Modifying the B2 Transmitter for V.F.O. Operation

Simple Modifications to the Oscillator Section

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There have been many requests for information on modifying the Type III Mark II transmitter (popularly known as the B2) for v.f.o. operation. The writers here describe how this can be effectively carried out without the need for constructing a separate unit.

AFTER trying various portable v.f.o. units, it was decided to provide an internal v.f.o. which would operate from the B2 power pack without increasing the current drain on the batteries. It was considered that, with the minimum of alteration to the existing crystal oscillator unit, the EL32 valve could be made to function as quite an efficient electron coupled oscillator and it was with this in mind that a B2 transmitter unit was modified and tested.

The front panel and controls were first removed and then the crystal selector switch, together with the cathode coil units. As it was intended to modify the transmitter for use on 1.8 Mc/s and 3.5 Mc/s, the former of the larger cathode coil was retained, stripped of its windings, and re-wound with 54 turns of closely wound No. 30 s.w.g. enamel wire, tapped at 14 turns from the earthy end. This coil was re-mounted in its original position.

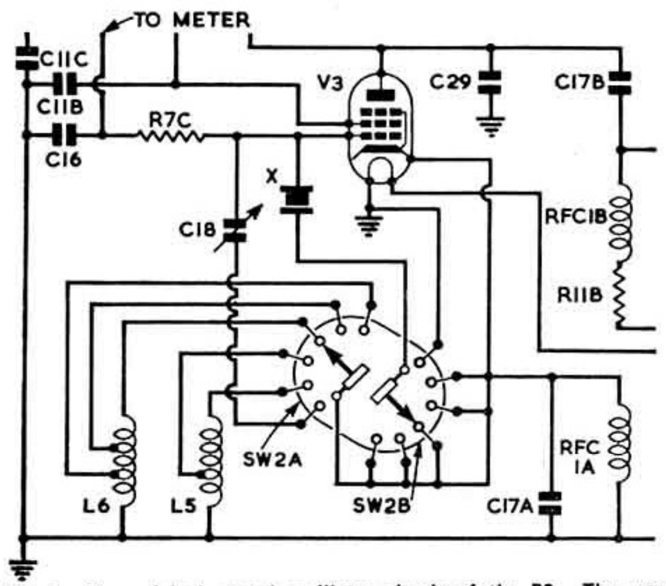

Fig. 1. The original crystal oscillator circuit of the B2. The component numbering is the same as in the circuit printed in the R.S.G.B. Members' Circular issued in October, 1947.

The remainder of the original wiring above the chassis associated with the 40μμF trimmer, which is fixed to the side of the chassis, was taken out, care being taken not to remove the connection to the cathode of the EL32, which passes through the chassis via a rubber grommet located near the 40μμF trimmer. This wire serves as a convenient connection to the cathode tap on the coil.

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Components Required

Additional components required are a small panel mounting air spaced trimming condenser of about 75μμF, this being the largest which could be accommodated, and two 316μμF silver mica condensers. The air spaced trimmer should be mounted on the panel in the position previously occupied by the crystal switch with one of the 316μμF silver mica condensers wired in parallel with it.

The remainder of the wiring is straight forward. The "hot" end of the coil should be connected to the fixed vanes of the tuning condenser. The earthy end of the coil can be earthed to the chassis by a solder tag on the metal cover holding the 40μμF trimmer. To this point it is necessary to connect one of the leads to this condenser which, as will be seen later, serves to set the band edge. The cathode tap from the coil is soldered to the lead from the cathode of the EL32 valveholder which was previously left poking through the chassis. The other side of the 40μμF trimmer is wired to the fixed vanes of the tuning condenser. As a precaution against faulty contact between the spindle of the tuning condenser and the chassis, the solder tag on the moving vanes of the tuning condenser was earthed to the chassis.

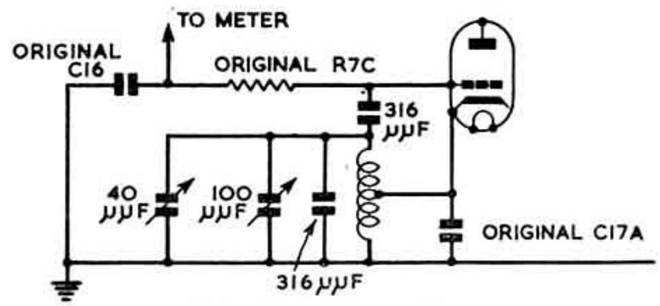

Fig. 2. The modified oscillator.

All that remains is to connect a grid condenser from the "hot" end of the tuning coil to the leg of the crystal socket which carries the connection to the cap of the EL32.

The grid leak to the EL32 is left undisturbed, thus permitting metering of the oscillator grid current.

1.8 Mc/s Operation

It was found necessary when the unit was used on 1.8 Mc/s, to arrange for a capacity of 130-140μμF to be placed in parallel with the grid tuning condenser of the 6L6 valve. This can be done by connecting the condenser in series with a switch mounted on the front of the panel near the top right-hand corner of the meter, thus enabling the capacitance to be switched in and out of circuit at will.

The unit was then re-assembled, a scale of cardboard or similar material being pasted over the calibrations of the crystal selector switch and the v.f.o. tuning condenser fitted with a suitable knob. (A slow-motion dial would be an asset here.)

The C17A 100 μμF silver mica condenser, which is shown in Fig. 1 wired between the cathode of the valve holder and earth, and situated under the chassis, was left in position as a result of an over-sight. As the unit worked well, this was not altered. It has been noted however, that this capacitance is effectively in parallel with the portion of the coil between cathode tap and earth.

V.F.O. Coverage

Drive to the 6L6 is the same when working from either the fundamental or second harmonic of the v.f.o. By judicious adjustment of the 40$\mu\mu$F trimmer, it is possible to make the v.f.o. cover from 1800 to 1915 kc/s. This adequately covers those portions of the band consistently used by the operators and also permitted full coverage of the 3.5 Mc/s band. If full coverage of 1.8 Mc/s is required, it can be obtained by adjusting the 40$\mu\mu$F trimmer at the expense of coverage on 3.5 Mc/s.

In a second unit which was similarly converted, a 100$\mu\mu$F air-spaced trimmer of smaller dimensions was accommodated in the space previously occupied by the crystal selector switch. With this condenser as tuning control for the v.f.o., rather better coverage of the 1.8 Mc/s band was secured, it being possible to tune to 1940 kc/s with only 49 turns on the coil, tapped at 13 turns from the earthy end. Full coverage of 3.5 Mc/s was still obtained.

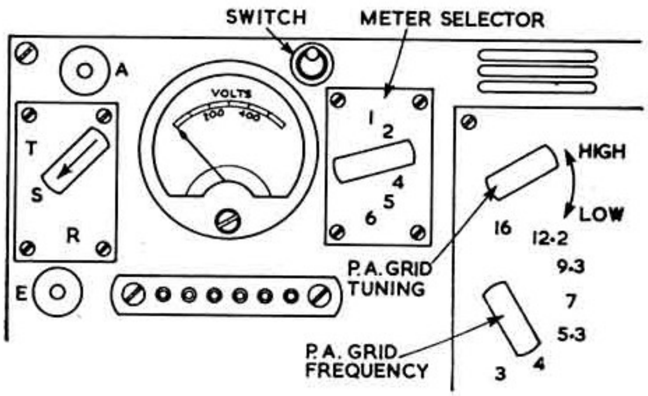

Fig. 3. Front panel arrangement of the B2.

Results Achieved

Both units work well. Adequate drive is obtained on both 1.8 Mc/s and 3.5 Mc/s and the output from the 6L6 was the same as with crystal operation. The v.f.o. is very stable and does not appear to suffer from drift due to warming up. Both transmitters were left on and monitored by station receivers for approximately an hour when no change in the pitch of the beat oscillator was noticed. A slight disadvantage is that the v.f.o. tends to pull somewhat when the p.a. stage is tuned but this effect is not as pronounced on 3.5 Mc/s when working on the second harmonic.

The transmitter keys well in the p.a. as previously and is remarkably free from chirp, except when the aerial circuit is particularly heavily loaded. (It has been found in the operator's judgment that judicious adjustment of aerial loading and grid drive will eliminate chirp to the ears of all but the hyper-critical.) No reports of chirp have been received when the units are mains operated.

A B2 unit, converted as above but with suitably reduced power, was used on 1.8 Mc/s and 3.5 Mc/s during National Field Day, 1955, and only one T8 report and three T9c reports received out of 400 otherwise T9 contacts! It might be mentioned that both units have been modified for screen modulation by the gating system and that details of this modification, which is equally as simple as that just described, are in course of preparation.

Television in the Service of Science

THE Seventh Memorial Lecture of the Television Society commemorating the life and work of Sir Ambrose Fleming, the inventor of the radio valve, was given this year by Professor J. D. McGee of Imperial College. Professor McGee, who is well-known for his pioneer work in the development of the Iconoscope, chose for his subject "Television in the Service of Science" and considered in detail the possible extension of television techniques for scientific purposes into the infra-red, ultra-violet and X-ray ranges of the spectrum.

Considering the infra-red radiation, two types of television microscope were described. The first used a conventional light source and television camera tube, while the second microscope used a flying spot scanner, photomultiplier and a display cathode ray tube.

Conventional ultra-violet microscopes covering the range 2,000 Angstrom units to 4,000 Angstrom units have been designed and used, but they have the limitation that the operator cannot observe what is happening to the specimen. Television techniques using an ultra-violet sensitive photo-cathode together with a quartz window can overcome this defect. This technique has great possibilities in the biological field and in particular for cancer research.

Radiologists employ X-ray techniques in their investigations and diagnoses in the medical field. However, with present practice, observations can only be made under dark adapted eye conditions, and it is known that under such conditions the eye loses acuity. This loss of acuity can be overcome by using an X-ray sensitive camera tube, operating on the photo-conductive principle. Existing image intensifier fluoroscope techniques could be extended by replacing the small viewing screen with a storage surface and scanning this in the normal manner to produce a television signal. For the observation of any rapid movement, the lag normally associated with photo-conductive surfaces would have to be overcome.

The detection of gamma-rays which are of even shorter wavelength than X-rays is at present being achieved by a phosphor/photo-multiplier combination. The quantum efficiency is, however, exceedingly low and the storage principle could be of great use.

A further application of television camera tubes is in the detection of faint optical images, for example as are encountered in astronomy and astro-physics. The main difficulties associated with existing optical telescopes are the long exposures required to record a satisfactory image of the distant stars, together with the general fogging due to sky glow.

The greater quantum efficiency of the photo-electric effect, which can reach 20 per cent., would help considerably in astronomy. In addition, it is known that the reciprocity law holds down to very low light levels; a wide range of wavelengths can be covered; electronic presentation is possible; the signal to noise ratio is improved; and that the sky background can be removed electronically. All these factors of the photo-electric effect could be useful in extending the range of the existing 200in. Hale telescope such that it would be possible to record stars whose brightnesses are three magnitudes smaller than those observed at present. This would mean that light would be observed from stars which had taken 5,000 million years to reach the earth.

In conclusion, Professor McGee outlined the requirement of a television camera tube which could effect this improvement in astronomy. The main properties of this tube would be good quantum efficiency, good linear integration, the target surface to be highly insulating, good reproducibility of pictures, and the rejection of the background signal.