

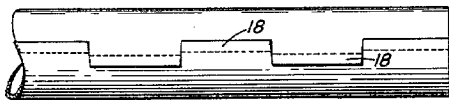
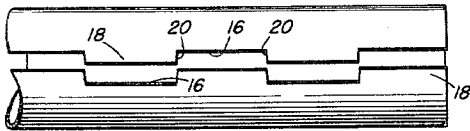
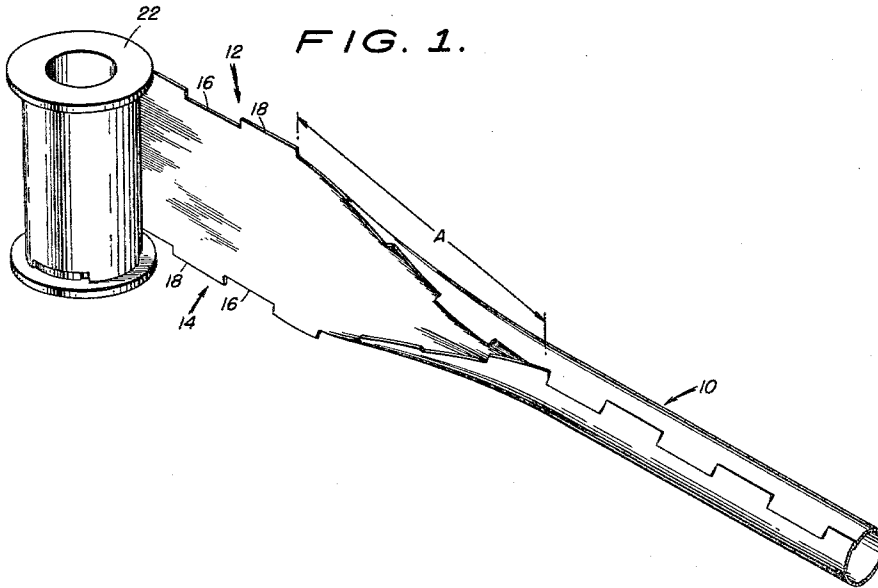
April 13, 1965

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3,177,987

INTERMITTENTLY-LAPPED EXTENDIBLE BOOM

Filed Feb. 26, 1962



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INTERMITTENTLY-LAPPED EXTENDIBLE BOOM

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Filed Feb. 26, 1962, Ser. No. 175,855

4 Claims. (Cl. 189—34)

This invention relates generally to extendible booms of the type utilized for radio antennas and the like; more specifically, it relates to an improved extendible boom construction that is more rigid and lighter in weight than present extendible booms.

Extendible booms of the type to which this invention relates are utilized where an antenna-like structure is required that can be initially carried in a compact, collapsed condition and which may be erected into a rod or boom several feet in length when required. One present collapsible and extendible boom of this variety is that shown in U.S. Patent 2,157,278, to R. B. Blackmore, the boom or antenna of this device consisting of a narrow flat tape several feet in length which possesses the characteristic that when it is not constrained in its flat condition it will form into a tube. The flat tape is initially wound upon a drum or spool, much in the manner of a carpenter's conventional collapsible steep rule. When it is desired to erect the boom the tape is merely unwound from the spool. The free end of the tape passes through an encircling mandrel which tends to guide it smoothly into its naturally tubular shape, and the result is a tubular boom several feet in length.

The Blackmore extendible boom has the advantages that the spool erecting unit is quite compact, and that the boom itself, being constructed of fairly thin metal, is relatively light in weight. Hence, the complete unit is quite adaptable to the limited space and weight requirements of aircraft, missiles and space satellites. The Blackmore boom is, however, not as rigid as is desired for some applications, especially where it is to be utilized in a satellite to support a weight mass.

It has been found that the attitude relative to the earth of a space satellite may be controlled by the method referred to as gravity orientation. In this method a weight mass is positioned at a distance of several feet from an orbiting satellite, the two being connected by a boom. The satellite will then so align itself that the centers of gravity of the satellite, the mass weight, and the earth lie on a straight line, a position that is maintained as the satellite circles the earth. The boom utilized in this method must be collapsible within the satellite during launching thereof, and must then be easily extendible when the satellite has entered its orbit. Additionally, the boom must be somewhat rigid when erected, for even though a condition of weightlessness exists in space there are still other forces to contend with. Finally, the boom and its erecting apparatus must be as light in weight as possible.

When a boom similar to that shown in the patent is employed in a satellite gravity orientation system it has been found that the edges of the tape must be overlapped for an arc length which often exceeds 180 degrees, which overlapping requires extra width for the tape and hence additional weight. Moreover, the added tape width requires a larger storage spool and larger erecting apparatus. It is highly desirable, especially because of the limited space and weight allowances in space vehicles, to provide a boom which is as light in weight and as small in size as is possible for a given desired rigidity. The improved boom of the present invention satisfies these requirements.

It is an object of this invention, therefore, to provide an improved extendible boom so constructed that it may be readily erected and collapsed, and which when erect is substantially rigid and capable of withstanding considerable torsional and deflective loading.

A further object of this invention is to provide an extendible boom that is lighter in weight and that occupies less volume than previous booms of the same general type.

Other objects and many of the attendant advantages of this invention 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 perspective of the extendible boom of the invention, showing the manner in which it assumes a tubular shape as it is unrolled from a storage spool;

FIG. 2 is an elevation view showing a portion of the boom with the notches and tabs along the mating edges thereof in confronting, unengaged position; and

FIG. 3 is a view in elevation showing the manner in which the tabs and notches engage to provide a substantially rigid boom.

In the extendible boom of the invention a narrow, elongated strip of thin, resilient metal is first so formed that in its normal unrestrained condition it will form itself into a tube, with the opposite longitudinal edges of the strip slightly overlapping. The overlapping edges are provided with alternating notches and tabs, the tabs on one edge of the strip being positioned opposite notches on the opposite edge thereof. When the boom has assumed its tubular shape with the notches and tabs interlocked it becomes quite rigid, the natural resiliency of the strip serving to keep it in its tubular shape. When it is desired to collapse the boom it is merely rolled upon a storage spool much in the same manner as a carpenter's flexible steel measuring rule. The boom of the invention is utilized with known erecting apparatus, such as is shown in said Patent 2,157,278, which apparatus includes an encircling cylindrical die to facilitate the strip's transition from a flat to a tubular state and return. Since the erecting apparatus is not a part of the invention it will not be described herein.

Referring now to the drawings, the extendible boom of the invention is shown in perspective in FIG. 1, and consists of a narrow, several feet in length, strip 10 of very thin material. The strip is constructed of beryllium copper or a similar material, and is but a few thousandths of an inch in thickness (the thickness of the strip is exaggerated in the drawings for clarity). The upper and lower edges 12 and 14 thereof each have a plurality of notches 16 and tabs 18 thereon, the notches on one edge being directly opposite the tabs on the opposite edge. As is best shown in FIG. 2, the sides of the notches 16 are defined by the side edges 20 of the tabs, which edges are slightly tapered so that the notches flare outwardly.

The strip 10 is fabricated in a manner whereby it naturally tends to form into a tubular shape. The strip is made from a flat piece of material, the notches and tabs first being formed therein. Then the strip is wound into an elongated tube, with the edges 12 and 14 overlapping for about 180 degrees arc length. The tube is then subjected to a heat treating process which causes it to assume a permanent set and to become resilient. Thereafter the strip is made flat and is wound upon a storage spool 22. It is emphasized that during the forming stage the edges 12 and 14 are overlapped for a substantial arc length, and that the notches and tabs are not interlocked during this time. The overlapping arc length during heat treating is substantially greater than the overlapping arc length of the edges 12 and 14 when the tabs and notches are interleaved.

When it is desired to form the extendible boom the strip 10 is unwrapped from its spool, and over a transition distance A the opposite edges 12 and 14 move toward each other until the tabs 18 on each edge are aligned with notches 16 on the opposite edge (FIG. 2). Movement of the edges continues until the tabs and notches interleave (FIG. 3) the tapered edges 20 facilitating this occurrence. The tubular boom is thus formed.

Because the circumference of the tube when the tabs and notches are interlocked is substantially greater than was the circumference thereof during the time when it was being heat treated, and because the inherent resiliency of the tube tends to make it circumferentially compress itself toward the permanent set position it acquired during heat treatment, the tabs and notches will tend to stay interlocked under most circumstances. The resultant extendible boom is capable of withstanding considerable bending and twisting without collapsing, and is far stronger in this regard than the merely overlapped construction of previous similar booms. Moreover, because the strip has cut-out portions and is substantially smaller in width for the same boom diameter than booms wherein extensive overlapping is required it is somewhat lighter in weight than such overlapped booms. The reduction in strip width also reduces the size of the storage spool and of other components of the erecting unit, thus resulting in a further weight reduction. Naturally, the smaller size apparatus resulting from the invention also requires less space wherever it is utilized.

Obviously, many 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 is:

1. An extendible element, comprising an elongated, narrow strip having alternating notches and tabs formed on the opposite longitudinal edges thereof, the tabs on one edge being positioned opposite the notches on the other edge, said strip being resilient and being so fabricated that it tends to form into an elongated tube the

longitudinal axis of which lies parallel to the longitudinal center line of said strip.

2. An extendible element as claimed in claim 1, wherein said notches are defined by said tabs, and wherein said tabs are progressively narrower, moving from the central portion of said element transversely toward the extreme longitudinal edges thereof.

3. In an extendible antenna device, an extendible element comprising an elongated, relatively thin, narrow strip having alternating tabs and notches formed on the opposite longitudinal edges thereof, said notches being defined by said tabs and the tabs on one edge being positioned opposite the notches on the other edge, said strip being resilient and having a predetermined set so that when unrestrained it tends to form into an elongated tube the longitudinal axis of which lies parallel to the longitudinal center line of said strip, said predetermined set in said resilient strip being such that the strip tends to form a tube having a circumference substantially less than the arc length measured between the bottom edge of oppositely positioned tabs on the edges of said strip, whereby said tabs and notches are resiliently urged into interlocking engagement when said strip assumes a tubular configuration.

4. An extendible element as claimed in claim 3, wherein said tabs are progressively narrower, moving from the central portion of said strip element transversely toward the extreme longitudinal edges thereof, and wherein said strip element measures a few thousandths of an inch in thickness.

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