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K. FRITZ

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ULTRA-SHORT WAVE SIGNALING

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Fig. 1

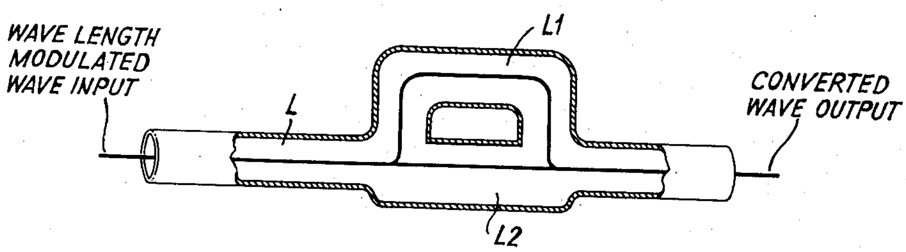
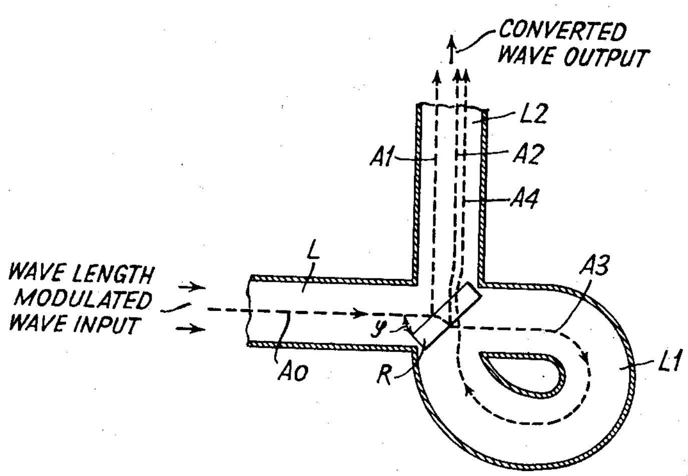


Fig. 2



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ULTRA SHORT WAVE SIGNALING

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4 Claims. (Cl. 178—44)

The present invention relates to a method of converting phase modulation, or frequency modulation into amplitude modulation, or vice versa, in the case of ultra-short waves, which method is to be employed more especially for the demodulation.

In the case of ultra-short waves it is extremely difficult, as is known, to carry out a uniform modulation with a higher degree of modulation, since the oscillation lines of the generators reveal rupture regions and because, furthermore, amplitude variations always entail variations in the phase and in the frequency and vice versa. If the modulation degree is very small, the demodulation is obviously very difficult and freedom from distortion can hardly be attained. These difficulties are eliminated in accordance with the present invention in that the modulation degree can be increased to any desired extent in the course of the conversion process of the one modulation type into the other modulation type, wherefore the actual demodulator need have but a low sensitivity.

In accordance with the present invention the modulated wave is applied to the working circuit across two paths having different travel time such that the phase variations of the wave are converted into amplitude variations and vice versa while increasing at the same time the degree of modulation.

The present invention can be employed to particular advantage in transmission systems which operate with travel time generators for instance with magnetron tubes, or retarding field tubes. In these generators a frequency modulation having a small frequency variation can be conveniently and safely carried out.

In practicing the invention use may be made of a great many different measures. Thus, double wire lines, or coaxial lines may be used, or the hollow tube lines which have come into use recently. It is obvious that an entirely wireless operation with the use of concentrated ultra-short wave likewise is within the scope of the present invention.

A simple example of execution of the invention is shown in Fig. 1 in which a line L branches into two lines L1 and L2 having different electric lengths and which then form again a common line. If a high-frequency wave arrives from one side of the line whereby the frequency of said wave is modulated with small variation, this wave will be split up into two components which after passing through the paths L1 and L2 meet again where they are brought into interference. Now, it can be easily seen that already the slightest frequency variations of the original wave result in a high amplitude variation of the wave resulting from the interference of the two part waves, if the travel difference is suitable, i. e., if it is chosen in such manner whereby at the upper limit of the frequency an addition of the amplitudes of the two part waves occurs, while at the lower limit a subtraction occurs. The degree of modulation of the resultant wave can be increased up to 100%. In order to set the resultant degree of modulation, it is of advantage to render the electrical length of one of the two paths variable.

If the very shortest waves are to be employed, an arrangement according to Fig. 2 more especially is of advantage in which a so-called hollow tube line is considered. In such a line L the wave A0 shown in broken lines propagates. At the end of the line a mirror R of dielectric material is arranged which reflects a part of the wave A0 into the extension of the line L, namely into the line L2 but admits another part. The latter part which is designated by A3 passes through a detour loop L1 and meets again the mirror from the rear thus entering the line L2 in part as wave A4. The part of A3 which is reflected at the rear side of the mirror again passes through the line L1 and again enters in part the line L2, etc. The directly reflected part of the wave A0 is formed by the two components A1 and A2 which derive from the reflection of the original ray at the front side and rear side of the mirror surface. The amplitudes of the waves A1 and A2 must have the same phase which condition can be easily realized through suitable choice of the thickness, the dielectric constant and the angle ϕ of the reflection plate. Now, just as in the case of Fig. 1, there will be added to these waves a second wave which has passed once, or several times the detour line L1. Now, if the length of the detour loop is suitably dimensioned such as was explained already on hand of Fig. 1, a weak frequency modulation of the wave A0 can be converted into a 100% amplitude modulation, if the interfering waves have the same amplitude. The amplitude ratio of the individual waves can be easily set through suitable choice of the various constants (dielectric constant, thickness of the reflection plate, etc.)

Aside from the conversion of the frequency modulation into an amplitude modulation also the production of a phase modulation through amplitude modulation is possible. However, it is to be presupposed hereby that the travel time difference of the two part waves assumes the order of a modulation period such as can be realized only in case of very high modulation frequencies. Then two waves having an amplitude-modulated constant phase difference form together a resultant oscillation whose phase depends on the amplitude difference of the quantities of the sum, i. e., the amplitude modulation has changed into a phase modulation.

In all cases care is to be taken that as much as possible only progressing waves appear, i. e., that the lines are well matched to which end suitable means are known as such.

What is claimed is:

1. In means for converting wave length modulations on ultra-high frequency wave energy into corresponding amplitude modulations on ultra-high frequency wave energy, a hollow tube line having an intake and an output, means for supplying wave length modulated ultra-high frequency wave energy to said intake, and means within said hollow tube line for increasing the length of the path over which some of said wave energy flows between said intake and said output, whereby the waves in following said two paths are relatively displaced in phase and the wave length modulations thereon are converted to corresponding amplitude modulations in the wave energy at said output.

2. In a device for converting modulaticns of one type on ultra-high frequency wave energy into corresponding modulations of another type on said ultra-high frequency wave energy, a hollow conductor having an intake opening and an output opening, means for supplying modulated ultra-high frequency wave energy to said intake, means for deriving modulated ultra-high frequency wave energy from said output opening, and wave phase displacing means in said conductor between said openings, said phase displacing means including a wave reflector which provides paths of different length, for said wave energy, between said openings to produce conversion of the modulation type.

3. In apparatus for converting modulations of a given character on wave energy into corresponding modulations of a different character on wave energy, a wave guide having an opening through which said first mentioned wave energy, a given characteristic of which is modulated, is fed to said guide and having an opening from which said second mentioned wave energy, a different characteristic of which is modulated, is derived, and wave phase displacing means within said guide so constructed and arranged as to cause portions of the wave energy to follow paths of different length as they pass from said first mentioned opening to said second mentioned opening, and to convert the modulations of one character to modulations of a different character.

4. In a device for converting wave length modulations on ultra-high frequency wave energy into corresponding amplitude modulations on said ultra-high frequency wave energy, a branched wave path, having an input and an output, the branches of said wave path comprising tubular wave guides of different lengths, means for supplying wave length modulated ultra-high frequency wave energy to the input of said branched path and for deriving correspondingly amplitude modulated ultra-high frequency wave energy from the output of said branched paths, said branched paths of different lengths being so constructed and arranged as to produce relative phase displacement in the wave energy portions flowing thereover from said input to said output to convert the wave length modulations thereon to corresponding amplitude modulations.

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