

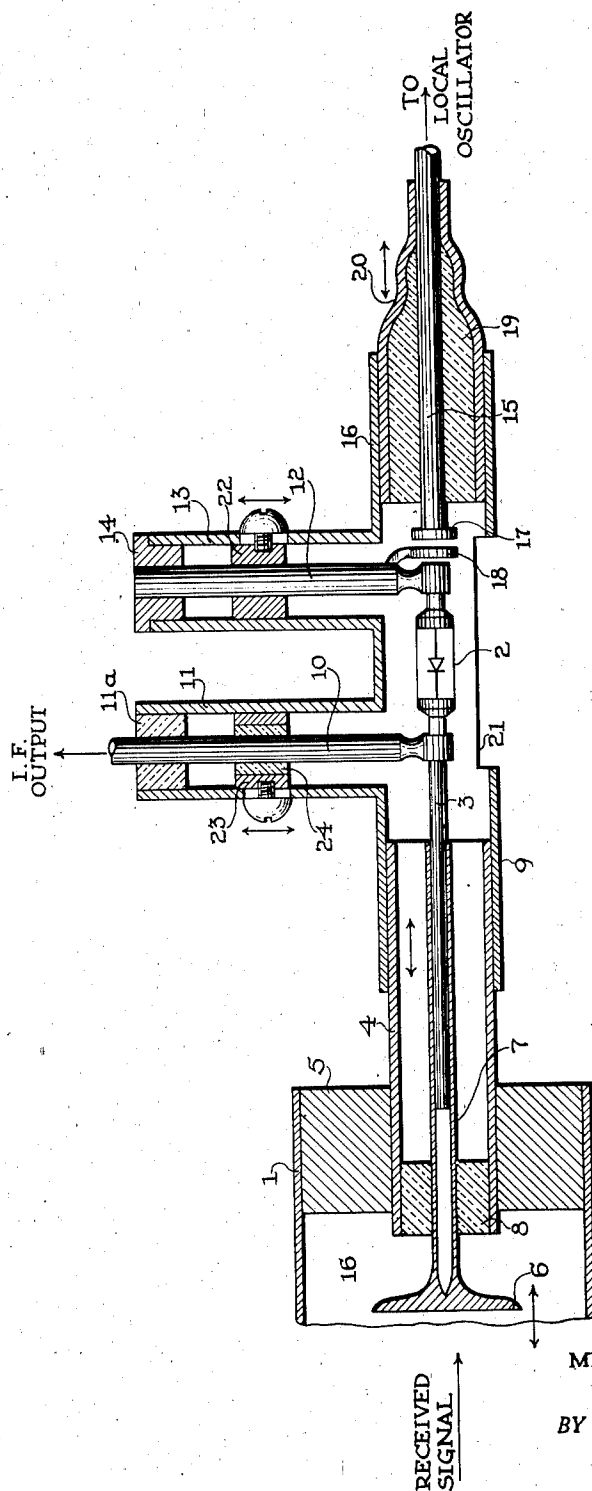
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CIRCUIT ARRANGEMENTS FOR MIXING OSCILLATIONS

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CIRCUIT ARRANGEMENT FOR MIXING
OSCILLATIONS

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6 Claims. (Cl. 250—20)

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This invention relates to circuit arrangements for mixing oscillations of high frequencies, such circuits being suitable for use in receivers of the superheterodyne type.

The object of the present invention is to provide a convenient arrangement of mixing circuit which is suitable for use in conjunction with wave guides.

According to the invention there is provided a circuit arrangement for mixing electrical oscillations of high frequency comprising a mixing element for mixing said oscillations, a tubular conductor in which said element is disposed and supported, said tubular conductor having inner conductors therein feeding one of said oscillations to one terminal of said element and the other of said oscillations to the other terminal of said element, the arrangement forming a coaxial line section with said element coupled between adjacent ends of said inner conductors.

Preferably the mixing element is of the crystal type although other devices having non-linear characteristics may be used, such as diodes.

One or both of the terminals or coupled ends of said element may be connected to a further co-axial line section or sections provided with an adjustable piston or pistons for impedance matching purposes. The inner conductor of said further co-axial line section or of one of said sections may serve as the output lead for the resultant oscillations, the piston associated with this lead being constructed to provide a capacitative short-circuit for the high frequency oscillations.

In order that the said invention may be clearly understood and readily carried into effect, it will now be more fully described with reference to the accompanying drawing which illustrates in longitudinal section a circuit arrangement constructed in accordance with the preferred form of the invention.

As stated above, the invention is of particular use as the mixing circuit of a superheterodyne receiver in which the signals are transmitted via a wave guide to the mixing circuit where they are mixed with local oscillations. As shown in the drawing, the reference numeral 1 indicates a portion of a wave guide along which the signals are transmitted, the wave guide comprising an outer conductor and the signals being conveyed along the air dielectric of the guide. In the preferred form of the invention shown the detector is of the crystal type indicated by the reference numeral 2 and forms a continuation of the centre conductor of a coaxial line which is coupled to

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the wave guide 1. The coaxial line comprises an inner conductor 3 and a surrounding tubular conductor 4, the end of the conductor 4 nearer the wave guide 1 being connected to and supported in a conducting disc 5 in turn connected to and supported by the wave guide 1. The signals transmitted along the wave guide 1 are collected by a disc 6 which is connected to a tubular conductor 7 forming part of the inner conductor 3 and into which the inner conductor 3 projects so as to be in contact therewith, the tubular conductor 7 being supported in the outer conductor 4 by an insulating block 8. The disc 6 and the tubular conductor 7 can be adjusted axially relatively to the guide 1. The outer conductor 4 co-operates with the left-hand end of a conducting sleeve 9 forming part of the outer conductor; the sleeve 9, together with the inner conductor 3 are capable of axial movement whereby the coaxial line comprising the conductor 4, sleeve 9 and conductors 3 and 7 are thus of a telescopic construction for impedance matching purposes. The inner conductor 3 is connected to a rod 10 which forms the inner conductor of a further coaxial line, the outer tubular conductor of which is indicated at 11 and is generally arranged at right-angles to the coaxial line formed by the conductors 3 and 4. The rod 10 is supported at its upper end in the outer conductor 11 by a block of insulating material 11a, the rod 10 thus serving to support the inner conductor 3 and one end of the crystal detector 2. The other end of the detector 2 is supported by a further rod 12, which also forms the inner conductor of a further portion of coaxial line, the outer conductor of which is indicated at 13, this line also projecting at right-angles to the inner conductor 3. The upper end of the rod 12 is supported by a metal block 14 in the outer conductor 13, this metal block forming a short circuit between the rod 12 and conductor 13.

The local oscillations to be mixed with the signals fed to the detector 2 via the conductor 3 are applied to the detector via a further portion of coaxial line telescopically associated with the right-hand end 16 of the sleeve 9. The further portion of coaxial line comprises an inner conductor 15 and an outer conductor 20 supported in contact with the sleeve 9 by an insulating block 19. The local oscillations are fed to the detector 2 via a capacity coupling comprising a disc 17 connected to the inner conductor 15 and another disc 18 connected to the rod 12. The further portion of coaxial line formed by con-

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ductors 15 and 20 is telescopically arranged as aforesaid, whereby the magnitude of the capacity coupling can be adjusted. An aperture 21 is provided in the sleeve 9 as shown, to permit replacement of the crystal. In use this aperture will be covered by a metallic plate.

In order to adjust the coaxial line formed by the conductors 12 and 13 for impedance matching purposes a short-circuiting piston 22 is provided arranged to slide relatively to the conductors 12 and 13 and to be clamped in the adjusted position. Further, for the purpose of adjusting the coaxial line formed by the conductors 10 and 11 in order to permit the passage of the intermediate frequency signals but to prevent the passage of high frequency signals along the conductor 10, a further short-circuiting piston 23 is provided associated with the coaxial line 10 and 11, this short-circuiting piston being capacity-coupled to the conductor 10 by the provision of a layer of dielectric 24 attached to the piston 23. This piston can also be clamped in its adjusted position.

With the construction shown, signals picked up are fed to one terminal or end of the crystal 2 and the local oscillations are fed to the opposite terminal or end of the crystal via the capacity coupling 17, 18, the intermediate frequency signals passing to intermediate frequency amplifiers (not shown) along the rod 10 which thus forms the intermediate frequency output lead. The construction described permits of the location of the detector inside the outer conductor of a transmission line so as to form effectively a continuation of the inner conductor of the line. It has been found that the feeding of the signals and the oscillations to be mixed to opposite terminals or ends of a crystal is a particularly advantageous feature, since the arrangement is found to be unselective and, moreover, the required impedance matching can be more readily obtained compared with other constructions.

The arrangement described has been designed for use with signals transmitted along the guide 1 in the E_{01} mode but it will be appreciated that the invention is not limited in this respect, since with suitable slight modification the invention can be employed with energy transmitted in other modes, such as the H_{10} or H_{11} mode.

What we claim is:

1. In combination, a wave guide carrying signal-modulated oscillations, a coaxial line comprising an outer conductor supported by the wave guide at one end thereof and an inner conductor extending into the wave guide at said one end for receiving said signal-modulated oscillations, a

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second coaxial line provided with an inner conductor axially spaced from the inner conductor of the first coaxial line, a source of local oscillations coupled to said inner conductor of the second coaxial line, a mixing element electrically connected between the adjacent ends of said two inner conductors, and means coupled to one of said inner conductors for deriving a frequency resulting from the mixing of said signal and local oscillations.

2. The combination defined in claim 1 wherein said mixing element is constituted by a crystal rectifier.

3. A circuit arrangement according to claim 1, wherein one end of said mixing element is connected to a further coaxial line section provided with an adjustable piston for tuning purposes.

4. A circuit arrangement according to claim 1, wherein both ends of said mixing element are connected each individually to an additional coaxial line section having an adjustable piston for tuning purposes.

5. A circuit arrangement according to claim 1, wherein one end of said mixing element is connected to a further coaxial line section provided with an adjustable piston for tuning purposes, and wherein the inner conductor of said further coaxial line section is arranged to serve as the output lead for the mixed oscillations.

6. A circuit arrangement according to claim 1, wherein one end of said mixing element is connected to a further coaxial line section provided with an adjustable piston for tuning purposes, and the inner conductor of said further coaxial line section is arranged to serve as the output lead for the mixed oscillations, and the piston associated with said output lead is constructed to provide a capacitative short-circuit for the high frequency oscillations.

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REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
2,106,769	Southworth	Feb. 1, 1938
2,142,159	Southworth et al.	Jan. 3, 1939
2,227,604	Smith	Jan. 7, 1941
2,382,693	Dallenbach et al.	Aug. 14, 1945
2,408,420	Ginzton	Oct. 1, 1946