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IMPEDANCE TRANSFORMER FOR WAVE GUIDES

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FIG. 1

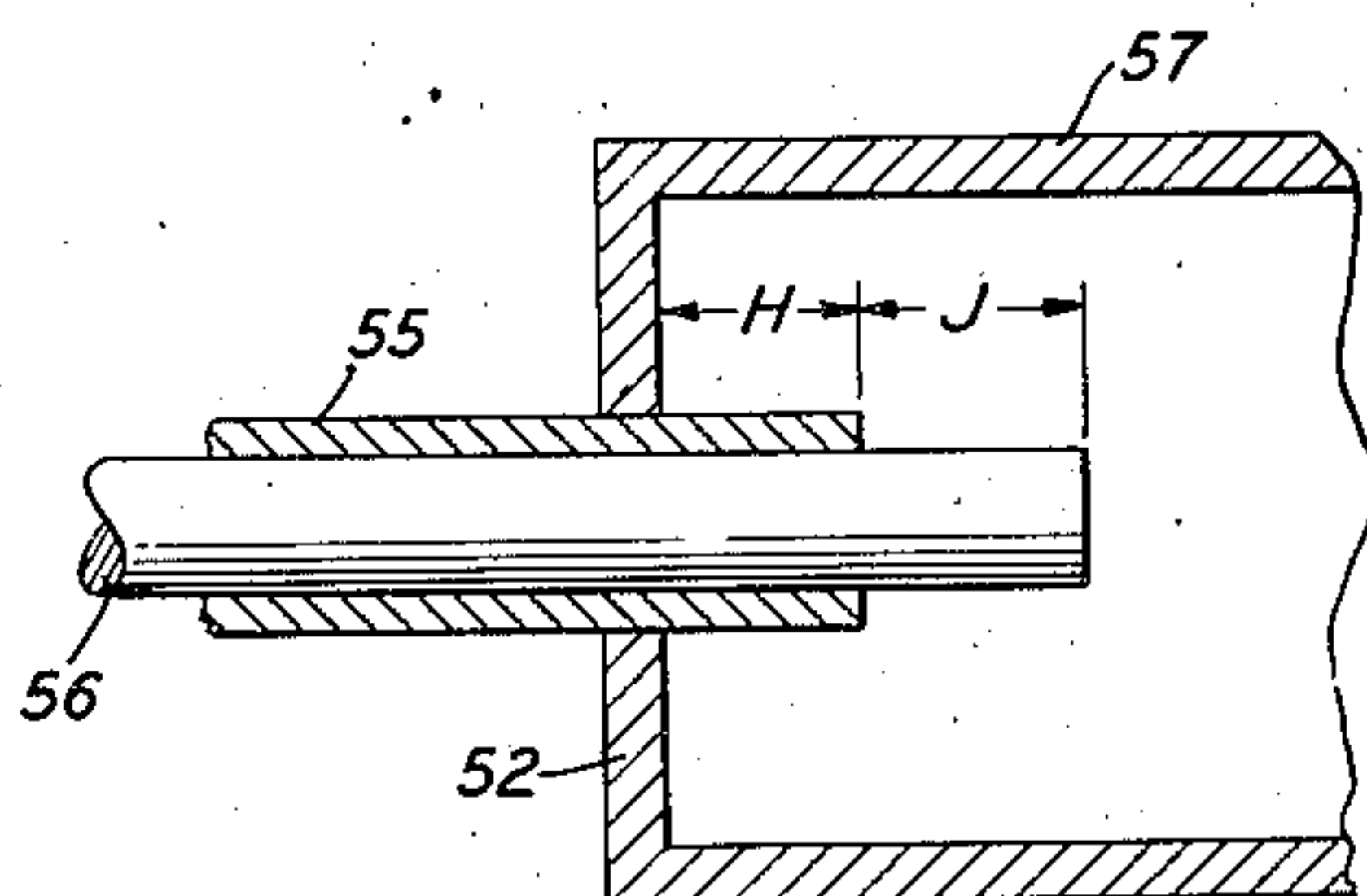
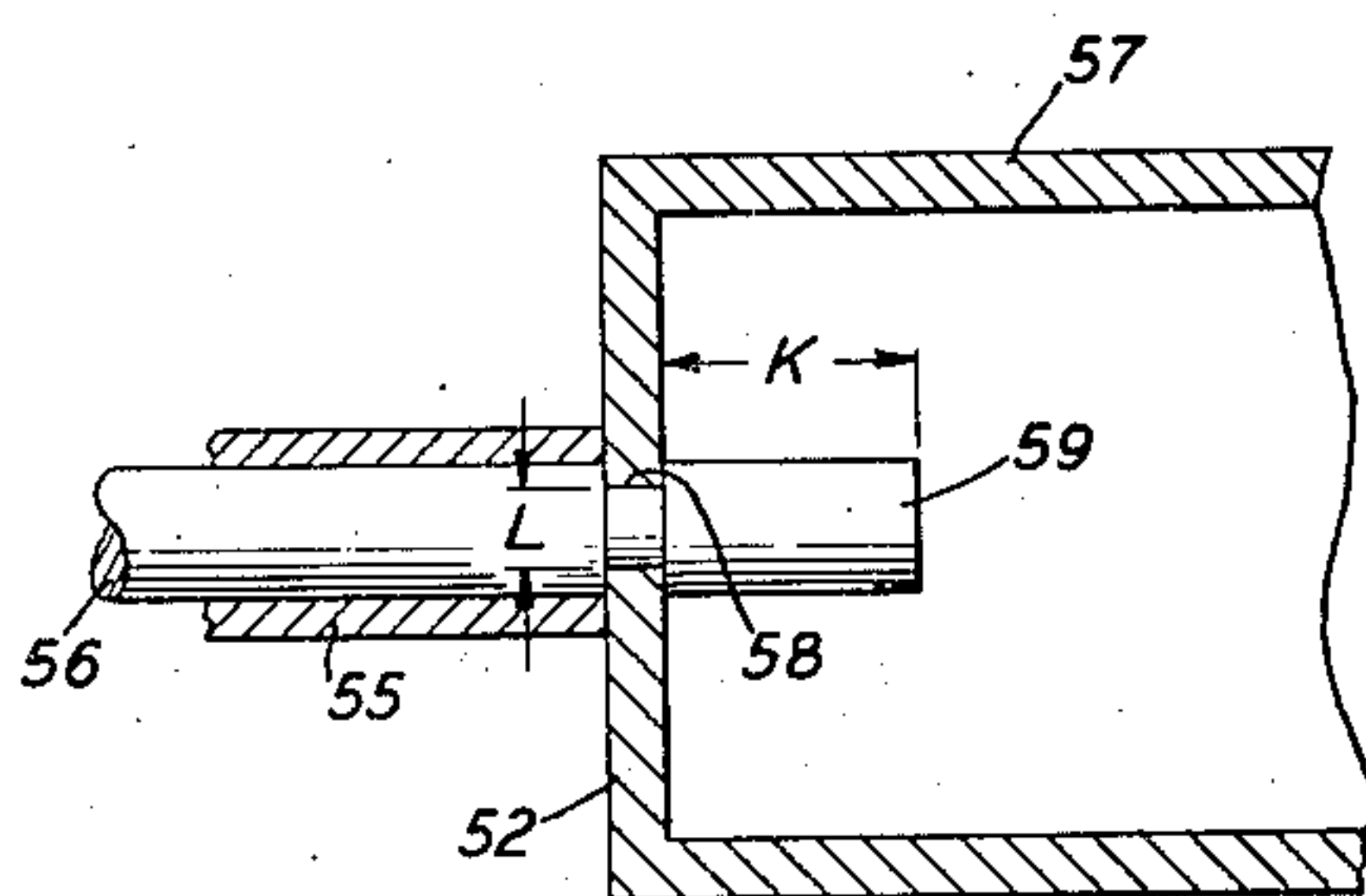


FIG. 2



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IMPEDANCE TRANSFORMER FOR WAVE GUIDES

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452,851. Divided and this application August
25, 1945, Serial No. 612,681

13 Claims. (Cl. 178-44)

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This invention relates to electromagnetic wave transmission and more particularly to impedance transformers for wave guides.

The object of the invention is to interconnect without impedance mismatch an air-filled wave guide and a solid-cored wave guide.

A uniform metallic sheath with or without a dielectric filler will serve as a guide for suitable electromagnetic waves. In cross-section the sheath may be circular, rectangular, or of other shape. For all frequencies above a minimum, known as the cut-off frequency, the guide acts like a transmission line and has a specific propagation constant and characteristic impedance. For any particular frequency there are an infinite number of cross-sectional sizes and shapes of guide which will have the same characteristic impedance.

In accordance with the present invention, means are provided for matching an air-filled wave guide and a solid-cored wave guide which differ in characteristic impedance. The sheaths of the guides are connected by an apertured end plate, the solid core extends through the aperture into the air-filled guide, and a metallic annulus is connected to the junction between the end plate and the sheath of the solid-cored guide. The length of the solid core extending into the air-filled guide and a dimension of the annulus are chosen to provide an impedance match at the junction of the guides. In one form the annulus is a cylinder extending for a distance along the portion of the core within the air-filled guide. In this case the critical dimension is the longitudinal length of the annulus. In another form the annulus is a radial extension of the end plate which fits into an annular groove in the solid core. In this case the critical dimension is the radial length of the annulus.

The nature of the invention will be more fully understood from the following detailed description and by reference to the accompanying drawing, in which like reference characters refer to similar parts and in which:

Fig. 1 shows in longitudinal cross-section an impedance transformer for interconnecting an air-filled wave guide and a solid-cored wave guide; and

Fig. 2 is a similar view of a modified form of the transformer shown in Fig. 1.

Fig. 1 is a cross-sectional side view of one form of transformer in accordance with the invention for connecting a wave guide having a cylindrical sheath 55 filled with a solid dielectric core 56 to a wave guide having a cylindrical sheath 57 filled

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with a material of lower dielectric constant such, for example, as air. The sheath 55 and core 56 pass through the end plate 52 and extend into the sheath 57 for a distance H. The core 56 alone extends beyond the sheath 55 for a further distance J.

In order to match one wave guide to another one, or to any other wave medium, it is, in general, necessary to have two independent tuning controls. In the system shown in Fig. 1 these controls are the distances H and J. The proper adjustment may be determined as follows. One of the guides is terminated in its characteristic impedance and wave energy is supplied to the transformer in such a way that it passes through a standing wave detector located in the other guide. Then the distances H and J are adjusted alternately to minimize the standing wave. The desired adjustment is attained when the detector indicates an absence of any standing wave.

Fig. 2 is a cross-sectional side view showing an alternative form of the transformer of Fig. 1. The portion H of the sheath 55 internal to the sheath 57 has been omitted and the core 56 has an annular groove 58 with an internal diameter L into which fits the end plate 52 to form a shunt impedance element. The core 56 extends into the sheath 57 for a distance K and, to facilitate assembly, this internal portion 59 may be a separate part which is attached in some suitable manner to the remainder of the core 56 after the portion having the groove 58 has been inserted into the circular hole in the end plate 52. The two variables in this transformer are the distance K and the diameter L. These are adjusted, as already explained, for no standing wave.

Although Figs. 1 and 2 show wave guide structures of circular cross-section, it is to be understood that, with suitable modification, the transformers may be applied to rectangular or other forms of wave guides.

This is a division of my copending application Serial No. 452,851, filed July 30, 1942.

What is claimed is:

1. In combination, a wave guide comprising an air-filled sheath, a second wave guide of different characteristic impedance comprising a second sheath and a solid dielectric core, an end plate having an aperture electrically connecting said sheaths, an end portion of said core extending through said aperture into said air-filled sheath, and a metallic annulus connected to the junction between said end plate and said second sheath, the length of said end portion of core and a dimension of said annulus being chosen to provide

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an impedance match at the junction of said guides.

2. The combination in accordance with claim 1 in which said core completely fills said second sheath.

3. The combination in accordance with claim 1 in which said annulus is a cylinder extending for a distance along said end portion of core.

4. The combination in accordance with claim 1 in which said annulus is a cylinder extending for a distance along said end portion of core, the longitudinal length of said cylinder being the dimension chosen for impedance matching.

5. The combination in accordance with claim 1 in which said core has an annular groove and said annulus is a radial extension of said end plate fitting into said groove.

6. The combination in accordance with claim 1 in which said core has an annular groove and said annulus is a radial extension of said end plate fitting into said groove, the radial length of said annulus being the dimension chosen for impedance matching.

7. In a wave-guide system, an air-filled wave guide, a second wave guide of different characteristic impedance comprising a sheath and a solid dielectric core, and impedance-matching means for interconnecting said guides comprising an end portion of said core and an end portion of said sheath both extending into the end of said air-filled guide.

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8. The combination in accordance with claim 7 in which said core completely fills said sheath.

9. The combination in accordance with claim 7 in which said sheath extends into said air-filled guide for a distance less than the length of said end portion of said core.

10. The combination in accordance with claim 7 in which said sheath extends into said air-filled guide for a certain distance and said core extends into said air-filled guide for a certain distance beyond the end of said sheath, said distances being adjusted to minimize the standing wave in said guides in the vicinity of their junction.

11. In a wave-guide system, an air-filled wave guide, a second wave guide of different characteristic impedance comprising a sheath and a solid dielectric core, and impedance-matching means for interconnecting said guides comprising an end portion of said core extending into the end of said air-filled guide, said core having an annular groove and said air-filled guide including an end plate apertured to fit into said groove.

12. The combination in accordance with claim 11 in which said core completely fills said sheath.

13. The combination in accordance with claim 11 in which the internal diameter of said groove and the length of said end portion of said core are adjusted to minimize the standing wave in said guides in the vicinity of their junction.

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