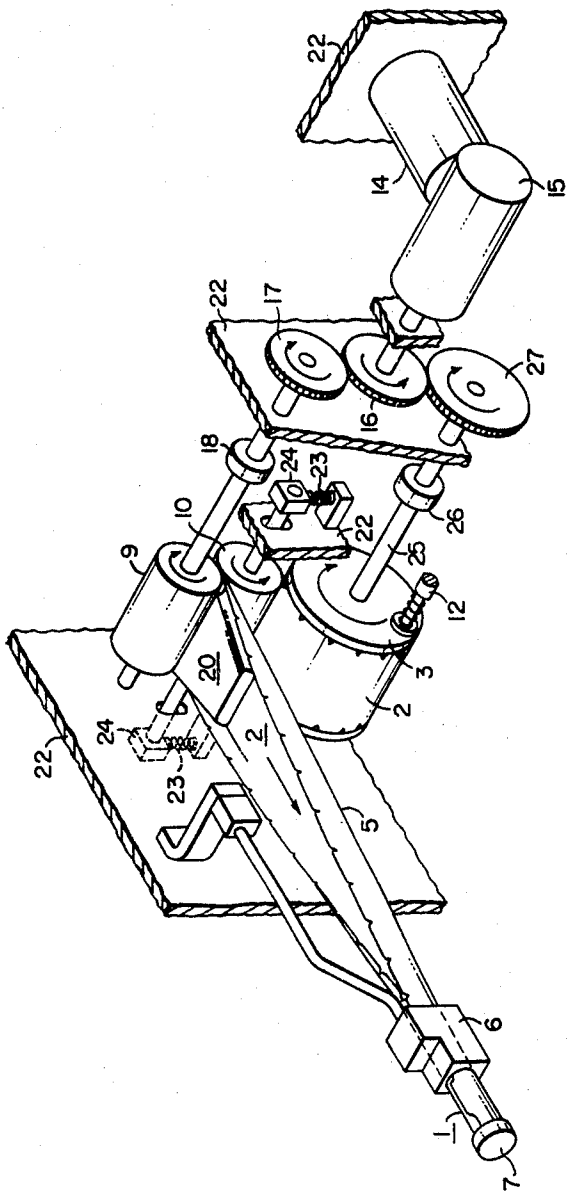
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SELF-FORMING-BOOM RETRACTING AND DEPLOYING APPARATUS

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WITNESSES

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SELF-FORMING-BOOM RETRACTING AND DEPLOYING APPARATUS

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ABSTRACT OF THE DISCLOSURE

During boom retraction, a storage reel driven by a reversible motor via a unidirectional coupling pulls the uncurled boom in strip form tightly therearound under tension imposed by turning resistance of pinch rolls operatively connected to such motor via a slip clutch. During boom deployment, the motor-driven power rolls pull the strip from the storage reel against a friction drag opposing its rotation, while the unidirectional coupling over-runs. In transit between storage reel and pinch rolls the strip is reversed in direction of travel. The motor couples to the slip clutch and unidirectional coupling via a drive system that tends to become locked when the motor is stopped.

The invention herein described was made in the course of a contract with the National Aeronautics and Space Administration.

BACKGROUND OF THE INVENTION

Field of the invention

Deploying and retracting apparatus for extendible booms formed from elongated thin strip material which is self-biased to curl transversely into a cylindrical configuration.

Description of the prior art

Maintaining the strip in a tightly-wound controlled state during play-out, wind-in, and while stopped, is difficult to obtain in the prior art apparatus, particularly in the presence of vibration which can prevail in certain environments of the apparatus.

SUMMARY

In the apparatus of the present invention, by virtue of the structural features of the present apparatus, a tension is maintained on the strip while it is being wound and unwound by motor operation from the storage reel and is locked in such tensioned state on the reel during its storage.

BRIEF DESCRIPTION OF THE DRAWING

The single figure is a three-dimensional schematic representation of a boom deploying and retracting apparatus embodying the invention.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to the drawing, the boom deployer-retractor apparatus is adapted for use in deploying continuously an extendible cylindrical boom **1** of the type formed from an elongated thin strip **2** of material such as beryllium copper, which is wound onto a storage reel **3** when in a retracted state and is self-biased by virtue of such as previous heat treatment to curl its side edges together to form a cylindrical configuration when unrestrained. It also may have locking tabs and notches formed in its side edges, such as shown, which mate together to provide an interlocked seam. Other booms with tabs and notches are disclosed in detail in U.S. Patents 3,144,104 and 3,177,987 to Weir et al. and Swaim, for example.

In accord with features of the invention, substantially the full length of the strip **2** is rolled up on the storage reel **3**, save for a leading section **5** between such reel and a boom guide **6** defining the boom entrance-exit portal of the device; a stop **7** being attached to the end of the boom to prevent its complete retraction into the apparatus and onto the reel. During deployment of the boom **1** the strip **2** is unwound from storage reel **3** by pinch rolls **9** and **10** arranged to accept the strip tangentially from such reel, pass it half way around the one reel in reverse of its direction leaving the storage reel and between the two reels for advancement outwardly through the guide **6**; such strip having curled itself into a cylinder shape in transit from such pinch rolls to such guide. A tension is maintained in the strip **2** on the storage reel **3** by a friction drag **12** which resists rotation of the storage reel **3** caused by the pinch-roll strip withdrawal. Rotary turning effort to accomplish such strip unwinding is obtained from a reversible motor **14** operatively connected to pinch roll **9** essentially by way of a harmonic drive unit **15** in sealed cooperation with a sealed housing of the motor, a pair of gears **16** and **17**, and a slip clutch **18**, as well as the required number of shafts for rotary support and/or transmission of such elements. A guide shoe **20** is disposed adjacent to the exit end of the pinch rolls **9** and **10** to prevent bending of the strip during playout which otherwise might result from increased thrust load on such strip as the boom **1** becomes extended to relatively long lengths. A frame means **2**, shown fragmentally, provides support for the components of the apparatus, and the pinch roll **10** is biased toward pinch roll **9** to provide a squeeze force on the strip **2** by such as compression springs **24** acting on journal members **24** for the shaft of such roll **10**.

During retraction of the boom **1**, the strip **2** is caused to wind onto the storage reel **3** by the reversible motor **14** through the medium of a shaft **25**, a unidirectional coupling **26**, that overruns during boom depolyment, and a gear **27** driven by gear **16**. Such strip windup by the reel **3** is resisted by a rotary restraint imposed on the pinch rolls **9** and **10** by the slip clutch **18**, the input end of which is also being driven by the motor **14** in the proper direction for the strip travel through the pinch rolls, but at a speed which is less than that required to keep up with such travel. Such restraint on the strip **2** being pulled around the storage reel by its rotation assures its becoming tightly wound thereon.

During deployment of the boom, the rotary components turn in the direction of the arrows marked thereon in the drawing, and such directions are reversed during boom retraction.

Once the motor **14** is stopped, during either boom retraction or deployment, the harmonic drive unit **15** tends to become self locking and unwinding of the strip **2** from the reel **3** is resisted by the friction drag **12** on such reel, and the slip clutch **18** which opposes pinch-roll rotation.

We claim:

1. Boom deploying and retracting apparatus comprising,

a thin elongated strip self-biased to curl edgewise into a cylindrical boom configuration when unrestrained,

a storage reel attached to one end of said strip and rotatable to cause such strip to be wound about its periphery and to permit unwinding of such strip therefrom,

a boom guide having an entrance-exit portal through which the opposite end of such strip extends in its cylindrical configuration as a boom,

rotatable pinch rolls between which said strip passes enroute from storage reel to boom guide,

friction restraining means imposing limited restraint to rotation of said storage reel,

a reversible motor,

a unidirectional coupling in rotary connection to the axis of said storage reel,

a slip clutch in rotary connection to one pinch roll, and

a drive system rotatably connecting said unidirectional coupling and said slip clutch to said motor,

and means for restraining rotation of said drive system when said motor is stopped,

the aforesaid being so constructed and arranged that operation of the motor in one direction turns the storage reel via the unidirectional coupling to wind the strip thereon against a rotary restraint imposed by the pinch rolls and determined by the slip clutch being driven by the motor in the strip wind-in direction but at a speed less than that required for the pinch rolls to keep up with the rate at which the storage reel pulls the strip through such pinch rolls, and operation of the motor in the opposite direction causes the slip clutch to turn the pinch rolls for withdrawing the strip tangentially from the storage reel against limited rotary restraint imposed on the storage reel by the friction restraining means while the unidirectional coupling is driven in an over-running state by said motor.

2. The apparatus of claim **1**, wherein the pinch rolls reverse the direction of strip travel between storage reel and boom guide.

3. The apparatus of claim **1**, wherein a stop is attached to the end of the boom which prevents such end from entering through said boom guide.

4. The apparatus of claim **1**, wherein said means for restraining rotation of said drive system when said motor is stopped is embodied in the construction of the drive system per se.

5. The apparatus of claim **1**, wherein said motor comprises a sealed housing in sealed cooperation with a sealed harmonic drive unit, a first gear driven by said unit, and a pair of gears driven by said first gear and in driving connection to said unidirectional coupling and to said slip clutch, respectively.

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