

(19)		Canadian Intellectual Property Office	Office de la Propriété Intellectuelle du Canada	(11)	CA 720917	(13)	A
		An Agency of Industry Canada	Un organisme d'industrie Canada	(40)	02.11.1965		

(12)

(21) Application number:	720917D	(51) Int. Cl:	
(22) Date of filing:	..		

(71) Applicant:	CANADA NATURAL RESOURCES.	(72) Inventor:	KLEIN GEORGE J ().
-----------------	----------------------------------	----------------	---------------------------

(54) **COILABLE EXTENSIBLE APPARATUS**

(57) **Abstract:**

This First Page has been artificially created and is not part of the CIPO Official Publication

This invention relates to a collapsible extensible apparatus. The apparatus of the invention is especially useful as an antenna or as a means for extending an instrument a desired distance outwardly from a body in which the apparatus of the invention is mounted, for example, a satellite, the apparatus of the invention acting as a carrying boom for the instrument in question.

The apparatus of the invention appears at present to be particularly valuable in space satellite applications where the satellite, at the time of launching, must not be encumbered by elements projecting any substantial distance outwardly from its walls, while, once the satellite is in orbit, it is desirable to project an antenna from the body of the satellite or position some measuring instrument at a known distance away from the body of the satellite. The apparatus is useful in other fields as well, and could, for example, advantageously be included amongst the emergency equipment stowed in lifeboats and aircraft, or could be used as a liner for holes produced by diamond drilling in mining operations and the like, to keep the drilled holes clean.

It is known that tempered spring steel and other spring materials which are hardened and tempered by heat treatment may be formed into a desired shape, without substantially altering the temper or other physical qualities of the material, by means of elastic deformation applied concurrently with a stress relieving heat treatment at a temperature slightly less than the original tempering temperature. The present inventor found that if a strip of tempered spring material of considerably greater length than width is elastically deformed into a tubular formation extending in the direction of its longitudinal axis with substantial overlap of the longitudinal edges of the strip, and if the strip is concurrently stress-relieved as just described, then even if the strip is subsequently tightly coiled at right angles



to its longitudinal axis, it will, whenever free to do so, revert to the tubular formation. A strip which has been so treated may therefore be described as having been preformed to assume, whenever free to do so, a tubular formation extending in the direction of the longitudinal axis of the strip with substantial overlap of the longitudinal edges of the strip. The present inventor further realized that if apparatus could be provided which would stow such a strip of material in a compact space yet would permit erection of the strip so that it could adopt the tubular formation which it had been biased to assume by the deforming and stress relieving steps, the strip would be useful both as an antenna or as a carrying boom for instruments as mentioned above, particularly in the case of space satellites.

The apparatus of the invention meets these desiderata and stows the extensible strip in a very compact manner which is of course a desirable feature in any space vehicle.

The apparatus of the invention may be generally defined as a coilable extensible apparatus comprising a thin strip of metal of much greater length than width which has been pre-formed to assume, whenever free to do so, a tubular formation extending in the direction of the longitudinal axis of the strip with substantial overlap of the longitudinal edges of the strip, a frame, a stowage reel rotatably mounted within said frame and adapted to stow the strip by winding it on the reel at right angles to the longitudinal axis of the strip, and a guide means mounted within said frame, said guide means having a base which is disposed at a tangent to said reel and a guiding section which is generally tubular and decreases in internal width with distance away from said reel.

The apparatus of the invention preferably includes a pull-out tape which may be inter-wound with the metal strip upon the stowage drum and is attached to a second reel which is positively driven by a small

motor also located within the frame. The motor drives the second reel and the second reel draws the pull-out tape off its stowage reel and thus positively drives the metal strip through the guide sleeve, at the same time supporting the partly spread out end of the metal strip in the region where it leaves the stowage reel to prevent it from buckling due to axial loading.

10 As the thin metal strip, tempered spring steel which is a few thousandths of an inch thick, or beryllium copper of the same order of thickness, are preferably employed. The pull-out tape itself may also be made of a thin strip of metal but any strong thin tape may be employed to play this role. One product which has been found useful as the pull-out tape is a tape made of a polyethylene terephthalate resin.

In drawings illustrating one presently preferred form of the apparatus of the invention:-

Figure 1 is a schematic view showing the winding arrangement of the pull-out tape and the metal strip,

20 Figure 2 is a perspective view of the apparatus of the invention, with a part of the tubular guide sleeve broken away so as to better show the thin metal strip in the process of forming itself into the tubular formation, and

Figure 3 is a central vertical section through the apparatus of the invention with the pull-out tape and the metal strip removed from the reels on which they are normally stowed.

In Figure 1, 10 indicates a reel for stowing the metal strip in interwound formation with the pull-out tape, while 11 indicates a reel upon which the pull-out tape is wound when it is drawn off the reel 10 so as to extend the metal strip. The metal strip itself is indicated at 12 while the pull-out tape has been labelled 13. The metal strip is one

which has been preformed to assume a tubular formation as previously described and it will be noted that, as soon as the strip 12 leaves the stowage reel 10, it commences to curve inwardly so that it assumes a full tubular formation when within a very short distance of the stowage drum, and eventually assumes, as may be seen in the drawings, an overlap of the order of 180°.

Turning now to Figures 2 and 3, it will be noted that the stowage reel 10 and the pull-out tape reel 11 are mounted by means of suitable shafts within a frame made up of a pair of similar side plates 14 and 15. Interposed between the side plates 14 and 15 is a guide sleeve 16 which is generally tubular and decreases in internal width with distance away from the reel 10. The guide sleeve 16 is mounted with its base generally tangentially disposed with respect to the reel 10 and the guiding section of the sleeve preferably has an inner surface which generally corresponds to the shape which would be assumed by the strip in the region of said reel if the strip were fed tangentially off the stowage reel in the absence of any guide sleeve.

In the embodiment of the invention illustrated in Figures 2 and 3 the strip of metal 12, when extended is intended to function as an antenna. To this end an antenna feed connection 17 is provided in the form of a multi-fingered contact cup which rides on the end of the antenna stowage reel shaft. The inner end of the antenna tube material is fixed to the shaft (in a manner not shown), while the contact cup is fixed relative to the frame so that the shaft rotates within it while the antenna is being extended.

Also mounted within the frame made up of the two side plates 14 and 15, is a motor 18 which is best seen in Figure 3. The motor 18 is preferably a small electric motor which is powered by a nickel-cadmium battery (not shown). The motor 18 has a drive shaft 19 which carries a gear 20, and this gear 20, through a gear reduction assembly which has been indicated generally by reference numeral 21, drives a

gear wheel 22 which is freely rotatably mounted on a shaft 23 which is employed to rotatably mount the pull-out tape reel 11. Fixed to the third shaft 23, as indicated at 24 in the drawings is a clutching member carrying teeth 24a which are normally engaged in detents formed in the hub of the gear wheel 22. An expansion spring 25, concentrically mounted on the shaft 23, serves to normally bias the clutching member 24 into engagement with the gear wheel 22, so that member 24, and in turn, the reel 11, will normally be rotated, though at a reduced speed, whenever the drive shaft 19 of the motor 18 is rotated.

Thus, to extend the strip 12 so as to form an antenna it is only necessary to energize the motor 18 whereupon said motor will rotate its shaft and in turn drive the pull-out tape reel 11. The pull-out tape 13 will then draw the metal strip 12 off the stowage reel 11 and cause said strip to pass through the tubular guide sleeve 16, whereupon it will form the desired extended tubular formation with the longitudinal edges of the strip overlapping.

Mounted upon the outer surface of the side plate 15 is a microswitch 26 which is wired in known manner, so that when depressed, it will act to cut-off the power supply to the electric motor 18.

Rotatably mounted by the side plates 14 and 15 of the frame is a rod 27. A follower arm 28 is rigidly mounted on the rod 27, and the rod 27 is biased by spring means (not shown) to rotate counter-clockwise, as viewed in Figure 2, thus causing the free end of the follower arm 28 to ride against the cylindrical surface of the reel 10, or whatever is wound upon the reel. The cylindrical surface of the reel 10 is provided with a slot (not shown) which will not be exposed until the metal strip has become fully extended because that slot will be normally covered by the parts of the metal strip 12 and tape 13 wound on the reel 10. However, once this slot is uncovered, the end of the biased follower arm will drop into it and thus lock the stowage reel 10 against further

rotation.

The end of the rod 27 extends slightly beyond the side plate 15 and has fixed to it a micro-switch cam 30 which, whenever the follower arm 28 drops into locking position in the slot in the reel 10, will rotate and come to a halt against a stop pin 31 on the upper surface of the side plate 15. As this occurs the micro-switch 26 will be depressed, thus deenergizing the motor 18.

The apparatus may be mounted in brackets 35 secured to the satellite or other unit in which the apparatus is to be employed by means of bolts 36 which pass through the side plates 14 and 15 and enter projections 37 which space the tubular guide sleeve 16 from the two side plates.

The apparatus may be adapted to be manually rewound by providing a squared head on the projecting end of the shaft which rotatably mounts the stowage drum 10. A gear such as the bevelled gear 38 may be locked upon the projecting end of this shaft to facilitate the rewinding. During rewinding the shaft 23 should be pressed downwardly so as to disengage the clutching member 24 from the gear wheel 22, thus disconnecting the tape reel 11 from the reduction gearing 21.

THE EMBODIMENTS OF THE INVENTION IN WHICH AN EXCLUSIVE PROPERTY OR PRIVILEGE IS CLAIMED ARE DEFINED AS FOLLOWS:

1. A coilable extensible apparatus comprising a thin strip of metal of much greater length than width which has been pre-formed to assume, whenever free to do so, a tubular formation extending in the direction of the longitudinal axis of the strip with substantial overlap of the longitudinal edges of the strip, a frame, a stowage reel rotatably mounted within said frame and adapted to stow the strip by winding it on the reel at right angles to the longitudinal axis of the strip, a guide means mounted within said frame, said guide means having a base which is disposed at a tangent to said reel and a guiding section which is generally tubular and decreases in internal width with distance away from said reel, a second reel rotatably mounted within said frame a pull-out tape anchored at one of its ends to said second reel and partially wound thereon, said pull-out tape being anchored at its other end, together with said strip of metal, to said stowage reel, whereby said metal strip and pull-out tape may both be interwound and stored on said stowage reel, and means for positively driving said second reel mounted within said frame whereby said pull-out tape may be caused to draw the strip, when stowed on the stowage reel, off said stowage reel, whereupon the unwound part of said strip will be projected through said guide sleeve and will assume a tubular formation extending in the direction of the longitudinal axis of the strip with substantial overlap of the longitudinal edges of the strip.

2. A coilable extensible apparatus as defined in claim 1, in which said second reel is mounted on a rotatable shaft and in which the means for driving the second reel is an electric motor having a drive shaft and means operatively connecting the drive shaft of said motor to said rotatable shaft.

3. A coilable extensible apparatus as defined in claim 1, or 2, including means for locking said stowage reel against further rotation when

said strip has been unwound therefrom to the fully extended position.

4. A coilable extensible apparatus as defined in claim 2, in which means are provided for locking said stowage reel against further rotation when said strip has been unwound therefrom to the fully extended position, and in which switch means are provided in association with said locking means for de-energizing said motor whenever said stowage reel is locked against further rotation.

5. A coilable extensible apparatus as defined in claim 1, or 2, in which said strip of metal is one which has been pre-formed to assume, whenever free to do so, a tubular formation extending in the direction of the longitudinal axis of the strip with an overlap of the longitudinal edges of strip which is of the order of 180 degrees.

6. A coilable extensible apparatus as defined in claim 1, or 2, in which said strip is made of spring steel.

7. A coilable extensible apparatus as defined in claim 1, or 2, in which said strip is made of beryllium copper.

8. A coilable extensible apparatus as defined in claim 2, in which said means operatively connecting the drive shaft of said motor to the shaft on which said second reel is mounted includes a gear wheel freely mounted on said last-mentioned shaft and a clutching member attached to said shaft and engageable with said gear wheel to bring about rotation of said second reel whenever said gear wheel is rotated with said clutching member engaged with said gear wheel, and means normally biasing said gear wheel and clutching member into the engaged position.

9. A coilable extensible apparatus as defined in claim 1, or 2, in which said guiding section of said guide means has an inner surface which generally corresponds to the shape which would be assumed by the strip in the region of said reel if the strip were fed tangentially off the stowage reel in the absence of any guide means.

*

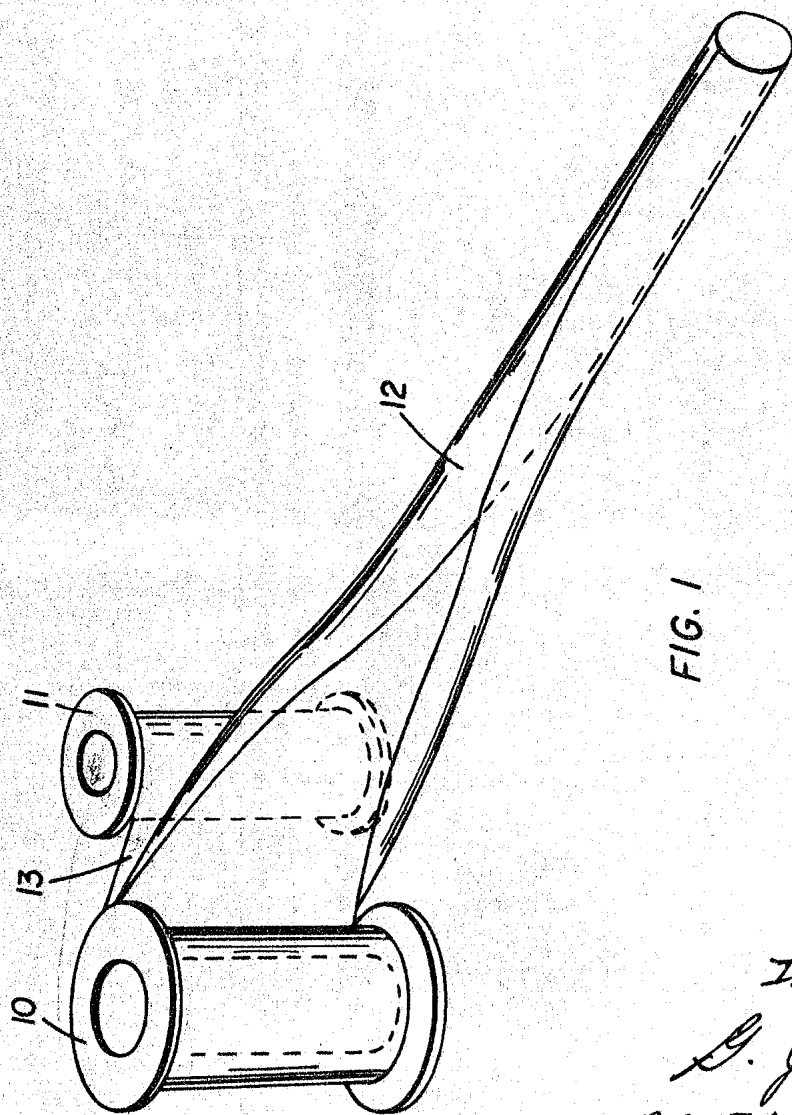


FIG. 1

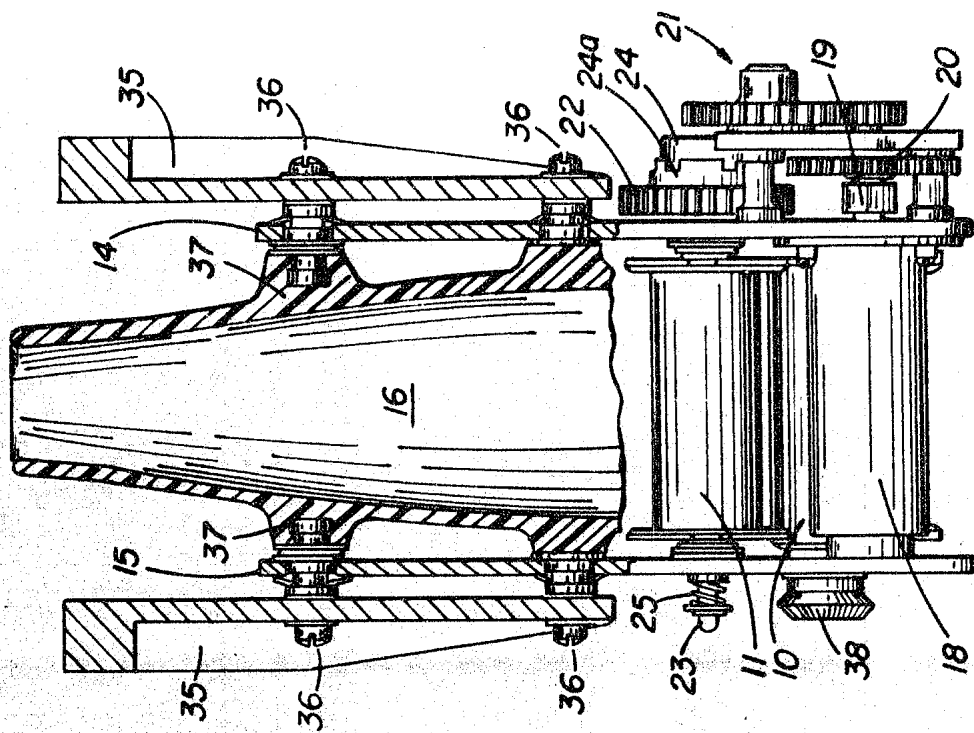


FIG. 3

INVENTOR
G. J. Klein
 PATENT AGENTS
Smart & Biggar

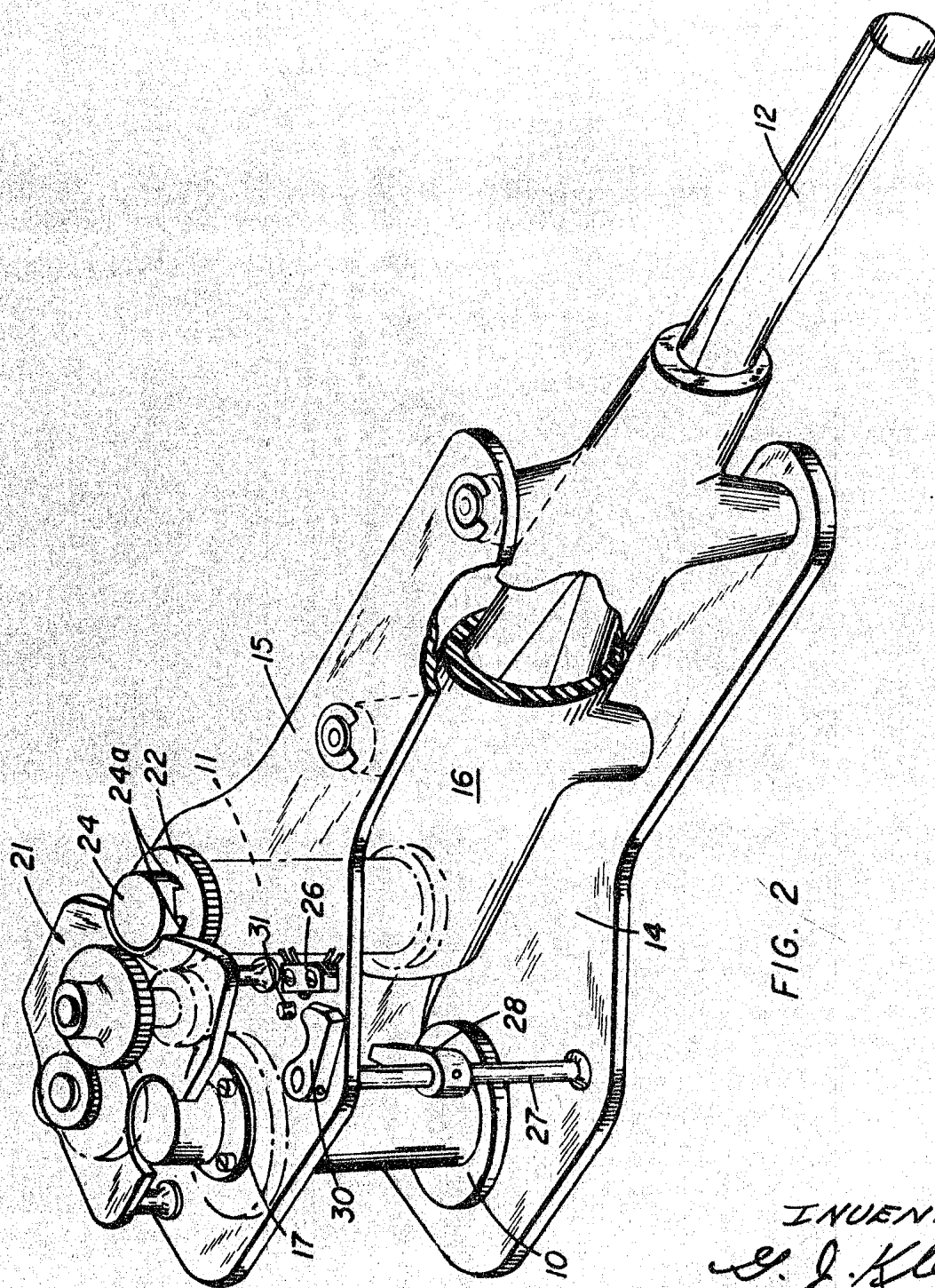


FIG. 2

INVENTOR
S. J. Klein
 PATENT AGENTS
Smart & Biggar