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(54) Waveguide monitoring arrangement

(57) An electromagnetic waveguide unit such as a diplexer includes a signal monitoring arrangement having a sampling passage (6) which links two sections (3, 4) of the waveguide for testing purposes allowing a proportion of the signal to bypass an electromagnetic cavity filter 5. The passage contains a cavity 7, and the waveguide sections have tuning projections 8 and 9 disposed opposite the passage 6. The size of the holes in the waveguide wall can thus be reduced to minimise return losses whilst allowing sampling across a broader range of operating frequencies. In addition, the spacing between the waveguide sections can be increased giving greater design flexibility.

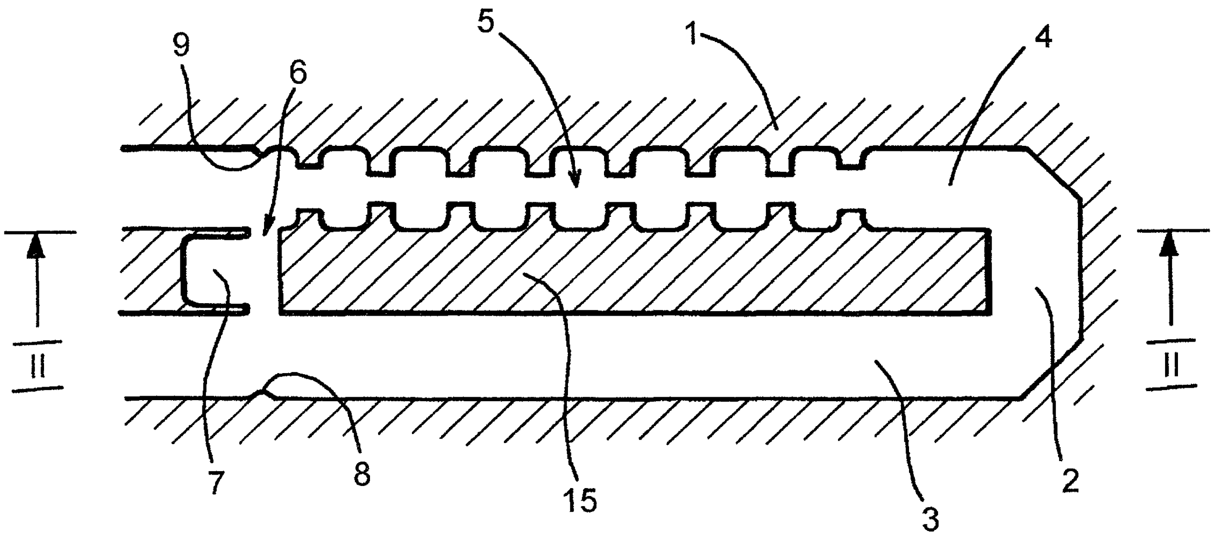

Fig. 1

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Description

TECHNICAL FIELD OF THE INVENTION

[0001] This invention relates to a built in monitoring arrangement for electromagnetic waveguide units which enables the performance of the unit to be monitored by sampling the signal at a defined level below the main signal and within a defined frequency band.

BACKGROUND

[0002] By way of example, the current known art as applied to a waveguide diplexer, involves linking the waveguide in front of one of the filters to the rear of that filter. This may be achieved by folding the waveguide back on itself and providing a hole through the wall of the waveguide bypassing the filter in the correct phase so that the signal passing through the hole emerges into the waveguide after the filter at the required signal level in the appropriate frequency band. If the hole in the waveguide is sufficiently small, it will not have a significant effect on the filter performance. In such an application, the hole may be easily produced by a simple milling operation.

[0003] If however, due to the sampling requirement or the distance between the two waveguide sections, the sampling hole needs to be so large that it causes a significant degradation in the performance of the filter, then alternative means must be used to sample the signal.

[0004] The present invention seeks to provide a new and inventive monitoring arrangement which allows a wider range of sampling conditions to be achieved and greater flexibility in the physical design of the waveguide unit without significantly degrading the performance of the unit.

SUMMARY OF THE INVENTION

[0005] The present invention proposes a electromagnetic waveguide unit which includes a signal monitoring arrangement having a sampling passage which links two sections of the waveguide for testing purposes, *characterised in that* the sampling passage contains a cavity.

[0006] Preferably at least one of said waveguide sections has a tuning projection disposed opposite the sampling passage.

[0007] The arrangement allows a significant reduction in the size of the sampling holes in the waveguide wall, minimising return losses, whilst allowing a uniform sampling figure to be achieved across a broad range of operating frequencies. At the same time the physical separation between the two parts of the waveguide can be increased allowing greater design flexibility.

[0008] The passage could be used to monitor the performance of a filter between the two sections of waveguide. By way of example of example the monitoring arrangement can be used as part of a self-test system for waveguide diplexers and multiplexers.

BRIEF DESCRIPTION OF THE DRAWINGS

[0009] The following description and the accompanying drawings referred to therein are included by way of non-limiting example in order to illustrate how the invention may be put into practice. In the drawings:

> <u>Figure 1</u> is a section through an electromagnetic filter provided with a monitoring arrangement in accordance with the invention;
>
> <u>Figure 2</u> is section II-II of Fig. 1;
>
> <u>Figures 3 to 5</u> are sectional views of a diplexer unit incorporating the filter and monitoring arrangement shown under three different conditions.

DETAILED DESCRIPTION OF THE DRAWINGS

[0010] **Fig.s 1 and 2**, show a metal block 1 containing a waveguide duct 2 which may be capped by a complementary block or cover plate (not shown). Part of the waveguide duct 2 is folded back on itself to form two adjacent sections 3 and 4 separated by an intervening wall 15. The thickness of wall 15 and the spacing between the two sections 3 and 4 is considerably greater than has hitherto been possible in arrangements where the wall is provided with a sampling hole. One of the waveguide sections 4 is configured with a series of resonant cavities forming an electromagnetic filter 5 in known manner.

[0011] A monitoring passage 6 is formed between the sections 3 and 4 bridging opposite ends of the filter 5, and the passage 6 contains a sampling cavity 7. Each of the waveguide sections 3 and 4 is provided with a respective tuning ridge 8, 9 disposed opposite the monitoring passage. By adjusting the dimensions of the sampling cavity 7, the size of the apertures formed where the passage enters the waveguide, and the size of the ridges 8 and 9, the return less of the passage can be reduced so that it has minimal effect on the performance of the filter across the range of operating frequencies. The inside dimensions of the cavity 7 can be adjusted together with the waveguide path length between the end of the filter and the inlet end of the passage in waveguide section 3, so that the target sampling value can be achieved across the required frequency band.

[0012] **Fig 3.** shows, again by way of example, how the described arrangement can form the transmit arm 20 of a waveguide diplexer. The diplexer further includes a receive channel 21 and an antenna arm 22 which are all connected by a combiner 23. The filter 5 in the transmit arm 20 is tuned to pass signals in a transmit frequency range f1 to f2 while the receive channel 21 has a filter 25 tuned to pass signals in a different receive frequency range f3 to f4.

[0013] The arrows in **Fig. 3** show the path of a transmitted signal in normal operation of the diplexer. A transmitted signal within frequency band f1 to f2 travels from the transmit input port *Tx* through the transmit filter 5 and into the combiner 23. In the combiner, part of the signal passes to the antenna. The other part of the transmit signal passes into the receive channel 21. The receive channel filter 25 only passes signals in the frequency range f3 to f4 so that the transmit signal is reflected back towards the antenna port *Ant.* This reflected signal interacts with the incident signal in the combiner so that the resultant signal is transmitted towards the antenna port in phase with the non-reflected part of the signal.

[0014] The arrows in **Fig. 4** show the path of a received signal under normal operating conditions. The receive signal in the frequency range f3 to f4 passes from the antenna port *Ant* to the combiner 23 where part of the signal travels with low loss through the receive filter 25. The other part of the receive signal passes into the transmit arm 20. The transmit filter 5 reflects the receive signal back towards the combiner so that the resultant signal is transmitted towards the receiver port Rx in phase with the non-reflected part of the signal.

[0015] **Fig. 5** shows the path of a test signal entering the transmit port Tx which can be used to self-test the receive filter and receiver system. This may be achieved in the following manner. A known level of signal in the receive band, f3 to f4, is fed into the *Tx* port. The signal is reflected by the transmit filter 5. A known small proportion of the reflected and non-reflected signals combine and travel through the monitoring passage 6, bypassing the transmit filter. Half of the signal then travels towards the combiner and half travels to, and is reflected from, the transmit filter 5. The reflected and non-reflected signals both travel to the combiner 23. This signal is then split by about 3 dB by the combiner so that about half of the test signal passes with known low loss through the receive filter 25 in the receive channel 21 to the receiver port Rx, where it can be measured against the predicted value.

[0016] In this way, the system can be self-tested by means of a simple, built-in, tuneable modification to the waveguide unit, which has a negligible effect on the normal operation of the system.

[0017] It will be appreciated that the features disclosed herein may be present in any feasible combination. Whilst the above description lays emphasis on those areas which, in combination, are believed to be new, protection is claimed for any inventive combination of the features disclosed herein.

Claims

1. An electromagnetic waveguide unit which includes a signal monitoring arrangement having a sampling passage (6) which links two sections (3, 4) of the waveguide for testing purposes,
characterised in that
the sampling passage contains a cavity (7).

2. An electromagnetic waveguide unit according to Claim 1, in which at least one of said waveguide sections has a tuning projection (8, 9) disposed opposite the sampling passage.

3. An electromagnetic waveguide unit according to Claim 1 or 2, in which the two sections of the waveguide (3, 4) are formed by a length of waveguide which is folded back on itself.

4. An electromagnetic waveguide unit according to any preceding claim, in which the two sections of the waveguide are linked by an electromagnetic filter (5).

5. An electromagnetic waveguide unit according to any preceding claim, in which one of said waveguide sections (4) is connected to a signal combiner (23).

6. An electromagnetic waveguide unit according to Claim 5, in which the signal combiner is connected to a third section of waveguide (21).

7. An electromagnetic waveguide unit according to Claim 6, in which the third section of waveguide contains a further electromagnetic filter (25).

8. An electromagnetic waveguide unit according to Claim 6 or 7, in which the signal combiner has an additional port.

9. An electromagnetic waveguide unit according to Claims 7 and 4, in which the two electromagnetic filers (5, 25) are tuned to reject different frequency bands.

10. An electromagnetic waveguide unit according to Claim 7, 4 or 9, in which the or each filter (5, 25) includes a series or resonant cavities.

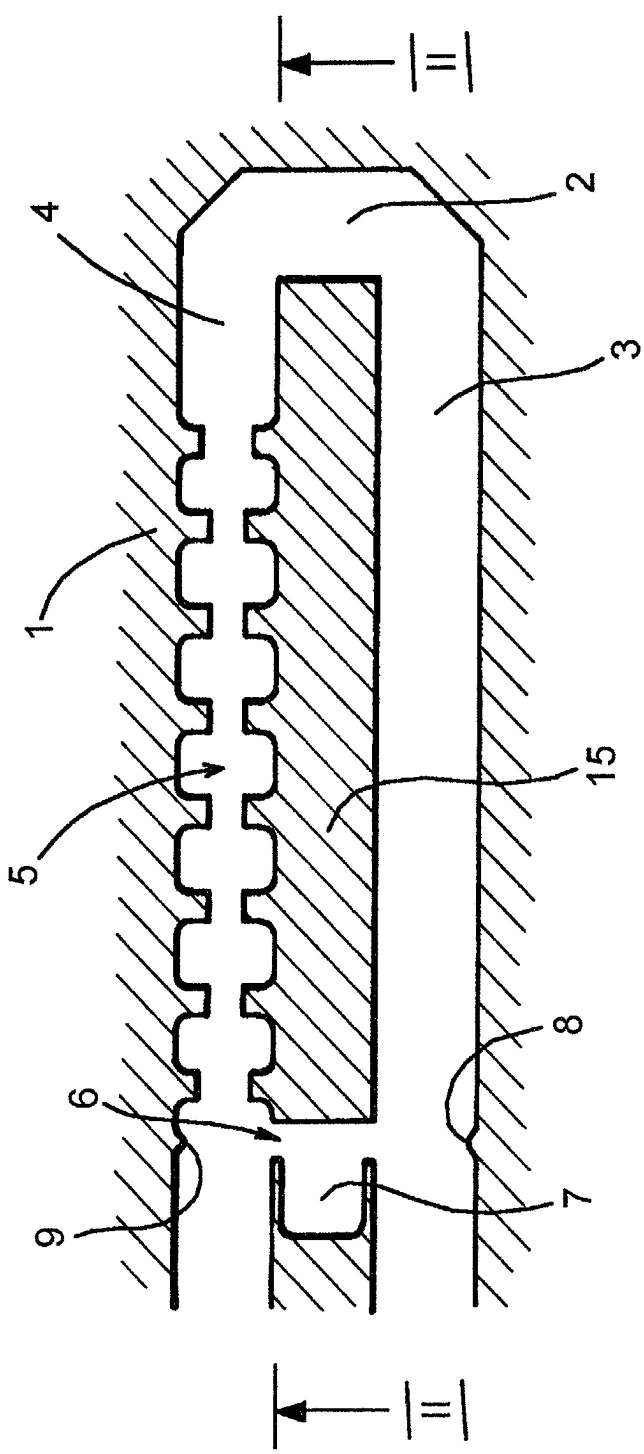

Fig. 1

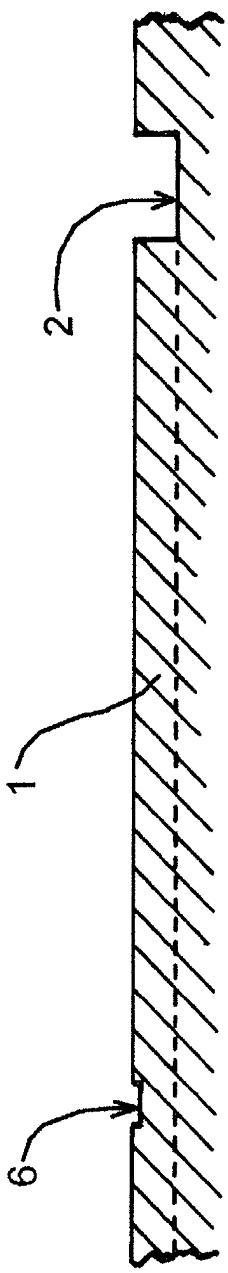

Fig. 2

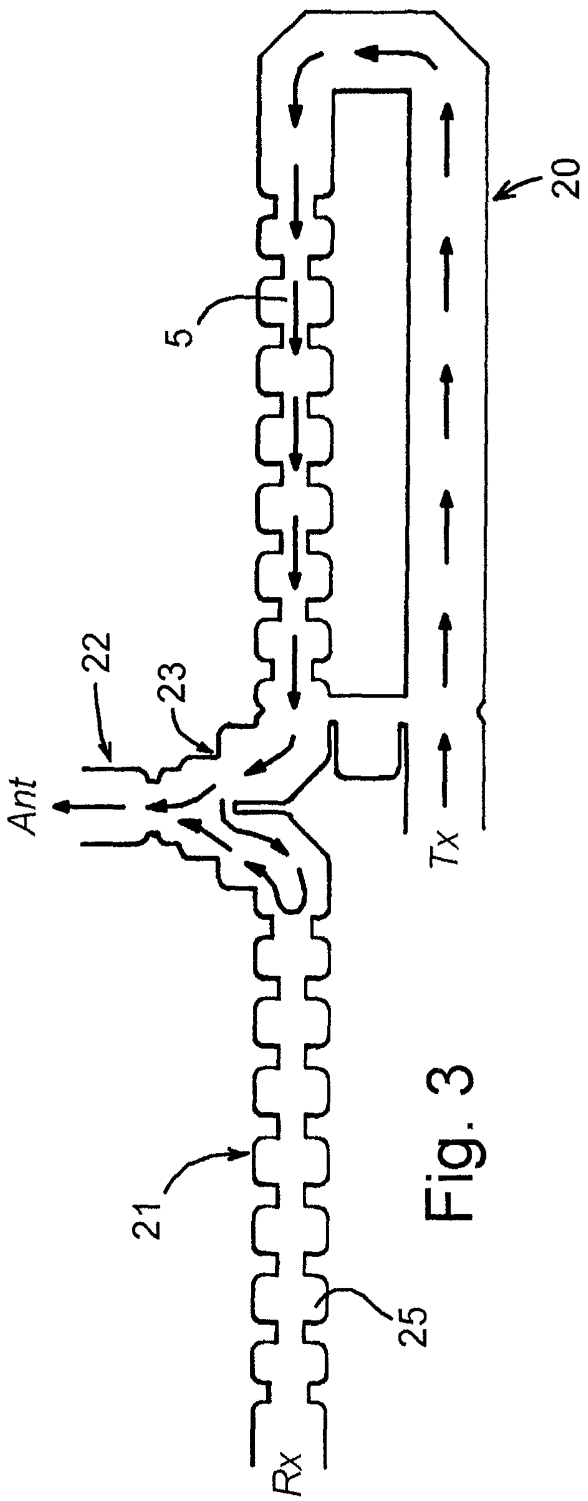

Fig. 3

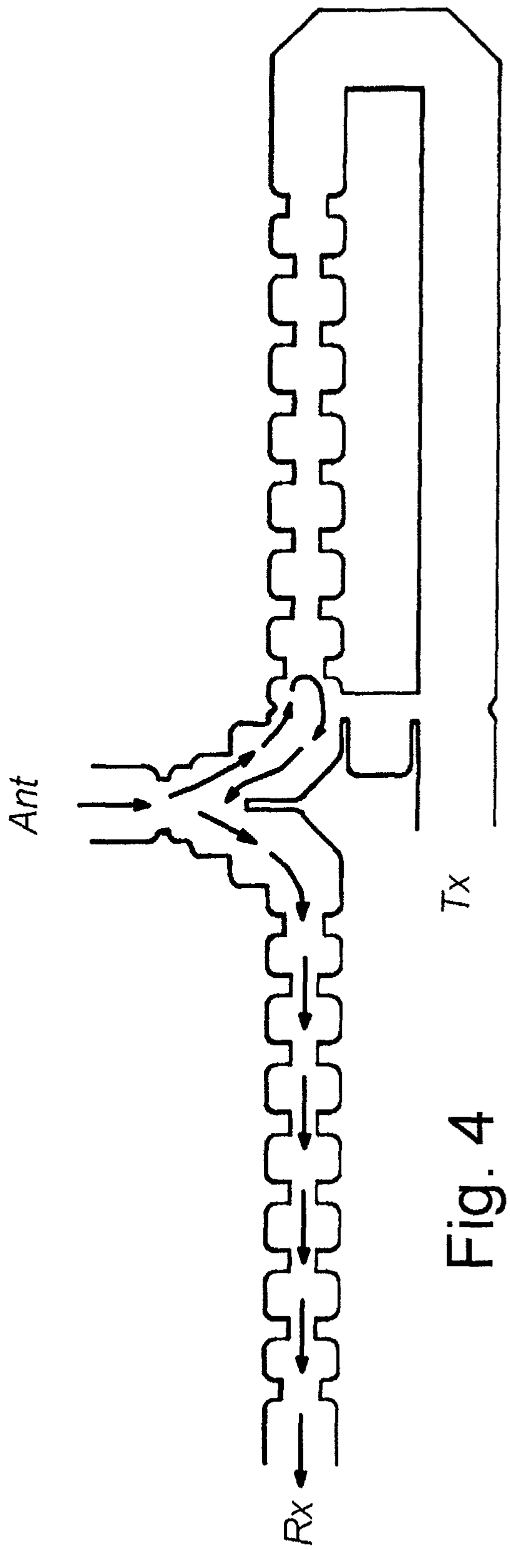

Fig. 4

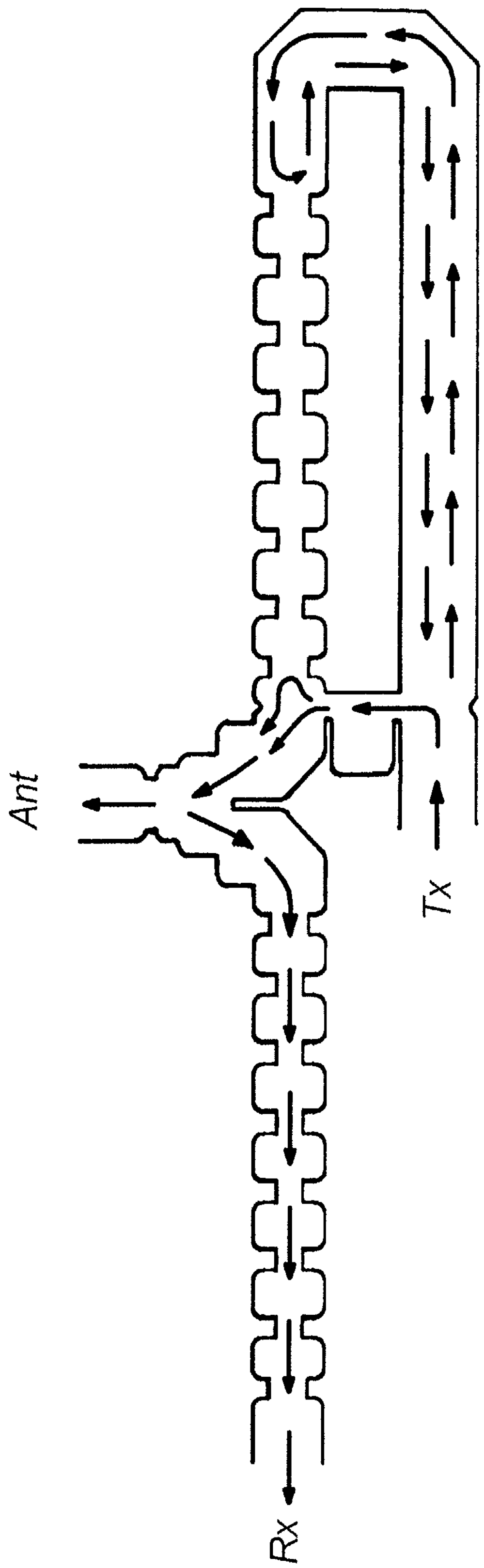

Fig. 5

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EUROPEAN SEARCH REPORT

Application Number
EP 03 25 0708

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
X	US 2 423 390 A (KORMAN NATHANIEL I) 1 July 1947 (1947-07-01) * column 5, line 45 - column 6, line 70 * * figures 3,4,6 * ---	1	H01P1/213
X	US 2 532 539 A (JULIUS HALPERN ET AL) 5 December 1950 (1950-12-05) * column 2, line 21 - column 3, line 71 * * figure 1 * ---	1	
A	DE 32 08 029 A (SIEMENS AG) 15 September 1983 (1983-09-15) * page 6, line 20 - page 9, line 29 * * figures 2,3 * * abstract * ---	1-10	
A	GB 2 359 197 A (BSC FILTERS LTD) 15 August 2001 (2001-08-15) * page 1, line 35 - page 2, line 7 * * figure 1 * * abstract * -----	4-10	

TECHNICAL FIELDS SEARCHED (Int.Cl.7)
H01P

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
MUNICH	16 May 2003	von Walter, S-U

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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A : technological background
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T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
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ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 03 25 0708

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
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16-05-2003

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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82