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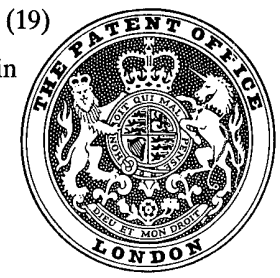

(54) IMPROVEMENTS IN OR RELATING TO SURFACE WAVE FILTERS OR DELAY LINES

(71) We, SIEMENS AKTIENGESELLSCHAFT, a German Company of Berlin and Munich, German Federal Republic, do hereby declare the invention for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:

The invention relates to surface wave filters or delay lines, using transducer electrodes on a piezo-electric substrate to launch and/or detect waves transmitted via the substrate.

It is known that any metallising of the surface of a piezo-electric substrate reduces the propagation velocity of elastic surface waves. In the case of a transducer formed by interdigitated electrodes with longitudinally weighted electrode fingers, for example, this effect causes those parts of any wave front passing the electrode finger overlap zone to encounter a comparatively densely metallised zone, whereas those parts of the wave front passing outside the overlap zone will each encounter a zone having comparatively little metallisation. The wave components passing in the less metallised zone will lead the other parts, and this results in an undesired distortion of the wave front, and thus introduces discrepancies between the effective frequency response and the desired frequency response of any particular transmission element.

In order to eliminate the effects of leading wave components it has been proposed that the deficiency of metallisation outside the finger electrode overlap zone could be compensated by the addition of dummy fingers. These dummy fingers can be insulated from the electrode fingers, or can be electrically connected to adjacent finger electrodes.

Such dummy fingers have the same breadth as the other electrode fingers, i.e. about a quarter of the synchronous wavelength of a propogated surface wave. Thus, they have the disadvantage that the reflections of the surface wave at the finger edges are added at the synchronous frequency, and this impairs the amplitude and phase frequency response right in the middle of the transmission band. To eliminate these annoying reflections, one proposed solution involves the use of electrode fingers in the form of split-fingers, where each electrode finger is a double strip. However, this gives undesirably narrow metallising strips, which are so delicate that they introduce production problems, and also have a higher resistance and thus cause increased losses of electrical energy.

One object of the present invention is to provide a delay line or filter of this type with a transit time compensator effective for elastic surface waves, in the peripheral zone of longitudinally weighted interdigitated electrode transducers, that is easy to manufacture, causes no additional reflections at the finger edges and does not produce high losses of electrical energy.

The invention consists in a surface wave filter or delay line in which a piezo-electric substrate is provided with one or more interdigitated electrode transducers for launching or detecting surface waves of mean frequency fo, via said substrate, the fingers of said transducers being longitudinally weighted and that part of the fingers lying outside their overlap zone forming feeders whose conductive breadth b is in each case at least approximately equal to $\lambda_0/2 = v/2f_0$; where λ_0 is the wavelength of the surface waves, at frequency f_0; and v is the propagation velocity of the surface waves.

This gives the advantages that the reflection components normally originating from the front and rear edges of the feeders are mutually equalising, so that the transmission band remains free of the edge reflection troubles normally caused by feeders, whilst the low internal resistance of the feeders

ensures that the area covered by the feeders forms a more precise equipotential area than is the case with known dummy fingers and that any difference in transit time as a result of differing breadths of metallisation is eliminated.

Preferably, the breadth of the feeders is varied to a small extent from λ_2 in accordance with frequencies within the pass band of the transducers, either such that each feeder individually, or such that groups of feeders, are tuned to mutually differing synchronous frequencies. In this way any middle reflections can be kept small despite the use of very broad-banded transmission elements.

The effect of the area covered by the feeders as an equipotential area can be further improved by interconnecting the feeders by additional webbing.

Preferably the feeders are connected with the earthed transducer electrode fingers and form part of a static shielding lying between input and output transducers of a filter or delay line.

The invention will now be described with reference to the drawing, in which a partly diagrammatic plan view is shown of one exemplary embodiment of an interdigitated electrode transducer for exciting elastic surface waves on a piezo-electric substrate with longitudinally weighted electrode fingers. The transducer has the form of a double symmetrical transducer in which a live electrode structure 1 is disposed centrally between two outer electrodes 2 and 3, which are connected to a reference potential, i.e. to earth potential. A zone 4 is shown by light shading, this being the zone in which finger electrodes 5 and 6 overlap and corresponding to the function $y = \sin x/x$.

The breadth b of feeders 7 extending from the electrodes 2 and 3 to the actual finger electrodes 5 is equal to half the wavelength of the surface wave that is to be transmitted or detected. A further reduction in the resistance can be obtained by providing additional transverse webbing 8 between the feeders 7.

Surface wave components moving to the right and generated in an area 41 of the overlap zone 4 would pass through a zone with a much higher metallisation density than those generated in the upper part of the area 42 and also moving to the right, if this were not equalised by the broadening of the feeders 7.

In the case where the elctrode fingers 5 and 6 and the interspaces between these electrode fingers 5 and 6 are not equal, i.e. where the fingers do not have a breadth of a quarter of the wavelength, the metallised area inside and outside the overlap zone could be different. If the breadth of the electrode fingers in the overlap zone is reduced, thereby making the metallised area smaller, this must be compensated for outside the overlap zone by reducing the number of feeders, and not by any reduction in the breadth of the feeders. Then it would be possible to connect a plurality of electrode fingers to any one feeder.

WHAT WE CLAIM IS:-

1. A surface wave filter or delay line in which a piezo-electric substrate is provided with one or more interdigitated electrode transducers for launching or detecting surface waves of mean frequency f_0 via said substrate, the fingers of said transducers being longitudinally weighted and that part of the fingers lying outside their overlap zone forming feeders, whose conductive breadth b is in each case at least approximately equal to $\lambda_0/2 = v/2f_0$; where λ_0 is the wavelength of surface waves at frequency f_0; and v is the propagation velocity of the surface waves.

2. A filter or delay line as claimed in Claim 1, in which the breadth b of the feeders varies to a small extent from $\lambda_0/2$ in accordance with frequencies within the pass band of the transducers, such that individual feeders or groups of feeders are tuned to mutually differing synchronous frequencies.

3. A filter or delay line as claimed in Claim 1 or Claim 2 in which the feeders are interconnected by connecting webbing.

4. A filter or delay line as claimed in any preceding Claim, in which the feeders are connected with the earthed transducer electrode or electrodes and form part of a static shielding between input and output transducers of the filter or delay line.

5. A surface wave filter or delay line substantially as described with reference to the drawing.

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1576455 COMPLETE SPECIFICATION

1 SHEET *This drawing is a reproduction of the Original on a reduced scale*