Dec. 24, 1963 W. E. LANFORD 3,115,630

REFLECTOR SPACE SATELLITE

Filed Feb. 11, 1960

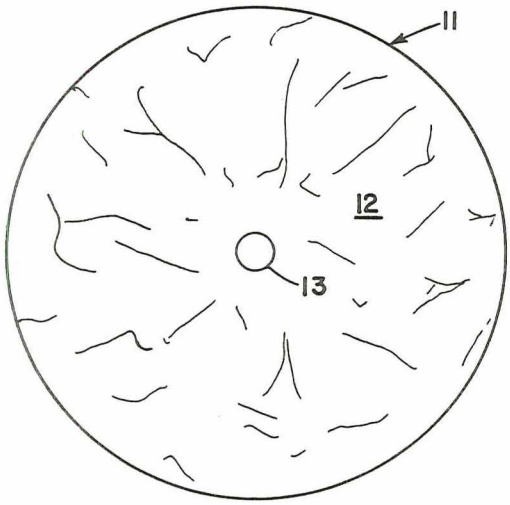

FIG. 1

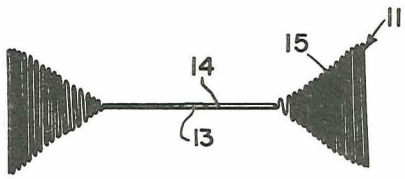

FIG. 3

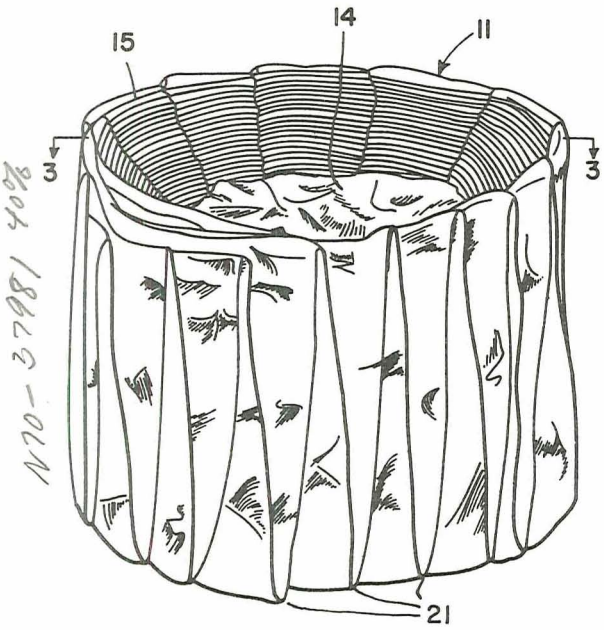

FIG. 2

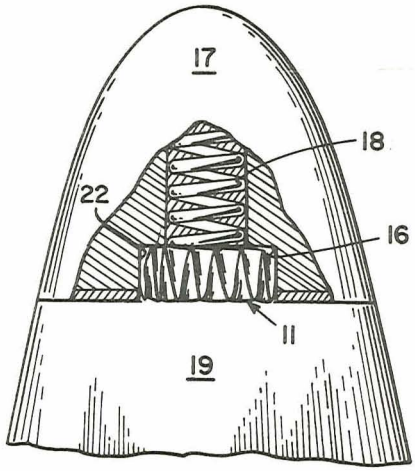

FIG. 4

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REFLECTOR SPACE SATELLITE

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2 Claims. (Cl. 343—18)
(Granted under Title 35, U.S. Code (1952), sec. 266)

The invention described herein may be manufactured and used by or for the Government of the United States of America for governmental purposes without the payment of any royalties thereon or therefor.

The invention relates generally to a packaging arrangement, and more particularly to a method of compactly packaging a centrifugally expandable lightweight and flexible sheet of material, such for example as a space reflector.

The problem has existed from the very start of recent scientific interest in space technology of how to deploy objects such as antennas, radar reflectors and the like into the earth's upper atmosphere and the regions of outer space. Antennas and the like are highly important in the electronic communications field since the electromagnetic waves of radio, television and radar can be transmitted from one point of the earth's surface to the antenna and then reflected, or bounced, back to another point on the earth's surface. By this method of transmission the range of communication can be greatly increased. However, the limited payload capabilities of present day carrier vehicles have restricted efforts to place satellites of this type in orbit about the earth.

Accordingly, one object of the present invention is to provide a novel space reflector.

Another object of this invention is to provide a new and improved method of packaging a reflector space satellite.

A further object of the invention is to provide a new and improved packaged flexible electromagnetic wave reflector.

A still further object of the instant invention is to provide a novel centrifugally expanded packaging configuration for a reflector space satellite.

One still further object of the invention is to provide a new and improved packaged lightweight space satellite capable of being contained in a restricted area and of being expanded in outer space by centrifugal force.

Generally speaking, the foregoing objects as well as others are accomplished in accordance with this invention by providing a circularly folded packaging arrangement for a flexible sheet which can be readily opened in outer space by the centrifugal force imparted to the packaged satellite by rotation of the carrier vehicle.

A more complete understanding of the invention and many of the attendant advantages thereof will be readily appreciated as the same becomes better understood by reference to the following detailed description when considered in connection with the accompanying drawings wherein:

FIG. 1 is a top view of the expanded reflector satellite;

FIG. 2 is a perspective view of the folded reflector satellite;

FIG. 3 is a cross sectional somewhat schematic view taken along line 3—3 of FIG. 2; and,

FIG. 4 is a side view of the folded reflector satellite in a carrier vehicle to be carried into outer space.

Referring now to the drawings wherein like reference numerals designate identical or corresponding parts throughout the several views, and more particularly to FIG. 1 whereon the satellite, generally indicated by the

reference numeral 11, is shown as being formed of a circular, thin, planar sheet 12. The sheet is preferably composed of flexible, lightweight aluminum coated plastics material, such for example as Mylar, having a thickness of approximately one mil to two mils, however, any similar flexible and tear resistant material capable of reflecting light and other electromagnetic waves may be used. An aperture 13 may be centrally formed in the circular sheet during the folding operation by the folding machine disclosed in applicant's copending patent application, Serial Number 8,203, filed February 11, 1960, now Patent Number 3,010,372.

As more clearly shown in FIG. 2, the reflector 11, in a packaged condition, is provided with a center substantially planar disc portion 14 which gradually develops into radial folds, or pleats, 15 extending to the periphery thereof, thereby forming saw-tooth folds thereon. Pleats 15 are shown as becoming progressively larger in height, or amplitude, toward the outermost edge of the reflector satellite 11. The saw-tooth edges 21 are preferably of uniform height and evenly distributed around the periphery. As shown somewhat schematically in FIG. 3, the upper and lower portions of pleats 15 are identical in amplitude increasing progressively towards the outer edge thereof. The satellite is therefore shown to be substantially symmetrical about the center axis when in a packaged condition.

The packaged configuration may be launched into the upper earth's atmosphere in a container 16 positioned in a nose cone 17 of a multistage rocket, as shown on FIG. 4, or from one of the later stages of the space probe. A spring 18 can be utilized to eject the packaged configuration from the posterior end of the nose cone upon separation thereof from the rocket motor 19.

The spin of the carrier is adequate of itself to open and expand the packaged satellite when ejected, thereby making the use of inflation means unnecessary and effecting a saving in payload. A space probe or carrier vehicle is necessarily spin stabilized and is therefore spinning about its longitudinal axis as the packaged configuration is ejected into outer space. The spin of the carrier vehicle is imparted to the ejected packaged configuration whereupon the folded configuration is fully opened by centrifugal force subsequent to the ejection thereof by resilient means 18. After opening, the configuration remains in the extended position due to the absence of atmosphere in the outer space regions.

The packaged configuration is very desirable in that a large sized circular planar satellite may be folded into a small compact packaged configuration which may be placed in a reasonably small cavity 22 in a nose cone 17. Moreover, although of a relatively large size, the satellite is extremely lightweight.

Obviously numerous modifications and variations of the present invention are possible in the light of the above teachings. It is therefore to be understood that within the scope of the appended claims the invention may be practiced otherwise than as specifically described.

What is claimed as new and desired to be secured by Letters Patent of the United States is:

1. A reflector space satellite capable of being compactly stored in a folded condition within a nose cone cavity of a carrier vehicle and being readily unfurled to an extended position at a predetermined altitude by centrifugal force, comprising:

a thin flexible plastics sheet of material having a reflective surface thereon;

said flexible plastics sheet when in the folded compactly stored position having

(a) a centrally located substantially planar disc portion,

(*b*) a series of radial pleats radiating outwardly from said centrally located disc portion,

(*c*) said pleats being spirally wrapped around said disc portion,

(*d*) the amplitude of said pleats progressively increasing from said disc portion to the outer periphery of said flexible sheet,

said flexible sheet upon being extended by centrifugal force at the predetermined altitude being readily unfurled to assume an essentially overall disc configuration.

2. A reflector space satellite as in claim 1 wherein said reflective surface is a coating of aluminum.

References Cited in the file of this patent

UNITED STATES PATENTS

1,926,053	Morgan	Sept. 12, 1933
2,017,054	Bruun	Oct. 15, 1935
2,189,562	Doerr	Feb. 6, 1940
2,758,771	Bauer	Aug. 14, 1956
2,763,002	Fitzgerald et al.	Sept. 11, 1956
2,815,883	Robins et al.	Dec. 10, 1957
2,881,425	Gregory	Apr. 7, 1959
2,942,794	Huso	June 28, 1960
2,967,652	Canfield et al.	Jan. 10, 1961
2,996,212	O'Sullivan	Aug. 15, 1961
3,010,372	Lanford	Nov. 28, 1961