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US 3644852 A

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UK CL (Edition K) **H1W WTS**
INT CL[5] **H01P**

(54) **Hollow waveguide switch**

(57) A hollow waveguide switch for connecting oppositely disposed terminals A to D, arranged in pairs, for right-angled waveguide switches, has a rotor (4) which is rotatable in corresponding stages. Manufacture of this rotor is considerably facilitated if, instead of the hitherto customary continuous channels, pockets (7, 8) are provided which are open at the sides, so that the respectively oppositely disposed inner wall region of the housing forms the second long right-angled side of the hollow waveguide switch. At the same time, the diameters of the rotor and the volume thereof are reduced, and also the diameter of the hollow waveguide switch as a whole. The length l of the innermost walls of the pockets satisfies the relationship $\lambda_{H/2} < l < \lambda_H$, where λ_H is the hollow waveguide wavelength.

Fig.3

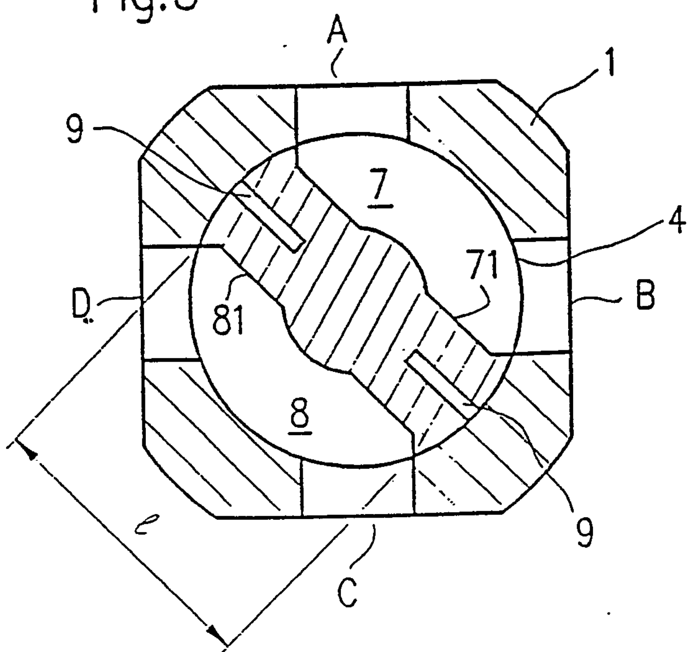

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Fig.1

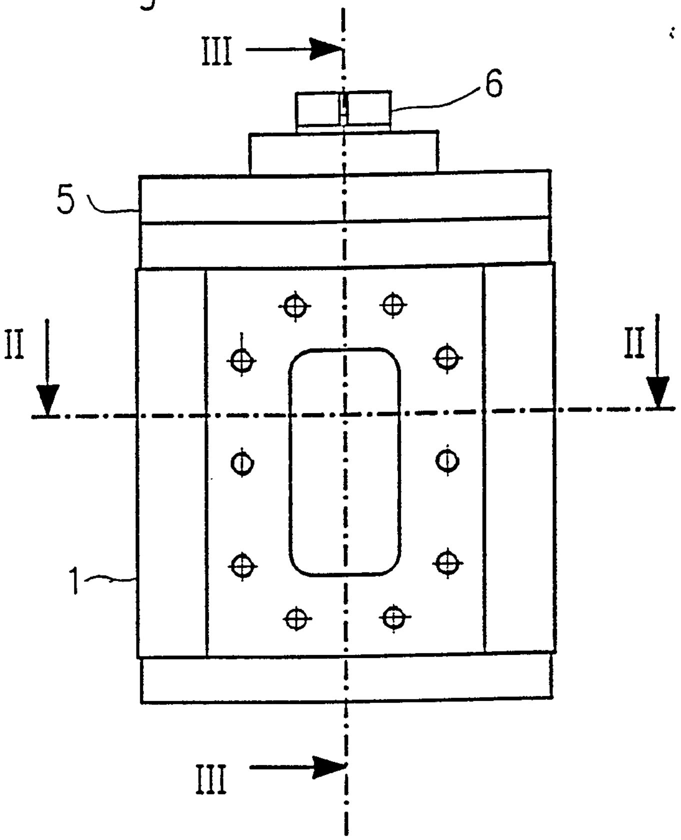

Fig.2

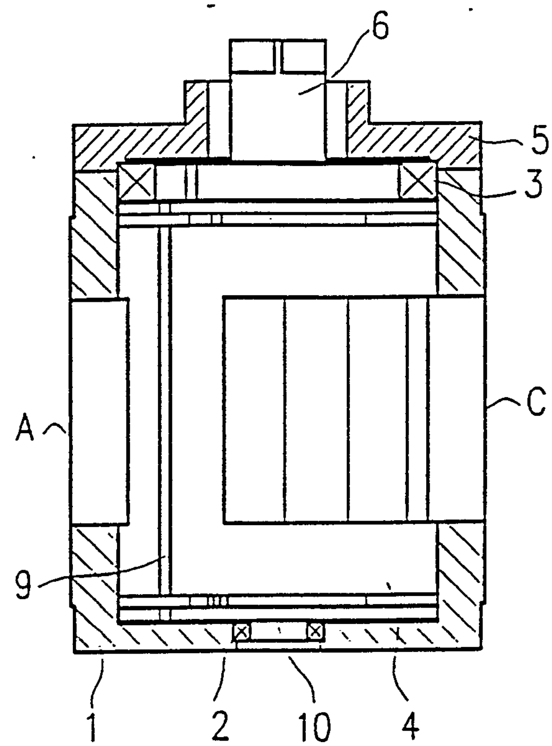

Fig.3

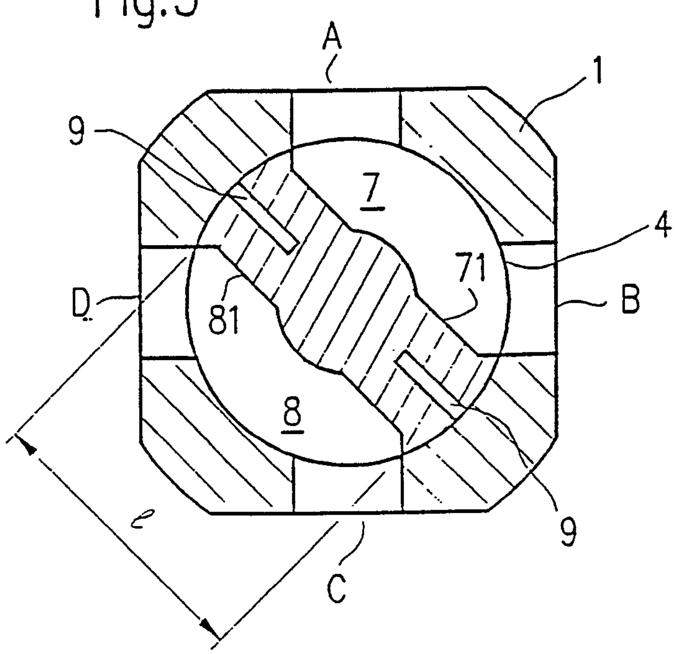

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Fig.4

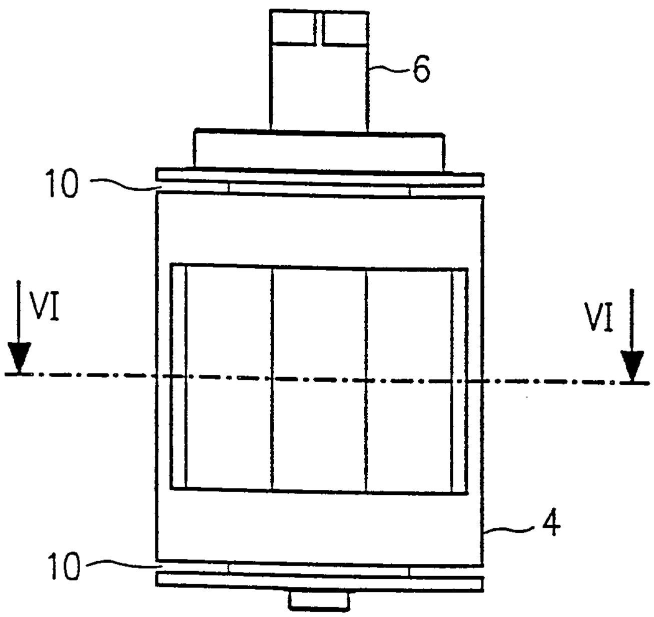


Fig.5

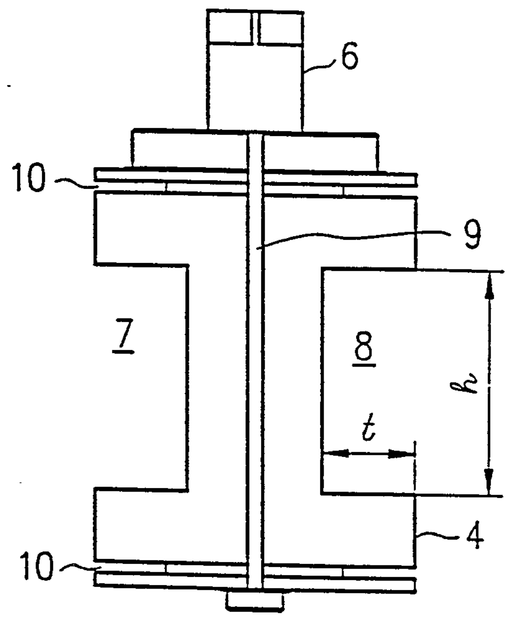
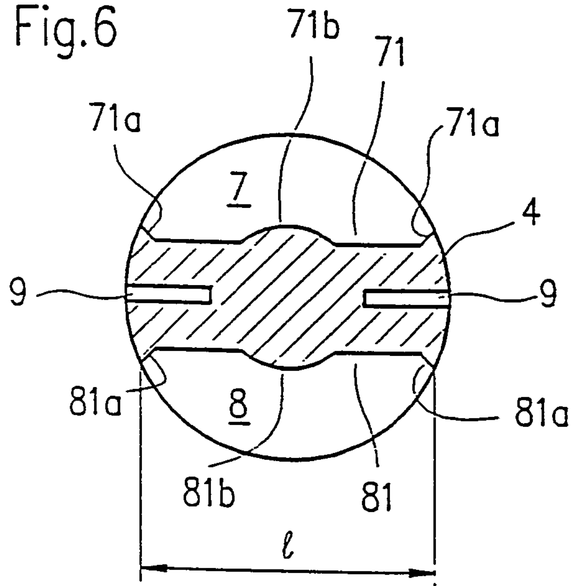


Fig.6



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HOLLOW WAVEGUIDE SWITCH

The invention relates to a hollow waveguide switch, in particular but not exclusively of the kind in which a housing is provided with four terminals for receiving respective rectangular, hollow waveguides, and a rotor is arranged in a hollow-cylindrical bore in the housing. The rotor is rotatable in steps of 90° about an axis at right-angles to the plane containing the longitudinal axes of the hollow waveguides, and the switch includes two open recesses which are mirror-symmetrical to a plane containing the rotor axis, by means of which recesses the terminals (A and B) and (C and D) are connected electrically together when the rotor is in a first position, and by means of which the terminals (A and D) and (B and C) are connected together when the rotor is in a second position.

A hollow waveguide switch of this kind is disclosed in US Patent no. 3 644 852, for example. Unlike hollow waveguide switches which have a rotor with two 90° arcs closed on the circumference in mirror-image relationship, this hollow waveguide switch is advantageous because the rotor is smaller, has less moving volume and is easily adjustable. However, it is only possible to achieve good values for the reflection coefficient and for cross-talk attenuation if the gap between the rotor and the inner wall of the housing is kept very small, since corresponding regions of this inner wall of the housing are involved respectively in conducting waves. However, even if this gap of small width is maintained, with hollow waveguide switches of this kind at specific frequencies within the operational frequency range there is a definite increase in the reflection coefficient and a deterioration in the cross-talk attenuation.

According to a first aspect of the invention there is provided a hollow waveguide switch comprising a housing having four terminals for receiving respective ends of hollow waveguides, the terminals being selectively electrically, optically or otherwise connectable one to another in pairs by means of a rotor supported in a bore in the housing, the rotor including a pair of recesses formed in opposite sides thereof, the rotor being such that in a first position thereof the terminals are connected in a first set of pairs and in a second position thereof the terminals are connected in a second set of pairs, wherein the recesses are shaped to satisfy the relationship $\lambda_H/2<l<\lambda_H$,in which λ_H is the wavelength of the waveguides and l is the length of the innermost walls of the respective recesses measured in the general direction of propogation of a wave through the switch.

According to a second aspect of the invention, there is provided a hollow waveguide switch comprising a housing which has four oppositely disposed terminals A, B, C, D arranged in pairs for receiving rectangular hollow waveguides, and a rotor arranged in a hollow-cylindrical bore in the housing and which is rotatable in steps of 90° about an axis at right-angles to the plane containing the longitudinal axes of the hollow waveguides, and two open recesses which are mirror-symmetrical to a plane containing the rotor axis, by means of which recesses the terminals A and B and C and D are connected electrically together when the rotor is in a first position, and by means of which the terminals A and D and B and C are connected together when the rotor is in a second position, wherein the equation $\lambda_H/2<l<\lambda_H$ is satisfied for the pockets, wherein λ_H is the hollow waveguide wavelength and l is the length measured in the direction of propogation of the hollow waveguide shaft of the inner wall of the respective pocket which corresponds to the long right-angled side of the attached hollow waveguide.

This proposal is based on the recognition that the deterioration observed in the reflection coefficient and the cross-talk attenuation with hollow waveguide switches of the known kind is caused because a resonance point occurs when the operational frequency is such that $\lambda_H/2$ is approximately equal to the length of the inner wall of the respective pocket.

Thus, there is provided a hollow waveguide switch of the kind disclosed in the introduction, wherein the reflection coefficient and the cross-talk attenuation within the operational frequency range are generally independent of frequency and constant even if a very small peripheral gap is not kept between the rotor and the housing.

In order to further improve the reflection factor and the cross-talk attenuation, it is preferable that the peripheral surfaces of the rotor, at least, which are disposed between the pockets are provided with radial or axial slits, which are deep enough to form bent $\lambda/2$-chokes in conjunction with the lengths of the gaps between the inner wall of the housing and the corresponding peripheral surface regions of the rotor.

It is possible to optimise the cross-talk attenuation by means of the preferable feature that the length l is measured so that it is greater than $\lambda_H/2$ to such an extent that the cross-talk attenuation between the hollow waveguide terminals is substantially independent of the frequency in the operational frequency range of the switch.

It is possible to minimise the reflection coeffecient by means of the preferable feature that the innermost wall of the rotor has a projection in the direction of the inner wall of the housing, which projection reduces the cross-section of the respective pockets.

There now follows a description of preferred embodiments of the invention, by way of example, with reference being made to the accompanying drawings in which:

Figure 1	shows a side view of a hollow waveguide switch according to the invention;
Figure 2	shows a longitudinal section along line II-II of Figure 1;
Figure 3	shows a cross-section along line III-III of Figure 1;
Figure 4	shows a side view of the rotor;
Figure 5	shows another side view of the rotor which has been rotated through 90° relative to Figure 4; and
Figure 6	shows a cross-section through the rotor along the line VI-VI in Figure 4.

The hollow waveguide switch shown in the drawings consists of a housing 1 which has a hollow cylindrical bore, in which a rotor 4 is rotatably mounted by way of bearings 2 and 3. The housing 1 is closed by a cover 5 which has a central opening for passage therethrough of a shaft 6 journalled therein and integrally formed with the rotor 4, on which journal a drive means, not shown, engages, which can be used to rotate the rotor 4 in 90° steps.

The housing 1 has four terminals A, B, C, D (see, in particular, Figure 3) for right-angled (or rectangular section) hollow waveguides.

Figure 1 shows the connecting flange corresponding to terminal C. Depending on its rotational position, the rotor 4 either connects the terminals A and B, on the one hand, and the terminals C and D, on the other hand, or connects the terminals A and D, on the one hand, and the terminals B and C, on the other hand. For this purpose, on the casing of the rotor 4 there are two mirror-symmetrical recesses, in the form of open recesses or pockets 7 and 8, the height h of which (see Figure 5) is equal to the length of the major axis of the rectangular cross-section of the hollow waveguide to be connected thereto. The depth t (see Figure 5) of the pockets 7 and 8 is generally equal to the length of the minor axis of the rectangular cross-section of the hollow waveguide which is connected thereto. The rear (inner) walls 71 and 81 (corresponding to the longer side of the hollow waveguide) are substantially flat, with the exception firstly of narrow, wedge-shaped sections 71a or 81a which are disposed in the plane of the associated wall of the terminals A to D. In the embodiment shown, the wedge-shaped sections 71a, 81a are at the edges of the inner walls. Without these surfaces 71a or 81a, either the depth t would be too small, or there could be no smooth transition to the terminals. Moreover, the inner walls 71 and 81 each have centrally a bulbous, thickened portion 71b, 81b. The bulbous thickened portions 71b, 81b reduce the cross-section, and thus reduce the depth, of the pockets at that place, which would otherwise somewhat impair the reflection coefficient. The length l of the pockets is of a size such that the relationship $\lambda_H/2<l<\lambda_H$ is satisfied, wherein λ_H is the hollow waveguide wave length. This prevents the occurrence of a resonance point, which, in turn, would impair the cross-talk attenuation between the terminals which are not connected together. By suitably selecting l within the range disclosed it is possible for the cross-talk attenuation to be kept essentially constant, indpendently of the frequency, in the operational frequency range of the switch.

Likewise, in order to improve the cross-talk attenuation, the peripheral surfaces of the rotor 4, disposed between the pockets, are provided with axial slits 9 and radial slits 10. These slits 9 and 10 are in depth such that together with the lengths of the respective gaps, not shown in the drawings, between the inner wall of the housing 1 and the corresponding peripheral surface regions of the rotor, calculated as far as the adjacently disposed abutment location between the rotor and one of the terminals A to D of the housing, they result in bent $\lambda/2$ chokes. $\lambda/2$-chokes, even in bent form, are known to those skilled in the art for the purpose of transforming short circuits, and no further description of them is required.

CLAIMS

1. A hollow waveguide switch comprising a housing having four terminals for receiving respective ends of hollow waveguides, the terminals being selectively electrically, optically or otherwise connectable one to another in pairs by means of a rotor supported in a bore in the housing, the rotor including a pair of recesses formed in opposite sides thereof, the rotor being such that in a first position thereof the terminals are connected in a first set of pairs and in a second position thereof the terminals are connected in a second set of pairs, wherein the recesses are shaped to satisfy the relationship $\lambda_H/2<l<\lambda_H$, in which λ_H is the wavelength of the waveguides and l is the length of the innermost walls of the respective recesses measured in the general direction of propagation of a wave through the switch.

2. A hollow waveguide switch according to Claim 1, wherein the cross sectional shape of the waveguide is elongate in a specified direction.

3. A hollow waveguide switch according to Claim 2, wherein the waveguide is rectangular in cross section.

4. A hollow waveguide switch comprising a housing which has four oppositely disposed terminals A, B, C, D arranged in pairs for receiving rectangular hollow waveguides, and a rotor arranged in a hollow-cylindrical bore in the housing and which is rotatable in steps of 90° about an axis at right-angles to the plane containing the longitudinal axes of the hollow waveguides, and two open recesses which are mirror-symmetrical to a plane containing the rotor axis, by means of which recesses the terminals (A and B) and (C and D) are connected electrically together when the rotor is in a first position, and by means of which the terminals (A and D) and (B and C) are connected together when the rotor is in a second position, wherein the equation $\lambda_H/2<l<\lambda_H$ is satisfied for the ~~pockets~~ recesses, wherein λ_H is the hollow waveguide wavelength and l is the length, measured in the direction of propagation of the hollow waveguide shaft, of the inner wall of the respective ~~pocket~~ recess which corresponds to the

long right-angled side of the attached hollow waveguide.

5. A hollow waveguide switch according to any preceding claim, wherein the peripheral surfaces of the rotor, at least, which are disposed between the pockets are provided with radial or axial slits, which are deep enough to form bent $\lambda/2$-chokes in conjunction with the lengths of the gaps between the inner wall of the housing and the corresponding peripheral surface regions of the rotor.

6. A hollow waveguide switch according to any preceding claim, wherein the length l is measured so that it is greater than $\lambda_H/2$ to such an extent that the cross-talk attenuation between the hollow waveguide terminals is substantially independent of the frequency in the operation frequency range of the switch.

7. A hollow waveguide switch according to any preceding claim, wherein the innermost wall of the rotor has a projection in the direction of the inner wall of the housing, which projection reduces the cross-section of the respective pockets.

8. A hollow waveguide switch generally as herein described, with reference to or as illustrated in the accompanying drawings.

9. Any novel combination or sub-combination disclosed and/or illustrated herein.

Patents Act 1977
Examiner's report to the Comptroller under Section 17 (The Search Report)

Application number

9121254.8

Relevant Technical fields

(i) UK Cl (Edition K) H1W (WTS)

(ii) Int Cl (Edition 5) SELECTED US SPECIFICATIONS IN IPC SUB-CLASS H01P

Databases (see over)

(i) UK Patent Office

(ii)

Search Examiner

MISS J E EVANS

Date of Search

16 JANUARY 1992

Documents considered relevant following a search in respect of claims 1 TO 8

Category (see over)	Identity of document and relevant passages	Relevant to claim(s)
A	US 3644852 (ALBEE) WHOLE DOCUMENT	1 TO 8

SF2(p)

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Category	Identity of document and relevant passages	Relevant to claim(s)

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