 1/32" pitch bet. turns.	16T. No. 30 S.S.C.	5/32"

*Tickler coil wound at bottom or pin end of 1¼" dia. form.
Prim. Turns interwound at lower end of Sec. (nearest tickler).
This winding not used on "antenna" coil.



This bottom view shows the placement of parts. Note that the panel is spaced from the chassis to accommodate the antenna trimmer and regeneration control.

ARTICLES ON GOOD 1 TO 5 TUBE SETS WANTED!

The Editors are looking for good set construction articles on:

A—One and Two Tube Receivers.
B—Sets using new "dual-purpose" tubes.
C—S-W Converters of efficient type and proven worth.
D—Transmitters, low-power, efficient types, and allied "Ham" station apparatus including Monitors, etc.

Send diagrams of set first and photo for editor's opinion, before shipping set.