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(54) Multiplexing system for plural channels of electromagnetic signals

Multiplexanlage für mehrere Kanäle mit elektromagnetischen Signalen

Système de multiplexage pour plusieurs canaux à signaux électromagnétiques

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Description

BACKGROUND OF THE INVENTION

This invention relates to microwave multiplexers operative with plural channels of electromagnetic signals and, more particularly, to the multiplexing signals of differing frequencies of a first set of signal channels with signals of differing frequencies of a second set of signal channels, wherein the first channels signals are circularly polarized and the second channel signals are linearly polarized prior to a combining of the two sets of signals.

Microwave multiplexers are employed in communication systems, such as in satellite communication systems, for combining numerous signal channels for transmission along a common transmission path such as an antenna feed. In a frequently employed form of satellite communication system, an antenna carried by a satellite transmits and/or receives electromagnetic signals propagating between the satellite and an antenna located on the earths surface. Plural signal channels separated by frequency and/or by polarization are communicated by the two antennas. It is important that the signals of all the channels, whether they be linearly polarized or circularly polarized, propagate along the same path in a common direction so that all of the signals transmitted by a transmit antenna reaches a receive antenna.

While multiplexing systems have been employed in both land-based and in satellite communication systems, a problem arises in that they have entailed mechanical complexity with undesirably heavy structures. At present, multiplexing systems with adequate mechanical simplicity and reduced mass, suitable for use in satellite and ground-based communication systems are unavailable.

SUMMARY OF THE INVENTION

The aforementioned problems are overcome and other advantages are provided by a multiplexing system as defined in claim 1 for combining a plurality of electromagnetic signals to propagate along a common path, preferably a square waveguide, which can be connected to an antenna feed horn of square cross section. Such a feed horn can support both circularly and linearly polarized electromagnetic waves. The square waveguide has opposed top and bottom walls and opposed sidewalls. Since the feed horn is common to both the circularly and the linearly polarized waves, an antenna reflector illuminated by the feed horn provides the same direction of radiation of signals at both of the polarizations.

The system is operative with a plurality of sets of signal channels including a first set of A-channel signals and a second set of B-channel signals. The system comprises the aforementioned square waveguide having a first end and a second end opposite the first end, and a circular polarizer having an input port and an output port, the output port being connected to the first end of the waveguide. All of the A-channel signals are fed into the input port of the polarizer. The A-channel signals differ in frequency from each other, and the B-channel signals differing in frequency from each other. All of the A-channel signal frequencies and all of the B-channel signal frequencies fall within a pass band of the waveguide, and all of the A-channel signals propagate through the polarizer and along the waveguide to the second end of the waveguide.

The B-channel signals are coupled into the square waveguide by a plurality of coupling means located at positions arranged serially along the waveguide, individual one of the coupling means operating at different ones of the B-channel frequencies for selectively coupling respective ones of the B-channel signals into the square waveguide to propagate toward the second end of the waveguide.

Each of the coupling means comprises a rectangular waveguide having a pair of opposed narrow walls and a pair of opposed broad walls, the width of a narrow wall being less than the width of a broad wall, the rectangular waveguide having an input port for receiving a B-channel signal. Also included within the coupling means is a filter assembly including plural cylindrical cavity filters interconnecting one of the broad walls of the rectangular waveguide with a wall of the square waveguide. A B-channel signal is coupled by the filter assembly from the rectangular waveguide to the square waveguide. Also, the filter assembly has a plurality of slotted apertures disposed at interfaces between the filter assembly and the square waveguide for coupling directionally a B-channel signal into the square waveguide to propagate towards the second end of the square waveguide.

In a first embodiment of the invention, the filter assembly of the coupling means comprises a first filter and a second filter. The two waveguides are parallel. The first filter connects between a broad wall of the rectangular waveguide and a sidewall of the square waveguide. The second filter connects between a sidewall of the rectangular waveguide and a bottom wall of the square waveguide. An interface between an end of the first filter and the rectangular waveguide and an interface between an end of the second filter and the square waveguide comprise, respectively, a first slotted end aperture extending transversely of the rectangular waveguide and a second slotted end aperture extending transversely of the square waveguide for coupling electromagnetic power through the interfaces. An interface between a side of the first filter and the square waveguide and an interface between a side of the second filter and the rectangular waveguide comprise, respectively, a first slotted side aperture extending parallel to a longitudinal axis of the square waveguide and a second slotted side aperture extending parallel to a longitudinal axis of the rectangular waveguide for coupling electromagnetic power through the interfaces.

In a second embodiment of the invention, the filter assembly of the coupling means again comprises a first

filter and a second filter. However, the two waveguides are perpendicular at the location of the coupling means. The first filter connects between a broad wall of the rectangular waveguide and a sidewall of the square waveguide. The second filter connects between a narrow wall of the rectangular waveguide and a top wall of the square waveguide. An interface between a side of the first filter and a broad wall of the rectangular waveguide and an interface between a side of the second filter and a narrow wall of the rectangular waveguide comprise, respectively, a first slotted side aperture extending transversely of the rectangular waveguide and a second slotted side aperture extending parallel to a longitudinal axis of the rectangular waveguide for coupling electromagnetic power through the interfaces. An interface between an end of the first filter and the square waveguide and an interface between an end of the second filter and the square waveguide comprise, respectively, a first slotted end aperture extending parallel to a longitudinal axis of the square waveguide and a second slotted end aperture extending transversely of the square waveguide for coupling electromagnetic power through the interfaces.

BRIEF DESCRIPTION OF THE DRAWING

The aforementioned aspects and other features of the invention are explained in the following description, taken in connection with the accompanying drawing wherein:

Fig. 1 is a diagrammatic view of a portion of a satellite communication system showing the multiplexing of two sets of signals by a set of microwave couplers constructed in accordance with the invention;

Fig. 2 is a perspective view of a coupler of Fig. 1 in accordance with a first embodiment of the invention;

Fig. 3 is an end view of the coupler of Fig. 2 taken along the line 3-3 in Fig. 2, portions of the figure being cut away to show coupling apertures; and

Fig. 4 is a perspective view of a coupler of Fig. 1 in accordance with a second embodiment of the invention.

DETAILED DESCRIPTION

Fig. 1 shows a multiplexer system 10 constructed in accordance with the invention and being employed as a part of a communication system 12 employing a satellite 14 for communicating with stations (not shown) on the earth. While the multiplexer system 10 is useful in numerous forms of communication systems and also in signal processing systems, it is particularly advantageous for a satellite communication system because of its mechanical simplicity and because the multiplexer system 10 is capable of outputting both linearly and circularly polarized electromagnetic waves along a single path 16. In the case of the satellite communication system 12, the path 16 couples multiplexed signals to a feed horn 18 for illuminating a reflector 20 of an antenna 22. To simplify the drawing, only a fragment of the reflector 20 is indicated in the drawing. The feed horn 18 has a square-shaped radiating aperture suitable for radiation of both a linearly polarized wave and a circularly polarized wave from a common focal point of the antenna 22. If desired, an aperture of circular cross section (not shown) may be employed, along with a waveguide transition from square to circular cross section, for illuminating the reflector 20.

The communication system 12 is operative with two forms of communication signals commonly employed in satellite communication, namely, the fixed satellite service (FSS) wherein the signal is radiated as a linearly polarized wave, and broadcast satellite service (BSS) wherein the signal is radiated as a circularly polarized wave. The FSS and the BSS signals are presented by way of example, it being understood that the multiplexer system 10 is operative, in general, with a first input signal channel, channel A, and a second input signal channel B, wherein each of the channels includes a plurality of signals offset from each other in the frequency spectrum by use of different carrier frequencies for each of the signals. By way of example, three such carrier frequencies are indicated for each of the channels. In Channel A, the three frequencies are shown as F1, F2, and F3. In channel B, the carrier frequencies are indicated as Fa, Fb, and Fc.

In the case of satellite communication, the signals are transmitted, generally, from an earth station to the satellite 14 to be amplified by well-known amplification means (not shown) on board the satellite 14, this being followed by retransmission back to the earth. The signals, subsequent to their amplification are indicated in Fig. 1 as being produced by signal sources 24 for the A-channel signals and signal sources 26 for the B-channel signals. By way of example, three of the sources 24 and three of the sources 26 are shown, it being understood that many more signals would be applied, in a typical situation, to each of the channels. Signals of the sources 24 are combined by a multiplexer 28 and applied to the A channel. Signals of the sources 26 are presented as a group 30 of separate signal transmission paths which, in a preferred embodiment of the invention, are constructed as a set of individual rectangular waveguides 34 of which three waveguides 34A, 34B and 34C are shown by way of example. Thus, each of channels has a plurality of signals at differing frequencies.

The multiplexer system 10 comprises a square waveguide 32 having a square cross section, the set of rectangular waveguides 34 each of which has a rectangular cross section, a circular polarizer 36 introducing a circular polarization to an electromagnetic wave, a circular polarizer 38 which introduces a circular polarization

to an electromagnetic wave orthogonal to the polarization of the polarizer 36, and a plurality of couplers 40. There is one coupler 40 for each of the signal frequencies of the B channel, each of the couplers 40 being tuned to a specific one of the frequencies of the B-channel signals. The couplers 40 are identified further by the legends Fa, Fb and Fc, and are coupled respectively to corresponding ones of the waveguides 34A, 34B and 34C. In the square waveguide 32, there are four sidewalls 42, each of which have equal width. In each rectangular waveguide 34, there is a top wall 44 and a bottom wall 46 which are of equal width, and two opposed narrow walls 48 which are of equal width. Typically, the width of the top wall 44 is twice the width of a narrow wall 48.

In the operation of the multiplexer system 10, the signals entering the rectangular waveguides 34 from the signal sources 26 are linearly polarized with the electric field being parallel to a narrow wall 48 in respective ones of the waveguides 34. The signals outputted by the multiplexer 28 are also linearly polarized upon application to an input port of the polarizer 36, and are converted by the polarizer 36 to a circularly polarized wave which enters into the square waveguide 32. Signals entering the rectangular waveguides 34 propagate from a first end of each waveguide 34 at a source 26 towards the opposite end of the waveguide 34 wherein there is located a load 50 having an impedance matched to that of the waveguide 34 for absorbing microwave power so as to inhibit the generation of reflections of power flow in the reverse direction within the waveguide 34. In the square waveguide 32, electromagnetic power outputted by the polarizer 36 flows through the square waveguide 32 in a direction towards the polarizer 38. With respect to the A-channel signals, the circular polarization introduced by the polarizer 36 is negated by the circular polarization of the opposite hand introduced by the polarizer 38 so that the A-channel signals are restored to their state of linear polarization in the path 16. The path 16 is constructed as a section of square waveguide as is the input section 52 of the feed horn 18. With respect to the signals of the B-channel, the various signals are coupled by respective ones of the couplers 40 from the rectangular waveguides 34 to the square waveguide 32. Each of the couplers 40 operates in a directional fashion to launch its respective B-channel signal in the square waveguide 32 in the same direction of propagation in which the A-channel signals propagate. Arrows 54 in the couplers 40 indicate the direction of propagation of the B-channel signals through the couplers 40.

Figs. 2 and 3 show the construction of a coupler 40 in accordance with a first embodiment of the invention. In addition to sections of each of the waveguides 32 and 34, each coupler 40 further comprises two cylindrical cavity filters 56 and 58 interconnecting the two waveguides 32 and 34. Each of the filters 56 and 58 comprises a sidewall 60, a top end wall 62 and a bottom end wall 64. In the case of the first filter 56, the sidewall 60 is provided with a first aperture 66 which extends through a sidewall 42 of the square waveguide 32 for communicating electromagnetic power between the filter 56 and the square waveguide 32. The aperture 66 is in the form of an elongated slot, and is shown in phantom in Fig. 2, and is also shown in a cut-away portion of Fig. 3. A second aperture 68 is formed in a bottom end wall 64 of the first filter 56, and continues through the top wall 44 of the waveguide 34 to couple power between the filter 56 and the waveguide 34. The second aperture 68 has the configuration of an elongated slot. A third aperture 70 having the shape of an elongated slot is formed within the sidewall 60 of the second filter 58 and extends through a narrow wall 48 of the waveguide 34 to couple power between the second filter 58 and the waveguide 48. A fourth aperture 72 having the form of an elongated slot is formed in the top end wall 62 of the second filter 58 and extends through a sidewall 42 of the square waveguide 32 for coupling power between the second filter 58 and the waveguide 32.

The orientations of the respective apertures 66-72 provide for magnetic coupling via the H components of the various electromagnetic fields in the respective waveguides 32 and 34 and filters 56 and 58. Typically, each of the filters 56 and 58 comprises two cavities 74 and 76 separated by a transverse plate 78 having a coupling iris 80, such as a circular iris. The design of a two-cavity filter is well known. Furthermore, the number of cavities, whether there be one cavity, two cavities, or more cavities, is a matter of choice, the decision being based on a desired characteristic to the pass band of the respective couplers 40. For example, a more sharply defined pass band is required for closely spaced frequencies of the various B-channel signals, whereas less sharply defined pass bands may be employed wherein the signal frequencies are spaced further apart along the spectrum.

In each of the couplers 40, the two waveguides 32 and 34 are parallel to each other in this embodiment of the invention. All four of the slots 66-72 are disposed in a common plane oriented transversely to the longitudinal axes of the two waveguides 32 and 34. The second aperture 68 disposed in the bottom end wall 64 of the first filter 56 and the fourth aperture 72 disposed in the top end wall 62 of the filter 58 are disposed with their longitudinal dimensions oriented transversely to the longitudinal axes of the waveguides 32 and 34. The first aperture 66 disposed in the sidewall 60 of the first filter 56 and the third aperture 70 disposed in the sidewall 60 of the second filter 58 are disposed with their longitudinal dimensions parallel to the longitudinal axes of the waveguides 32 and 34.

In Fig. 4, there is a shown a coupler 40A which is an alternative embodiment to the coupler 40 of Figs. 2 and 3. In Fig. 4, the rectangular waveguide 34 is oriented perpendicularly to the square waveguide 32. The two filters 56 and 58 are employed for coupling electromagnetic power between the two waveguides 32 and 34. However, the orientation of the two filters 56 and 58 differs from

that shown in Figs. 2 and 3. In Fig. 4, the bottom end wall 64 of each of the filters 56 and 58 contacts a sidewall 42 of the square waveguide 32. Sidewalls 60 of the filters 56 and 58 contact, respectively, the top wall 44 and a narrow wall 48 of the rectangular waveguide 34. There are four coupling apertures 82, 84, 86 and 88 providing for coupling of electromagnetic power from the waveguide 34 to the waveguide 32 via the two filters 56 and 58. A first aperture 82 having the shape of an elongated slot passes through the sidewall 60 of the first filter 56 and through the top wall 44 of the rectangular waveguide 34, the first aperture 82 being oriented in a direction transverse to the longitudinal axis of the rectangular waveguide 34. The second aperture 84 passes through the bottom end wall of the first filter 56 and through a sidewall 42 of the square waveguide 32, the second aperture 84 having the configuration of an elongated slot with longitudinal dimension parallel to an axis of the square waveguide 32. The third aperture 86 is disposed in a bottom end wall 64 of the second filter 58 and passes through a further sidewall 42 of the square waveguide 32, the third aperture 86 having the configuration of an elongated slot with longitudinal dimension transverse to the longitudinal axis of the square waveguide 32. The fourth aperture 88 is disposed in the sidewall 60 of the second filter 58 and passes through a narrow wall 48 of the rectangular waveguide 34, the fourth aperture 88 having the configuration of an elongated slot with longitudinal dimension parallel to the longitudinal axis of the rectangular waveguide 34.

Also indicated in Fig. 2 and Fig. 4 are transverse dimensions of the waveguides 32 and 34, the transverse dimension, or width, of a sidewall 32 of the square waveguide 32 being identified by the letter a. Also, the top wall 44 and the bottom wall 46 of the rectangular waveguide 34 have a width equal to the dimension a. The narrow walls 48 of the rectangular waveguide 34 have a width b where b is equal to one-half of a. The diameter of each of the filters 56 and 58 is approximately equal to the dimension a. If desired, the filters 56 and 58 can be constructed with a plurality of cavities as has been disclosed in Fig. 3.

The preceding description has provided for the construction of a multiplexer system suitable for combining dual signal channels wherein each channel has plural signals with differing frequencies. The construction of the multiplexer system provides for a combination of both of the signal channels to propagate along a common path suitable for an antenna feed. Furthermore, the combining is accomplished in the fashion which provides for linear polarization of the signals of one channel and circular polarization of the signals of the other channel.

Claims

1. A system (10) for combining a plurality of electromagnetic signals (24, 26) to propagate along a common path (16), the system (10) being operative with a plurality of sets of signal channels including a first set of circularly polarized A-channel signals (24) and a second set of linearly polarized B-channel signals (26), the system (10) comprising:

a transmission line (32) having a first end and a second end opposite said first end,

a circular polarizer (36) having an input port and an output port, the output port being connected to the first end of said transmission line (32), all of said A-channel signals (24) being fed into the input port of said polarizer (36), the A-channel signals (24) differing in frequency and the B-channel signals (26) differing in frequency, all of the A-channel signal frequencies and all of the B-channel signal frequencies falling within a pass band of said transmission line (32), and all of the A-channel signals (24) propagating through said polarizer (36) and along said transmission line (32) to the second end of said transmission line (32);

a plurality of couplers (40) located at positions arranged serially along said transmission line (32), individual ones of said couplers (40) operating at different ones of the B-channel frequencies for selectively coupling respective ones of said B-channel signals (26) into said transmission line (32) to propagate toward the second end of said transmission line (32).

2. The system of claim 1, characterized in that the transmission line (32) comprises a symmetric waveguide (32),

wherein each of said couplers (40) comprises a rectangular waveguide (34) having a pair of opposed narrow walls (48) and a pair of opposed broad walls (44, 46), the width of a narrow wall (48) being less than the width of a broad wall (44, 46), the rectangular waveguide (34) having an input port for receiving a B-channel signal (26); and

wherein each of said couplers (40) further comprises a filter assembly (56, 58) including plural cylindrical cavity filters interconnecting one of said broad walls (44, 46) of said rectangular waveguide (34) with a first wall (42) of said symmetric waveguide (32) and one of said narrow walls (48) of said rectangular waveguide (34) with a second wall (42) of said symmetric waveguide (32), the second wall (42) of said symmetric waveguide (32) being perpendicular to the first wall (42) of said symmetric waveguide (32), the B-channel signal (26) being coupled by said filter assembly (56, 58) from said rectangular waveguide (34) to said symmetric waveguide (32).

3. A system according to claim 1 or claim 2, characterized in that said filter assembly (56, 58) has a plurality of slotted apertures (66, 68, 70, 72; 82, 84, 86, 88) disposed at interfaces between said filter

assembly (56, 58) and said symmetric waveguide (32) for coupling directionally the B-channel signal (26) into the symmetric waveguide (32) to propagate towards the second end of said symmetric waveguide (32).

4. A system according to claim 2 or 3, characterized in that in said coupler (40), said filter assembly (56, 58) comprises a first (56) and a second (58) of said cylindrical cavity filters, said symmetric waveguide (32) comprises opposed top and bottom walls (42) and opposed sidewalls (42), said first filter (56) connects between a broad wall (44) of said rectangular waveguide (34) and a sidewall (42) of said symmetric waveguide (32), said second filter (58) connects between a narrow wall (48) of said rectangular waveguide (34) and a bottom wall (42) of said symmetric waveguide (32).

5. A system according to claim 3 or 4, characterized in that an interface between an end of said first filter (56) and said rectangular waveguide (34) comprises a slotted end aperture (68) extending transversely of said rectangular waveguide (34) for coupling electromagnetic power.

6. A system according to any of claims 3 - 5, characterized in that an interface between an end of said second filter (58) and said symmetric waveguide (32) comprises a slotted end aperture (72) extending transversely of said symmetric waveguide (32) for coupling electromagnetic power.

7. A system according to any of claims 3 - 6, characterized in that an interface between a side (60) of said first filter (56) and said symmetric waveguide (32) comprises a slotted aperture (66) extending parallel to a longitudinal axis of said symmetric waveguide (32) for coupling electromagnetic power.

8. A system according to any of claims 3 - 7, characterized in that an interface between a side (60) of said second filter (58) and said rectangular waveguide (34) comprises a slotted aperture (70) extending parallel to a longitudinal axis of said rectangular waveguide (34) for coupling electromagnetic power.

9. A system according to any of the above claims, characterized in that said circular polarizer (36) rotates the electric field of an electromagnetic wave propagating along said symmetric waveguide (32) in a first direction of rotation, said system (10) including a second circular polarizer (38) having an input port and an output power and being coupled via its input port to the second end of said symmetric waveguide (32), said second circular polarizer (38) rotating the electric field of an electromagnetic wave propagating along said symmetric waveguide (32) in a second direction of rotation, thereby restoring A-channel signals (24) to linear polarization and imparting a circular polarization to B-channel signals (26).

10. A system according to any one of the above claims, characterized in that in each of said couplers (40), said filter assembly (56, 58) comprises a first (56) and a second (58) of said cylindrical cavity filters, said rectangular waveguide (34) is perpendicular to said symmetric waveguide (32), and said symmetric waveguide (32) comprises opposed top and bottom walls and opposed sidewalls (42); and

said first filter (56) connects between a broad wall (44) of said rectangular waveguide (34) and a sidewall (42) of said square waveguide (32), and said second filter (58) connects between a narrow wall (48) of said rectangular waveguide (34) and a top wall (42) of said symmetric waveguide (32).

Patentansprüche

1. System (10) zum Kombinieren von einer Vielzahl von zur Ausbreitung längs eines gemeinsamen Pfades (16) bestimmten elektromagnetischen Signalen (24, 26), wobei das System (10) mit einer Vielzahl von Sätzen von Signalkanälen arbeitet, zu denen ein erster Satz von zirkular polarisierten Signalen (24) eines A-Kanales und ein zweiter Satz von linear polarisierten Signalen (26) eines B-Kanales zählen, mit:

einer Übertragungsleitung (32) mit einem ersten Ende und einem dem ersten Ende gegenüberliegenden zweiten Ende,

einem Zirkularpolarisator (36) mit einem Eingangsanschluß und einem Ausgangsanschluß, wobei der Ausgangsanschluß mit dem ersten Ende der Übertragungsleitung (32) verbunden ist, alle A-Kanal-Signale (24) in den Eingangsanschluß des Polarisators (36) eingespeist werden, die A-Kanal-Signale (24) sich in der Frequenz unterscheiden und die B-Kanal-Signale (26) sich in der Frequenz unterscheiden, alle Frequenzen der A-Kanal-Signale und alle Frequenzen der B-Kanal-Signale in ein Durchlaßband der Übertragungsleitung (32) fallen, und alle A-Kanal-Signale (24) durch den Polarisator (36) hindurch und längs der Übertragungsleitung (32) zu dem zweiten Ende der Übertragungsleitung (32) wandern;

einer Vielzahl von Kopplern (40), die an seriell längs der Übertragungsleitung (32) angeordneten Positionen vorgesehen sind, wobei einzelne der Koppler (40) an unterschiedlichen Frequenzen der B-Kanal-Frequenzen arbeiten, um jeweilige der B-Kanal-Signale (26) selektiv in die Übertragungsleitung (32) zu koppeln, so daß sie sich in Richtung auf das zweite Ende der Übertragungsleitung (32)

ausbreiten.

2. System nach Anspruch 1, dadurch gekennzeichnet, daß die Übertragungsleitung (32) einen symmetrischen Wellenleiter (32) umfaßt,

wobei jeder der Koppler (40) einen rechtwinkligen Wellenleiter (34) mit einem Paar von sich gegenüberstehenden schmalen Wänden (48) und einem Paar von sich gegenüberstehenden breiten Wänden (44, 46) umfaßt, die Breite einer schmalen Wand (48) geringer ist als die Breite einer breiten Wand (44, 46) und der rechtwinklige Wellenleiter (34) einen Eingangsanschluß zum Empfangen eines B-Kanal-Signales (26) aufweist; und

wobei jeder der Koppler (40) ferner eine Filteranordnung (56, 58) mit mehreren zylindrischen Kavitätsfiltern umfaßt, die eine der breiten Wände (44, 46) des rechtwinkligen Wellenleiters (34) mit einer ersten Wand (42) des symmetrischen Wellenleiters (32) und eine der schmalen Wände (48) des rechtwinkligen Wellenleiters (34) mit einer zweiten Wand (42) des symmetrischen Wellenleiters (32) verbinden, wobei die zweite Wand (42) des symmetrischen Wellenleiters (32) senkrecht zu der ersten Wand (42) des symmetrischen Wellenleiters (32) verläuft und das B-Kanal-Signal (26) durch die Filteranordnung (56, 58) von dem rechtwinkligen Wellenleiter (34) in den symmetrischen Wellenleiter (32) gekoppelt wird.

3. System nach Anspruch 1 oder Anspruch 2, dadurch gekennzeichnet, daß die Filteranordnung (56, 58) eine Vielzahl von geschlitzten Aperturen (66, 68, 70, 72; 82, 84, 86, 88) aufweist, die an Grenzflächen zwischen der Filteranordnung (46, 48) und dem symmetrischen Wellenleiter (32) angeordnet sind, um das B-Kanal-Signal (26) richtungsempfindlich in den symmetrischen Wellenleiter (32) zu koppeln, damit es sich in Richtung des zweiten Endes des symmetrischen Wellenleiters (32) ausbreitet.

4. System nach Anspruch 2 oder Anspruch 3, dadurch gekennzeichnet, daß in dem Koppler (40) die Filteranordnung (56, 58) ein erstes (56) und ein zweites (58) von den zylindrischen Kavitätsfiltern umfaßt, wobei der symmetrische Wellenleiter (32) eine obere und eine gegenüberliegende untere Wand (42) sowie gegenüberliegende Seitenwände (42) umfaßt, das erste Filter (56) eine Verbindung zwischen einer breiten Wand (44) des rechtwinkligen Wellenleiters (34) und einer Seitenwand (42) des symmetrischen Wellenleiters (32) herstellt, und daß zweite Filter (58) eine Verbindung zwischen einer schmalen Wand (48) des rechtwinkligen Wellenleiters (34) und einer unteren Wand (42) des symmetrischen Wellenleiters (32) herstellt.

5. System nach Anspruch 3 oder Anspruch 4, dadurch gekennzeichnet, daß eine Grenzfläche zwischen einem Ende des ersten Filters (56) und dem rechtwinkligen Wellenleiter (34) eine geschlitzte Endapertur (68) umfaßt, die sich zur Kopplung von elektromagnetischer Energie quer zu dem rechtwinkligen Wellenleiter (34) erstreckt.

6. System nach einem der Ansprüche 3 bis 5, dadurch gekennzeichnet, daß eine Grenzfläche zwischen einem Ende des zweiten Filters (58) und dem symmetrischen Wellenleiter (32) eine geschlitzte Endapertur (72) umfaßt, die sich zur Kopplung von elektromagnetischer Energie quer zu dem symmetrischen Wellenleiter (32) erstreckt.

7. System nach einem der Ansprüche 3 bis 6, dadurch gekennzeichnet, daß eine Grenzfläche zwischen einer Seite (60) des ersten Filters (56) und dem symmetrischen Wellenleiter (32) eine geschlitzte Apertur (66) umfaßt, die sich zur Kopplung von elektromagnetischer Energie parallel zu einer Längsachse des symmetrischen Wellenleiteres (32) erstreckt.

8. System nach einem der Ansprüche 3 bis 7, dadurch gekennzeichnet, daß eine Grenzfläche zwischen einer Seite (60) des zweiten Filters (58) und dem rechtwinkligen Wellenleiter (34) eine geschlitzte Apertur (70) umfaßt, die sich zur Kopplung von elektromagnetischer Energie parallel zu einer Längsachse des rechtwinkligen Wellenleiters (34) erstreckt.

9. System nach einem der vorhergehenden Ansprüche, dadurch gekennzeichnet, daßder Zirkularpolarisator (36) das elektrische Feld einer elektromagnetischen Welle, die sich längs des symmetrischen Wellenleiters (32) ausbreitet, in eine erste Rotationsrichtung dreht, wobei das System (10) einen zweiten Zirkularpolarisator (38) mit einem Eingangsanschluß und einer Ausgangsleistung umfaßt, der über seinen Eingangsanschluß an das zweite Ende des symmetrischen Wellenleiters (32) gekoppelt ist, wobei der zweite Zirkularpolarisator (36) das elektrische Feld einer sich längs des symmtrischen Wellenleiters (32) ausbreitenden elektromagnetischen Welle in eine zweite Rotationsrichtung dreht, wodurch A-Kanal-Signale (24) wieder in linearer Polarisation hergestellt werden und den B-Kanal-Signalen (26) eine zirkulare Polarisation verliehen wird.

10. System nach einem der vorhergehenden Ansprüche, dadurch gekennzeichnet, daß in jedem der Koppler (40) die Filteranordnung (56, 58) ein erstes (56) und ein zweites (58) der zylindrischen Kavitätsfilter umfaßt, der rechtwinklige Wellenleiter (34) senkrecht zu dem symmetrischen Wellenleiter (32) ist, und der symmetrische Wellenleiter (32) eine

obere und eine gegenüberliegende untere Wand sowie gegenüberliegende Seitenwände (42) umfaßt; und

das erste Filter (56) eine Verbindung zwischen einer breiten Wand (44) des rechtwinkligen Wellenleiters (34) sowie einer Seitenwand (42) des quadratischen Wellenleiters (32) herstellt, und das zweite Filter (48) eine Verbindung zwischen einer schmalen Wand (48) des rechtwinkligen Wellenleiters (34) und einer oberen Wand (42) des symmetrischen Wellenleiters (32) herstellt.

Revendications

1. Un système (10) pour combiner un ensemble de signaux électromagnétiques (24, 26) de façon qu'ils se propagent le long d'un chemin commun (16), le système (10) fonctionnant avec un ensemble de jeux de canaux de signaux comprenant un premier jeu de signaux de canal A (24) polarisés de façon circulaire, et un second jeu de signaux de canal B (26) polarisés de façon linéaire, le système (10) comprenant :

une ligne de transmission (32) ayant une première extrémité et une seconde extrémité opposée à la première extrémité,

un polariseur circulaire (36) ayant un accès d'entrée et un accès de sortie, l'accès de sortie étant connecté à la première extrémité de la ligne de transmission (32), tous les signaux de canal A (24) étant appliqués à l'accès d'entrée du polariseur (36), les signaux de canal A (24) ayant des fréquences différentes et les signaux de canal B (26) ayant des fréquences différentes, toutes les fréquences des signaux de canal A et toutes les fréquences des signaux de canal B étant comprises à l'intérieur d'une bande passante de la ligne de transmission (32), et tous les signaux de canal A (24) se propageant à travers le polariseur (36) et le long de la ligne de transmission (32), vers la seconde extrémité de la ligne de transmission (32);

un ensemble de coupleurs (40) placés à des positions disposées en série le long de la ligne de transmission (32), des coupleurs (40) individuels fonctionnant à différentes fréquences parmi les fréquences de canal B pour coupler sélectivement à la ligne de transmission (32) des signaux respectifs parmi les signaux de canal B (26), pour qu'ils se propagent vers la seconde extrémité de la ligne de transmission (32).

2. Le système de la revendication 1, caractérisé en ce que la ligne de transmission (32) comprend un guide d'ondes symétrique (32),

dans lequel chacun des coupleurs (40) comprend un guide d'ondes rectangulaire (34) ayant une paire de parois étroites opposées (48) et une paire de parois larges opposées (44, 46), la largeur d'une paroi étroite (48) étant inférieure à la largeur d'une paroi large (44, 46), le guide d'ondes rectangulaire (34) ayant un accès d'entrée pour recevoir un signal de canal B (26); et

dans lequel chacun des coupleurs (40) comprend en outre une structure de filtres (56, 58) comprenant plusieurs filtres à cavité cylindrique reliant l'une des parois larges (44, 46) du guide d'ondes rectangulaire (34) à une première paroi (42) du guide d'ondes symétrique (32), et l'une des parois étroites (48) du guide d'ondes rectangulaire (34) à une seconde paroi (42) du guide d'ondes symétrique (32), la seconde paroi (42) du guide d'ondes symétrique (32) étant perpendiculaire à la première paroi (42) du guide d'ondes symétrique (32), le signal de canal B (26) étant couplé par la structure de filtres (56, 58) du guide d'ondes rectangulaire (34) au guide d'ondes symétrique (32).

3. Un système selon la revendication 1 ou la revendication 2, caractérisé en ce que la structure de filtres (56, 58) comprend un ensemble d'ouvertures en forme de fentes (66, 68, 70, 72; 82, 84, 86, 88) disposées à des interfaces entre la structure de filtres (56, 58) et le guide d'ondes symétrique (32), pour coupler de façon directionnelle le signal de canal B (26) au guide d'ondes symétrique (32), pour qu'il se propage vers la seconde extrémité du guide d'ondes symétrique (32).

4. Un système selon la revendication 2 ou 3, caractérisé en ce que dans le coupleur (40), la structure de filtres (56, 58) comprend un premier (56) et un second (58) des filtres à cavité cylindrique, le guide d'ondes symétrique (32) comprend des parois supérieure et inférieure opposées (42) et des parois latérales opposées (42), le premier filtre (56) est installé entre une paroi large (44) du guide d'ondes rectangulaire (34) et une paroi latérale (42) du guide d'ondes symétrique (32), et le second filtre (58) est installé entre une paroi étroite (48) du guide d'ondes rectangulaire (34) et une paroi inférieure (42) du guide d'ondes symétrique (32).

5. Un système selon la revendication 3 ou 4, caractérisé en ce qu'une interface entre une extrémité du premier filtre (56) et le guide d'ondes rectangulaire (34) comprend une ouverture d'extrémité en forme de fente (68) s'étendant transversalement au guide d'ondes rectangulaire (34), pour le couplage d'énergie électromagnétique.

6. Un système selon l'une quelconque des revendications 3 à 5, caractérisé en ce qu'une interface entre une extrémité du second filtre (58) et le guide d'ondes symétrique (32) comprend une ouverture d'extrémité en forme de fente (72) qui s'étend trans-

versalement au guide d'ondes symétrique (32), pour le couplage d'énergie électromagnétique.

7. Un système selon l'une quelconque des revendications 3 à 6, caractérisé en ce qu'une interface entre un côté (60) du premier filtre (56) et le guide d'ondes symétrique (32) comprend une ouverture en forme de fente (66) qui s'étend parallèlement à un axe longitudinal du guide d'ondes symétrique (32), pour le couplage d'énergie électromagnétique.

8. Un système selon l'une quelconque des revendications 3 à 7, caractérisé en ce qu'une interface entre un côté (60) du second filtre (58) et le guide d'ondes rectangulaire (34) comprend une ouverture en forme de fente (70) s'étendant parallèlement à un axe longitudinal du guide d'ondes rectangulaire (34), pour le couplage d'énergie électromagnétique.

9. Un système selon l'une quelconque des revendications précédentes, caractérisé en ce que le polariseur circulaire (36) fait tourner dans un premier sens de rotation le champ électrique d'une onde électromagnétique se propageant le long du guide d'ondes symétrique (32), ce système (10) comprenant un second polariseur circulaire (38) ayant un accès d'entrée et une puissance de sortie, et qui est couplé par l'intermédiaire de son accès d'entrée à la seconde extrémité du guide d'ondes symétrique (32), ce second polariseur circulaire (38) faisant tourner dans un second sens de rotation le champ électrique d'une onde électromagnétique qui se propage le long du guide d'ondes symétrique (32), pour ainsi rétablir en polarisation linéaire les signaux de canal A (24), et communiquer une polarisation circulaire aux signaux de canal B (26).

10. Un système selon l'une quelconque des revendications précédentes, caractérisé en ce que dans chacun des coupleurs (40), la structure de filtres (56, 58) comprend un premier (56) et un second (58) des filtres à cavité cylindrique, le guide d'ondes rectangulaire (34) est perpendiculaire au guide d'ondes symétrique (32), et le guide d'ondes symétrique (32) comprend des parois supérieure et inférieure opposées et des parois latérales opposées (42); et

le premier filtre (56) est installé entre une paroi large (44) du guide d'ondes rectangulaire (34) et une paroi latérale (42) du guide d'ondes carré (32), et le second filtre (58) est installé entre une paroi étroite (48) du guide d'ondes rectangulaire (34) et une paroi supérieure (42) du guide d'ondes symétrique (32).

FIG. 1

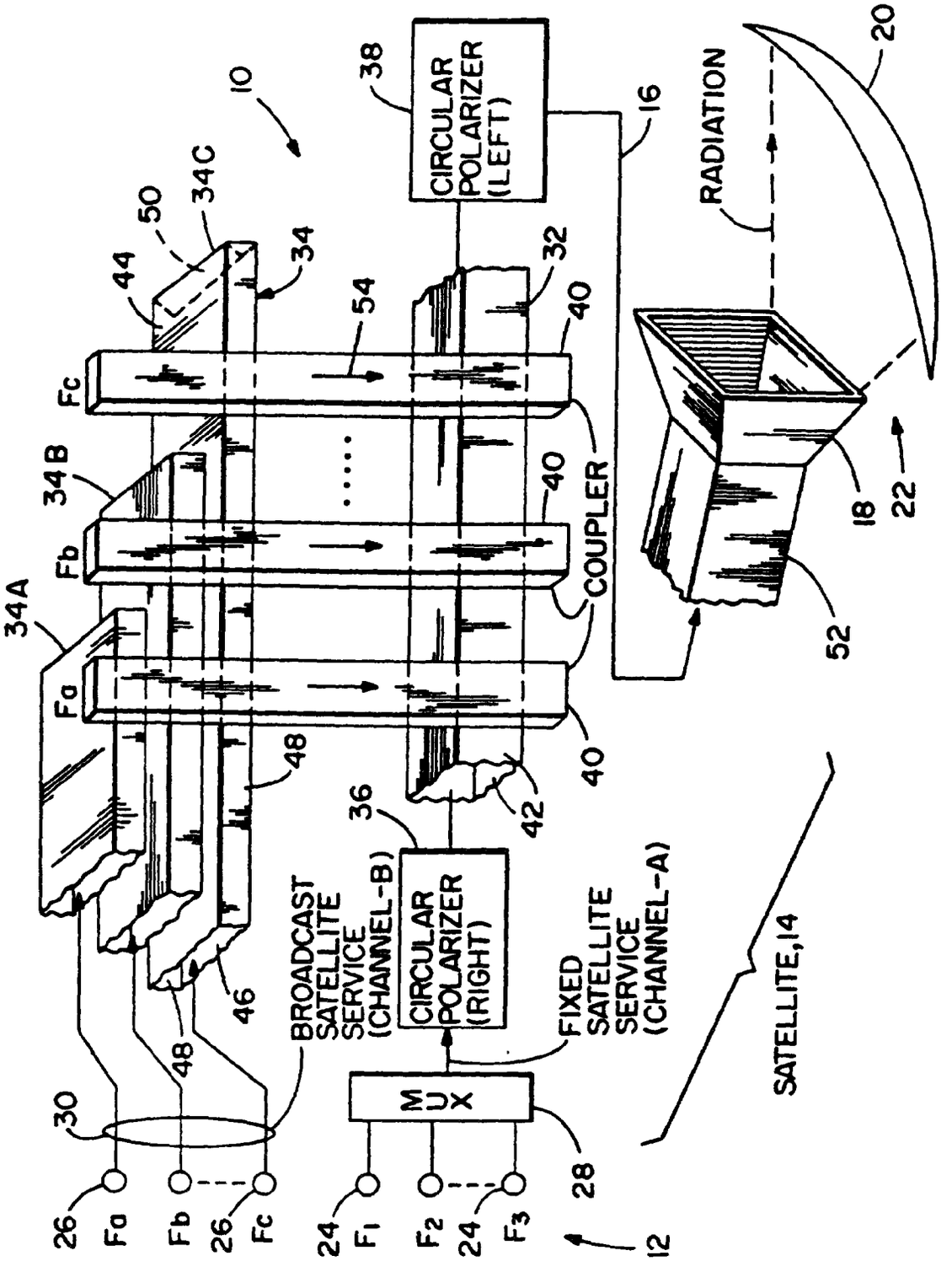

10
38
CIRCULAR POLARIZER (LEFT)
16
RADIATION
20
34C
50
44
34
32
54
40
Fc
34B
Fb
40
COUPLER
34A
Fa
40
18
22
52
48
36
42
BROADCAST SATELLITE SERVICE (CHANNEL-B)
CIRCULAR POLARIZER (RIGHT)
FIXED SATELLITE SERVICE (CHANNEL-A)
SATELLITE, 14
48
46
30
MUX
28
26
Fa
Fb
26
Fc
24
F1
F2
24
F3
12

FIG. 2

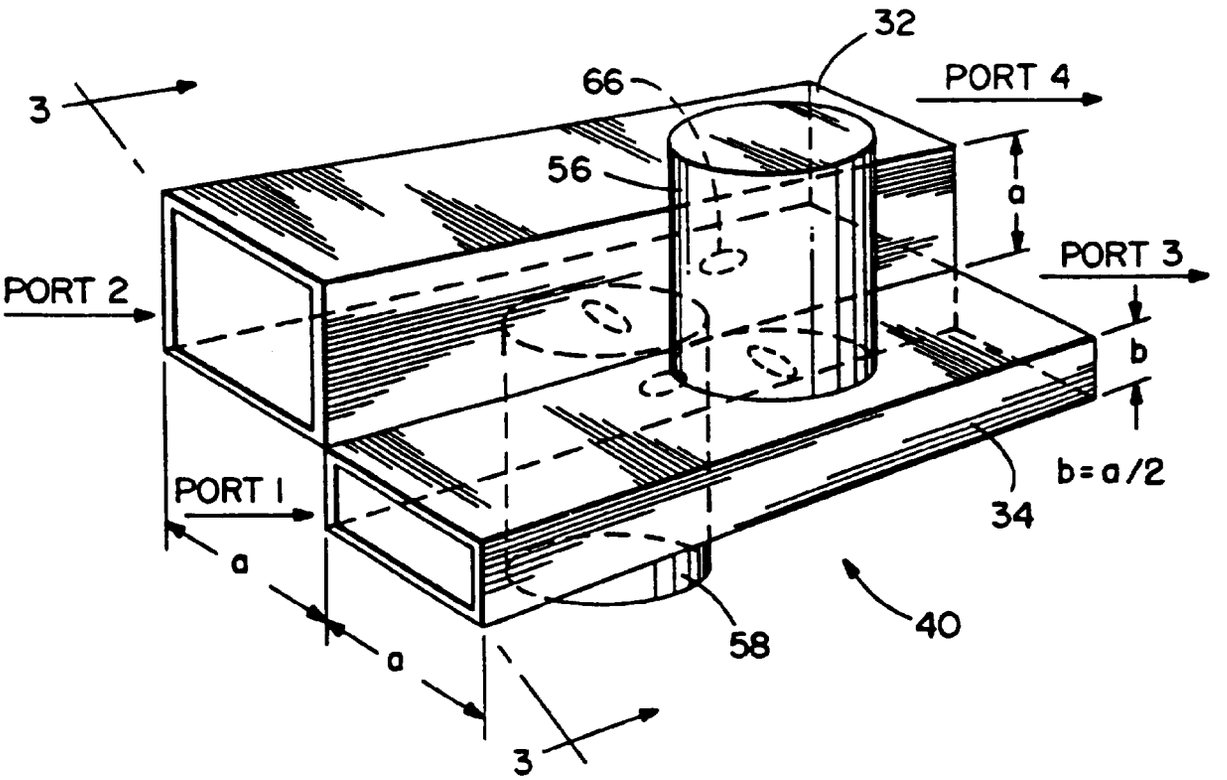

32
66
PORT 4
3
56
a
PORT 3
PORT 2
b
b=a/2
34
PORT 1
a
a
58
40
3

FIG. 3

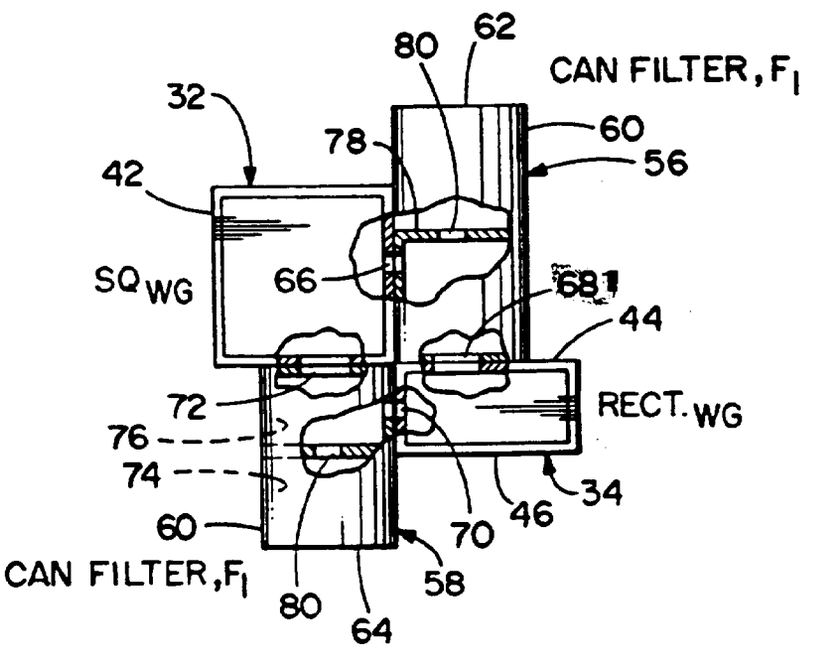
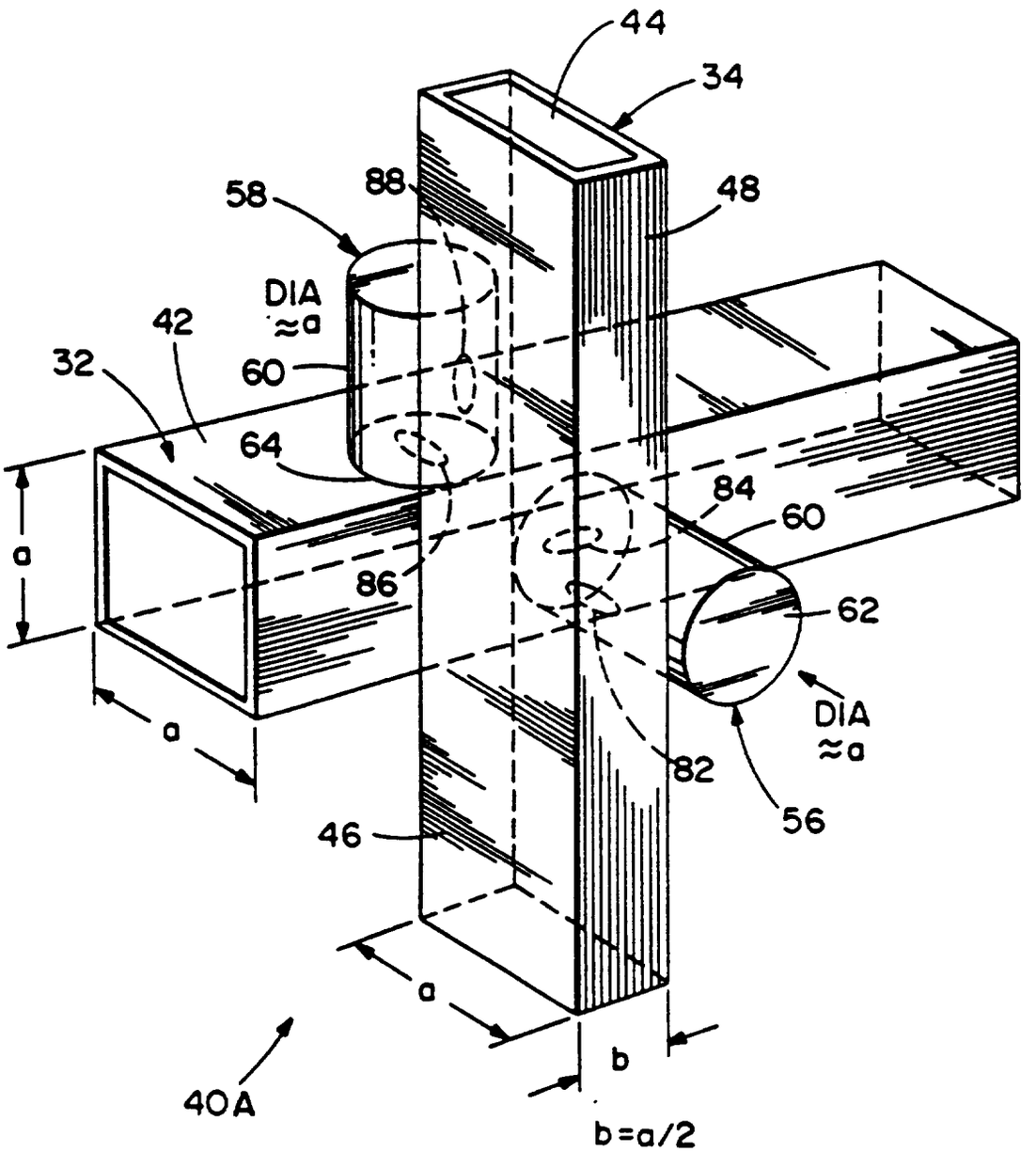

80
62
CAN FILTER, F_1
32
78
60
42
56
SQ_{WG}
66
68
44
72
RECT. WG
76
74
34
46
60
70
CAN FILTER, F_1
58
80
64

FIG. 4


44
34
58
88
48
DIA
≈a
42
32
60
64
84
60
a
86
62
DIA
≈a
a
82
56
46
a
b
40A
b=a/2