THE OMNIVOX is a feature packed simple, flexible audio preamp/vox/transmitter control and phone patch unit. Integrated into this design project are the following author's dozen features:

1. 6GR6 gated beam VOX tube for positive anti-trip.
2. Automatic Level Control (ALC) of audio amplifier for uniform modulation from microphone and telephone inputs.
3. Hybrid phone patch with 6AL7-GT twin indicator tube to monitor voltage into line and ALC operation.
4. Individual phone and master gain controls.
5. Adjustable VOX Sensitivity, anti-trip and holding time controls.
7. Shaped audio band-pass from 250-3000 cps.
8. Visual indication of ALC has voltage.
11. Zero audio output until control relay operates.
13. Auxiliary audio output position (with attenuated speaker output) for recorder or oscilloscope.

(continued on page 2)

WEFPQ MONITORS PHONE PATCH being handled through the OMNIVOX (just below receiver) installed in his station. Operating console also includes transceiver (top to receiver), and — on lower level — speaker, power switch panel (center) and audio system for transceiver. Large cabinet at left houses final amplifier with pair of GI-87's, phase modulator and power supplies. WEFPQ operates principally on double sideband.

CLOSE-UP VIEW of the OMNIVOX centered on a 3½ x 10-inch wall pencil. Switch, fuse and pilot light on left control external power supply for the OMNIVOX.

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A block diagram of this system is shown in Fig. 1. Only four tubes are used in the functional amplifier and centered stages. In addition, a 6AL-5T grid indicator tube provides constant monitoring of the signal applied to the telephone line when using the phone patch. The indicator tube provides an indication of the quality of the telephone line, giving a visual indication of "zero-beat" and furnishes an indication of the amount of ALC voltage developed.

The gain of the audio system is about 70 decibels, providing adequate amplification from a crystal or other high impedance low level microphone to yield 25 watts at the audio output terminals when no ALC voltage is developed.

The input amplifier in the schematic diagram, Fig. 2, is driven through the master gain control (R6) which provides the load for the crystal microphone. It also acts with R6 and R9 as a voltage divider to control the amount of telephone signal fed to V4.

Preamplifier V4 drives the pentode section of a 5AN8 (V5A), connected as a gain controlled audio amplifier. Inter-stage coupling capacitors C6 and C9 provide low frequency attenuation. Circuit and tube capacitances coupled to C6 provide higher frequency attenuation, resulting in an audio frequency response characteristic shown in Fig. 3.

The output circuit of V6 is composed of R10, C10, R11 and R12 in series with the load connected to the output jack (J2) and the input impedance of V7 connected through R5. When the OMNIVOX is in the "receive" (R6 not energized) condition, the audio output jack (J1) is grounded through one of the normally closed contacts of R9.

Thus, no audio output can appear at J2 from the speaker feeding into the microphone, even though both audio stages may be operating at full gain. The paralleled resistance of R5 and R6 is 50,000 ohms, and this, in shunt with R3, provides a load resistance of 33,000 ohms for V5A. The audio voltage developed across this load resistance is coupled to V7 to provide additional gain for the "rectifier" circuits of V4, which provide a positive voltage from V3A for driving the gating tube (V4) and a negative voltage from V7 for the ALC bias on V6A.

In addition, should the positive going output of V7 exceed the 7.5 volts developed by R5 and C9 to the cathode circuit of V6, the 47,000-ohm resistance of R4 is shunted across the plate load to reduce the peak gain and provide moderate limiting action. Should greater clipping be desired, R4 can be reduced. The peak voltage at which clipping begins can be adjusted by changing the value of R6 to develop more or less DC voltage. (It is recommended that R6 be no less than 600 ohms.)

The output of V4 is coupled through C6 to V7 where it is rectified and fed to the usual circuit of R5, R12, C10, R11, and C9 to provide a negative voltage proportional to the amplitude of the
audio output. When this voltage is fed back through R8 to the grid of V9, the operating point of this tube is shifted to reduce the gain of the stage. By adjusting the Gain Limiting Threshold control, the amount of audio limiting can be varied over a wide range.

The circuit is fast acting and has a control range of more than 20 decibels with a normal threshold setting about 1/2 open, as shown in Fig. 4. The control voltage is monitored by one section of V5, and provides a relative indication of the output voltage from V9. Rectifier V9 is driven from amplifier V8 through C9 and the VOX Sensitivity control (R4). The DC output of this circuit is developed across R9 and R10 and charges C10 to provide a positive gating voltage for control tube (V5).

Output from the receiver is applied to the primary of T1. (continued on page 4)

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**TABLE 1 — PARTS LIST—OMNIVOX**

<table>
<thead>
<tr>
<th>Part</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>C1-25</td>
<td>25 µfd, 25-volt electrolytic</td>
</tr>
<tr>
<td>C10-10</td>
<td>10 µfd, 10-volt electrolytic</td>
</tr>
<tr>
<td>C11-10</td>
<td>10 µfd, 450-volt electrolytic</td>
</tr>
<tr>
<td>J1</td>
<td>Ceramic microphone jack</td>
</tr>
<tr>
<td>J2</td>
<td>Chrysler type 1-pin phone jacks, or phone jacks</td>
</tr>
<tr>
<td>L1</td>
<td>1-turn pi-wound rf choke</td>
</tr>
<tr>
<td>R1</td>
<td>350,000-ohm potentiometer, linear taper</td>
</tr>
<tr>
<td>R2</td>
<td>10,000-ohm potentiometer, linear taper</td>
</tr>
<tr>
<td>R3</td>
<td>5,000-ohm, 2-watt adjustable wire wound resistor</td>
</tr>
<tr>
<td>R4</td>
<td>1,000,000-ohm potentiometer, linear taper</td>
</tr>
<tr>
<td>R5</td>
<td>250,000-ohm potentiometer, linear taper</td>
</tr>
<tr>
<td>R6-25</td>
<td>25-ohm wire wound potentiometer</td>
</tr>
<tr>
<td>R15</td>
<td>300-volt relay, 1,000-ohm facility bell switch (Foster-Brundrett 1042-070)</td>
</tr>
<tr>
<td>R16</td>
<td>600-volt relay, 600-volt secondary with positive center tap</td>
</tr>
<tr>
<td>T1</td>
<td>500-turn turntable transformer, 1200-ohm primary, 400-ohm secondary</td>
</tr>
<tr>
<td>R9</td>
<td>Matching transformer, 500-ohm primary, 400-ohm secondary</td>
</tr>
</tbody>
</table>

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**FIG. 3. COMPLETE SCHEMATIC DIAGRAM of the OMNIVOX. Only those parts which require additional identification are shown in TABLE 1 — PARTS LIST. Resistors are in ohms, 1/2-watt rating and ±10 percent tolerance, unless otherwise marked. Capacitors are in microfarads (µfd), paper types of 600-volt DC rating, except where noted. Basic parts of tube diagrams are numbered.**
OMNIVOX (continued from page 3)

small output transformer operated backwards, where it is stepped up and rectified by a 1N48 diode. (D.7).
The voltage developed across C6 and R8 provides negative-going pulses of voltage which are superimposed on the positive DC voltage on the No. 1 grid of V6 by adjusting the Anti-Trip control (R9). An additional RC filter (R3 and C1) provides a DC voltage to the deflection electrodes of V6 which is proportional to the peak audio voltage delivered by the receiver to the OMNIVOX. Thus the pattern of three sections of vertical grid voltage is fed from the receiver, as shown in Fig. 2.

HEART OF THE CONTROL SECTION

OMNIVOX is the 6BN6 ganged beam tube (V1). This tube is constructed in such a way that its plate receives current only when both of the grids are cut off. Thus an anti-trip voltage at the No. 1 grid can cut off the beam and, regardless of the amount of positive voltage on the second control grid, the plate cannot draw current. By this means, anti-trip action is not a matter of delicate balance between opposing voltages.

The 6BN6 (V1) operates with nearly constant cathode current, developing 9.5 volts across R6, and providing cut-off voltage for the second control grid. The first grid is connected to a voltage divider made up of R6, R7, and R8, whose combined 300 volts to ground, and is clamped at zero bias. Thus, in the absence of anti-trip voltage derived from receiver output, the input gate is open.

Since the second grid is cut off, no plate current flows until audio voltage applied to V1 develops a positive gating bias at the 6BN6's second grid. This starts plate current flow in the 6BN6, causing R6 to, in turn, control the audio output signal from V6, modulate the speaker and close the external VOX control circuit on terminals 7 and 8.

The gating bias remains on the second control grid of V1 as long as there is sufficient positive voltage across C1. The HOLD control (R3) adjusts the discharge time of C1. Space charge effects in V1 further modify the discharge characteristics so that the components specified give a range of HOLD from milliseconds to continuously on. In the Methyl position of S1, the cutoff bias for the second gating grid is removed and closed R3.

PHONE PATCH SECTION

OMNIVOX is a hybrid circuit made up of a pair of transformers, a balancing network, cou-
pling capacitors and a pi-section RF filter for the phone extension line. In the OFF position of Sr, the patch is off and is completely out of the circuit (with the exception of the RF filter which is left in at all times). In the AUX position of Sr, the receiver output is switched to the Receiver Output jack (Jr.). Simultaneously a 30 ohm resistor is connected in series with the speaker voice coil to attenuate the audio output about 30 decibels.

In the PATCH position of Sr, the hybrid transformers are connected to the telephone line through low-leakage paper coupling capacitors (C3 and C4). In addition, while the speaker remains attenuated, a tee network is connected between the receiver output and the primary of Tr, which couples audio from the receiver to the telephone line.

Earlier, it was explained that the 6AL7 (Vi) was driven by a negative voltage proportional to the peak receiver output voltage. In the PATCH-ON position of Sr, Rs (in the tee network) can be adjusted so that the maximum audio voltage supplied to the "phone line" is equal to the maximum allowable line voltage (usually about 0.77 volts) for a specific amount of pattern compression on V4. The escutcheon plate shown in Fig. 6 is marked for this purpose. Once this calibration has been accomplished, the 6AL7-GT eye tube monitor provides a direct means for checking the audio level to the line. This makes it possible for the operator to adjust the station receiver audio output to the proper patch operating level.

The Balance control (Ra) is used to adjust the current flow through the two sections of the primary of Tr due to the presence of voltage across the secondary of Tr, so that receiver output is not coupled through Tr to the audio amplifier section of OMNIFOX. To adjust Ra, the patch is switched on (after you have dialed an understanding friend on the line) and the Phone Gain control (Ra) is opened to impress voltage from the secondary of Tr on V4. Receiver output is being fed into Tr in this case and the circuit may tend to oscillate unless the Sensitivity control (Rx) is at minimum gain.

With the Threshold control (Rx) about mid-point, the Patch-Balance control (Ra) may be adjusted slowly until the ALC monitoring section of V4, indicating the amount of audio voltage out of Vi, shows zero output voltage. The Master Gain control (Rb) may be opened further to increase the system gain for more precise balance. Although this adjustment is quite sensitive, the visual indication provided by V4 makes this a simple operation. Following the balancing of the hybrid circuit, the calibration of phone line voltage versus V4 pattern compression should be checked.

The OMNIFOX may now be operated from the phone line by adjusting the Master Gain, Phone Gain (Rs), and Sensitivity controls (Rx) appropriately. Slight compression of gain by ALC action from the voice input on the line should be indicated by V4. When the microphone in the telephone is providing the audio signal, the ALC will reduce the gain of V4 (depending on the setting of the Threshold control) so that the audio output is not excessive even though the output from the handset is many times greater than the usual phone line signal.

Note that the reduced speaker output in the Patch-ON position of Sr helps prevent audio feedback from speaker to telephone microphone. Changing Sr from "PATCH-ON" to "PATCH-OFF"". (continued on page 6)}
OMNIVOX (continued from page 5)

"Amp," provides an immediate disconnect between the phone line and the patch circuit without a blast from the speaker. When running a phone patch through the OMNIVOX, the positive gating action of the VOS control tube and the easy shift from automatic to manual control, provide sufficient flexibility to meet the variety of operating conditions and degree of familiarity with patch procedures likely to be encountered. The 6AL7-T7 monitoring indicator is also useful for frequency checking and zero-heating to net or roundable frequencies. Since the indicator is DC-coupled to the VX48 anti-strip diode, and the time constant of the filter is relatively short, the compressed pattern opens abruptly as zero-heat is approached between the received signal and the heating signal from a transmitter VFO, crystal calibrator, or inter-polaration oscillator.

It is possible to see the beat note down to about 2 cph with this system (this is usually close enough for most tuning). In order to use this feature on SSB it may be necessary to insert some carrier while setting the transmitter on frequency. For DSB (used by the author), or for AM, carrier is readily available at the operating frequency.

CONSTRUCTION of the author's model OMNIVOX was accomplished in an 8 x 12 x 3-inch chassis.

The pictures of the completed unit on pages 2, 5 and 6 show most of the pertinent constructional details. A smaller chassis size could be used if smaller parts than those from the author's junk box are available.

Controls which may be used during normal operation were mounted on the front side of the chassis in the locations shown in the drilling diagram, Fig. 7. The four control tubes (V1 to V4) were mounted internally on a small sub-chassis bracket running parallel to the front panel. Fabrication details of this bracket are shown in Fig. 8. The 6AL7-T7 indicator tube (V5) is mounted on another bracket made from 1/8-inch thick sheet aluminum, located so that the tube protrudes through the 11/2-inch diameter hole in the chassis front panel (and back panel, too).

An 8-terminal barrier strip for external signal connections, the Gen Limiting Threshold (R39), Pitch Balance (R45) and Calibrate (R46) controls, the Receivers Output (L1) and Audio Output (L2) jacks, and control relay (R50), are mounted on the rear side of V1 chassis. Power for the heater and plate power come in from a 6VDC plug.

Almost all wiring is run with insulated hookup wire. Leads from J1 to R6 to the control grid of V3, and to the Phone Gain control (R64) are run with shielded single conductor wire. Small parts are mounted on lugs of components that connect with, and on terminal strips.

TESTING THE OMNIVOX, when completely assembled consists of connecting it to a power supply furnishing 300 volts DC at 60 milliamperes, and 6.3 volts at 2 amperes. The audio section should be checked out first, and then bias voltage measurements in the ALC circuit are taken to check its operation.

The VOX circuit should then be tested, and calibration of the indicator eye tube is completed. Instructions for adjusting the various controls have been given hereofore in the description of the OMNIVOX, and will not be repeated here. Balancing and testing of the Phone Patch circuit should be done last after the other adjustments have been completed.

Finally the chassis cover plate is bolted in place, and the controls are mounted, and the OMNIVOX is installed in the rear side of a V1 chassis. The power station. The package has been designed so that it can be set under, or on top of, a receiver, speech amplifier, etc. Or, it can be stood on end between units on the operating desk. If the latter position is chosen, vent holes should be drilled in the chassis sides which form the bottom and back sides of the unit. It also should be secured to the bottom side.

Operation of OMNIVOX is pretty much automatic once the Microphone Gain, Telephone Gain, and VOX Sensitivity controls have been set. The Anti-Feed control should be adjusted so that the speaker noise does not actuate the VOX circuit. The Hold Time control should be set to individual tastes, with sufficient hold in time so that R50 remains closed between spoken sentences.

Proper operation of the OMNIVOX circuitry may easily be adapted to existing transmitter audio equipment, if desired. The audio gain-controlled amplifier, with its speech frequency range emphasis, as the VOX circuit too, are superior to similar circuits found in some commercial transmitters.

Improve your amateur station by incorporating the complete OMNIVOX, or portions of the circuit, into your equipment.

FIG. 8. LAYOUT DIAGRAM for the sub-chassis on which the four miniature tubes are mounted. A strip of 1/8-inch thick aluminum 4 1/2 x 3 inches is required.
VERSATILE POWER-CONTROL BOX

by Philip E. Hoffius, W9GFS

Few amateur stations today have equipment permanently wired to power lines through disconnect switches; rather, the trend toward tabletop units with simple power cord connections has sometimes brought about a tangle of extension cords and cube taps, necessary to connect a receiver, moderate power transmitter, and accessory equipment to the power line.

A useful accessory to lessen the power-line haywire may be easily constructed in the form of an AC outlet box—shown in the accompanying illustrations. The mechanical design can be tailored to fit individual installations. The box shown in use at W9GFS was intended for mounting on the side of a desk. A different layout would permit other mounting positions.

THE SCHEMATIC DIAGRAM, Fig. 1, shows the outlets split into groups: (1) those that remain on as long as the box is plugged in, intended for a desk lamp and clock; and (2) those controlled by a main switch S1 and intended for the receiver, transmitter, and accessories. A fuse is included in the circuit for all of the outlets.

The input plug and all of the outlets but one are mounted on the rear of the box, since constant accessibility is not necessary. One outlet in the group not controlled by the switch is mounted on the front to allow ready accessibility for a soldering gun. The neon lamp on the front of the box indicates when the switchfed group of outlets are on.

The switch allows all of the units to be turned on or off without the use of the switches on the individual units. The switch on the model shown requires a key to turn it on; this prevents children from energizing the equipment. A conventional wall-switch which has the same dimensions may be substituted.

All of the outlets used are of the polarized type, and care should be taken in connecting the plugs on the attachment cord to preserve the polarity relationship. If the box will be used within reach of a ground, a 3-wire safety type plug should be used to ground the box.

This control box usually will handle transmitters rated at up to 200 watts input. Higher power transmitters, especially those in the kilowatt class, should be powered from a separate circuit. However, all station equipment except a large transmitter can be controlled by the power control box. Devote one or two evenings to eliminating your line cord haywire by constructing this handy box.
A New Feature —
MEET OUR AMATEUR TUBE DISTRIBUTORS —

Uncle Dave Marks, WZAPF (center), visited the amateur radio station at Yucca City, NVICN, on a trip to Europe recently. At left is Dr. Lois Castaldi, HCL, who acted as interpreter and, at right, Don Black, Chief Operator and Custodian of VICN.

WZAPF is widely known as the operator of UNCLEDAVE’S Radio Shack in Albany, New York. During several foreign and globetrotting tours, Dave has met thousands of radio amateurs, and may well have set a record for this feat.

CAPACITORS FOR HAMS — General Electric’s new line of “application rated” Service-Designed Alumadyn® capacitors will replace more than 1,000 different types with only 225 pedestal and tubular types. Amateurs will find them ideal for replacement, or for new home-built equipment. Ask for them at your G-E Tube Distributor’s.

MEET OUR AUTHORS —

WPGG — Philip E. Huffield, found a solution to the usual thanks of power cords and tube taps in the most power control box for his station described on page 7.

Phil’s previous contributions to G-E HAM NEWS have been the GADGET BAKST and niceties in the September-October, 1959 issue, and “OPERATING G-E HI-FI TUBES AS MODULATORS” in the January-February, 1960 issue.

Vocationally, WPGG is a technical data engineer with G-E’s Reacting Tube Department here in Owensboro. He has authored several articles for QST, Electronics World, and other publications.

WAPQ — Allen (Allie) P. Hinske, earned a commercial radio prescription, with automatic gain control, voice-controlled break-in circuit, and phone patch. The result, after more than a year of construction and testing, is the OmniVOX described in this issue on pages 1 to 6.

Allie’s fine station is shown on page 1. The transmitter is completely home constructed, including the exciter unit at the right.

WAPQ is Manager of Advanced Development Engineering for General Electric’s Reacting Tube Department in Owensboro. He and his staff are busy engaged in developing exotic new television devices like TUMAS circuits, the tiny high-temperature, radioactive, resistive, pentode electronic circuits described on page 2 of the July-August, 1959 issue.