REFLECTOR ANTENNA FOR TELECOMMUNICATION NETWORK

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The local microwave telecommunication network (LMTN) is a combined distributive network of multichannel television and digital multichannel telephone communication at the UHF band. Currently it is one of the most perspective directions of telecommunication networks development in Ukraine. The LMTN may be used by govermental and private offices, the residents of separate houses and groups of such houses, individual users, remote users: villages, outskirts and others. The communication between LMTN may be provided by satellite and relay lines.

Currently for the purposes of LMTN the band of 11,7...12,5 GHz with possibility of spreading up to 13,5 GHz is used. The mastering of millimetre wave band is considered to be perspective. A single LMTN radius is about 30 km while using transmitting antenna having circular pattern at horizontal plane with the gain more than 15 dB and receiving directive antennas with the gain of 25...27 dB.

As a transmitting antenna of a central station of LMTN we suggest a three reflector antenna meeting the above mentioned requirements. The structure of a transmitting antenna is shown in Fig.1. It consists of main reflector 1 made in the form of a revolution body with parabolic working surface, auxiliary reflector 2 with elliptic working surface and hyperbolic subreflector 3, feeder 4 and mounting elements. Parabola forming the surface of the main reflector has a top at the point O offset relatively to the symmetry axis A-A at a distance L. The surfaces of the reflectors were formed by revolution around this axis. The ellipse of auxiliary reflector is positioned in such a way that one of it's focuses coincides with the focus of parabola F1 that has a spatial form of a ring, the second one with a focus of hyperbola F2. The second focus of hyperbola F3 coincides with the phase centre of the feeder F4.

Focal length and eccentricity of the ellipse were calculated by the following formulas:

$$f_э = \frac{L}{2} \cdot tg\,\varphi_э \left(ctg\frac{\varphi_0}{2} - tg\frac{\varphi_э}{2} \right),$$

$$e = \frac{L}{L + 2f_э\, tg\frac{\varphi_э}{2} \cdot \cos\varphi_э},$$

where $\varphi_э$ – an angle of slope of the large axis of ellipse to focal axis of the main reflector; φ_0 – an angle between the focal axis and a ray directed from the focus F1 to the edge of the main reflector.

The above mentioned parameters, focal length and distance of offset L of the main reflector were selected using barycentric method [1]. As a result we developed and produced the antenna with the following parameters: main reflector diameter in the plane perpendicular to the A-A axis – 946 mm; the focus of parabola – 108,6 mm; the diameter of auxiliary reflector – 264 mm; eccentricity of ellipse – 0.58, subreflector diameter – 130 mm; eccentricity of hyperbola – 2,84. The view of the antenna is shown in Fig.2. Fig.3a demonstrates a typical pattern of the antenna in horizontal plane at the frequencies of 11,7 and 12,5 GHz. The unevenness of the antenna pattern doesn't exceed 1,5 dB. The pattern of the antenna in the vertical plane at orthogonal cross section at the frequency of 12,1 GHz is shown in Fig.3b. The measured gain of antenna at the working band is more than 15,5 dB.

The developed transmitting antennas for LMTN have been installed in Kremenchug, Sebastopol, Poltava and Kiev.

References

1. Gryanik M.V., Loman V.I. Baricentral method in the design of reflector antennas tasks // Telecommunications and Radio Engineering. 1994, N 2.

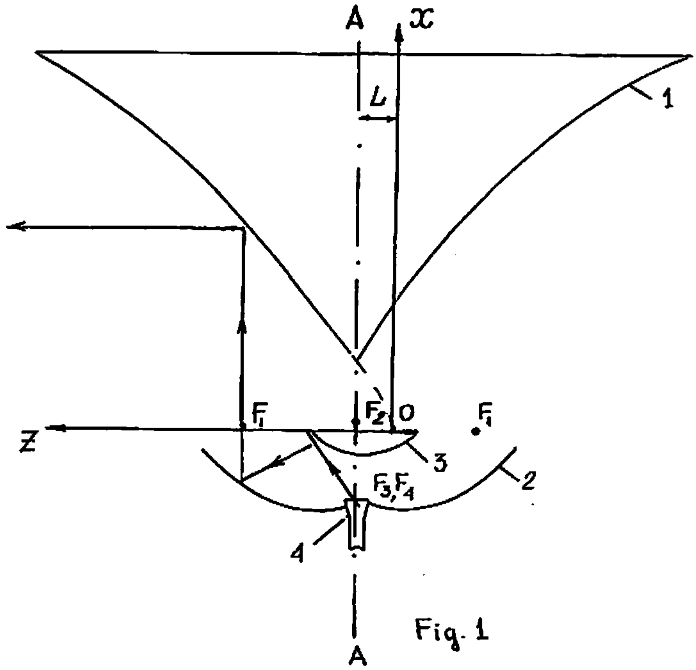


Fig. 1

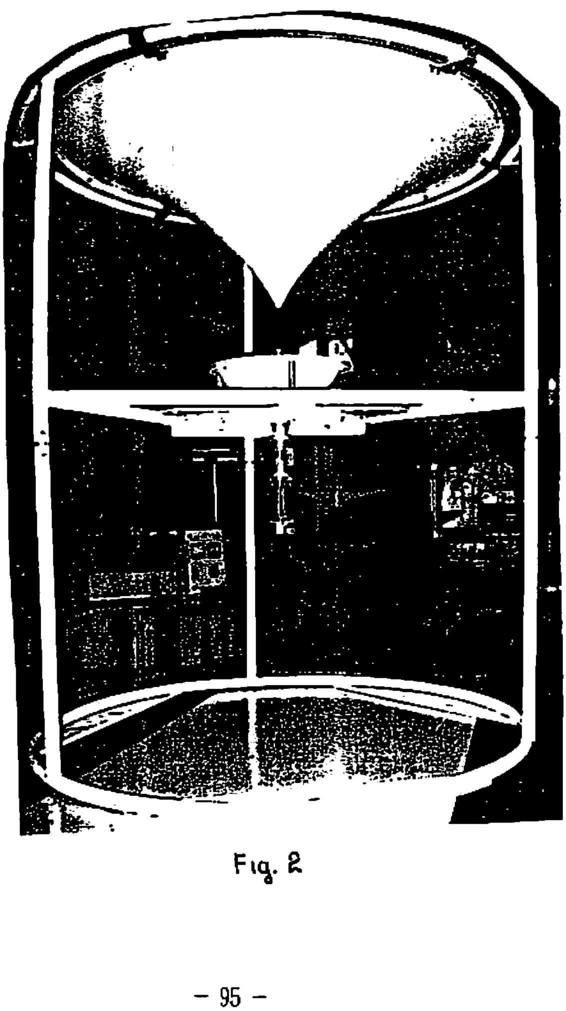
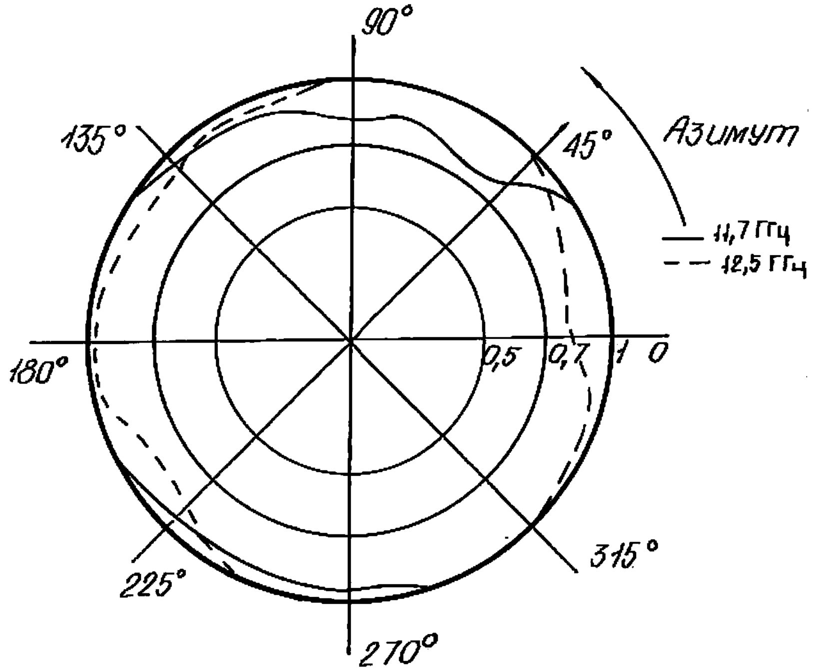
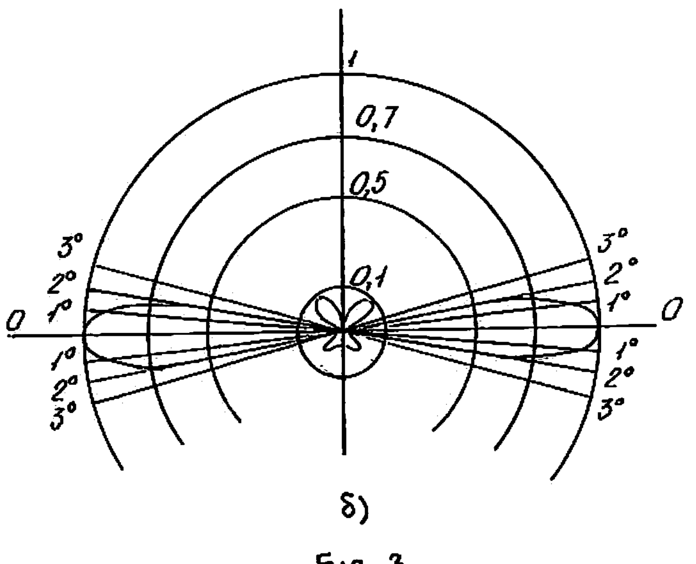


Fig. 2


90°
135°
45°
Азимут
11,7 ГГц
12,5 ГГц
180°
0,5
0,7
1
0
225°
315°
270°

а)


1
0,7
0,5
0,1
3°
2°
1°
0
1°
2°
3°
3°
2°
1°
0
1°
2°
3°

б)

Fig. 3