PART II—RADIO AND SOUND

TYPES AND ALLOCATION OF AIRCRAFT RADIO EQUIPMENT

In order to acquaint the Service in general with the various types of radio equipment now in use in aircraft, the following article describes the present aircraft radio installations.

Aircraft operating from battleships are provided with a model MJ equipment which is a telegraph transmitter and receiver contained in one case. The transmitter is rated at 15 watts output in the frequency range, 545–585 kilocycles, and at 30 watts output in the range 1,005–1,465 kilocycles. The transmitter-receiver with tubes weighs 37 pounds. Power for operation is obtained from an engine driven direct current generator, double voltage: 14.6 volts, 6 amperes and 500 volts, .325 ampere and weighing 24.5 pounds. The transmitter utilizes a colpitt's circuit with a type 38110 master oscillator tube and two of the same type in parallel for the power amplifier. The receiver, frequency range 500 to 1,465 kilocycles, uses two type 38036 tubes as radio frequency amplifiers and one 38036 as a detector. The audio amplifier is a type 38038 with a type 38037 as an audio oscillator or howler. To provide for transfer from reception on the trailing antenna to reception on the homing loop, a switch marked "ANT-LOOP" is provided on the front of the receiver panel. The fixed loop is located in the wings and so placed that it receives a minimum signal when the plane is headed directly toward or away from the transmitting station. To facilitate tuning the transmitter and receiver to desired frequency, a crystal frequency indicator (C.F.I.) weighing 4.75 pounds is provided as a separate unit. The oscillator uses a type 38037 tube with tuned plate tank circuit and secondary coupling from the tank inductance back to the crystal. This MJ set is designed to mount in the same space as the Navy models MB and MF equipment.

Aircraft operating from 8-inch cruisers and VO–VS planes on carriers are provided with model MF–1 or MF–2 equipments. The transmitter and receiver are contained in the same case in each model, weight 36.75 pounds, and each tarnsmitter is rated at 75 watts. The MF–1 transmitter has a frequency range of 545–995 kilocycles and the MF–2, 545–1,000 kilocycles. Power is furnished from a shunt wound, double voltage (15 and 1,000 volts) direct-current, four-pole, self-excited generator weighing 35 pounds.

The MF–1 transmitter employs a Navy type 38111 as the master oscillator and one as a power amplifier while the MF–2 uses CG 1984 tubes, a similar arrangement. The receivers are nonradiating with tuned r.f. detector and two stages of audio amplification. Type SE 3864 tubes are used in the MF–1 and type 38064 in the MF–2. An "ANT-LOOP" switching arrangement similar to that described under MJ equipment is provided on each of these models. A separate C.F.I. is provided for each equipment, that for model MF–1 having a frequency range 545 to 995 kilocycles, uses two CW 1344 tubes, one as an oscillator and one as an audio amplifier, while the C.F.I. for the MF–2 uses type 38064 tubes. This MF equipment is designed to mount in the same space as the MB and MJ equipments.

Aircraft operating from 6-inch cruisers are provided with MB-2 and MB–3 equipment. The transmitter and receiver are contained in the same case. The MB–2 has a rated output of 30 watts frequency range 545–995 kilocycles, and weighs 35 pounds. The MB–3 is similar except that the upper frequency limit is 1,000 kilocycles and weight is 35 pounds 12 ounces. Power is obtained from an engine-driven direct-current generator which is shunt wound, double voltage (15–500 volts), four-pole, self-excited and weighs 23 pounds including the filter. The circuits are similar to those previously described (M.O.–P.A.) under the MJ and MF models and employ type CG 2566 in the MB–2 and 38110 tubes in the MB–3. The receivers are identical and of the nonradiating type and consist of one stage of r.f. amplification, regenerative detector, and two stages of a.f. amplification. The MB–2 uses SE 3864 tubes and the MB–3 uses type 38064. The homing device, loop, and switching arrangement is similar to that in the equipment previously discussed.

At the present time the Bureau of Engineering contemplates replacing all of the above models with a new "universal" transmitter, model GP, which cover a frequency range of 350 to 9,050 kilocycles and an output of 100 to 125 watts. This set will be capable of operation on CW, MCW, and ICW and will be of about the same weight and size as the MF models. The receiver with this equipment will cover a frequency range of 24–13,575 kilocycles using plug-in coils and incorporating automatic volume control.

The fighter planes on carriers are provided with model GF transmitters and model RU–2 receivers. The transmitter comprises an r.f. oscillator, r.f. amplifier, coupling circuit, modulator stage and a tone oscillator. Type 38110–A tubes are used except for the modulator which employs a type 38142. The output is approximately 1.5 watts over a frequency range of 6,200–7,700 kilocycles. The equipment weighs 43 pounds, which includes the transmitter,

other transmitting equipments. For single-seat planes dual coil sets are provided with remote switching so that the pilots of these planes may "throw down" from the high-frequency communication channel to the intermediate frequency-direction finding channel. The RAM receivers cover the ranges 200 to 1,500 kc and 1,500 to 13,575 kc simultaneously in 2 separate receivers operated from a common dynamotor. In order to conserve cockpit space near the operator these receivers, which are of the all-wave superheterodyne type, are split into radio-frequency units and intermediate frequency—audio-frequency units. The radio-frequency units are approximately 8 by 7 by 9 inches and contain all receiver controls on the front panels. Remote controls are provided, however, for quick attachment if conditions do not permit mounting the radio-frequency units convenient to the operator. These receivers will be used with the model GN transmitters as two-channel equipment in liaison airplanes.

CRYSTAL FREQUENCY INDICATORS

Model no.	Number on contract	Manufacturer	Designated for—	Status
LJ	60	Hygrade Sylvania	VP	Delivered, being issued with GO equipments.
LJ-1	145	General Electric	VS, VSB, VSO, VOS	Delivery about Aug. 1, 1935.
LM	200	Radio Research Co.	VP, VS, VSB	Delivery about May 1, 1936.

These CFI units cover a frequency range of 195 to 13,600 kc. The LJ has 10 crystals ground to Navy frequencies. Frequency checks may be made against the crystal direct, or at any frequency in the range of the instrument against the heterodyne oscillator which has first been checked against a crystal point and then moved to the desired frequency in accordance with the calibration. The manufacturer is attempting to improve the accuracy of the heterodyne oscillator of the CFI and if successful will eventually modify all the LJ's. The LJ–1 has 10 crystals ground to selected frequencies (not necessarily naval) for checking the heterodyne oscillator. With this instrument frequency settings are made against the heterodyne oscillator, this first having been checked against a crystal and a correction applied. The accuracy demonstrated by the instrument in flight tests of the preliminary models was better than 0.025 percent. The LM has but one crystal of the type AT cut and is expected to be provided with a very high-grade heterodyne oscillator. The use of the AT cut crystal will make errors due to change in ambient temperature negligible, since the guaranteed temperature coefficient of this crystal is better than one part in a million per degree centigrade. Frequency settings are made as in the LJ and LJ–1 CFI's.

The above CFI's are all designed for airplane use in conjunctio with receiving equipments and transmitting equipment of the GC and GP series. None will be carried with GF series equipments The procurement of this type of CFI in the future will depend upo developments looking toward better frequency stability of aircraft transmitters and receivers. If necessary to ensure accurate setting of frequencies in an airplane, they will be provided, but, needless to say, it is very desirable to dispense with this class of equipment altogether.