



Combining Units, Filterplexers and Diplexers

COMBINING UNITS

When it is desired to combine two separate transmissions on different frequencies, originating from different transmitters, onto one aerial feeder a combining unit is used. These are commonly in use for f.m. broadcasting and for television, the requirements in each case being rather different.

(a) For f.m. broadcasting

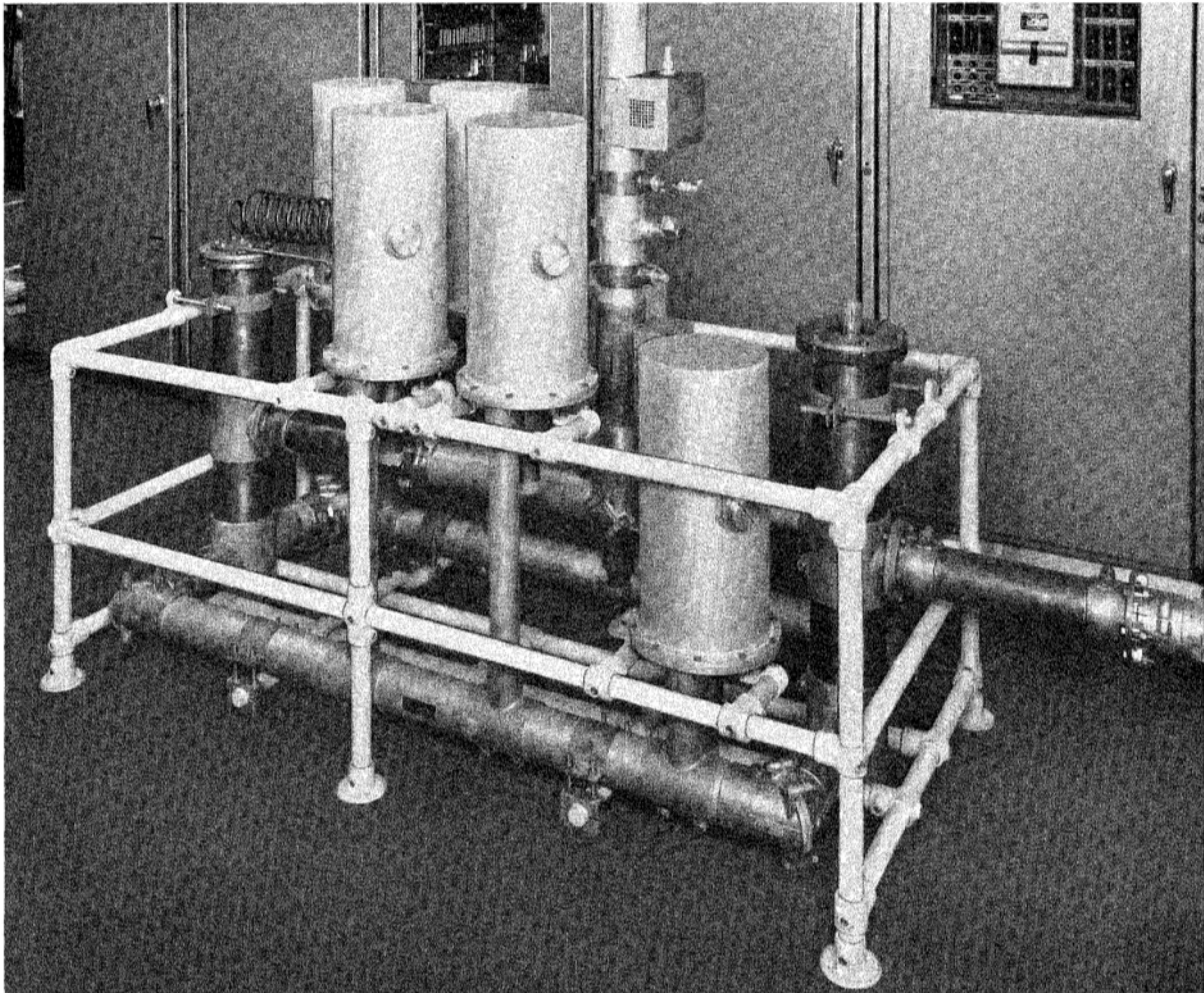
In f.m. broadcasting it frequently becomes desirable to combine two, three or even four separate transmissions in one feeder. For two transmissions it is permissible to use a

T-stub filter with two resonators (acting as T-stubs) in each transmission line, spaced at approximately one quarter-wavelength and tuned to stop the frequency of the opposite line. The two lines are then joined in a straight T-connector, with suitable transformation. Such a combining unit obtains a high crosstalk protection but, being of non-constant impedance input characteristic, is only suitable for narrow-band operation. Where more than two f.m. transmissions are to be combined, a ring-type combining unit can be supplied. This unit is constructed from a ring of coaxial feeder

in the form of two quarter-wave squares with one common side. At each end of the common side are connected T-stub resonators, tuned to provide an open-circuit at one input frequency and a short-circuit at the second input frequency, at the point of connection of the stub. The corners of the ring form the input and output terminals. The output is connected diagonally opposite one of the inputs, the second input is connected to the corner adjacent to the output, and a balancing load to the remaining corner. Where more than two transmissions are to be combined, two already combined inputs

A Band III filterplexer.

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are fed into the corner opposite the output terminal, the single transmission being fed to the other input.

(b) For television broadcasting

Combining units are also used on television to combine sound and vision wherever it is not necessary to do the vestigial sideband shaping in the same equipment. This is particularly so where the shaping of the vestigial sideband is achieved at a low level in the vision transmitter. A ring-type combining unit, similar to that used for f.m. broadcasting, is used to combine the vision and sound transmission, the vision being the wideband input corresponding to the two programme inputs in the f.m. case.

These combining units are available for medium-power applications and are constructed for 2 in. rigid feeder suitable for wall mounting. For certain lower-power applications smaller units are available, using compact resonators and flexible feeder.

DIPLEXERS

Diplexers are used to combine two transmissions of the same frequency into one transmission line, or alternatively to split one transmission into two components. The two components, whether being combined into, or arising from, a single transmission, are of equal amplitude but may be in phase or in antiphase according to the method of connecting the diplexer.

Such diplexers are available in two different forms physically. On Band I, a ring of coaxial feeder, with one arm acting as a phase inverter, is used. On Band III a compact diplexer of integral coaxial construction is available. Either of these can be supplied separately but they are normally used as components of the filterplexers described in the next paragraph.

FILTERPLEXERS

Function

Television standards throughout the world call for the use of vestigial sideband operation in order to economize in the use of available frequency space. The shaping of the vestigial sideband is sometimes achieved at low level in the vision transmitter, but more frequently at high-power level. Instead of using a separate vestigial sideband filter and combining unit, the functions of these two equipments are combined in a filterplexer. The function of the filterplexer is therefore to provide the shaping of the vestigial sideband and at the same time to combine the vision and sound transmissions in one transmission line. Marconi filterplexers are available for most of the television standards in current use.

Methods of operation

The basic configuration is that of two diplexers joined back-to-back by two lengths of coaxial feeder.

The vision signal is fed into the first diplexer in such a way that it is split into two components, equal in amplitude and phase, travelling along the connecting length of feeder to the second diplexer. This diplexer is connected so that the split vision signals re-combine into the aerial feeder. The vestigial shaping is achieved by connecting T-stub resonators in both arms of feeder, tuned to reflect the energy in the unwanted part of the sideband. By staggering the relative position in the two arms of feeder of these 'notch' resonators by one quarter-wavelength, the two components of reflected energy arrive back at the first diplexer in anti-phase.

Therefore instead of combining at the connection to the vision transmitter they appear at the fourth connection of the diplexer, where this unwanted energy is dissipated in an air-cooled balancing load. The sound transmitter is connected to the fourth position on the second diplexer. This causes the sound transmission to split into two components of equal amplitude but in anti-phase. These components travel back along the coaxial arms of the filterplexer. More T-stub resonators are connected in these arms, this time tuned to reflect the sound frequency.

Again by staggering the relative position of the 'notch' resonators in the two arms, the sound components arrive back at the diplexer in phase. The combined component therefore appears, not at the sound transmitter connection, but at the aerial feeder along with the vision transmission.

Mechanically, the filterplexers are composed of rigid feeder and tubular resonators. The ring type of diplexer is employed on Band I, the integral coaxial type on Bands III, IV and V. The filterplexers are free-standing in a tubular steel framework.

Data Summary

(Note: The following figures are typical only. The equipments available can be set up to meet the majority of requirements in current demand.)

Combining units - broadcasting

Power input: 10 kW per input.

Operating frequencies: In the band 87-103 Mc/s.

Input impedance: 51.5 Ω ; v.s.w.r, not greater than 1.1:1.

Insertion loss: Not greater than 0.25 dB.

Crosstalk: Not worse than 45 dB.

Combining units - television broadcasting, v.h.f.

Power input: 1 kW vision, 500 W sound.

Operating frequencies: In the bands 41-88 Mc/s and 174-223 Mc/s.

Input impedance: 50 Ω ; v.s.w.r at vision carrier not greater than 1.05:1.

Insertion loss: Not greater than 0.25 dB on vision carrier. Not greater than 0.7 dB on sound carrier.

Crosstalk: Not worse than 30 dB throughout the channel.

Filterplexers

	Band I	Band III	Band IV & V
Power input vision (kW):	10	20	25
Power input sound (kW):	5	10	12.5

Operating frequencies in the bands (Mc/s):
41-88 174-223 470-960

Input impedance:

51.5 Ω	51.5 Ω	50 Ω
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(v.s.w.r at vision carrier not greater than 1.05:1)

Insertion loss: Not greater than 0.25 dB on vision carrier. Not greater than 0.5 dB on sound carrier.

Crosstalk: Not worse than 30 dB throughout the channel.

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