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A WIDE BAND LOCAL OSCILLATOR FOR 403 MC/S RAWIN RECEIVER

The India Meteorological Department has been using a 403 M /s radio direction finding system with commercially available receivers. These receivers are designed for a carrier frequency band of about 396 to 407 Mc/s and have an I. F. of 19 Mc/s. The tuning range of the local oscillator of these receivers is so narrow that when local oscillator tube or some components are changed, it often becomes difficult to cover the entire frequency band of interest due to change of inter electrode capacitance from tube to tube etc and the consequent shift of the oscillator frequency range. The present note describes the characteristics of a wide band tunable oscillator that has been built in order to eliminate these difficulties. Need for such an oscillator was also felt because of the current project for developing a 403 Mc/s radiosonde receiver to suit the future requirements of the department.

Description — The oscillator utilizes a single-plate semi-butterfly tuning device in push pull configuration, as shown in Fig. 1. The two triode plates of 6 J 6 are connected to the two ends of the Stator Capacitor sectors where the impedance is maximum over the entire frequency band. Absence of any cathode resistance ensures highly efficient operation around class C condition. H.T. with due isolation by an R. F. choke is fed to the centre of the inductance arm and the output is taken through a loose magnetic coupling by means of a loop placed below the inductance arm (not shown in the figure). Such output is suitable for being fed to the two grids of the balanced triode mixer that follows it. Energy feedback through inter electrode capacitance and through the Lecher wire connected to the grid is sufficient to sustain oscillation.

The semi-butterfly has the following mechanical specifications —

Stator	
Oute: diameter	4·15 cm
Width of inductance arm	0·48 cm
Thickness	0·092 cm
Capacitance sector angle	180°
Number of plates	One
Rotor	
Radius	4·15 cm
Thickness	0·48 cm
Angle	180°
Number of plates	One
Rotor to stator separation	1 mm

The rotor is mounted on a perspex rod which is coupled to the panel knob through worm gear that gives a reduction of 40. The external dimensions of the unit are such that it fits exactly in the commercial receiver now in use in the department.

When the rotor blade overlaps the two capacitor sections, the frequency is minimum because of maximum capacitance and inductance. The frequency is maximum when the rotor covers the inductance arm, thereby reducing the inductance due to eddy current shielding.

The maximum value of inductance is given by the following expression for an unshielded semi-butterfly of 180° stator and rotor (*see ref.*)

$$L = 1{\cdot}35\times\tfrac{1}{2}\times 0{\cdot}01257r\left(\ln\frac{36r}{h+w} - 2\right)$$

where,

r = radius of the stator

h = width of the inductance arm

w = thickness of the inductance arm,

all dimensions being in cm.

This value of inductance indicates the low frequency limit. High frequency limit is difficult to estimate because of the uncertainties in inductance value when the rotor shields the inductance arm.

Performance — Fig. 2 shows the output characteristics and tunability of the unit. The output against frequency is relative and is with respect to that at 420 Mc/s. Above that frequency, the output is so small that it is not shown, though the circuit continues to oscillate upto a frequency of 440 Mc/s. The upper and the lower curves represent the variation of frequency with different rotor positions. The total tuning range is of the order of 100 Mc/s in contrast with the 27 Mc/s covering by the commercial unit. Almost linear variation of frequency ensures uniform scanning rate and a reduction of 40 of the rotor speed gives about 15 Kc/s per degree of the panel knob rotation. The tuning range can, however, be changed by changing the rotor and stator angles and their spacing, though a wider tuning range is unnecessary from the view point of maximum expected frequency shift as also because it gives coarser tuning.

The fall in output at higher frequency is due to eddy current damping in the rotor when it covers the inductance arm. Keeping in mind that I.F. of the commercial receiver is 19 Mc/s and that of the projected one is 30 Mc, it is obvious that output does not change much at 384 or 373 Mc/s bands. In fact for such small changes, the conversion gain of a balanced triode mixer that follows it, does not change appreciably within

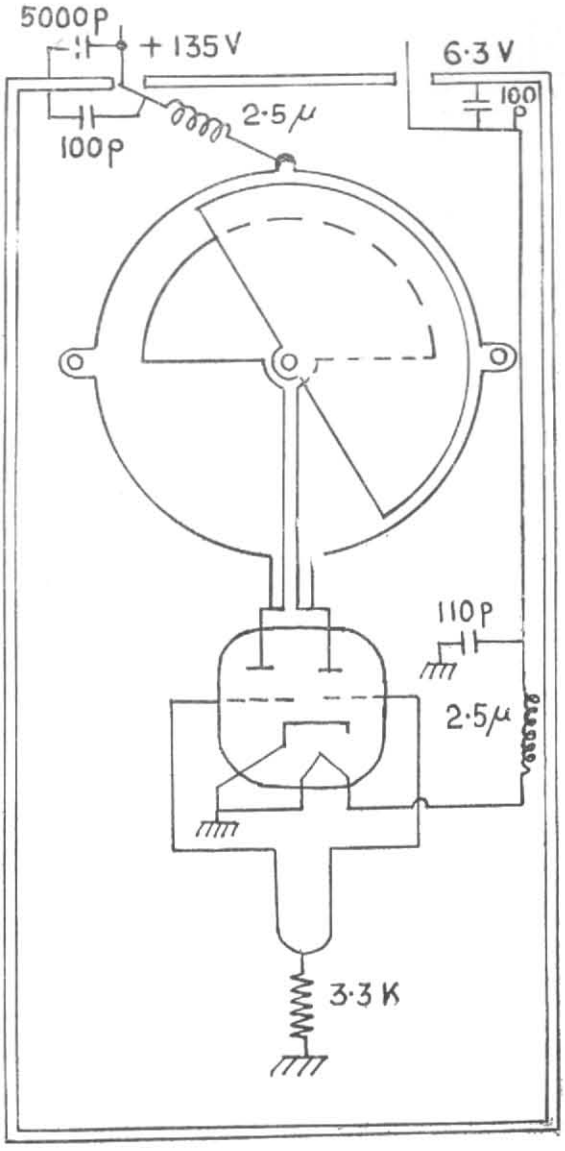

Fig. 1. Schematic diagram of the Oscillator

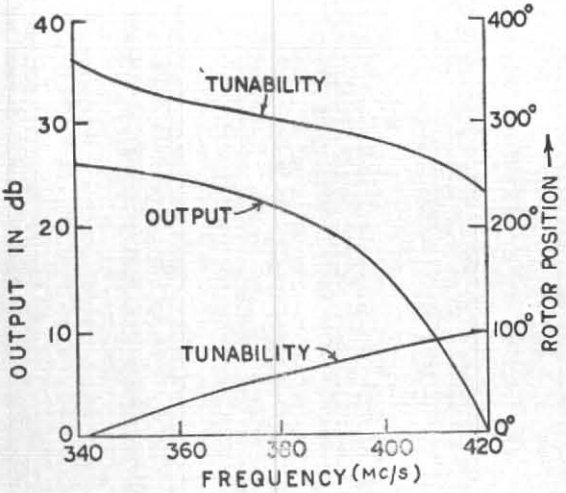

Fig. 2. Output and tuning characteristics

a narrow carrier band. The unit has been tested by incorporating it into the commercial receiver whose sensitivity remains unchanged with this unit.

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REFERENCE

Radiation Res. Lab. 1948 *Very high Frequency Technique*, 2, p. 754, McGraw Hill, N.Y.