

RADIO — ELECTRONICS

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IN THIS ISSUE
Electronic Flash Gun
Fundamentals of Radio Servicing

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SEE TELEVISION SECTION

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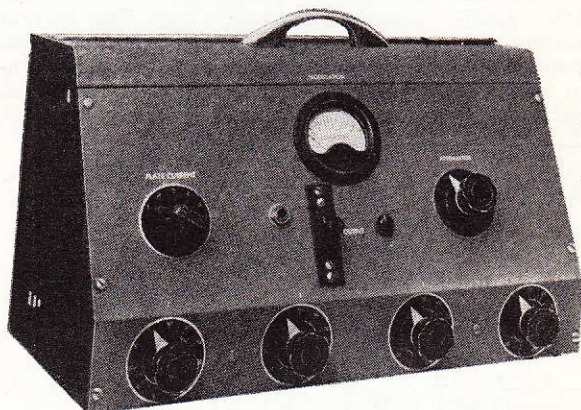
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LATEST IN RADIO ELECTRONICS TELEVISION

Audio Console Controls Sound



A preamplifier-mixer permits the recordist, PA operator, or remote-broadcasting engineer to control and monitor programs

By RICHARD H. DORF

YOU may not own a broadcasting station, but if you have a collection of audio equipment—AM and FM tuners, phonograph assemblies, and microphones—your needs are very much like those of a typical radio or recording studio. You need some way to control and co-ordinate your equipment, some way to group the pieces together and operate them as a single flexible system. You may want to hear a record or a radio program or use your microphones in quick succession or use two of these items at a time.

The audio control console described in this article acts as a clearinghouse for all your audio components. The turn of a knob or the movement of a switch channels any or all of four sound sources either into the loudspeaker or to a recording amplifier or to both at the same time. In a more expanded form a console such as this is the nerve center in every broadcast studio, the device responsible for the flexibility which allows you to hear the musical backgrounds behind speakers or any of the innumerable common effects.

The console is easy and inexpensive to build, and its appearance is good

enough to satisfy even the feminine members of the household. Its use requires some revamping of most of your sound sources, but the modifications will pay off in convenience. There will be no more plugging and unplugging components every time you want to use them, no more limitations on the length of cables, no more hum pickup or high-frequency losses from long lines.

How to convert

The revamping consists mainly of converting all your devices to 500 ohm output. Most mikes (except crystals, which cannot be used) are available with 500-ohm output at no extra cost. If you already have high-impedance dynamics or ribbons, the manufacturer will install a new transformer for a very small charge. High-impedance, high-level devices like tuners can be converted to 500 ohms without using a transformer, as explained later. Because each input has high gain, resistive losses caused by the impedance change are made up in the console.

Examination of the circuit diagram (Fig. 1) shows that the console is very simple. Four 500-ohm T-pads are used

as mixers. The step-type pads sold for broadcast use are rather expensive, so wire-wound controls were used. Several makes of these are on the market, but the only ones found noiseless enough to work at low level are the IRC J-977's.

The pads are connected so that input and output impedances of the mixer are about 500 ohms. If more or less than four inputs are wanted, the same connections are used, but the value of the 300-ohm build-out resistors is changed. Some impedance value other than 500 ohms can be used, should there be any reason for it. If Z is the impedance of each input and N the number of inputs, then the value of each build-out resistor is $Z(N-1)$.

The output of the mixer goes through a high-fidelity line-to-grid transformer to the 6SF5 grid. A UTC A-10 was used in the console because it is small and relatively inexpensive.

The 100,000-ohm master gain control at the first grid of the 6F8-G (a 6SN7-GT works just as well) controls the over-all level.

The volume control at the 6J5 grid is mounted on the chassis and is screw-driver-adjusted. It fixes the maximum gain of the console for whatever devices are used. The advantage is that only the necessary minimum of hum- and noise-producing gain is present.

The plate-to-line transformer is another miniature high-fidelity unit, a UTC A-26. The A-26 is actually made for push-pull, low-level outputs and was used only because it was on hand. The UTC A-24 (or any other similar high-fidelity unit) made for a single plate can be used, but the value of the primary shunt resistor will have to be changed. These high-quality transformers (input and output) help to give an over-all frequency response flat to within approximately ± 1 db from 30 to 15,000 cycles.

The decibel meter is permanently connected across the transformer secondary, as is the monitor jack. The line jack is connected through the output switch, which substitutes a 500-ohm dummy-load resistor when the line jack

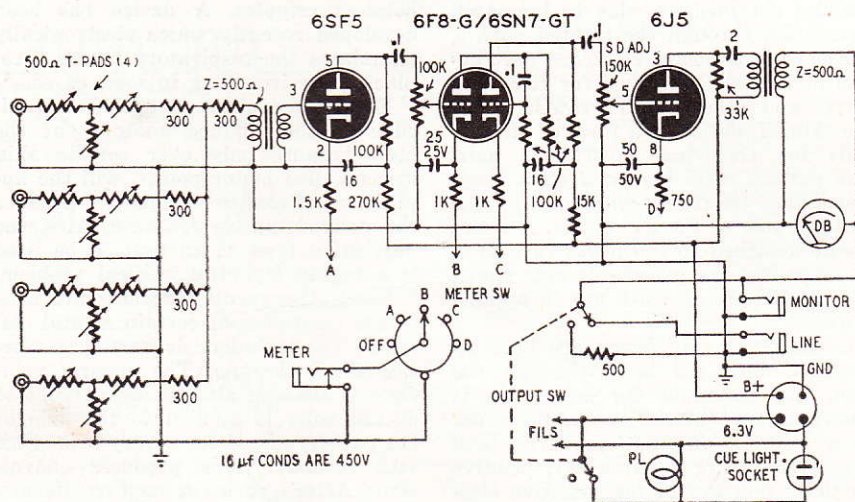


Fig. 1—Formula in text shows how more inputs can be added or a different impedance used.

is switched out. A second set of contacts on the output switch lights a pilot lamp on the front panel to indicate that audio is being fed out. There is also a receptacle for the plug on a cable leading to an external pilot lamp. This is useful in recording; it is actually an "on-the-air" cue. The line jack feeds the recording amplifier and when the output switch is pushed down (a lever-type switch is used), the external light, which has been placed where the player or speaker can see it, lights.

As a help in locating trouble and for preventive maintenance, the meter switch transfers the live contact of the meter jack to any of the four cathodes, keeping the other cathode resistors grounded. A rotary tap switch with a wafer which shorts all unused contacts is used. After the console is built, plug a milliammeter in the jack and make a note of the reading for each tube. In the future, any substantial change in the reading will indicate trouble.

A standard sloping-panel steel cabinet 14 x 8 x 8 inches was used for the housing, into which a 13 x 7 x 2-inch chassis just fits.

Construction

Begin by fastening the chassis to the lower (vertical) portion of the front panel, being careful to fit the two so that the assembly will slide easily into the cabinet. A pair of screws and nuts through chassis and panel will do the fastening job nicely and the attenuator shanks will make it indestructible. Now make holes through the two for the input attenuators. Be sure to center these vertically because the pads are none too small for the space.

On the chassis, the tubes and transformers are mounted in a line, with the 6F8-G in the center, far enough back to clear the meter. In the chassis photo, the components are in logical order from right to left, beginning with the input transformer.

All connectors are mounted on the rear chassis apron. A 2-inch-high slit along the rear wall of the cabinet makes the rear chassis apron readily accessible. From right to left in the photo are the four input connectors, the power connector (a 4-prong male), the socket for the external pilot-lamp connection, line and monitor jacks.

Under the chassis there is no crowding. Mount components where convenient. Shield all leads up to the input transformer primary.

An external power supply furnishing filament voltage (6.3 volts) and about 250 volts B is necessary. The writer uses a single supply for the console and a recording amplifier. The cable from the supply should terminate in a four-pin female plug to avoid shock. *Don't use a tube socket on the console and a male plug on the power cable.*

Connections

Any microphone (or other device) which has a 500-ohm output impedance can, of course, be connected to any input. Tuners having high-impedance

outputs can be connected as shown in Fig. 2-a. The potentiometer should be adjusted for the recommended tuner load impedance. The level across the 500-ohm resistor will usually be about the same as that of a microphone. Exactly the same scheme can be used with the output of the preamplifiers generally used with modern magnetic phonograph pickups. It can also be used with high-output crystal pickups, but usually there will not be enough level unless the variable resistance is made too small to allow good bass response. The scheme shown on page 89 of the October issue of RADIO-ELECTRONICS is a better one.

The console can also be fed from the loudspeaker voice-coil terminals of any receiver or amplifier. Fig. 2-b shows how this is done. The impedance of the speaker line is not important. The speaker can be left connected, or it can be replaced with a dummy load. Adjust the variable resistance until enough level is being fed to the console.

Any monitor amplifier having a high-impedance input can be connected to the monitor jack, the length of the line between it and the console being unimportant. Effectively, this is a low-impedance line bridged by the amplifier grid.

At least one amplifier with a 500-ohm input must be connected to the line jack when audio is switched to it because the output transformer must always be terminated in 500 ohms. The amplifier need not use a transformer, however. Simply connect a 500-ohm resistor across the high-impedance input, in parallel with the line from the console. If additional amplifiers are to be fed by the console, just parallel their

inputs. But all except one should have high-impedance inputs so that only about 500 ohms is across the console.

No equalizers should be placed in the console. One of the console's advantages is that each external amplifier or sound

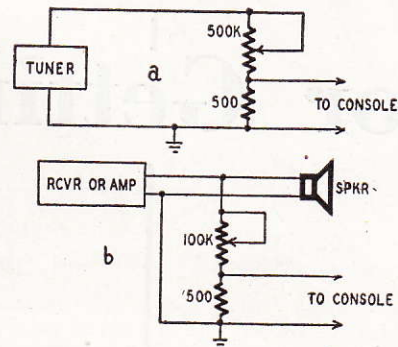


Fig. 2—How to connect a tuner or a receiver.

source can be equalized for its particular job without affecting the others.

MATERIALS FOR CONSOLE

Resistors: 5—300, 1—750, 2—1,000, 1—1,500, 1—15,000, 4—100,000, 1—270,000 ohms, 1/2 watt; 1—500, 1—33,000 ohms, 1 watt; 1—100,000-ohm potentiometer, 1—150,000-ohm, screwdriver-adjusted potentiometer; 4—500-ohm, wire-wound T-attenuators (IRC J-977).

Capacitors: 3—0.1, 1—2 µf, 600 volts, paper; 1—25 µf, 25 volts, 1—50 µf, 50 volts, 2—16 µf, 450 volts, electrolytic.

High-fidelity transformers: 1—input, 500 ohms to single grid; 1—output, low-level, push-pull plates (or single plate—see text) to 500-ohm line.

Switches: 1—d.p.d.t., lever-type (Centralab 1458) and face plate; 1—5-position, rotary, meter-insertion (Centralab type G wafer).

Connectors: 4—single-circuit, chassis-mounting microphone connectors; 1—4-prong, chassis-mounting male plug; 1—2-contact, chassis-mounting female socket; 2—single-circuit, non-shorting, 1—single-circuit, shorting phone jacks.

Tubes: 1—6SF5, 1—6F8-G or 6SN7-GT, 1—6J5.

Miscellaneous: 1—decibel meter; 1—6.3-volt pilot-lamp assembly; 3—octal tube sockets; 1—sloping-panel metal cabinet, 14 x 8 x 8 inches; 1—chassis, 13 x 7 x 2 inches; knobs, dial plates, and necessary hardware.

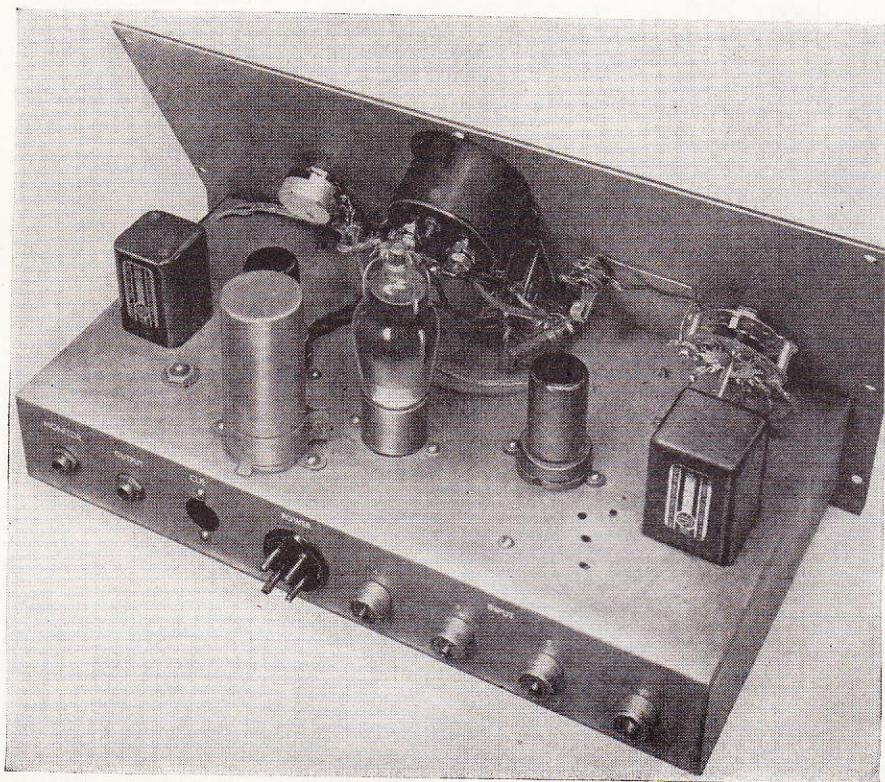


Photo shows chassis and panel pulled out of cabinet. Male power connector is used for safety.