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BUREAU OF ENGINEERING

Report on

Test of Weston Test Oscillator Model 694, Serial No. 114 Range 113 to 3120 Kc.

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AUTHORIZATION

1. The test of this equipment was authorized in Bureau of Engineering letter S67/74(5-21-W8) of 22 May 1934, Bu.Eng.Prob.F1-6.

PURPOSE OF TESTS

2. The investigation and test of Weston improved Model 662 test oscillator, the instrument submitted for this test being marked model 694, serial No. 114, to ascertain any superior features of design which might be useful for incorporating in Naval radio apparatus, and general performance characteristics.

EQUIPMENT UNDER TEST

3. The subject oscillator is manufactured by the Weston Electrical Instrument Corporation, Newark, New Jersey, and employs one pentagrid converter tube commercial type 1A6, which functions both as a radio frequency oscillator, and as an audio frequency oscillator for modulating the radio frequency output. The frequency range is 113 to 3120 Kcs, which is covered by a four position range switch, marked 'LI', 'HI','BC' and 'SW'. Tuning is accomplished by a single dial, graduated 0 to 100, the higher numbers indicating lower frequencies.

On the panel, in addition to the range switch and tuning dial, are an attenuator control, without dial or graduations; a modulation 'on' and 'off' switch; a filament 'on' and 'off' switch; a filament rheostat control; and three jacks marked 'High Output', 'Low Output' and 'Ground'. The panel is of moulded black composition insulating material, with sheet copper backing, the complete oscillator being contained in a copper case, with black, wrinkle finish which measures 8-1/4" high, 5-1/2" wide, and 4-3/4" deep. One 22-1/2 volt plate supply battery, Burgess Type 4156, and two Unicells 1.5 volt each for filament lighting are contained in the oscillator case.

There is also provided a carrying case, of wood leatherette covered, and with a leather handle. The outside dimensions of this case are 6-1/2" x 8-13/16" x 9-1/16", and the oscillator complete with batteries, tube, and carrying case weighs 9-1/2 lbs. A shielded output cable, with tips to fit the output jacks, is provided.

Grid No. 1 of the type 1A6 tube serves as the control grid, and grid No.2 as the anode in connection with a Hartley circuit for producing radio frequency oscillations. No. 4 grid serves as the control grid and the plate as the anode in connection with a reversed feed back circuit to produce audio frequency oscillations. The electron st within the tube serves as the coupling agent between the two circuits, whereby the r.f. output is modulated at the frequency of the audio oscillator.

The four way multiple band change switch varies both the grid and plate inductances in the radio frequency oscillator, varies the coupling between these inductances, also adds capacity in parallel to the tuning capacitor for the lower frequency bands.

A closed circuit containing an inductance coil, and resistance in series is coupled to the r-f oscillator grid indictance, the potential drop across this resistance being used as the output of the oscillator. Attenuation is obtained by varying the point at which this resistor is tapped.

The audio oscillator is tuned to 740 cycles, and oscillations may be stopped by closing the "Modulator" switch, which grounds the audio oscillator grid. When this is done unmodulated radio frequency is delivered at the output terminals.

A schematic diagram of the oscillator is shown on Plate 1.

METHOD OF CONDUCTING TESTS

4. A model LC standard signal generator was used to supply input voltages to an experimental model receiver, to measure the output of the subject test oscillator by substitution method. A General Electric Cathode-ray Oscillograph Type HC-10-A1 was used to determine the character and percentage of modulation. The output of the subject oscillator was amplified by using the tuned radio frequency stages of the experimental receiver, in order to produce operating voltages of greater magnitude at the signal terminals of the cathode-ray oscillograph. Photographic reporduction was made of the image appearing on the screen.

The following tests were made:

(a) Measurement of maximum and minimum output obtainable, at three points in each frequency band.

(b) Determination of frequency range of each band, and overlap.

(c) Test for dead spots in the oscillator.

(d) Operation of the attenuator, and stability of frequency with its operation.

(e) Recording of modulation envelope by cathode-ray oscillograph.

RESULTS OF TESTS

5.(a) The maximum and minimum output in microvolts is shown in the following tabulation for three points in each band, as obtained by substitution method.

Band	Oscillator Dial	Frequency KC	Max. Output	Min. Output
LI	100	113	5200	0
	50	181	8800	0.5
	0	310	8800	1.
HI	69	246.5	292	0
	50	309.5	2280	0
	0	555	1320	0

Band	Oscillator Dial	Frequency KC	Max.Output	Min.Output
SW	94	1555	8200	0.8
	50	2270	11800	2.
	0	3120	17900	2.3

The following maximum outputs in microvolts were obtained at harmonics of the oscillator frequency -

Oscillator frequency	Output 2d Har.	3d Har.	4th Har.
2270	230	150	22
3120	800	44	2

(b) The frequency range of each band, as shown in tabulation under test (a) is as follows:

LI	113 to 310 Kc
HI	246.5 to 555 Kc
BC	690 to 1600 Kc
SW	1555 to 3120 Kc

There is ample overlap except between bands HI and BC, where there is a gap from 555 to 690 Kc. This, however, is due to failure of the oscillator to function over the entire range of the dial, as discussed under test (c).

(c) Dead spots were found at the low frequency end of bands "HI" and "BC". In band "HI" oscillations failed, and unmodulated output could not be obtained above 69 on the dial. With the modulator on, only feeble oscillations were obtained from 69 to 80 on the dial.

In band "BC" unmodulated output could not be obtained above 66 on the dial, and with the modulator on only feeble oscillations were obtained from 66 to 82 on the dial.

In the Weston publication "Instructions for the Use of Radio Service Oscillators" dated December, 1932, on page 1, the following statement appears: "The 550 Kc end of the broadcast band and the low Kc end of the intermediate band are the best points in checking new tubes, since the normal output of the oscillator is lowest in these two regions".

While this statement apparently was made in connection with the use of a different type of tube, as in previous models of Weston oscillators, it is also found to be true in the case of the subject oscillator, which uses the type 1A6 tube. This tube has a lower mutual conductance factor than the types previously used, and this characteristic is believed to be accountable for failure of oscillations at the points indicated, when used with the low anode potential available in this oscillator. It is also believed that this factor is variable in different tubes of this type, but additional tubes were not available to substitute in this test. However the voltage of the plate supply battery was increased up to a total of 45 volts for a test, and with this

additional voltage oscillations could be obtained, with the modulator off, in the broadcast band over all but the last 12 degrees on the dial. The point where oscillations failed advanced concurrently with addition of small steps of voltage.

(d) Attenuation is obtained in continuously variable degrees from maximum output to a high minimum of 9 microvolts in the broadcast band where the output is the greatest, and to smaller minima as the maximum output decreases.

The output being obtained by coupling a closed circuit, with inductance and resistance in series to the oscillator circuit, there is considerable reaction on the frequency of the oscillator with operation of the attenuator. This however is minimized by reason of the series parallel arrangement of the resistance in the closed circuit, whereby there always remains at least 400 ohms in series at any position of the attenuator arm.

(e) Plate 2 shows an oscillogram of the modulation envelope which indicates practically 100 per cent modulation. Oscillations appear to be entirely damped out over a portion of each cycle of the modulation frequency oscillator. The DC voltage supplied to the plate, the screen and the anode grid of the radio frequency oscillator is from the same source. When the modulator is "on", the effective mutual conductance of the tube is varied at modulation frequency and during a part of the modulation cycle (740 cycles) the mutual conductance is lowered sufficiently to either stop or limit the amplitude of r-f oscillation thus giving the desired modulation.

CONCLUSIONS AND RECOMMENDATIONS

6. The subject oscillator may be used with either a modulated or unmodulated output, and the wave form in either case is considered satisfactory, with practically 100 percent modulation at frequencies in the broadcast band and above, the percentage of modulation decreasing however at the lowest frequencies.

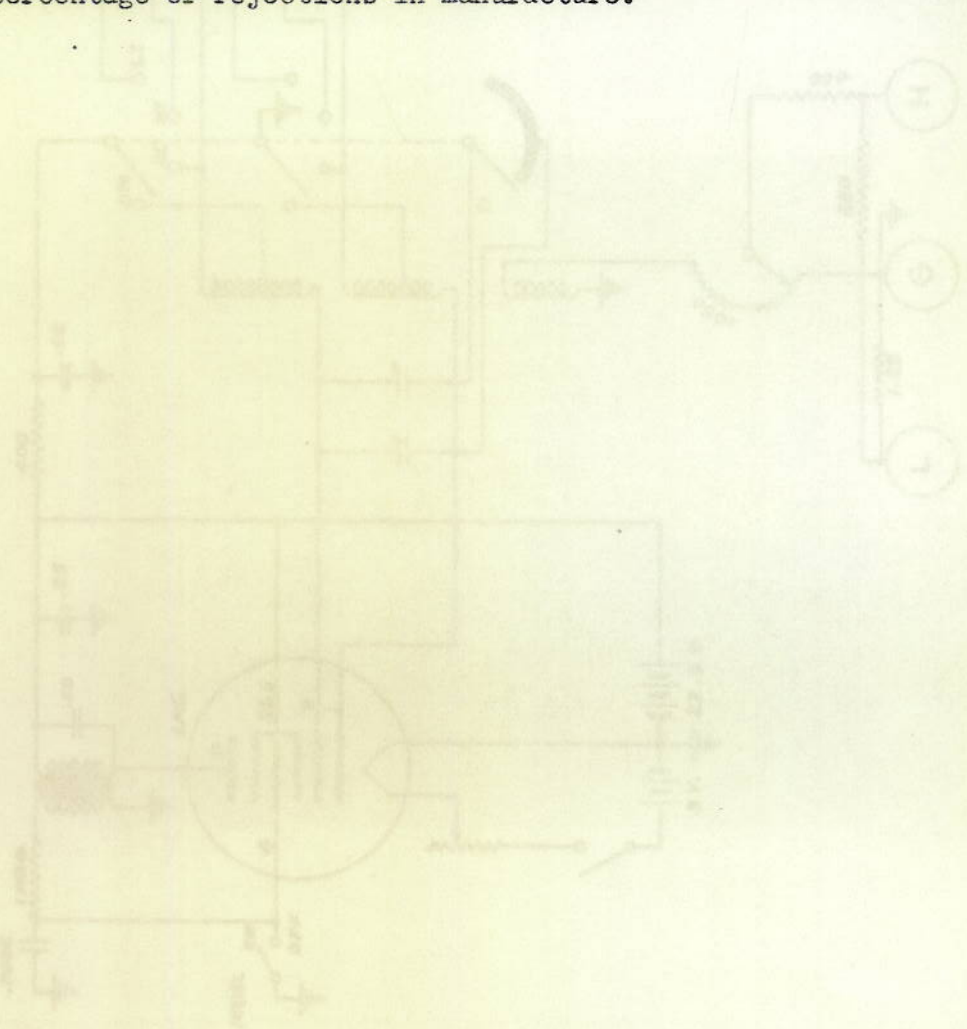
The maximum output was found to vary from 292 microvolts at 246.5 Kc to 77000 microvolts at 1600 Kc, with an average of 7600 microvolts in the "Low Intermediate" band; 1297 microvolts in the "High Intermediate" band; 51100 microvolts in the "Broadcast" band; and 12633 microvolts in the "short wave" band.

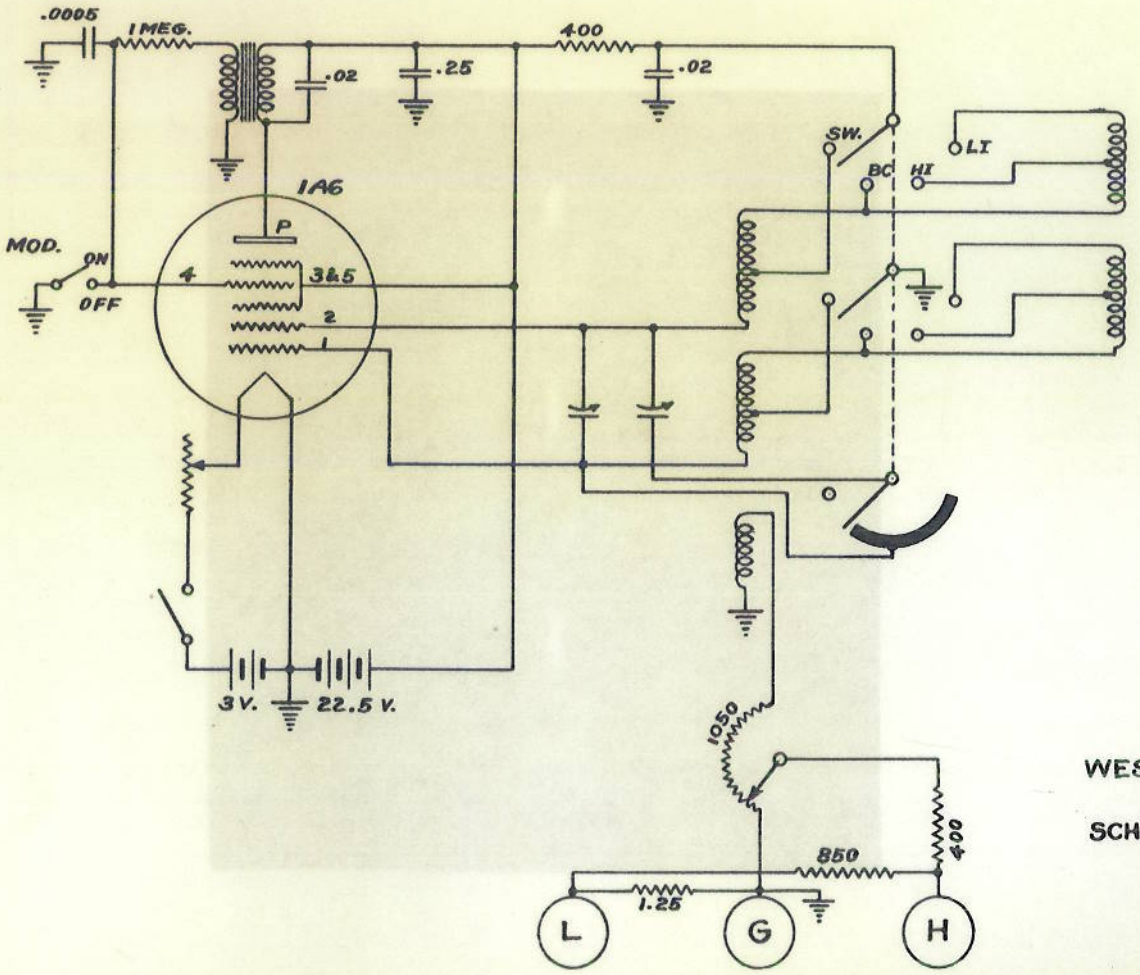
It is believed the subject oscillator would be useful as a readily portable instrument for servicing purposes, where determination of the magnitude of the output is not required, and where stability of frequency with operation of the attenuator is not necessary.

This instrument can by no means be considered as a substitute for a standard signal generator, and its use for lining up the intermediate frequency stages of the Models RAA, RAB receivers is not recommended. It might be possible to make such use of the instrument providing reference was made to a suitable frequency standard with each adjustment of the attenuator.

Typical calibration curves only are furnished with the instrument, and suitable provision is not made for maintaining frequency stability.

The use of a pentagrid converter tube to perform the functions which would otherwise require two tubes is considered a desirable feature both from the standpoint of battery expenditure and the increased number of hours of service which may be obtained without replacement of batteries. However, it is well known that the constants of this type of tube are not uniform in production and that there is a large percentage of rejections in manufacture.





WESTON OSCILLATOR
MODEL 694
SCHEMATIC CIRCUIT

PLATE I

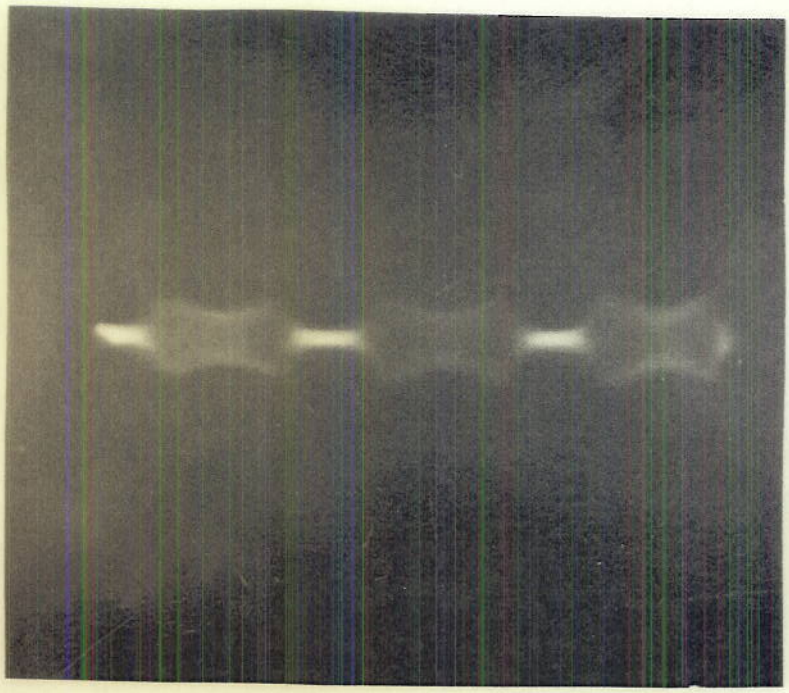


PLATE 2