

Tone Modulating the BC -221

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A modification increasing the versatility of a popular surplus unit.

MANY HAMS who have purchased the BC-221 series of frequency meters have desired to incorporate some method of modulating the variable oscillator to use the instrument as a signal generator, and also to permit easy identification of its signal when spotting a receiver in the crowded ham bands.

After spending a hard-earned \$2.50 at a radio supply house for an assortment of items supposed to make a modulator for the frequency meter, and after spending several hours trying to get the thing to work, that approach was given up. The following circuit was then incorporated in the BC-221, which provides sufficient modulation to easily identify the signal on a receiver permitting its use as a signal generator at least through 54 mc, which is as far as it has been tested. Besides it allows partial control of the frequency of modulation and complete control of the percentage of modulation by adjustment of the GAIN control on the front panel.

The only parts required are three condensers—two 0.01 μ f, one of them preferably mica, one .002- μ f mica, and one SPST toggle switch. The modification will be described for the BC-221-J model, since this seems to be the most common type available on the surplus market. The same circuit will work equally well on several of the other models checked.

A single tie point is mounted under the chassis secured by one of the screw heads which holds the 6A7 tube clamp in position. The 0.01- μ f paper condenser (C1) is mounted between this point and pin 3, the screen grid lead, of the 6A7 socket. A double tie point is mounted under the head of one of the screws which holds the oscillator condenser compartment shield in place. This screw is close to the large grommet on the left-hand side of the chassis (viewed from the rear with the chassis in an inverted position). On this double tie point is mounted the 0.01- μ f mica condenser (C2).

Modification Procedure

Remove the 6A7 mixer tube from its socket by loosening the clamp holding the base of the tube. Now very carefully, in order not to damage the low frequency oscillator coil (part No. 17), remove the wire connected to the terminal of condenser 44a, which is the lead from the 8750-ohm screen grid dropping resistor and the screen grid pin on the variable frequency oscillator socket. If the leads of C3 are cut off to a length of about

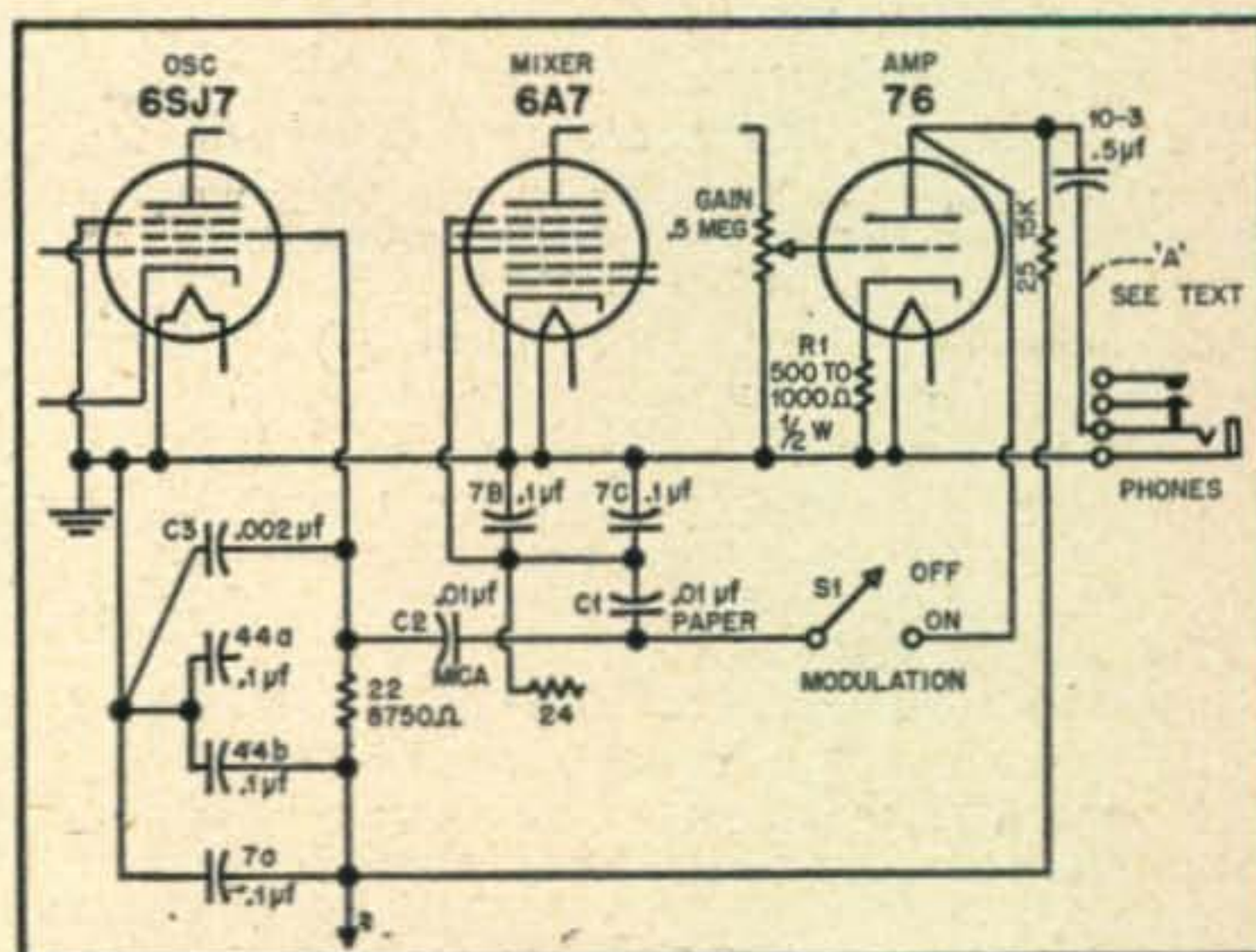
$\frac{1}{2}$ " the condenser will be self-supporting and require no additional support. Solder one lead of the .002- μ f mica condenser (C3) to the "C" or ground terminal of condensers 44a and 44b. To the other lead of C3 solder the wire removed from condenser 44a and also solder a 7" length of push-back wire and run it through the grommet near the condenser. Since this condenser now forms the screen grid bypass circuit of the v.f.o. it is important that it be capable of as little vibration as possible.

The toggle switch *S1* is mounted in the upper left-hand corner of the front panel. The $\frac{1}{2}$ " mounting hole is centered $1\frac{3}{4}$ inches down from the top of the panel and $1\frac{1}{2}$ inches in from the left-hand edge. This lines the switch up with the CORRECTOR control on the right side and brings it in^o line vertically with the PHONE jacks below it.

The other end of the 7" lead from C3 is connected to one side of C2, mounted on the double tie point. The other side of C2 is connected to the lead from C1 on the single tie point. A lead is also run from this single tie point to one contact of the SPST toggle switch. The other contact of the toggle switch is connected to *pin 2* of the 76 socket, the plate lead of the 76 amplifier. The last two leads mentioned, from the switch contacts, should be dressed neatly into the corners of the chassis, and where practicable should follow the cabling already in place.

In order to permit operation of the BC-221 on an a-c filament supply the cathode of the 76 amplifier should be removed from its connection to *pin 5* of the 76 socket and connected to ground

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BC-221 circuit modifications to add tone modulator.

spatial picture of the ionosphere. As shown in a recent article² the analysis of sporadic-E data may provide the answer to many geophysical and meteorological questions, but, whether or not that will ever be possible depends upon the quality and the number of observations received in this project. Reviewing the possibility of materially aiding scientific research can leave little doubt that the success of this project will create another useful service of amateur radio.

2 O. P. Ferrell, "The Radio Amateur and Upper Atmosphere Research," *CQ*, Feb., 1949, page 25.

MODULATING THE BC-221

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(pin 1) through a $\frac{1}{2}$ -watt resistor (*R1*) of any value between 500 and 1000 ohms. Otherwise the six volts of a.c. injected into the cathode from the filament circuit renders the instrument useless as a c-w monitor and also makes it very difficult to calibrate the oscillator when setting up a frequency accurately.

It is to be noted that when using the variable oscillator as a signal generator the earphones must not be inserted in the PHONE jack, a dummy plug being inserted instead, in order to keep the filaments lighted. This is necessary because the output circuit of the 76 is loaded by the phones to such an extent that very little output is obtainable to modulate the 6SJ7 variable oscillator. An added refinement would be to substitute a DPDT toggle switch for the SPST switch illustrated, and so connect it that when it is thrown to the modu-

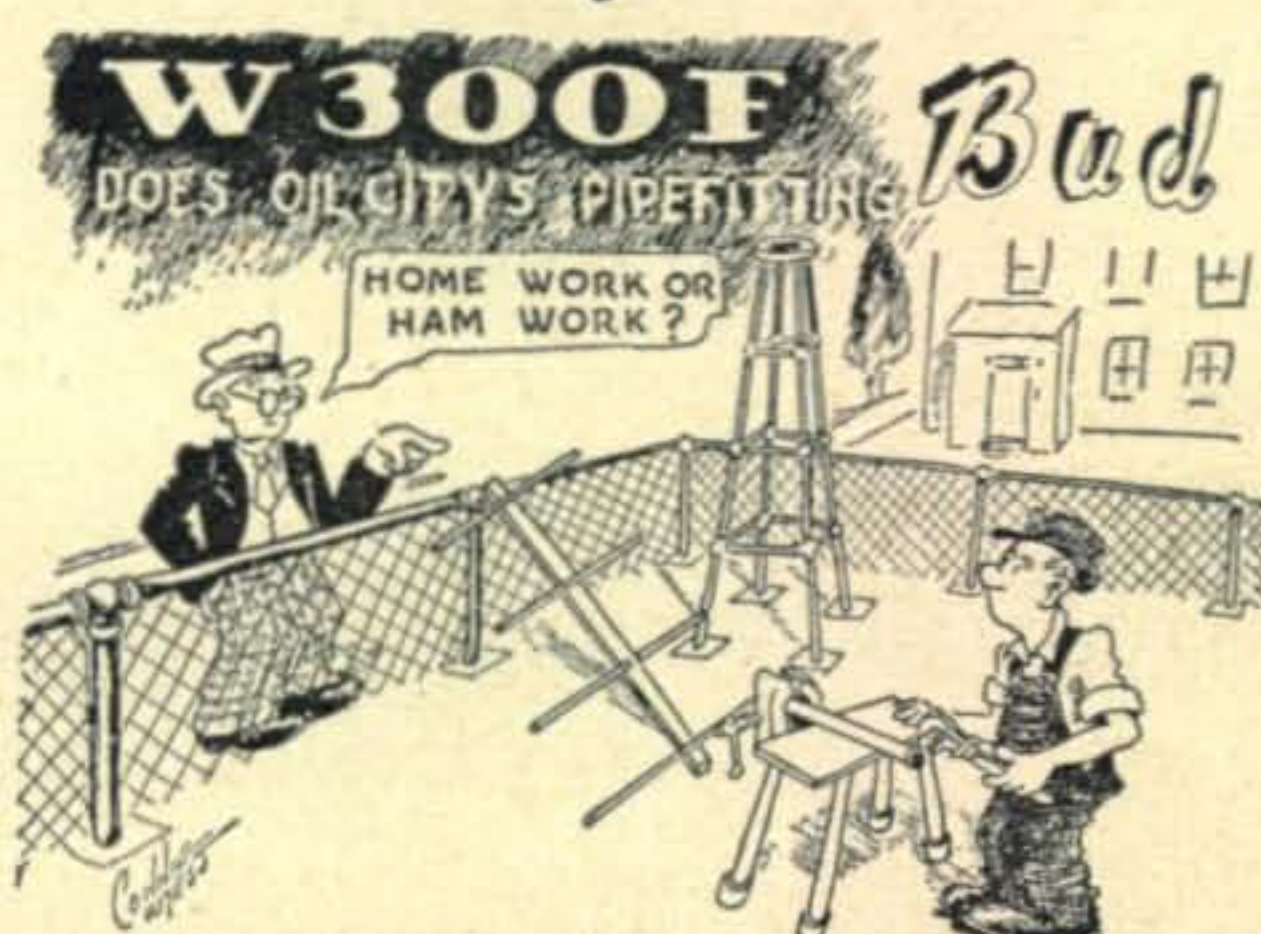
lated position, the earphones are disconnected from the plate circuit of the 76 amplifier tube. This is shown as point *A* in the diagram. This would obviate the necessity of a dummy plug when using the BC-221 as a signal generator.

Operation

In operation, the frequency meter is turned on and set up in the usual manner, with the dummy plug inserted in one of the PHONE jacks and the modulation switch thrown to the "on" position. The GAIN control is advanced in a clockwise direction until the desired percentage of modulation is obtained. In the particular BC-221-J modified by the author the tone is about 300 to 400 cycles. However, by adjustment of condenser *C1* it could

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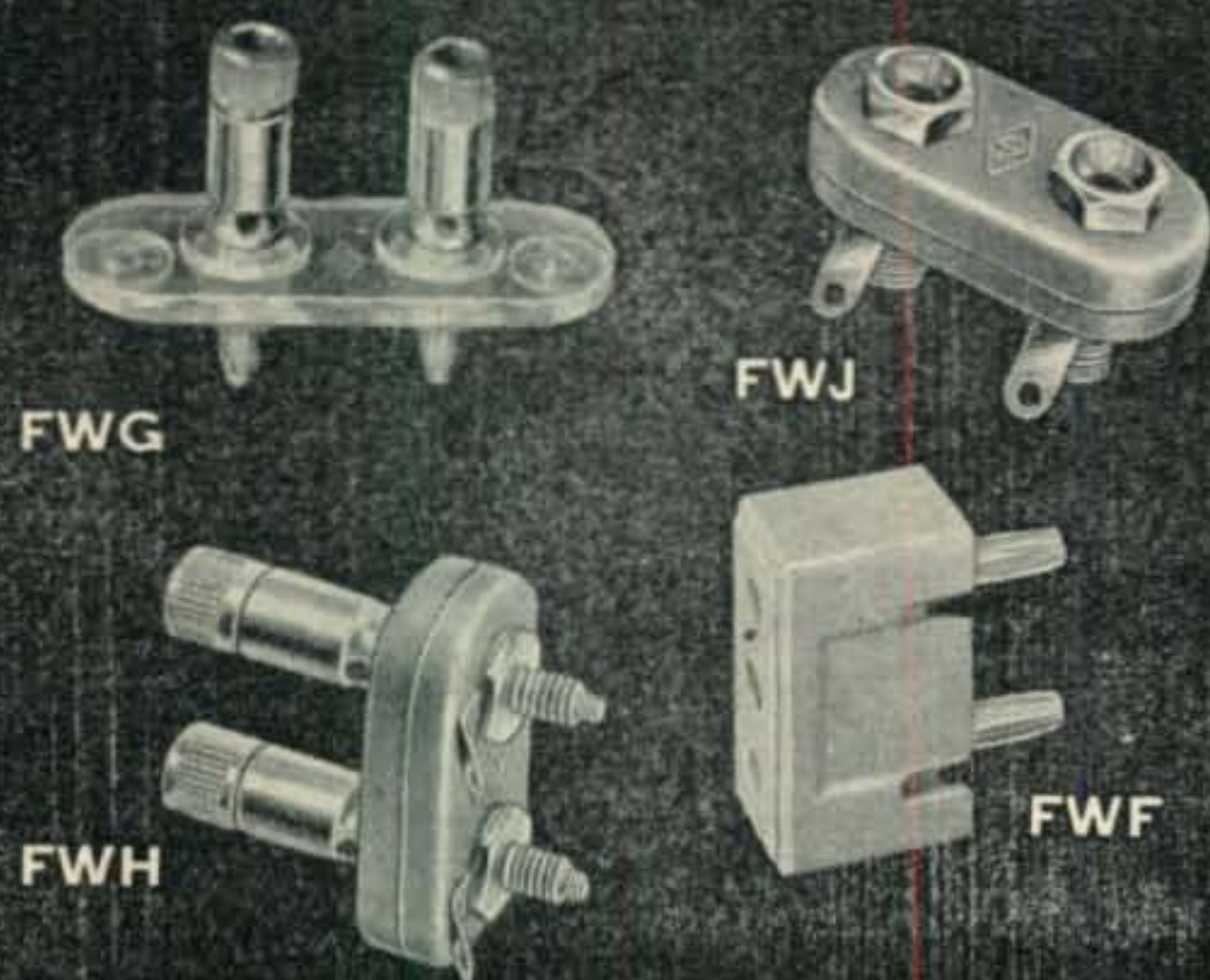
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be adjusted to any desired frequency in the audio range around 400 cycles.

It was felt that although a greater percentage of modulation could be obtained by connecting the junction of condensers *C1* and *C2* to the injection grid of the 6A7, since this is directly connected to the output circuit of the 6SJ7 oscillator tube, the accuracy of the frequency meter might be impaired—hence the screen grid feedback path was chosen.

When using the BC-221 as a frequency measuring device, it is desirable for most accurate results that the modulation switch be in the "off" position, as a natural product of modulation is the carrier plus and minus the modulation frequency.

The short time required to modify the BC-221 for modulation is well spent, and it also enhances its use as a test instrument. As a final caution, *do not touch or change* anything connected with the frequency determining circuits, since to do so may throw the meter out of calibration.

STATION DESIGN

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the receiver when transmitting. If break-in operation is desired, this relay can be bypassed by the transmit-receive switch on the receiver front panel. The other relay is the auxiliary control relay for the main line contactor.

Behind the power supply section another grill-work panel is installed for ventilation of that section. Below this grill are the terminal blocks for connection to the three power supplies. In the lower left-hand corner may be seen the main line fuse block.

All metal parts, chassis, grill-work panels, aluminum angles, braces, copper mesh, etc., are securely bonded together with $\frac{1}{2}$ " x $\frac{1}{16}$ " copper strap which terminates at a large binding post in the lower rear right-hand corner of the cabinet. A length of #8 wire from this binding post to a water pipe provides a substantial ground.

Seven wires of an eight-conductor, shielded, rubber-covered cable furnish the control circuits for the drive motor and Selsyn generator of the dual 10-20 beam. The eighth wire and the grounded shield are connected to phone jacks, one at the transmitter and the other at the antenna. A pair of sound-powered phones plugged into this circuit provides a convenient means of communication when adjusting or tuning the antenna.

PROP-PITCH MOTOR

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With the conversion completed and the beam up in the air you will find the beam rotating much smoother and much quieter. An input of about 9 volts at 3 amps will drive it around at about 1 r.p.m. The brush noise is a thing of the past as the motor consumes considerably less power.

What? You have left over parts? Don't ask me what they are good for.