

1 "Microwave Antennas"

2

3 This invention relates to antennas, particularly (but
4 not exclusively) planar antennas for receiving
5 microwave signals such as direct broadcasting by
6 satellite (DBS) signals.

7

8 There are known planar antennas comprising an array of
9 horns communicating with one or more waveguide systems,
10 and in which the horns and waveguides are formed from a
11 sandwich of moulded planar members. The planar members
12 may be plastics mouldings with electrically conductive
13 surfaces formed by metallisation. See for example my
14 published International Patent Applications WO89/09501
15 and WO91/20109.

16

17 While antennas of the foregoing type have proved
18 successful, there is a need for further improvement
19 with a view to ease of mass manufacture and reduction
20 in manufacturing cost.

21

22 Accordingly, the present invention provides an antenna
23 comprising a plurality of generally planar members
24 secured together in face-to-face relationship to form

1 an array of cavities and a waveguide system, each
2 cavity being in communication with at least one
3 waveguide channel, each of the planar members having a
4 given overall thickness transverse to its principal
5 plane, said thickness being constituted by a membrane
6 of relatively small thickness formed three-
7 dimensionally in a generally corrugated fashion.

8
9 Preferably, each of the planar members is a vacuum
10 forming.

11
12 Preferably, each of the planar members is formed by
13 vacuum forming a plastics material and thereafter
14 metallising at least one side of the vacuum formed
15 material.

16
17 From another aspect, the present invention provides a
18 method of manufacturing an antenna, comprising forming
19 a plurality of generally planar members, each of the
20 planar members having a given overall thickness
21 transverse to its principal plane, said thickness being
22 constituted by a membrane of relatively small thickness
23 formed three-dimensionally in a generally corrugated
24 fashion, positioning the planar members in face-to-face
25 relationship to form an array of cavities and a
26 waveguide system, each cavity being in communication
27 with at least one waveguide channel, and securing the
28 planar members together.

29
30 In a preferred form of the invention, the planar
31 members are secured together by ultrasonic welding; for
32 this purpose the mating faces of the planar members may
33 be provided with ribs or the like which fuse to form
34 weld beads during the ultrasonic welding.

35

1 Embodiments of the present invention will now be
2 described, by way of example only, with reference to
3 the drawings, in which:

4
5 Fig. 1 is an isometric view, sectioned along a
6 transverse plane, of an antenna element according
7 to the present invention;
8 Fig. 2 shows part of Fig. 1 in greater detail, to
9 an enlarged scale;
10 Fig. 3 illustrates a preferred means used in
11 securing together parts of the assembly of Figs. 1
12 and 2;
13 Fig. 4 is a plan view illustrating the
14 construction of a modified form of waveguide
15 channel; and

16 Fig. 5 is an enlarged cross-sectional scrap view
17 on the line 5-5 of Fig. 4.

18
19 Referring particularly to Figs. 1 and 2, an antenna
20 element generally designated at 10 is in the form of a
21 4x4 array of receiving horns 12. In practice, the
22 element 10 would be assembled with like elements to
23 provide a larger array as a single antenna. The
24 antenna element 10 comprises five generally planar
25 members 14 - 22.

26
27 The first planar member 14 is formed to provide the
28 horns 12, each of which is of tapering square section,
29 terminating in a lower wall 24 and circular aperture
30 26.

31
32 The second and third planar members 16, 18 together
33 define cylindrical cavities 28 aligned with the
34 circular apertures 26, and first closed, rectangular
35 section channels 30 extending along the length of the

1 antenna element 10. The cavities 28 terminate in a
2 plane partial end wall 32 defining a D-shaped slot 34.

3
4 The fourth and fifth planar members 20, 22 together
5 define bottom sections 36 to the horn cavities, and
6 second closed, rectangular section passages 38. Each
7 bottom section 36 has an upper part 39 corresponding to
8 the D-shaped slots 34, and a lower part 40 forming an
9 open-topped channel communicating with one of the
10 second passages 38.

11
12 The first channels 30 communicate with the cavities 26
13 by means of passageways 40 as indicated in Fig. 2.

14
15 Each of the planar members 14 - 22 is separately formed
16 by vacuum forming of a suitable plastics material.
17 Techniques of and materials for vacuum forming are well
18 known per se and will not therefore be described in
19 detail herein. The walls of the horns, cavities and
20 channels have the effect of providing a corrugated
21 formation to each member, thus giving a reasonable
22 degree of rigidity which is increased when the five
23 members are secured together.

24
25 After vacuum forming, one side, as appropriate, of each
26 member is metallised in any suitable fashion, and thus
27 when the members are secured together the surfaces of
28 the horns, cavities and channels which are adjacent the
29 received microwave radiation are conductive metallised
30 surfaces. The channels 30 and 38 thus act as
31 waveguides for differently polarised microwave signals
32 separated by the conformation of the cavities 26, as is
33 known per se.

34
35 The five members may be secured together in any

1 suitable manner. For example, they may be secured
2 together by adhesive. A preferred feature of the
3 present invention, however, is to secure the planar
4 members together by means of ultrasonic welding. For
5 this purpose, as illustrated in Fig. 3, the mating
6 faces such as the lower face 50 of the first member 14
7 and the upper face 52 of the second member 16, are
8 provided with ribs 54 which fuse to form continuous
9 welded beads during ultrasonic welding.

10

11 Referring to Figs. 4 and 5, there is illustrated an
12 alternative construction of a moulded element 60 which
13 partially defines the wave guides, for example in
14 substitution for the element 22 in the above
15 embodiment.

16

17 Fig. 4 shows a 12 x 12 array, but it will be understood
18 that the arrangement can be applied to any desired size
19 of array.

20

21 The element 60 is once again a vacuum forming in which
22 a single membrane of material is formed to provide
23 upper faces 62 and lower faces 64 joined by side webs
24 65 to define waveguide channels 66. In this
25 embodiment, however, the upper faces 62 are defined
26 only as flanges in the vicinity of the waveguide
27 channels 66, and elsewhere the material is cut away to
28 form void spaces 68.

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30 This configuration is particularly efficient and
31 results in a weight reduction of approximately 30%. In
32 addition, the particular design minimises the extent of
33 area which requires to be metallised.

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1 CLAIMS

- 2
- 3 1. An antenna comprising a plurality of generally
4 planar members secured together in face-to-face
5 relationship to form an array of cavities and a
6 waveguide system, each cavity being in
7 communication with at least one waveguide channel,
8 each of the planar members having a given overall
9 thickness transverse to its principal plane, said
10 thickness being constituted by a membrane of
11 relatively small thickness formed three-
12 dimensionally in a generally corrugated fashion.
13
- 14 2. An antenna according to claim 1, in which each of
15 the planar members is a vacuum forming.
16
- 17 3. An antenna according to claim 2, in which each of
18 the planar members is formed by vacuum forming a
19 plastics material and thereafter metallising at
20 least one side of the vacuum formed material.
21
- 22 4. An antenna according to any preceding claim, in
23 which each of said membranes is continuous across
24 the whole area of the antenna.
25
- 26 5. An antenna according to any of claims 1 to 3, in
27 which the waveguide channel is partially defined
28 by one said membrane which is cut away to form
29 void spaces in areas of the membrane not
30 immediately adjacent the waveguide channel.
31
- 32 6. A method of manufacturing an antenna, comprising
33 forming a plurality of generally planar members,
34 each of the planar members having a given overall
35 thickness transverse to its principal plane, said



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- 1 thickness being constituted by a membrane of
2 relatively small thickness formed three-
3 dimensionally in a generally corrugated fashion,
4 positioning the planar members in face-to-face
5 relationship to form an array of cavities and a
6 waveguide system, each cavity being in
7 communication with at least one waveguide channel,
8 and securing the planar members together.
9
- 10 5. A method according to claim 4, in which the planar
11 members are secured together by ultrasonic
12 welding.
13
- 14 6. A method according to claim 5, in which the mating
15 faces of the planar members are provided with ribs
16 or the like which fuse to form weld beads during
17 the ultrasonic welding.
18
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