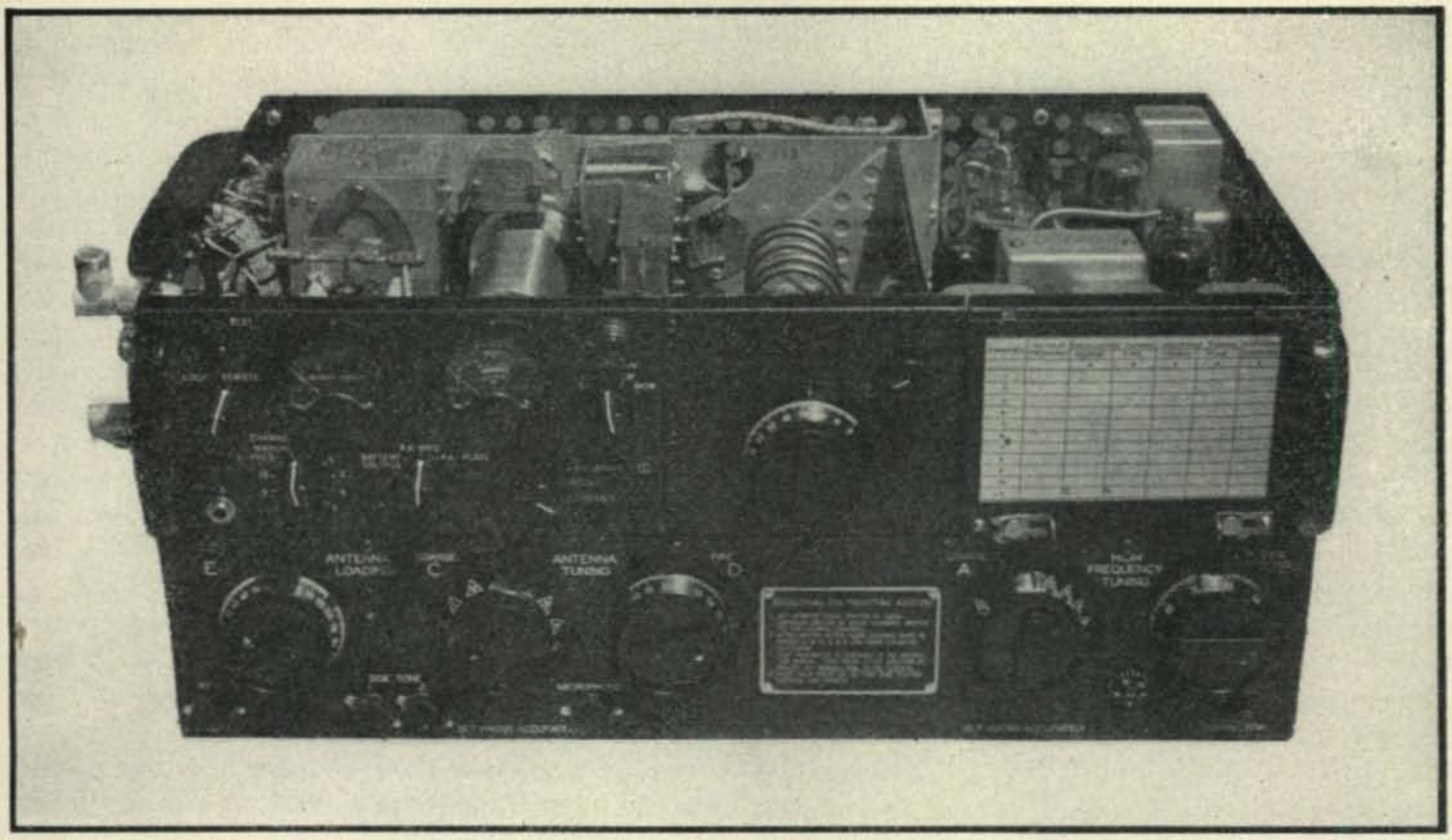

The Collins Autotune AN/ART/13. This model, after conversion, has two additional controls, the high frequency tank condenser dial and the variable antenna link control, located just above the nameplate.

Another Method of Converting the ART/13

R. D. VALENTINE, W2GX* and ATHAN COSMAS, W2PKD**

In the November, 1946 issue of CQ, Paul Rafford, W2GQM, described a method of converting the very popular ART/13 transmitter to amateur use. In the light of the experience of these two writers, the *Rafford* method may be simplified by designing a suitable 10-11 meter tank coil and pruning the coils of the master oscillator in such a fashion that the output frequency range extends from 3.4 to 30.6 mc, instead of the original range from 2.0 to 18.1 mc. Although this destroys the frequency calibration as supplied with the ART/13, the transmitter may be easily recalibrated with the aid of a communications receiver and the *CFI* unit built into the ART/13.

Description of the ART/13

The AN/ART/13 or ATC/1 uses an 837 v.f.o. operating between 1000 kc and 1510 kc in two ranges: 1000 to 1200 kc and 1200 to 1510 kc. The band of oscillator frequencies available depends upon the position of the oscillator range switch *S101*, which adds or removes padders to the tuned circuit of the fundamental oscillator. The output of the v.f.o. must be multiplied from two to twelve times to cover the frequency range desired. This is accomplished in two 1625 multiplier stages. The first 1625 operates as a doubler, tripler, or quadrupler; the second 1625 operates only as a tripler. The first multiplier is controlled by switch *S102;* the second by switch *S103*. The positions of *S101*, *S102*, and *S103* are governed by the *A* control on the front panel.

The inductance *L101* in the v.f.o. and the two inductances in the multipliers, *L105* and *L106*, are slug-tuned. The slugs are ganged for simultaneous fine frequency adjustment and are controlled by dial *B* on the front panel.

An 813 is used in the final amplifier and functions at all frequencies as a straight amplifier. From positions 1 to 6 inclusive (2.0 to 6.0 mc) on the *A* control, the output of the first 1625 multiplier is connected to the grid of the 813. In position 7 to 12 (6.0 to 18.1 mc) of the *A* control, the output of the first multiplier drives the second multiplier which in turn feeds the 813 final. The output circuit of the 813 consists of controls *C*, *D* and *E* that are handled from the front panel and constitute the Collins Antenna Network. In positions 1 to 7 inclusive of the *C* control, the

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antenna tuning circuit functions as an *L* network. From positions 8 to 12 the antenna is loaded by a pi-network, while in position 13 the tuner again becomes an L network, but with a small inductor *L114* in shunt with the variometer controlled by *D*.

Converting to Amateur Operation

Since the frequency range below 3.5 mc is just so much waste in the ART/13, it was decided to prune the coils in the oscillator to permit 10-meter operation without the addition of another doubler stage as suggested by Rafford. In order to make the coil changes it is necessary to remove the right side wrap-around panel of the transmitter case. This is accomplished by taking out seven screws in the rear and ten screws at the side of the case. This exposes an aluminum shield that covers the housing of the h-f oscillator coil. This must also be removed. When this is done the multiplier inductances *L105* and *L106* and the oscillator inductance *L101* are exposed to view.

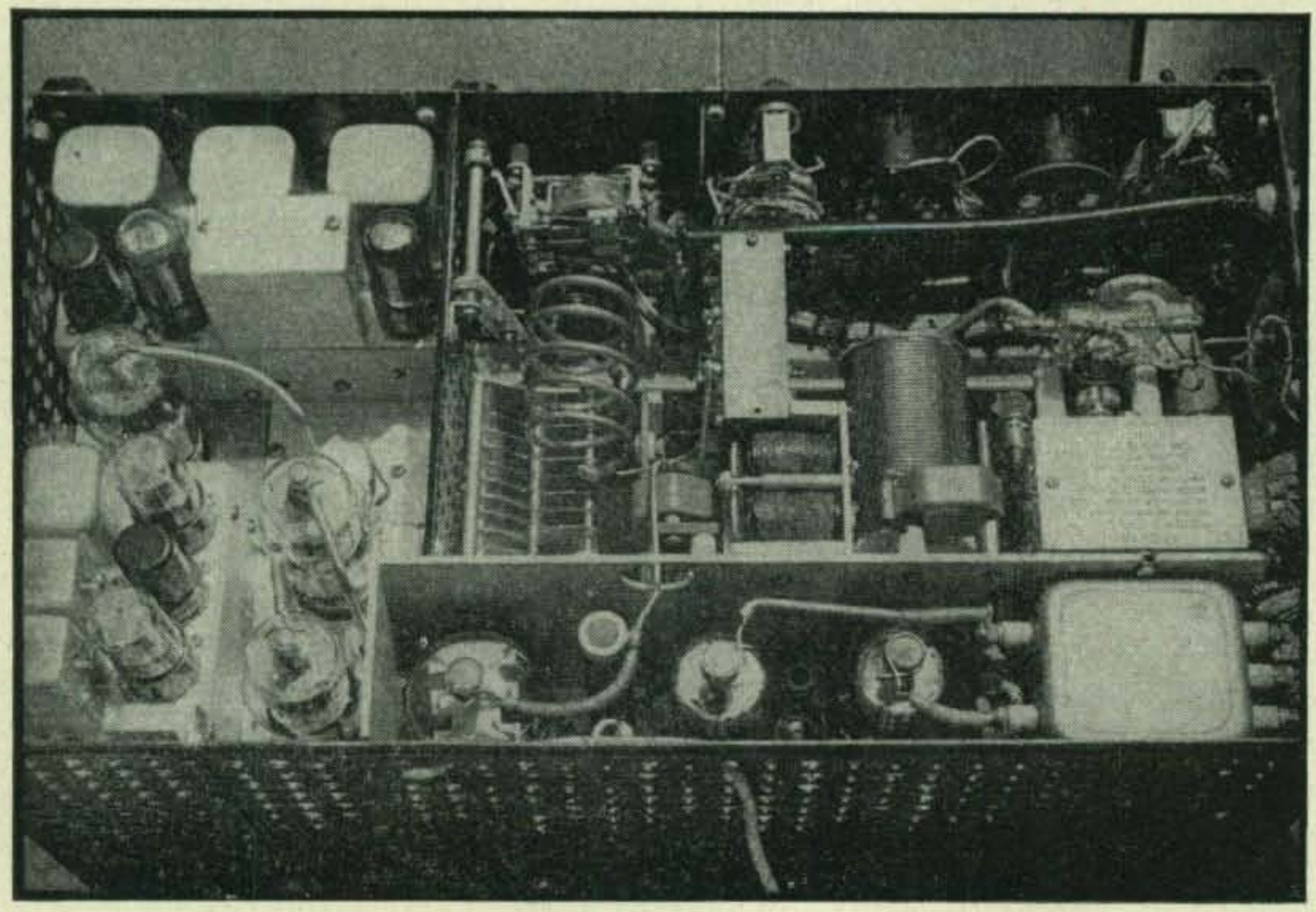
It will be noted that all three coils are wound with a few turns close-wound at one end, a section of widely spaced turns followed by a long section of close-wound turns. The reason for this unconventional method of winding is to obtain a nearly straight-line-frequency calibration for the *B* control. The terminal at the end of the long section of the winding is the cold r-f end. Approximately 40 per cent of the winding is removed from each coil, beginning at the cold r-f terminal.

The oscillator coil *L101* has originally 47 turns and 28 are removed. The first multiplier coil *L105* has 28 turns originally, of which 16 are removed. The second multiplier coil *L106* has 9 turns and 5 are removed. These turns may be carefully removed without disturbing the coil forms. It is neither necessary nor advisable to remove the complete coils in order to make the changes. When the correct number of turns have been removed, re-solder the end to the terminal lug.

In extending the frequency range of the transmitter, it is necessary to substitute another tank circuit for the 813 when operating the 10-meter band. Position 13 could not be used for this purpose since a cam-operated switch on the shaft of the *A* control disables the oscillator and the multiplier stages by opening their respective cathode resistor connections. However, it is possible to retain completely automatic 10-meter operation by re-positioning the cam and the connections of the two jumpers on switch *S114*. When this is done the oscillator and the multipliers follow through normally and at the same time the relay *K105* functions to substitute the h-f tank circuit for the Collins network.

In order to make these changes it will be necessary to remove the frequency multiplier unit from the assembly. The following procedure is recommended:

1. Remove tubes and remove the autotune cover plate and bottom plate.
2. Remove autotune unit *A*. This is done by turning the dial locking bar to the unlocked position and unloosening the two No. 10 Bristol set screws in the dial. Then turn the dial and locking bar counterclockwise together until the bar comes free. Remove the dial and locking bar, then remove the dial back plate by loosening the two long screws on the top end of the unit and the short screws on the bottom end of the unit.
3. Lift the autotune unit out, being very careful not to move any of the mechanisms from



Top view of the ART/13 showing placement of parts for the high frequency tank.

the time the unit is loosened until it is again securely in place.

4. Remove the screws holding the seeking switch *S109* to the casting and swing out the switch.
5. Remove the wires leading to the multiplier coils at the rear of the h-f oscillator unit. Remove the buss wire connected to the coupling condenser *C116*.
6. Remove the two screws just behind the second multiplier clamp shell and the two screws just in front of the multiplier clamp shell. This multiplier may now be pulled out sufficiently to remove the nut holding the ground wire lug on the fire-wall assembly. Remove the cable connector *J115* from *P101* in the multiplier unit. The multiplier unit may now be lifted out of the transmitter completely.

It is now possible to move the cam that actuates switch *S114* from its normal position of closing the switch on position 13 to its new position of closing on 12. By reference to the wiring diagram it will be seen that *R130* and *R131* must be kept in the circuit. This is done by placing jumpers across the controlling contacts of *S114*. With these changes completed, the multiplier unit may now be re-installed.

The relay *K105* may be operated manually by a SPST switch shown in *Fig. 1*. With the SPST switch closed, all 11 channels may be set for automatic operation 11 and 10 – or a combination, with the low frequencies available by opening the SPST switch may be set up.

High Frequency Tank Circuit

The next step is to install the new tank coil circuit for the 813 final amplifier. The unit is a conventional one and with the *Bud JC-1540* tuning condenser it will adequately cover the 10 and 11-meter bands. The following procedure is recommended for this installation.

1. Remove all tubes, the leads from *C118*, and finally *C118* itself.
2. Cut the four connections at the terminals of *L109*. Remove the two *L109* tinned wires that connect to relay *K105*. Remove *L109* and install a one-inch standoff insulator in the *L109* mounting hole.
3. Put solder lugs on the heavy insulated wire that carries the B+ and on the No. 10 tinned wire that carries the B+ to the 813. Place lugs under screw at the standoff.
4. Remove the tinned wire between the *Loading Coil* binding post and *K105*. The standoff insulator supporting this wire can be used in step *2* above. The terminal on *K105* will be used for the plate circuit of the 10-meter tank.

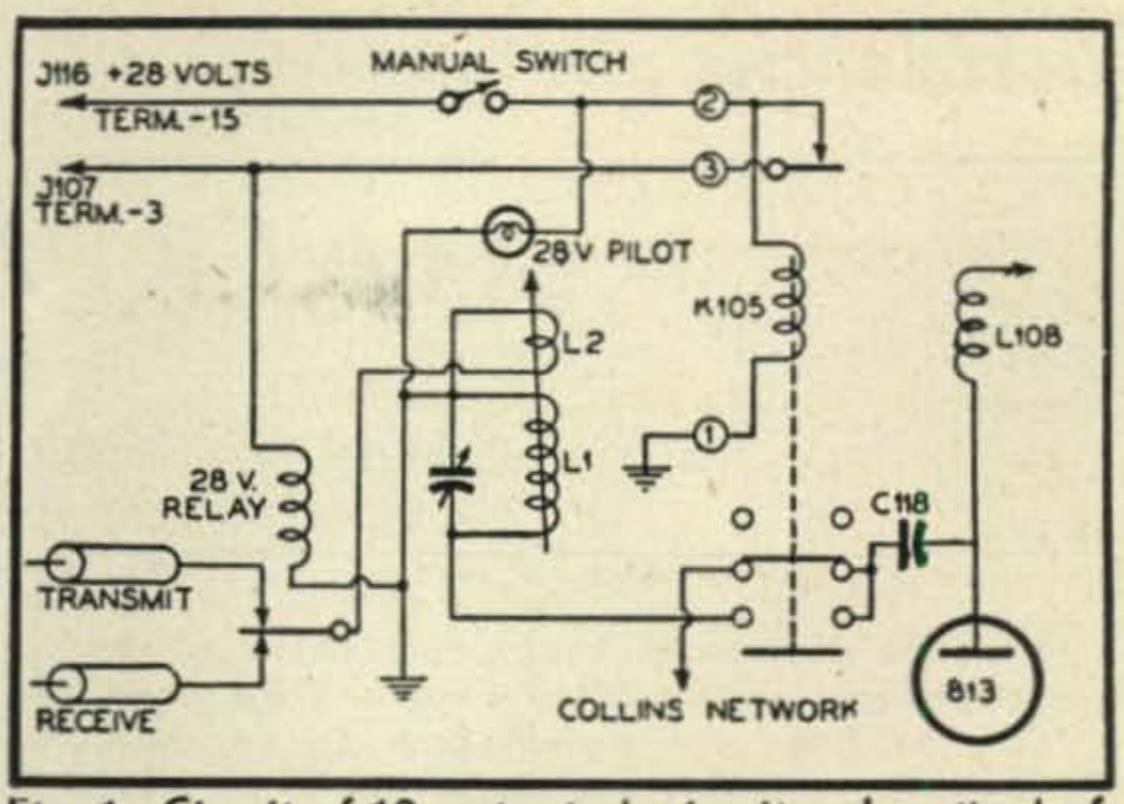


Fig. 1. Circuit of 10-meter tank circuit and method of wiring into transmitter. The variable condenser across *L1* is single section, 50 μμf, Bud JC-1540 or equivalent. *L1* is 5 turns of ⅛" copper tubing 1½" i.d. *L2* is 2 turns of No. 10 wire.

5. Remove the wire from the *Condenser* binding post to the vacuum keying relay. It is necessary to be extremely careful with the keying relay leads as they require a small Bristol wrench.
6. Remove the solder lug from the *Receiver* binding post and solder it to the *Condenser* binding post. The two binding posts on the ceramic bowl now serve as transmit and receive antenna connections for all low frequency positions.
7. Remove the *Receiver* and *Load Coil* binding posts and install two coax feed-thru connectors. These will serve as transmit and receive antenna connections for all h-f positions.
8. Remove the *Low Frequency* front panel and install the 28-volt antenna changeover relay, 10-meter coil and condenser unit. See *Fig. 2* for the suggested positioning.
9. If manual operation is to be used, it will be necessary to install a SPST switch and pilot light and remove and tape the end of wire from terminal *2* of the *K105* holding coil. Replace panel and complete wiring. Substitute a +28 volt lead from terminal #15 *J116* to terminal 2 on *K105*, as shown in *Fig. 1*.

Oscillator Recalibration

After the wiring changes have been made it is necessary to replace the shield cover, the wrap-around cover and the tubes. The condensers for tuning the multiplier stages are accessible from the bottom of the transmitter. To check for oscillation, remove the high voltage fuse and apply the filament voltage. Set *A* control to position one and the *B* control to midscale. With the power level switch at *Tune* and the emission switch at *CW* apply the low voltage to the oscil-

[*Continued on page 66*]

Marshall and Loretta Ensor, now WØBSP–WØUA

ity, so even a nod of the head would change the tone of the signal and would bring me wide awake when dropping off to sleep . . . "

Loretta at present is chairman of the YLRL zero district and is one of the original members of this organization. Pre-war she took part in the 160-meter YLRL phone nets.

Besides Loretta and Marshall, who is again an Industrial Arts instructor at the Olathe High School, there is a third ham in the family—Marshall's wife, Ina, W9TRY, an instructor in the local junior high school.

Loretta still lives in Olathe, Kansas, on the Ensor farm. Her hamming activities have suffered a little in recent years, as she carried on the management of the farm during the war, while Marshall was in the navy. She's still busy with canning, care of the bees, and gardening, and very proud of some unusual varieties of flowers and trees that she's been able to grow on Kansas soil. Her other interests are fancy sewing (quilting, crocheting, embroidery, hand-made rugs), stamp collecting, and local grange activities.

CONVERTING THE ART/13

[*from page 35*]

lator. Check for output by touching a neon lamp to the plate of the oscillator and the first multiplier. The second multiplier is checked by switching the *A* control to position seven and then touching the neon lamp to the second multiplier plate.

If the appropriate changes have been made in *L101*, the frequency range in position one of the *A* control should be approximately 1700 to 2100

kc. On position two of the *A* control the oscillator frequency range will be from 2000 to 2600 kc. We may now make a coarse calibration of the 1700 to 2100-kc range of the oscillator. First, tune a communications receiver to 1700 kc. Set the *A* control to position 1, the emission selector to *CW* and the power level switch to *Calibrate*.

When the low voltage is applied, somewhere between divisions 500 and 700 on the *B* control a signal should be heard in the receiver. The 1700-kc point on the *B* dial should be tabulated. Tune the communications receiver successively to 1800, 1900, 2000 and 2100 kc and at each spot frequency tabulate the setting of *B* when the transmitter signal is picked up. The 2100-kc position should be at approximately 1900 on the *B* control.

The same coarse check can now be made for the 2000 to 2600-kc oscillator range, except that the *A* control is now at position 2.

It is now possible to begin calibration of the *B* control. First set *A* to position 1 and set *B* to the approximate setting for 1700 kc. Plug a pair of headphones into the *Sidetone* jack and adjust the sidetone gain control for maximum signal in the headset. Rotate *B* control slowly for zero beat with the output of the 50-kc oscillator CFI-8Q. This zero beat point is now the correct 1700-kc calibration. The reading, however, should be very close to the approximate setting as determined in the coarse calibration. It is necessary to emphasize here that in addition to the 50-kc beat from the CFI unit there will also be a 25 and a 12.5-kc beat, which are much weaker, Therefore it is of utmost importance that the strongest beat be tuned and that the *B* control reading correspond fairly closely to the coarse readings. Once this primary point has been found, the *B* control is slowly rotated, zero-beating at every 50-kc point and carefully tabulating the control markings for each 50 kc in range.

The same procedure is followed in calibrating the 2000 to-2600-kc range, except the *A* control is moved to position 2. An actual calibration of a converted AN/ART/13 is shown in *Fig. 3*. This should be of assistance where the wiring and coil modifications have been followed as indicated in this article.

Adjusting the Multipliers

Peaking the multiplier circuits for operation in the amateur bands is accomplished by the adjustment of multiplier padder condensers, *C111* and *C115*. *C111* consists of six adjustable ceramic padder condensers associated with the first multiplier stage. *C115* consists of another six ceramic condensers, but associated with the second multi-

"A" CONTROL	OSCILLATOR FUNDAMENTAL (KC)	FIRST MULTIPLIER	SECOND MULTIPLIER	FINAL OUTPUT FREQ. (MC)
1	1700-2050	DOUBLER		3.4 to 4.1
2	2050-2550	DOUBLER		4.1 to 5.1
3	1700-2050	TRIPLER		5.1 to 6.1
4	2050-2550	TRIPLER		6.1 to 7.6
5	1700-2050	QUADRUPLER		6.8 to 8.0
6	2050-2550	QUADRUPLER		8.0 to 10.2
7	1700-2050	DOUBLER	TRIPLER	10.2 to 12.3
8	2050-2550	DOUBLER	TRIPLER	12.3 to 15.3
9	1700-2050	TRIPLER	TRIPLER	15.3 to 18.4
10	2050-2550	TRIPLER	TRIPLER	18.4 to 22.8
11	1700-2050	QUADRUPLER	TRIPLER	20.4 to 24.0
12	2050-2550	QUADRUPLER	TRIPLER	24.0 to 30.6
13	Not used	Not used	Not used	

Fig. 2. Frequency range for the various positions of the "A" control on a converted Collins Autotune transmitter, showing fundamental oscillator range, multiplier function and final output frequency.

plier stage. With the transmitter placed bottom end up and the panel facing you, the first bank of condensers visible is the *C111* group. They are designated by letters from *A* to *F* and correspond to steps 1 to 6 on control *A*. The second band of condensers is the *C115* group, which, from left to right, are designated *A* to *F* inclusive and correspond to steps 7 to 12 on control *A*.

The multiplier stages are peaked in the following steps.

1. Set *A* to position 1 and *B* to the center of the 80-meter band.
2. Apply low voltage supply, place power level switch in the *Tune* position and the emission switch on *CW*.
3. Place the meter selector switch in the *Grid* position.
4. Use an insulated screwdriver and slowly rotate the small metal lip that protrudes from capacitor *C111A* and adjust for maximum grid reading.
5. Rotate *A* control to position 2, the 2 peak *C111B* for maximum grid reading. Repeat this for steps 1 to 6 on the *A* control, peaking the proper *C111* padder in each case.
6. Set the *A* control on position 7 and peak *C115A* for maximum grid reading. Repeat this procedure on position 8 and for *C115B* and each position to 12, peaking the proper *C115* padder as before.

To make fine adjustments for each band it is necessary on 40 meters to set the *A* control to position 4 and *B* to the center of the band. Then re-adjust *C111D* for maximum grid reading. For the 20-meter band set *A* to position 8 and *B* again to the center of the band. Then re-adjust *C115B* for maximum grid reading. Recheck adjustment *C111B* for maximum grid reading.

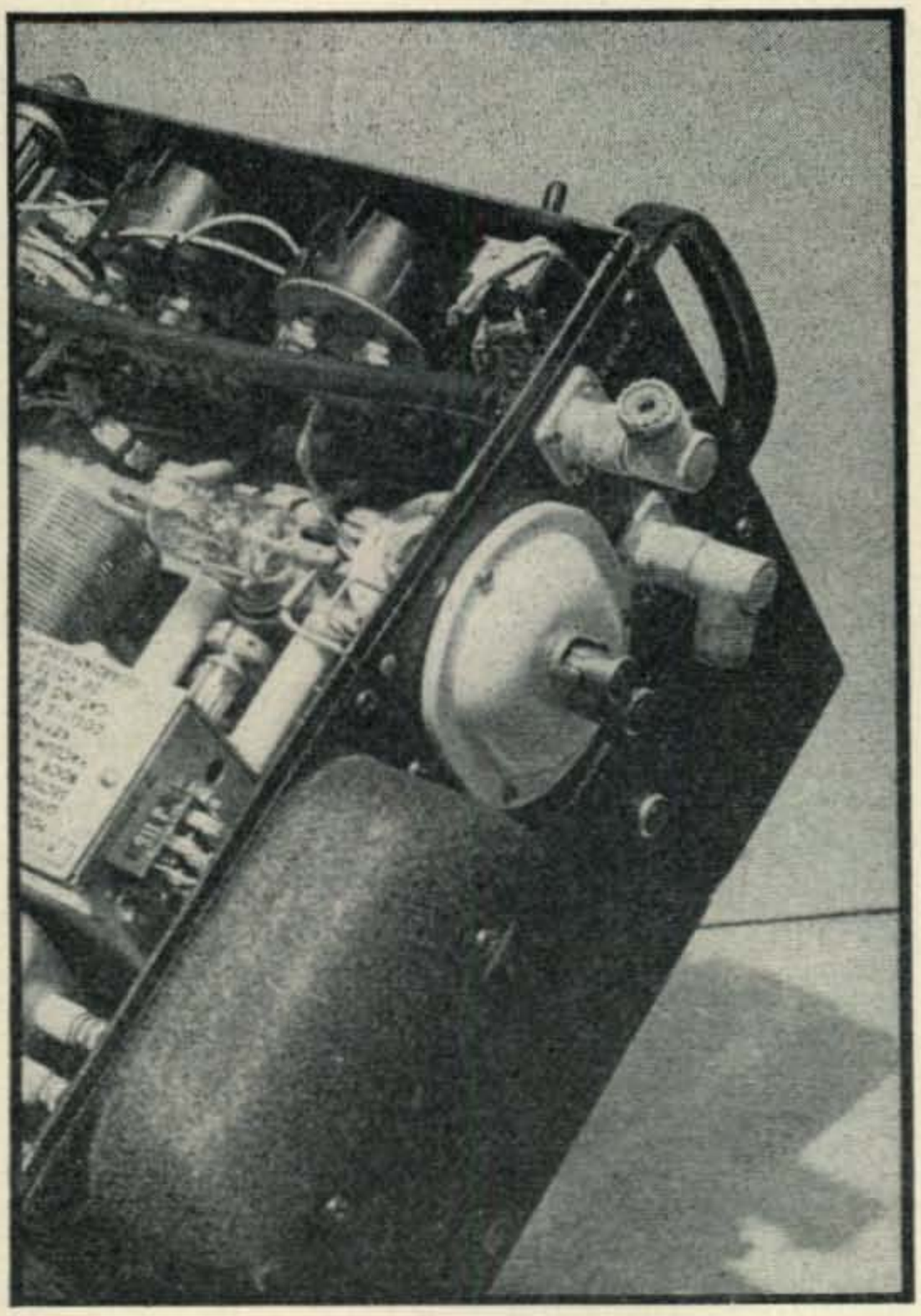
On the 15-meter band, set *A* to position 11 and *B* to the approximate center of this band. Adjust *C115E* for maximum and then recheck *C111E* also for maximum grid current. In the 10-meter or 11-meter band set control *A* to position 12

and *B* to a frequency that will multiply to about 28.5 mc (2375 kc for example). Adjust *C115F* for maximum and then recheck *C111F*. It may be necessary to check the frequency with an absorption wavemeter, since the range of *C115F* is sufficient to make the second multiplier operate as a doubler in place of the usual tripler—its normal function.

After-Thoughts

The audio response of the ART/13 may be improved by the removal of *C205* (.001 μf) in the speech amplifier. This will raise the high frequency response about 2 db at 6000 cycles. By substituting a .03 μf for *C202* (20 μf) the response will be substantially flat to about 10,000 cycles. *C205* need not be removed from the unit, since it is only necessary to clip off the lead on the plate side. Similarly, *C202* need not be removed from the unit.

Certain models of the ART/13 require an improved grounding of the 813 to prevent parasitic oscillation. This is accomplished by removing the 813 and the panel cover over the tube socket. It will be noted that three socket contacts are joined by a jumper and are soldered together. To connect these to the chassis ground, solder another short length of wire to them and tie the



End view, showing low frequency and high frequency antenna connections.

the free end under the hexagonal support post. Remove the bottom post screw, clean away paint and re-install.

There is some confusion about the various readings of the *Plate* meter. In the position labeled *Battery Voltage* the meter reads 54 volts full scale. In the *P. A. Grid* position it reads 17 ma full scale. In the *P. A. Plate* position it reads 300 ma. In the latter position each major division on the arbitrary scale is equal to 30 ma. The current reading here is taken by reading the voltage drop across a 13.4-ohm resistor. In the second position a voltage drop across *R111* of 235 ohms is read. Half scale in this position corresponds to 8.5 ma. Tuning readings of the final plate current should always be taken in the *CW* position. If the plate current readings are taken in the *Voice* position they will include the static modulator current of about 40 ma.

LETTERS

[*from page 6*]

There are other cases of illeg l operation pendin , but these two cases will serve as examples to show that it is both foolish and expensive, in addition to being convicted of a felony, to attempt to operate a station illegally in this country. When convicted by the Court of violating the Communications Act, both the amateur's operator and station licenses are revoked by the Commission. With the advent of television and frequency modulation, it is necessary for the Commission to monitor all types of communication, so that the various channels may be kept clear of interference. In cases where amateur operators operate out of band unintentionally, the Commission notifies them to recheck their equipment to definitely ascertain that they are in the proper band and that they are not emitting spurious emissions. This is done to keep service adjacent to the amateur frequencies clear of interference. In some cases, it has been found that the persons have been operating illegally in the amateur band on fone. Examination of these people have always disclosed that they are unable to pass a thirteen word per minute code test, which is required by all legitimate amateurs, whether they operate c.w. or fone. The Commission is well aware of the benefits to radio engineering and communication engineering derived from amateur operation and encourages any persons interested in radio communication to further their interest by actually operating in the amateur bands. It is only necessary that the persons who desire to become amateurs acquaint themselves with the communication laws and qualify technically to operate these stations. It is also felt that amateurs owe it to themselves, as an organization, to discourage any illegal or clandestine operation, since most of these operations cause considerable interference to other types of service and this is a reflection on the amateurs as a whole, unless it is definitely established that the person causing the interference is not a legitimate amateur. By assigning call letters and having the amateur's address available, it is possible to locate the amateur immediately if he unknowingly causes interference to other types of service, such as aviation, airlines, etc. In a case of a "bootlegger" appropriating an amateur call, it is necessary that the Commission use direction finding methods in order to actually locate the offender. In such cases, in addition to having their equipment confiscated, and in some cases the equipment costs a considerable sum of money, the persons illegally operating are subject to a fine, imprisonment, or both, depending upon the seriousness of the offense.

During the war, the Radio Intelligence Division, which is now combined with the Field Engineering and Monitoring Division, was charged with locating and apprehending any clandestine or subversive radio activity. Through this experience, the Radio Intelligence Division had built up an efficient organization which the Commission feels can cope with all illegal or unauthorized communications. Throughout the war, it was realized by all how important communications are and also the importance of keeping communication channels clear, in addition to locating and suppressing any subversive or clandestine radio communications. For this reason, it is believed that most United States Court Judges take the attitude that violations of Sections 301, 303 and 318 of the Communications Act of 1934, as amended, are a serious offense, as exhibited in the sentencing of the two cases described.

Arthur Batcheller, Engineer in Charge.