High-power HF Communication Systems

WORLD-WIDE telephony and telegraphy services, utilizing transmitters of peak envelope power ranging from 1 to 30 kW are characterized by the ever-increasing complexity of their terminal equipment. Much of this is so closely associated functionally with the transmitting and receiving auxiliaries that logically it should be provided by the radio manufacturer. In ISB operation this is especially true of the various forms of multiplexing equipment.

In addition, therefore, to standard drives and receiving adaptors the Marconi Company has developed a range of terminal equipment including fully-equipped transistorized radio telephone terminals, multi-channel two-tone voice-frequency telegraphy equipment and transistorized error-correcting and multiplex systems with a variety of ancillaries.

Although much equipment is employed on fixed services it must be flexible in application and should be capable of the following:

ISB or SSB telephony	A3a or A3b
Low-power DSB telephony	A3
Multiplex telegraphy on ISB	A7
Frequency-shift telegraphy	F1
Frequency-shift diplex telegraphy	F6
Facsimile	F4
Simple on/off CW	A1

The necessary flexibility is achieved by using linear power amplifiers with built-in mixer circuits and harmonic generator stages, into which the required modulation can be injected from external units at a fixed intermediate frequency of 3·1 Mc/s. This is applied in push-pull to the cathodes of a balanced modulator, whilst crystal-controlled primary oscillators supply an off-set drive frequency via the harmonic generator as a parallel input to the grids.

The output, which is at radiated frequency, then passes through successive power stages in the linear amplifier to a grounded-grid final stage.

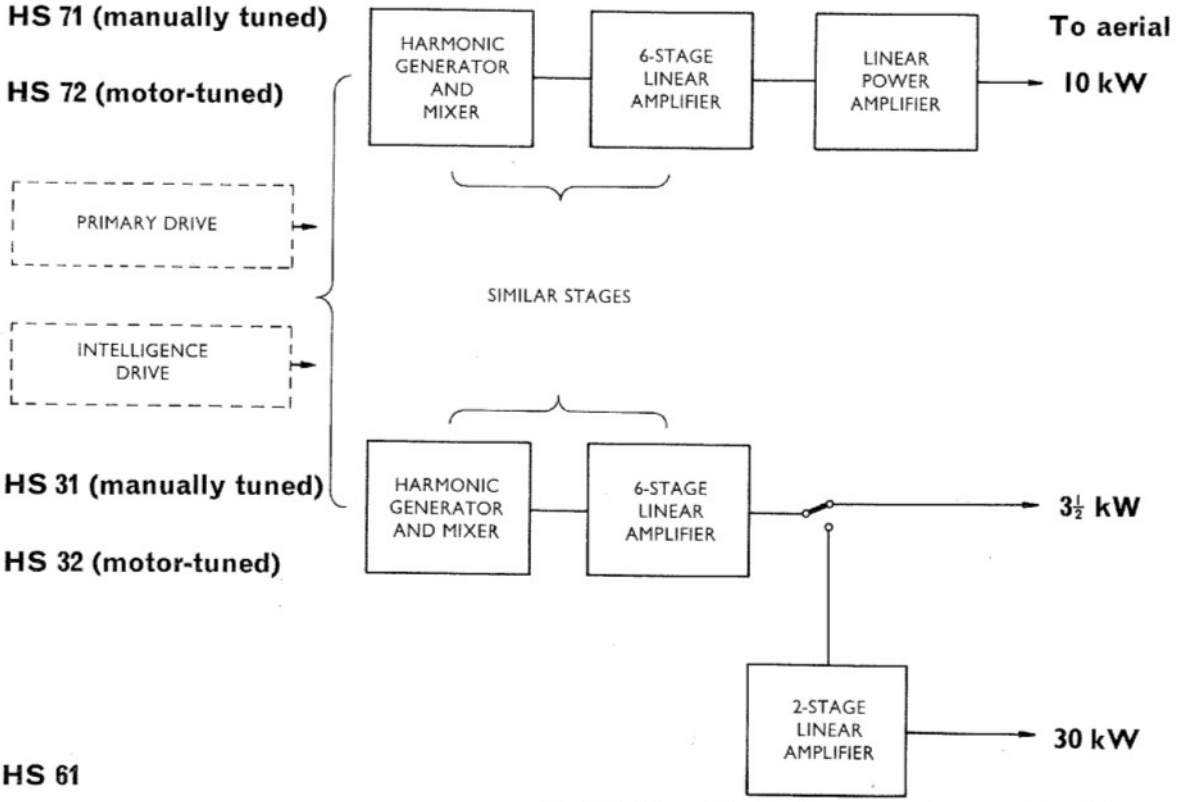

Fig.1. The Marconi family of linear transmitters and HF amplifiers.

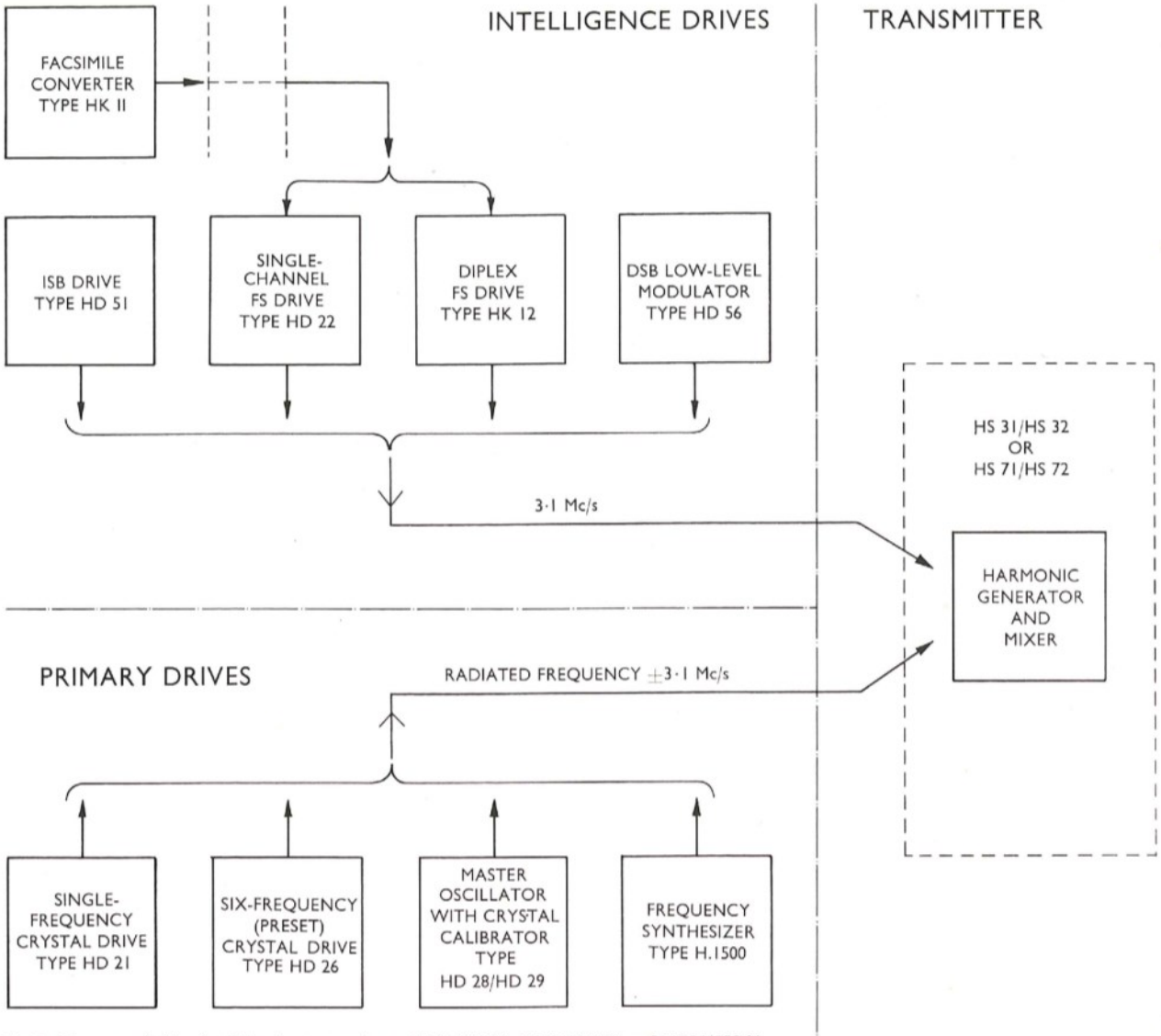

Fig.2. Diagram of drive facilities for transmitters HS31/HS32, HS71/HS72 and HS31/HS61.

The diagram of drive facilities, Fig.2, includes the current Marconi range of primary and intelligence drives which provide the basic equipment for all modes of telephony, telegraphy and facsimile.

SYSTEMS

Owing to the great increase during the last decade in the number of registered frequencies in the HF band, it is important to make the most economical use of the available frequency spectrum, while minimizing interference from adjacent channels. Thus there is an urge towards higher frequency stability, and techniques which make possible the use of narrower bandwidths.

Independent sideband transmission already dominates in international telephony services and its use for 100- and 200-baud multiplex two-tone or narrow-shift FM voice-frequency telegraphy appears to be more favoured than FSK and diplex services, with their greater spectrum occupancy.

Automatic error-correcting multiplex systems are reinforcing this pattern in telegraphy by increasing the reliability of circuits, and extending their range of utility to include international radio telex and leased lines shared by groups of subscribers working into sub-dividers.

For the combined ISB transmission of speech and VF telegraphy, current practice is to place a group of up to six two-tone or twelve FM channels in a 3 kc/s speech band, by feeding the output of the VF terminal into one of the speech channels of an ISB drive. A double diversity ISB or SSB receiver demodulates the complex signal and the telegraph tones are fed into the receiving counterpart of the VF terminal, where the channels are filtered and converted into polar keying outputs.

When automatic error correction is included in the circuit each two- or four-channel terminal is fed with the aggregate output from one of the VF channels, and the return path is used to request repeats of detected errors.

This pattern is followed by Marconi Autoplex, a time-division multiplex system with automatic error detection and correction, employing a seven-unit error-detecting code in conjunction with a repetition cycle in accordance with CCIR Recommendation No.242 (Los Angeles, 1959). The system is synchronous, transmission speed being controlled by a highly stable oscillator. The

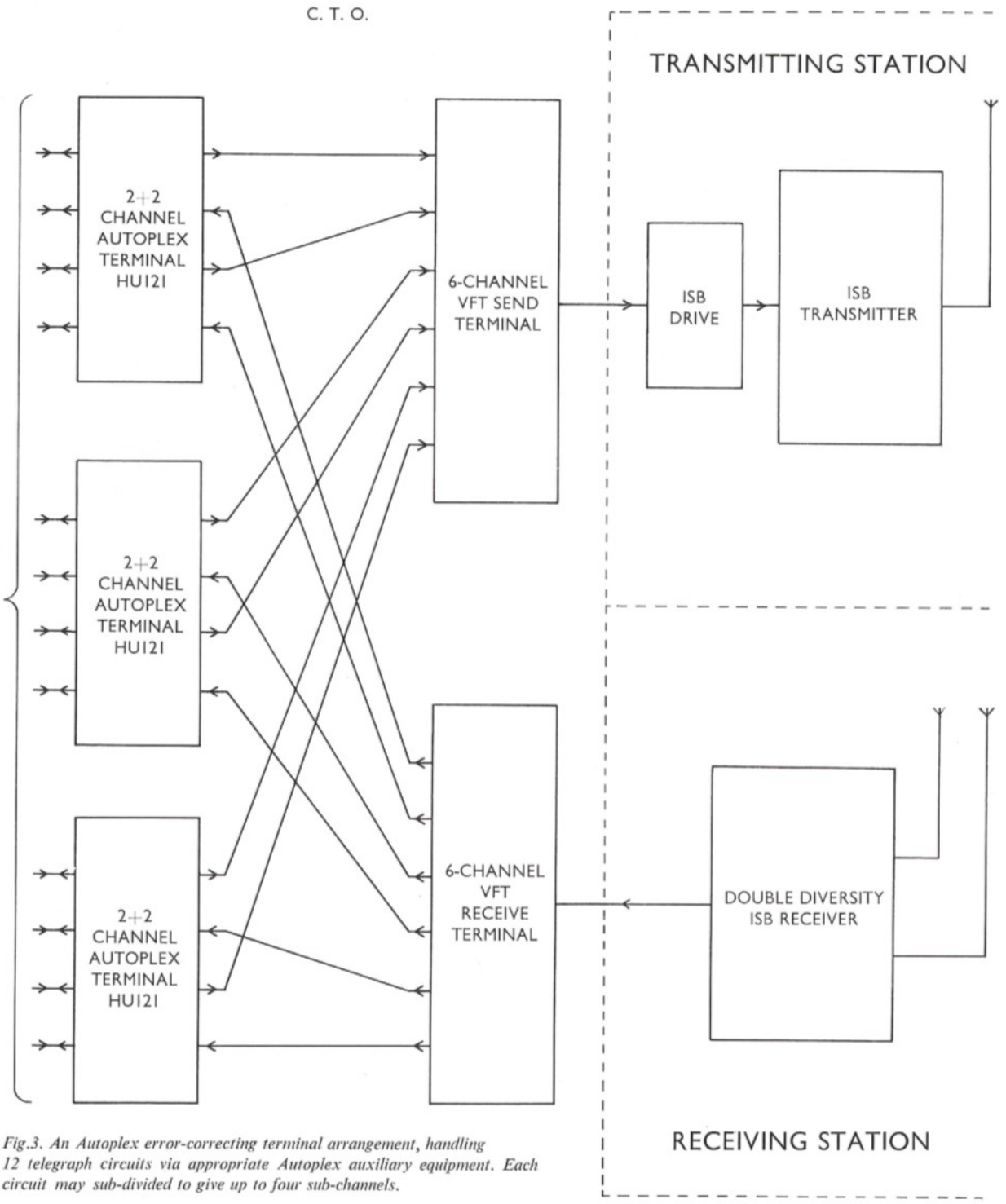

Fig.3. An Autoplex error-correcting terminal arrangement, handling 12 telegraph circuits via appropriate Autoplex auxiliary equipment. Each circuit may sub-divided to give up to four sub-channels.

diagram, Fig.3, illustrates the operation of three two-channel send-receive Autoplex terminals in a CTO.

The requirements for a telephony link are different, but not less specific. Provision must be made for a high standard of technical supervision, and there must be circuits for preventing loop instability, automatic adjustment of gain and protection against noise. It is also the function of telephone terminal equipment to introduce secrecy, either by simple inversion or five-band privacy ('scrambling') and to provide facilities for channel shifting to enable two 3 kc/s speech bands to be combined in a 6 kc/s channel, for transmission and reception on a single sideband.

Transistorized telephone terminal equip-

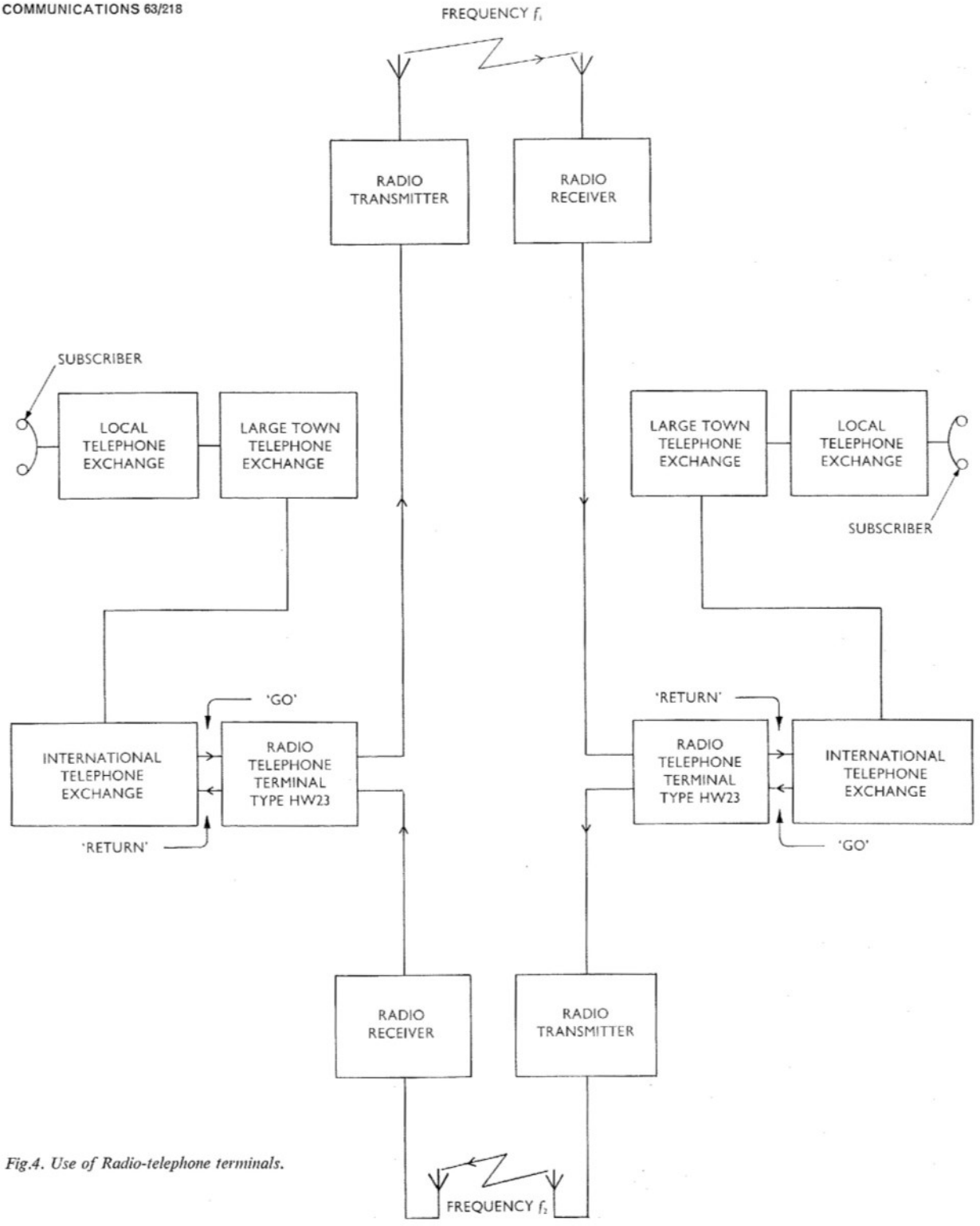

Fig.4. Use of Radio-telephone terminals.

ments for 2- or 4-channel arrangements exist to complete the range of main station equipment. In addition there is a range of ancillaries for power matching, coaxial feeder distribution and switching. This enables complete stations to be planned and equipped.

All aspects of HF system planning can be dealt with, including advice on propagation, aerial systems and forecasting.

Marconi

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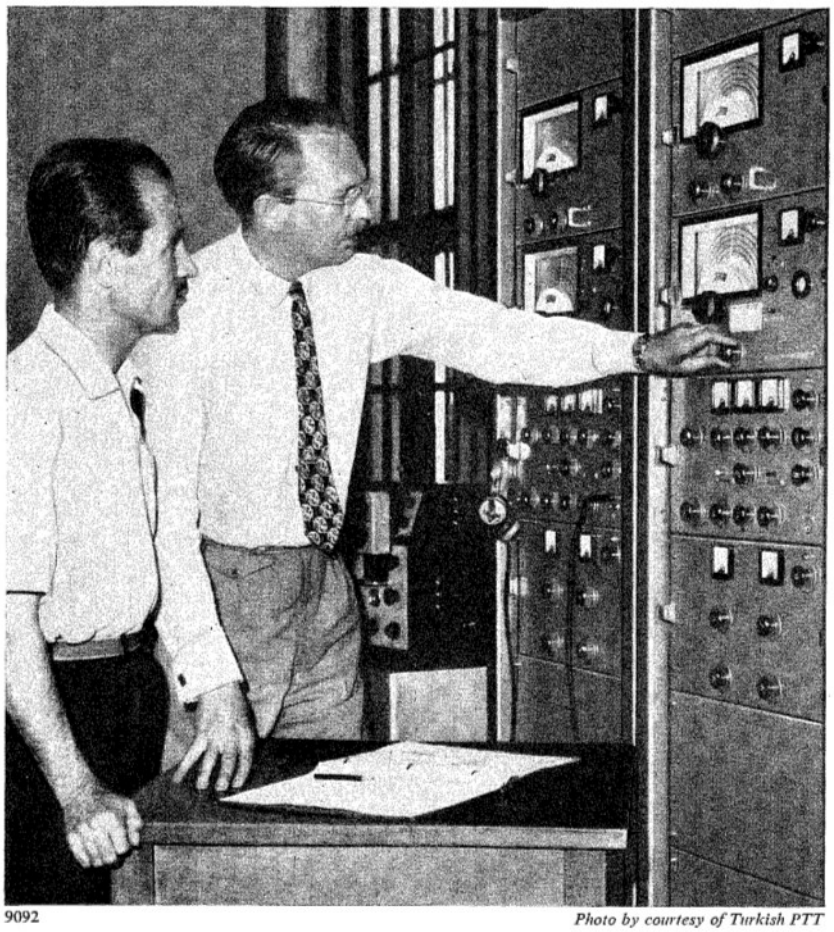
Marconi House, Chelmsford, Essex
Telephone: Chelmsford 3221 · Telex: 1953
Telegrams: Expanse Chelmsford Telex



9092 *Photo by courtesy of Turkish PTT*

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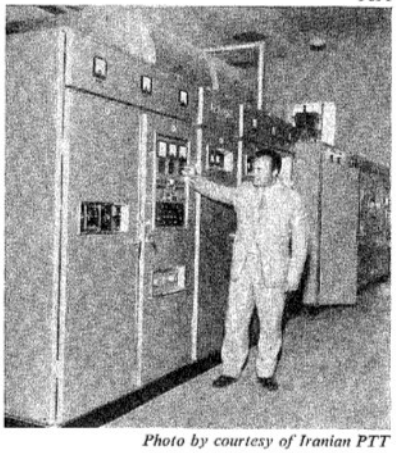
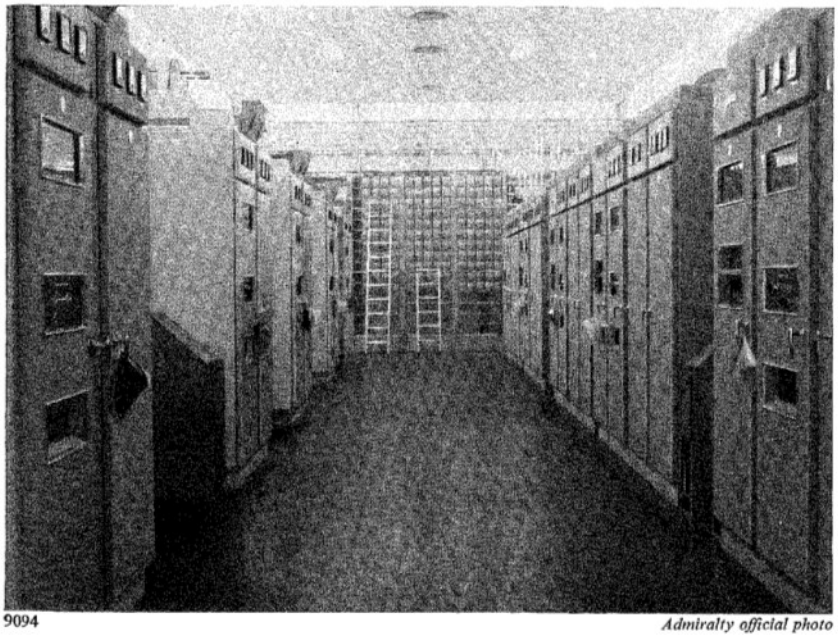


Photo by courtesy of Iranian PTT



9094 *Admiralty official photo*

Above: At Tehran, Iran, Marconi's have installed two HS 31 HF ISB transmitters together with HR 21 and HR 11 receivers and HL 13/HL 14 multi-channel VF telegraph equipment. Additional power amplification to 30 kW is provided by an HS 61 linear amplifier, shown here. It can be used with either of the HS 31 transmitters.

Above left: Two HR 21 receivers, recently installed in a Turkish P & T receiving station near Ankara.

Left: Marconi transmitters at the new British Admiralty communications station, Mauritius.