

Dec. 18, 1956

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2,774,944

SPACER DISK ARRANGEMENT FOR COAXIAL CABLES OR THE LIKE

Filed May 20, 1955

Fig. 1

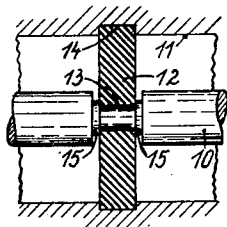


Fig. 2

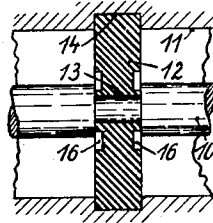
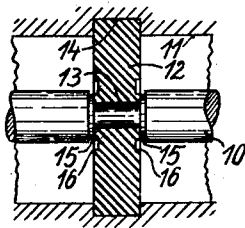


Fig. 3



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Application May 20, 1955, Serial No. 510,004
In Germany October 1, 1948

Public Law 619, August 23, 1954
Patent expires October 1, 1968

8 Claims. (Cl. 333—96)

This invention is concerned with a spacing disk arrangement for high frequency lines, coaxial cables or the like, and its purpose is to reduce wave reflection at the places where the spacer disks are positioned.

The mounting of the inner conductor or conductors, in high frequency lines, is to be considered primarily in connection with the assemblies, such as plug means or terminal closures used therefor. The insulation in the parts of a high frequency line adjacent the spacing disks is generally formed wholly or partially of air, and the insertion of the spacer disks which exhibit a higher dielectric constant therefore causes dielectric inhomogeneities in longitudinal direction which in turn lead to variations in the characteristic impedance and therewith to wave reflection.

In order to avoid such characteristic impedance variations at the places of the spacing disks, the suggestion has been made, in connection with coaxial high frequency cables, to increase the diameter ratio between the inner diameter of the outer conductor and the outer diameter of the inner conductor, by the provision of recesses, in such a manner, that the same characteristic impedance will appear at the places of the spacing disks for wave lengths which are high relative to the disk thickness or the dimensions of the recesses in axial direction, as will appear in the neighboring portions of the high frequency line. This practically amounts to saying that the inner conductor and/or the outer conductor has to be provided with annular grooves which are engaged by the spacing disks.

It was found, however, that this expedient which has the object to make the ratio of inductance and capacitance at the place of the spacing disk identical with that in the adjacent parts thereof, is not sufficient to avoid reflections at the corresponding place. This is due to the fact that higher capacitances occur per unit of length along the side walls of the disks than centrally thereof. In view of this irregular distribution of capacitance which stems from the distortion of the electric field at the place of the spacing disk, the disk exhibits a limiting frequency so that disturbing reflections can appear incident to the transmission of very short waves.

In order to avoid this drawback, it has been suggested to provide a conical form for the transition surfaces between the annular grooves and the adjacent parts of the outer conductor of the high frequency line. This, however, requires grooves the dimensions of which become in axial direction rather large, thereby coming disadvantageously into the order of magnitude of one fourth of the shortest waves to be transmitted.

The invention provides spacing disk arrangements for high frequency lines wherein the disks for the inner conductor or conductors enter into annular grooves formed in the inner and/or outer conductor or are held therein, providing thereby for a diameter ratio between the inner diameter of the outer conductor and the outer diameter of the inner conductor which satisfies the requirement

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$$\ln D/d = \frac{Z\sqrt{\epsilon}}{60}$$

wherein Z is the characteristic impedance of the adjoining line and ϵ the dielectric constant of the disk material, reflections upon transmission of very short waves being avoided by making the diameter ratio D/d so that the requirement

$$Z = \frac{60 \ln D/d}{\sqrt{\epsilon}}$$

is satisfied with regard to the characteristic impedance Z in the adjoining line, and by providing next to the spacing disk auxiliary annular recesses in the conductor or forming along the side walls of the disk auxiliary recesses in the disk material so that along the entire spacer disk there will appear a characteristic impedance which is identical or nearly identical with the characteristic impedance of the connected line.

The various objects and features will appear from the following description of the accompanying drawing showing longitudinal sectional views of coaxial cables.

Fig. 1 shows an embodiment with an undercut spacer disk support and auxiliary undercuts formed on the inner conductor adjacent the side walls of the disk, said undercuts constituting the auxiliary recesses;

Fig. 2 illustrates a similar support but having auxiliary grooves formed in the side walls of said disk constituting said auxiliary recesses; and

Fig. 3 shows an embodiment in which the features of Figs. 1 and 2 are combined.

In each of the Figs. 1 to 3, the outer conductor 11 and the spacer disk 12 are shown in section while the inner or center conductor 10 is shown in elevation.

The spacing disk 12 engages in known manner annular grooves 13 and 14 of the conductors for reliable mounting thereof. The annular grooves are dimensioned so that the same characteristic impedance as in the neighboring parts of the high frequency line will appear at the point of the spacing disk in accordance with the requirement

$$Z = \frac{60 \ln D/d}{\sqrt{\epsilon}}$$

In accordance with the invention, there are provided, in the embodiment shown in Fig. 1, immediately adjacent the disk 12, on the inner conductor, auxiliary undercut portions 15, and in the embodiment according to Fig. 2, there are provided auxiliary grooves 16 along the side walls of the disk.

The arrangement compensates the increased capacitance values along the side walls of the disk in its effect on the characteristic impedance, thereby avoiding occurrence of a limiting frequency at the disk. The depths of the undercuts 15 and of the grooves 16 may be determined empirically or mathematically. The configuration is suitably such that it can be easily produced with negligible tolerances.

The features of Figs. 1 and 2 may be combined as shown in Fig. 3. There are provided auxiliary undercut portions 15 on the inner or center conductor 10, as in Fig. 1, and auxiliary grooves 16 in the side walls of the spacer disk 12, as in Fig. 2. The advantage of this embodiment is that the undercuts 15 and the grooves 16 may be made shallower as compared with the corresponding undercuts and grooves provided in Figs. 1 and 2.

Changes may be made within the scope and spirit of the appended claims in which is defined what is believed to be new and desired to have protected by Letters Patent.

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I claim:

1. A spacing disk arrangement for high frequency lines comprising an inner and an outer conductor, a spacing disk for the inner conductor entering into an annular groove formed in at least one of said conductors and being held thereby, the ratio between the inner diameter D of the outer conductor and the outer diameter d of the inner conductor corresponding to

$$\ln D/d = \frac{Z\sqrt{\epsilon}}{60}$$

wherein Z is the characteristic impedance of the adjoining line and ϵ the dielectric constant of the disk material, the diameter ratio D/d being such as to satisfy with respect to the characteristic impedance of the adjoining line the requirement

$$Z = \frac{60 \ln D/d}{\sqrt{\epsilon}}$$

and wherein auxiliary recesses are formed in at least one of the coating elements comprising the conductors and the spacing disk, to produce in operation in axial direction along the entire spacing disk a characteristic impedance which corresponds substantially to that of the adjoining line.

2. An arrangement and cooperation of elements according to claim 1, wherein said auxiliary recesses are undercuts formed in one of said conductors.

3. An arrangement and cooperation of elements ac-

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cording to claim 1, wherein said auxiliary recesses are undercuts formed in said inner conductor adjacent said disk.

5 4. An arrangement and cooperation of elements according to claim 1, wherein said auxiliary recesses are formed in said disk.

5. An arrangement and cooperation of elements according to claim 1, wherein said auxiliary recesses are formed in at least one side wall of said disk.

10 6. An arrangement and cooperation of elements according to claim 1, wherein an annular groove is formed in each side wall of said disk, said grooves constituting said auxiliary recesses.

15 7. An arrangement and cooperation of elements according to claim 1, wherein an annular groove is formed in each side wall of said disk directly adjacent said inner conductor, said grooves constituting said auxiliary recesses.

20 8. An arrangement and cooperation of elements according to claim 1, wherein said auxiliary recesses comprise undercuts formed in said inner conductor and an annular groove formed in each side wall of said disk.

References Cited in the file of this patent

UNITED STATES PATENTS

2,623,122 Weber et al. Dec. 23, 1952

FOREIGN PATENTS

828,861 Germany Jan. 21, 1952