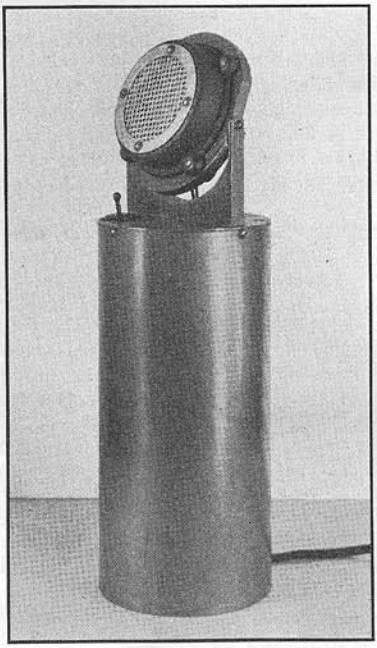
A Sure-Fire Condenser Microphone

Full Design Details for the Amateur Builder

By Howard F. Anderson, W1BVS*

WHY, when you talk condenser microphone to most amateurs, do they throw up their hands and say "N.D."? Well, probably because many condenser mikes are so insensitive that they require too much audio gain, are too complicated to make and too tricky to adjust. The one here at W1BVS has good sensitivity, is easily built and has a dual adjustment feature that eliminates the trickiness. It has given perfectly satisfactory results and most always causes comment on the part of the fellows worked because of the very good quality and lack of background noise.

The two most important features in a condenser mike are the adjustment of the tension on the diaphragm and the adjustment of the gap between the diaphragm and back plate. The two adjustments should be entirely independent of each other. Otherwise when the gap is right the diaphragm tension is likely to be wrong, and *vice versa*. If the adjustment to give the proper diaphragm tension for good frequency response makes the gap too great, then the sensitivity is poor. If the adjustment to give the proper gap for good sensitivity makes the diaphragm tension other than what it should be for good frequency response, then the "quality" is punk. Unlike the usual condenser mike intended for amateur construction, this one provides for independence of these two all-important adjustments and does it simply.



THIS PROFESSIONAL APPEARING AND WORKING CONDENSER MICROPHONE HAS SEPARATE ADJUSTMENTS FOR DIAPHRAGM TENSION AND CONDENSER GAP, GIVING HIGH SENSITIVITY AND EXCELLENT FREQUENCY RESPONSE. THE HEAD AMPLIFIER IS CONTAINED IN THE BASE

The materials used for this job require a minimum of machine work and are of a type that is generally available, the whole thing being built around an obsolete magnetic loud-speaker unit of a type widely distributed in years past and still to be found kicking around radio shop "grave-yards" in goodly numbers. As an alternative to this unit, the whole head can be machined to the specifications given in the drawings.

First procure from the junk pile, or some of your friends, an old Atwater-Kent goose-neck speaker of the vintage of about 1925; the model number of this one is 636722. Any amateur will recognize this speaker. It has an adjustable unit in the base. Throw away the horn and unscrew the unit from the base and throw the base away too. Now dissect the unit and take out the pole pieces, magnets, diaphragm and tension ring. Save the tension ring and diaphragm and heave out the pole pieces and magnets.

The first construction is the back-plate mounting. Salvage a 4-prong bakelite tube base, break out the pins and cut off the top so that the shell is $1\frac{1}{16}$-inch long, being sure that it is cut true. Drill out two of the pin holes and also drill two $\frac{1}{8}$-inch holes to match in the back of the speaker unit so that the sawed-off base can be fastened on the little ears in the center. Also drill a $\frac{1}{8}$-inch hole centered in the tube-base bottom, and countersink from the outside for the $\frac{6}{32}$ flat-head screw which goes up through the socket to hold the back plate, as shown in the drawings. The back plate is made from a piece of brass $1\frac{3}{4}$ inches in diameter and about .020 inch thick, perforated with $\frac{1}{16}$-inch holes. This can be obtained in any hardware store. A piece of the same material $2\frac{5}{8}$ inches in diameter is used on the front of the mike to keep poking fingers and other things away from the diaphragm. The back plate *must be flat*, and is soldered to the screw coming up through the center of the tube base. This plate forms one connection of the mike, the shell being

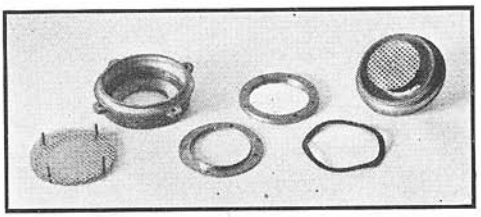
*28 Maple St., Torrington, Conn.

the other. This completes the rear section.

Now for the diaphragm and front end. First take the front shell and make a hole 1½ inches in diameter in the center of it. This can be turned out in a lathe or made by drilling a row of holes and using a hammer and chisel, with a file for finishing. Also drill the four ⅛-inch holes for mounting as shown in the drawing and photographs.

Now make up the three rings as per the drawings. These are of brass and can be turned out very easily in a lathe. In case one is not handy, the two diaphragm rings can be cut out of flat stock, the circle-of-holes method being used to make the openings. These rings must be flat, and can be made so by putting a piece of No. 00 emery cloth on a flat piece of board and grinding them with a circular motion until a really flat surface is obtained. On the tension ring (the one with the projecting lip) a little ingenuity on the part of the amateur will be called for. If a lathe is available, the whole thing can be turned out of one piece of brass. If hand tools are the only recourse, the logical procedure is to make the two pieces separately and sweat them together with solder. One thing to remember is that the projection of the tension ring that goes against the diaphragm must be smooth and have no burrs or rough spots. Otherwise when the ring is drawn up it may punch a hole in the diaphragm.

The diaphragm is made either of duraluminum .001-inch or less thick, or of the foil from a cigarette package. That from "Old Gold" is about the right thickness and tensile strength. If you use the foil take it off very carefully from a new



THE ESSENTIALS OF THE CONDENSER UNIT

They go together in the order shown, from left to right, and are identified as the front cover screen, head casing, diaphragm tension ring, diaphragm and diaphragm ring assembly, back-plate tension spring and, finally, the back-plate assembly. Further details are shown in the drawing.

package, so as not to make any creases or pinholes in it, and cut it out the same size as the old diaphragm, using the latter as a templet. Before cutting, however, put the tinfoil on a smooth piece of paper such as a page from *QST*, making sure there is no dirt under it, and smooth with a soft piece of cloth. After cutting out the diaphragm, put it in between its two rings and

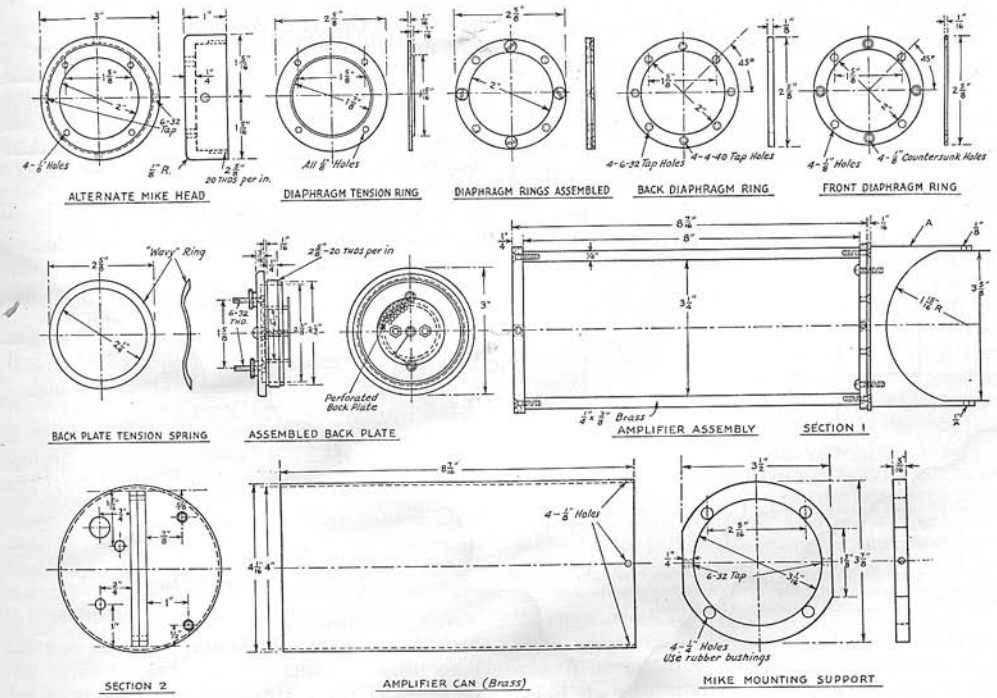
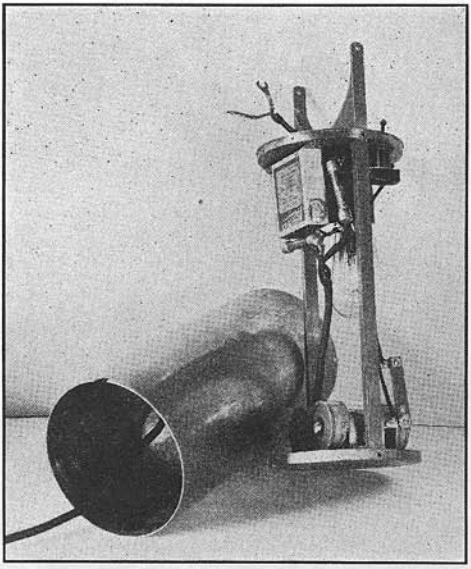


FIG. 1 — DETAIL OF THE CONDENSER-HEAD COMPONENTS

tighten the four small screws which hold it in place.

Now for the assembly. The diaphragm tension ring goes into the front of the unit first, with its flat surface toward the front. Be sure the four



THE AMPLIFIER ASSEMBLY SLIDES OUT OF ITS SHIELD

A Type '30 tube is used. The condenser head fits in the forked mounting and can be tilted to a convenient angle.

holes in the front of the unit line up with those in the tension ring. Next put on the front plate or screen and insert the four screws. Then put in the diaphragm assembly with the thin ring toward the tension ring. Line up the screws and take up

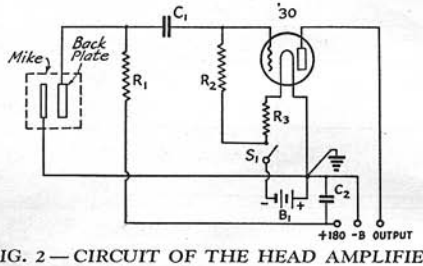


FIG. 2 — CIRCUIT OF THE HEAD AMPLIFIER

R_1 — *3-meg. coupling resistor.*
R_2 — *5-meg. grid resistor.*
R_3 — *17-ohm filament resistor (20-ohm unit with 3 ohms shorted).*
C_1 — *0.006 μfd.*
C_2 — *1.0 μfd.*
S_1 — *Single-pole single-throw "A"-battery switch.*
B_1 — *Two flash-light cells (large type) in series.*
"Ground" indicates connection to shield.

on them a bit. *Be sure and take up evenly on all four screws until you see the wrinkles in the diaphragm just disappear.* Do not take up much after this occurs because that is about the proper tension. Now slip in the spring (the wavy ring) that keeps tension on the back part of the unit, and screw in the back section.

Before going further, connect a dry cell and a pair of 'phones, or high-resistance voltmeter, in series across the mike terminals. If you screw in the back part of the mike carefully you will hear a click and a grating noise, when the diaphragm and back plate just touch. *Do this very carefully — you might ruin the diaphragm.* When you hear the click (which means that the back plate is against the diaphragm), back off just a hair and blow on the diaphragm, not too hard, and adjust until there is no noise.

This completes the head unit. The mounting and amplifier can be made to suit the individual, but one thing must be remembered. *Keep the lead from the back plate to the grid condenser and grid as short as possible.* As shown by the photos, the tube is hung upside down in the head amplifier to make these connections meet this requirement. The head-amplifier shield can be cylindrical like the one shown, which is 4 inches in diameter and 8½ inches high, or can be square. A dry-cell "A" battery for a Type '30 tube may be placed right in the shield, as is done in this case. With a tube drawing more filament current it would be necessary to use an external "A" supply and an additional pair of leads in the cable. The circuit of the head amplifier is shown in Fig. 2.

As to the number of stages necessary for good output, here at W1BVS I use either of two amplifiers. One is a Western Electric 7-A which has one '12-A in the first stage and two '71-A's push-pull in the second stage. The other amplifier is single stage using a '33 pentode. Either of these works into a pair of '45's push-pull; and these excite two Type '10's as Class B modulators. And the '10's will put out 50 watts of audio nicely, as I can prove.

So there is nothing terribly complicated about a condenser mike, and any amateur who knows how to use a few tools can build one. The drawings show an alternative design in case one has the facilities of lathe to turn one up. When using the mike, do not put it inside a copper or tin box that may be subject to mechanical vibration and which will set up an unpleasant ringing sound.

If a little care and patience are observed, I am sure that any amateur can build a mike as good as this one and I know it will improve the quality of the output from his station. It is well worth the time and small amount of money spent.

Strays

W9GXI has an 82 that has been giving service for a month at 950 volts and 150 mils, and has been used intermittently at 1125 volts and 200 mils — and this with a condenser-input filter. Some tube!