



'Secar' Secondary Surveillance Radar System

THE need for greater safety in an increasing volume of air traffic and the resulting complexity of the A.T.C. has demanded a supplement to Primary Radar. The Marconi Company, in conjunction with Compagnie Française Thomson-Houston, has designed and manufactured SECAR, an advanced secondary surveillance radar.

SECAR extracts information, giving the 3-dimensional position and identity from aircraft fitted with ICAO specified Secondary Radar transponders. Interrogation signals are transmitted from the ground to activate the transponder which will, if certain criteria are met, automatically transmit a coded reply.

Features

- Operates with all ICAO specified transponders.
- Improved sidelobe suppression performance.
- Two and Three pulse interrogation.
- Integral control and interrogate aeriels.
- Maximum interrogation rate.
- Can operate on all modes.
- Interlacing in any combination of modes.
- Active and Passive function decoding.
- Active and Passive height decoding.
- Digital defruiting.
- Processes both 64 and 4096 information codes.
- De garbling and code correlation facilities.
- Unique remote control facilities.

Fully transistorized.

Easily integrated with all surveillance radars.

EQUIPMENT

The SECAR system consists of a unique type of aerial; Interrogator/Responder; and comprehensive decoding and processing equipment. Two pulse and three pulse interrogation on all modes is possible with sidelobe suppression considerably better than ICAO specification. Mode interlace facilities allow up to three different modes to be transmitted in sequence, changing at successive p.r.f.'s. When additional modes are required the interlace pattern becomes a function of aerial rotation, and any requirement can be met.

A single transmitter, used with a Marconi patented aerial switching system, provides control and interrogate functions; the appropriate aerial channels being automatically selected. Different horizontal radiation patterns are synchronously produced for two or three pulse operation.

The p.r.f. is limited to maximum ICAO interrogation of 450 p.p.s by a patented technique which inhibits sync pulses instead of the normal p.r.f. division process. Thus maximum interrogations are ensured irrespective of the p.r.f. of any associated primary radar.

Decoding facilities with code correlation establish the validity of replies and either 64 or 4096 codes can be accommodated. Digital defruiting rejects all asynchronous replies. Code extraction equipment passes replies,

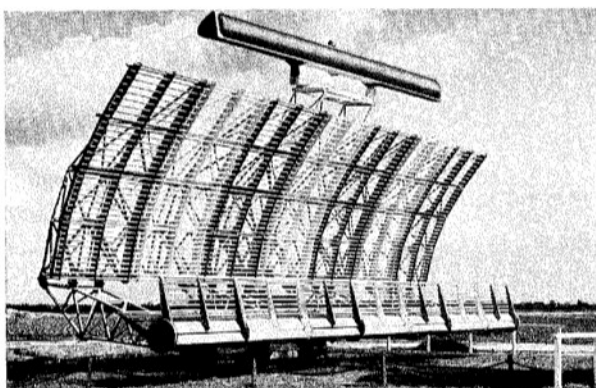
when certain criteria are met, to be decoded. Both garbled and interleaved replies can be detected, and discriminated to produce positional information only for garbled replies or positional and code information for interleaved replies. Virtually no information is lost.

The extracted information is transferred to the decoding equipment in parallel form. However, where long distances are involved, conversion to serial form is provided. The height information pulses are converted to binary coded decimal form.

All operational controls and displays are on a single panel, where modes, codes, and P.P.I. display symbols can be selected. Facilities for height zone preselection are incorporated and information is displayed in alpha numeric form. Marconi or T.H. character generation equipment can be used to display information directly on PPI displays. An alarm system gives warning in Emergency or Radio Failure situations.

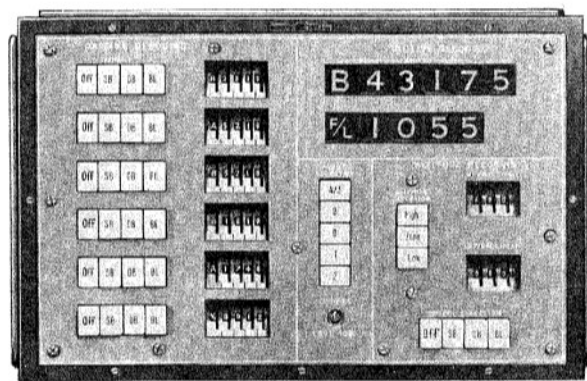
The Secar system is inherently flexible: the aerial is suitable for mounting on a variety of primary radars, or it can be slaved to, or operate independent of, primary radar. The modular decoding equipment is extremely versatile and information from up to 12 interrogators can be processed and fed to up to a 100 operator positions.

Secar employs solid state devices wherever possible for reliability, indeed the decoding equipment is completely transistorized and a limited number of standard circuits are used. Easy access for maintenance can be obtained to all of the equipment and monitor



SECAR aerial co-mounted on an S 264 Radar.

X1135



A typical SECAR operator's control panel.

9952

points are provided. A comprehensive ERP-sensitive system performance monitor is also available. Integration of the system with existing primary radar can be achieved easily. Either a separate set of cables can be used for passing Secar signals from aerial to decoder sites or a modulated carrier system which passes all information down an existing Primary Radar Co-axial cable connecting the two sites.

Data Summary

INTERROGATOR/RESPONDER

Transmitter interrogation frequency (crystal controlled): 1030 Mc/s ± 0.2 Mc/s.

Control frequency (crystal controlled): 1030 Mc/s ± 0.2 Mc/s.

Type of interrogation: 2 or 3 pulse.

Interrogator output: Greater than 55½ dBW ERP.

Modes: A, B, C, D.

Receiver frequency (crystal controlled): 1090 Mc/s ± 0.2 Mc/s.

Intermediate frequency: 60 Mc/s.

Receiver sensitivity: -90 dBm at RMS signal + noise-to-noise ratio of 2:1.

Noise factor: 8 dB.

Limited output: 3 V at 10:1 S/N into 75 Ω .

Receiver protection: By filter giving 70 dB peak loss outside passband.

Tolerable power at input: 50 mW peak.

Bandwidth: 15 Mc/s at -3 dB.

Tolerance of bandwidth: ± 1 Mc/s over range -30 to +70 deg C.

Receiver drift: 0.03 Mc/s per deg C over range -55 to +125 deg C.

Receiver type: Linear/IAGC.

S.T.C Law

Modes B, C and D: Adjustable between -10 and -60 dB relative to normal gain 10 μ sec after P3 recovery rate +6 dB time octave.

Modes A: Adjustable between -10 and -35 dB relative to normal gain 10 μ sec after P3. Recovery rate +6 dB/time octave.

Interrogator/responder sizes (approx):

Height 7 ft (210 cm)

Width 3 ft (90 cm)

Depth 2 ft (60 cm)

Weight 1400 lb.

Power supply: 220 to 240 V $\pm 10\%$ single phase a.c at 45 to 60 c/s.

Power consumption (approx): 1.3 kVA.

Temperature limits: -20 to +55 deg C at 85% rel. humidity (100% humidity at +30 deg C). Storage without damage from -45 to +70 deg C. Start without damage from -35 deg C.

AERIAL

Interrogator horizontal beamwidth: 2.25° at -3 dB rel. to peak.

Interrogator gain: 24 dB.

Interrogator sidelobe level: 24 dB rel. to peak.

System interrogation horizontal beamwidth:

2 pulse: 3.4° mean } adjustable to meet
3 pulse: 2.9° mean } operational requirements.

Interrogator vertical beamwidth: 40° at -3 dB rel. to peak.

Control vertical beamwidth: 40° at -3 dB rel. to peak.

Beam shaping: Marconi patent.

Aerial tilt: Adjustable in 5° increments.

Turning speeds (free running): 3 to 15 r.p.m.

Azimuth error between primary radar and SECAR aeriels:

½° max. for winds of 60 knots.

1° max. for winds of 90 knots.

Wind survival: 130 knots.

Matching: (50 Ω)

Transmit band: Better than 1.5:1.

Receiver band: Better than 2.0:1.

Separate mounting

Weight (approx): 3000 lb.

Turning power: 5 h.p nominal.

Temperature limits: -30 to +50 deg C.

Full impact of solar radiation up to 350 Btu/sq. ft per hr.

Co-mounting

Height 1½ ft (45.7 cm)

Depth 1½ ft (45.7 cm)

Width 30 ft (914 cm)

Weight (approx) 700 lb. (320 kg)

DECODING

Basic technique: Digital range quantization.

System filters: Digital defruiting and de-garbling.

Types of decoding: All aircraft replying with framing pulses spaced 20.3 μ sec apart.

Active function

Active height

Passive function

Passive height

Emergency and

radar failure

} selectable at PPI
with full flexibility

Choice of 3 symbols for passive decoding.

Active readout: Alpha-numeric indicators associated with PPI or Alpha-numeric characters written on PPI.

Power supply: 220 V, single phase a.c 220/380 V three phase.

Power consumption: 1.3 kVA for each cabinet.

Temperature limits

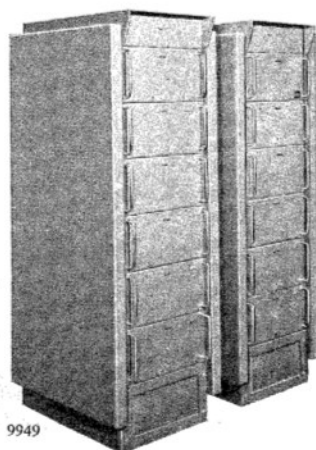
Operation: -10 to +55 deg C.

Storage: -20 to +70 deg C.

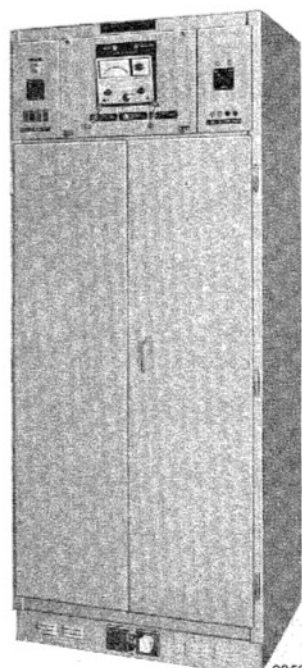
Humidity: 85%.

Control position: Assembly permitting six pre-selected mode code combinations plus one variable. Division of the air space into three altitude zones with the altitudes of the upper and lower zones adjustable in fractions of one hundred feet.

Presentation on PPI: Single or double bars associated with the primary radar echo, depending on the function decoding chosen.



Decoder and processing equipment.



Interrogator/Responder

Marconi

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