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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
WASHINGTON, D.C. 20546

(NASA-Case-KSC-10392) COLLAPSIBLE HIGH GAIN ANTENNA Patent (NASA) 5 p CSCL 17B

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Unclas
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REPLY TO ATTN OF: GP

TO: KSI/Scientific & Technical Information Division
Attention: Miss Winnie M. Morgan

FROM: GP/Office of Assistant General Counsel for Patent Matters

SUBJECT: Announcement of NASA-Owned U.S. Patents in STAR

In accordance with the procedures agreed upon by Code GP and Code KSI, the attached NASA-owned U.S. Patent is being forwarded for abstracting and announcement in NASA STAR.

The following information is provided:

U.S. Patent No. : 3,737,912

Government or Corporate Employee : U.S. Government

Supplementary Corporate Source (if applicable) : _____

NASA Patent Case No. : KSC-10392

NOTE - If this patent covers an invention made by a corporate employee of a NASA Contractor, the following is applicable:

Yes ☐ No ☒

Pursuant to Section 305(a) of the National Aeronautics and Space Act, the name of the Administrator of NASA appears on the first page of the patent; however, the name of the actual inventor (author) appears at the heading of column No. 1 of the Specification, following the words "... with respect to an invention of . . ."

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Enclosure
Copy of Patent cited above

United States Patent [19]

Cribb

[11] **3,737,912**

[45] **June 5, 1973**

[54] COLLAPSIBLE HIGH GAIN ANTENNA

[75] Inventor: **Herbert E. Cribb**, Satellite Beach, Fla.

[73] Assignee: **The United States of America as represented by the Administrator of the National Aeronautics and Space Administration**, Washington, D.C.

[22] Filed: **Sept. 16, 1971**

[21] Appl. No.: **181,024**

[52] **U.S. Cl.** **343/880**, 343/889, 343/895, 343/883

[51] **Int. Cl.**.....**H01q 1/08**

[58] **Field of Search**.....343/705, 747, 880, 343/889, 895, 901, 883, 868

[56] **References Cited**

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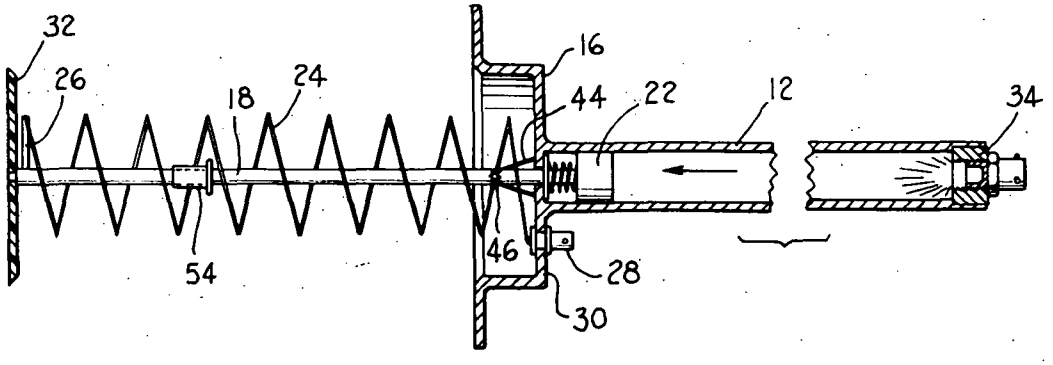
[57] **ABSTRACT**

A lightweight small high gain antenna which is capable of being packaged in a collapsed form and automatically expanded when in use. The antenna includes a cylindrical housing having a rod with a piston adjacent one end extending therethrough. Attached to the outer end of the rod in a normally collapsed state is a helical wire coil. When the gas producing means is activated the piston and rod are shifted outwardly to expand the wire coil. A latch means is provided for holding the helical coil in the expanded position.

4 Claims, 8 Drawing Figures



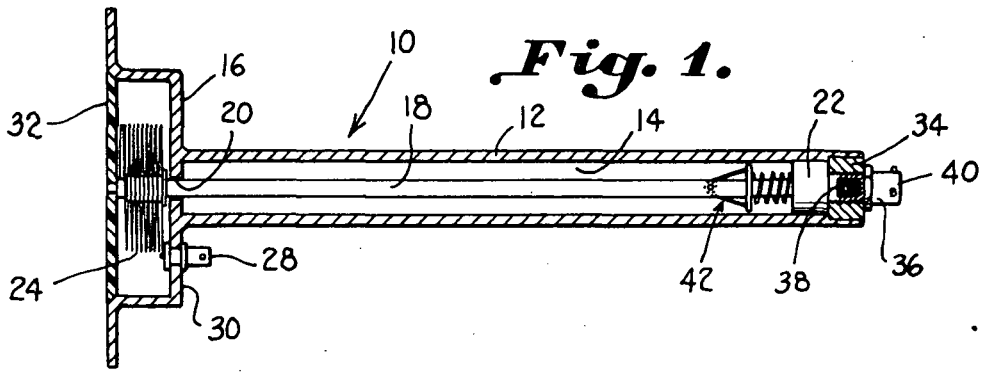


Fig. 1.

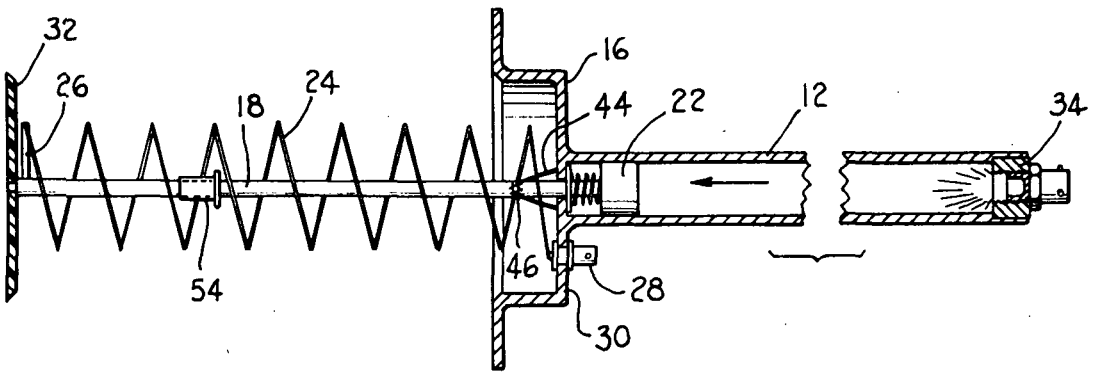


Fig. 2.

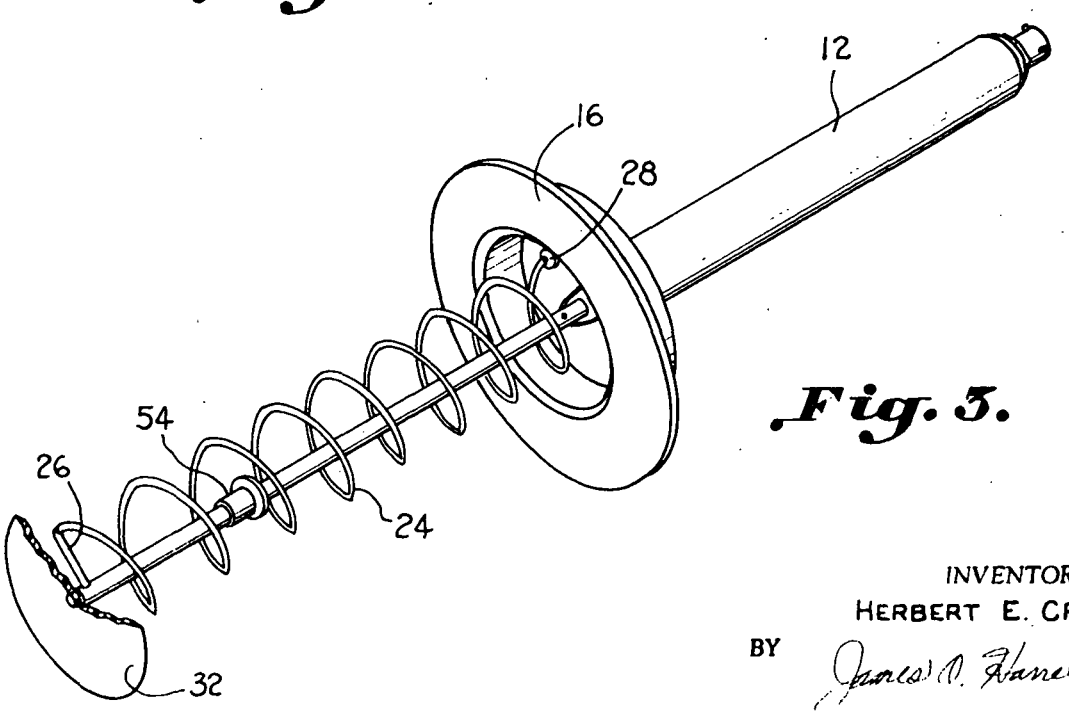


Fig. 3.

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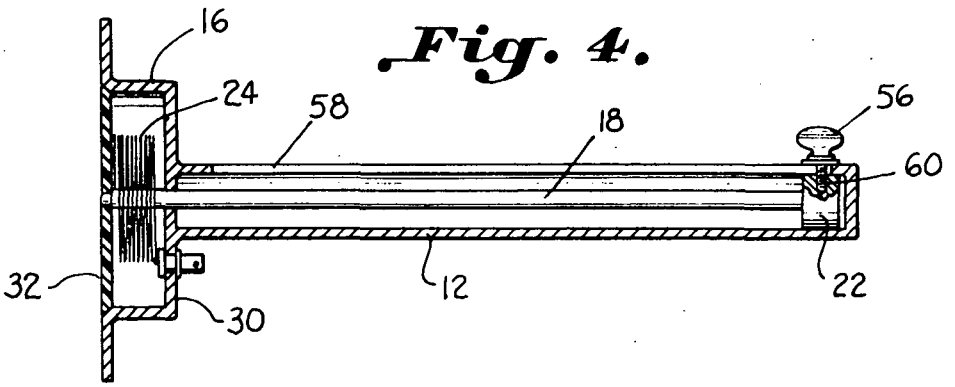

Fig. 4.

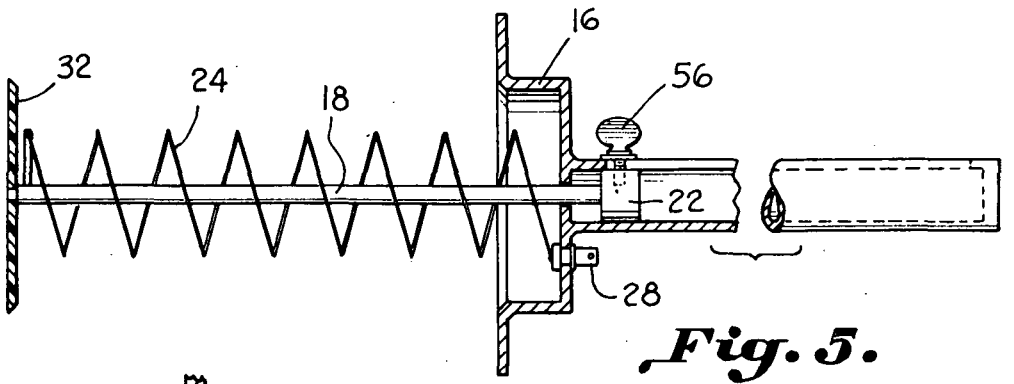

Fig. 5.

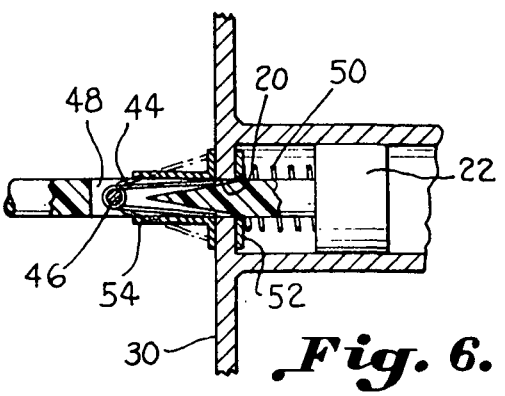

Fig. 6.

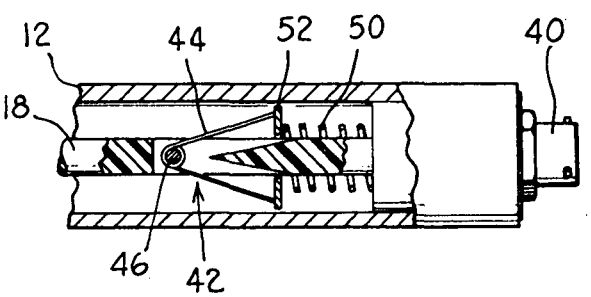

Fig. 7.

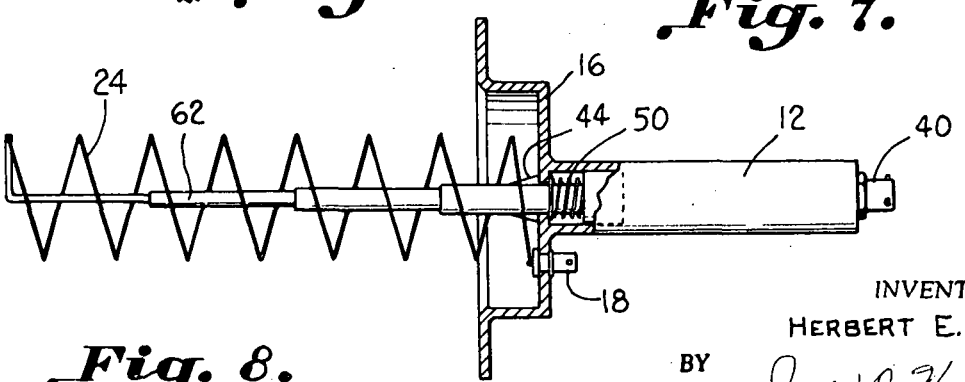

Fig. 8.

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COLLAPSIBLE HIGH GAIN ANTENNA

This invention described herein was made by an employee of the United States Government, and may be manufactured and used by or for the Government for Governmental purposes without the payment of any royalties thereon or therefor.

This invention relates to a collapsible antenna, and more particularly to a lightweight antenna that can be automatically expanded to an operable position.

Heretofore, in order to obtain high gain in antennas usually large dish and horn-type antennas, as well as cavity zero gain antennas, were utilized to obtain high gain. One problem with these antennas is that they are heavy and they must be relatively large in order to obtain the desired gain.

As this country begins to explore the planets it is necessary to have relatively small lightweight high gain antennas that can be packaged in space vehicles and automatically expanded at their desired location, for example, on a planet in order to send back telemetry data. Expandible antennas such as disclosed in U.S. Pat. No. 2,885,674 have been utilized heretofore, but no means have been provided for automatically expanding them responsive to an electrical signal.

In accordance with the present invention, it has been found that difficulties encountered with present day antennas may be overcome by providing a novel, collapsible antenna. This antenna includes the following basic parts: (1) An elongated cylindrical housing having an elongated bore therein, (2) an enlarged housing carried adjacent an outer end of the cylindrical housing communicating with the elongated bore, (3) an elongated rod is carried in the elongated bore with the outer end of the rod extending out the outer end of the bore into the housing, (4) a piston is carried on an inner end of the rod having a diameter substantially equal to the internal diameter of the elongated bore, (5) a normally collapsed helical coil is carried in the enlarged housing with one end of the helical coil being coupled to an outer end of the rod and the other end coupled to an electrical connector. (6) a gas producing means is carried in the cylinder between the piston and the inner end so that when such is activated the expanded gas pushes the piston and the rod outwardly so as to expand the helical wire coil, and (7) a latch is provided for holding the helical wire in the expanded position.

Accordingly, it is an important object of the present invention to provide a collapsible antenna which can be automatically expanded to the operating state.

Another important object of the present invention is to provide a lightweight high gain antenna which can be packaged in a relatively small container so that it can be carried on a space vehicle and expanded in outer space.

Still another important object of the present invention is to provide a collapsible antenna which utilizes a helical coil that is enclosed within a housing with a cover thereon which is automatically removed when the helical antenna is expanded.

Other objects and advantages of this invention will become more apparent from a reading of the following detailed description and appended claims taken in conjunction with the accompanying drawings wherein:

FIG. 1 is a cross-sectional view illustrating a collapsible antenna constructed in accordance with the present invention,

FIG. 2 is a cross-sectional view illustrating a collapsible antenna constructed in accordance with the present invention in the expanded position,

FIG. 3 is a perspective view illustrating the collapsible antenna in the expanded position,

FIG. 4 is a cross-sectional view illustrating a modified form of the invention wherein the antenna can be manually expanded,

FIG. 5 is a cross-sectional view illustrating the modified form of the invention of FIG. 4 in the expanded position,

FIG. 6 is a fragmentary enlarged cross-sectional view illustrating the latch means for the antenna in a latched position when the antenna is expanded,

FIG. 7 is an enlarged cross-sectional view illustrating the latching means positioned within the cylinder in the unlatched position,

FIG. 8 is still another modified form of the invention wherein a telescoping rod is utilized in expanding the antenna.

Referring in more detail to the drawings, and in particular, FIG. 1, there is illustrated a collapsible antenna generally designated by the reference character 10 which includes an elongated cylindrical housing 12 having an elongated bore 14 extending therethrough. An enlarged cup-shaped housing 16 is secured to the outer end of the cylindrical housing 12 by welding or any other suitable means. An elongated rod 18 is carried in the elongated bore 14 with an outer end extending through a hole 20 provided in the base of the cup-shaped housing 16. A piston or plunger 22 is carried on the inner end of the rod 18 and has a diameter substantially equal to the internal diameter of the elongated bore 14. A normally collapsed helical wire coil 24 is carried in the cup-shaped housing 16 with the outer end of the coil attached to a post 26 carried adjacent the outer end of the rod 18. The inner end of the helical coil 24 is connected to an RF connector 28 extending through a base portion 30 of the cup-shaped housing 16. A disc-shaped cap 32 is provided on a reduced end portion of the rod 18 for enclosing the cup-shaped housing 16.

A plug 34 is provided in the inner end of the cylindrical housing 12 for receiving a pyrotechnic gas producing device 36. The gas producing device 36 includes a conventional gas cartidge 38 which has a bridge wire (not shown) extending therethough. When an electrical signal is applied to the pyrotechnic device through a connector provided in the end 40 thereof (not shown) such ignites the powder charge releasing gas pressure against the end of the plunger 22 forcing the plunger to move forward in the cylindrical housing 12.

A locking mechanism 42 which is best shown in FIGS. 1, 2, 6 and 7 is provided adjacent the inner end of the rod 18 for automatically latching the antenna in the expanded position, such as shown in FIG. 2. The locking mechanism includes a V-shaped spring member 44 that is coupled to the rod by a pin 46. The rod is provided with a slot 48 so that the V-shaped spring member can be folded into the plunger rod 18 to allow the rod to be pushed inward until the antenna cover 32 is seated in the cup-shaped housing 16.

A shock absorbing spring 50 is carried between the plunger 22 and a washer 52 to absorb some of the shock created when the gas expandes the helical antenna outwardly. The washer 52 engages the base por-

tion 30 of the cup-shaped housing slightly compressing the spring.

A sleeve is provided on the outer end of the elongated rod 18 so that it can be slipped over the V-shaped spring 44 to allow the V-shaped spring 44 to pass through the opening 20 in the base of the cup-shaped housing 16 in order to fold up the antenna.

FIG. 4 illustrates a modified form of the invention wherein means 56 is provided for manually sliding the rod 18 outwardly. The cylindrical housing 12 has an elongated slot 58 in the wall thereof, through which a finger operated bolt 60 is allowed to pass. The inner end of the finger operated bolt 60 is threaded into the plunger 22. When it is desired to expand the antenna the bolt 60 is loosened and the rod 18 is shifted to the left manually by pushing the enlarged head to the left. The antenna is locked into the expanded position, such as illustrated in FIG. 5, by tightening the bolt 60 against the cylindrical housing 12.

FIG. 8 illustrates still another modified form of the invention wherein a telescoping rod 62 is utilized instead of the solid rod 18 so that the antenna housing 12 can be shortened.

In operation, referring in particular to FIG. 1, if the antenna is positioned in a space vehicle, upon receiving the signal to expand such an electrical signal is fed through the end of the pyrotechnique device 36 and passes through a bridge wire to ignite the powder charge 38 releasing gas pressure against the plunger 22 forcing the plunger to move forward in the antenna housing 12 until the locking mechanism 42 passes through the base of the cup-shaped housing 16. The locking spring 44 extends and locks the rod 18 and helical coil 24 in the expanded position which is illustrated in FIGS. 2 and 3. As is shown, the cap 32 is automatically removed from the end of the cup-shaped housing 16 when the rod 18 is extended.

To check the antenna for pre-launch checkout a suction cup can be pressed over the antenna cover 32 and the operator slowly pulls the piston 22 forward until the locking mechanism 42 is activated. After checkout is complete, the rod 18 is pulled out slightly and the sleeve 54 is pushed over the locking spring arms 44 making them fold into the plunger rod 18. The antenna is then pushed back into the cylindrical housing 12 until the cover 32 is reseated on the cup-shaped housing 16.

In one particular embodiment the antenna is designed for S-band frequency. The coil 24 is an eight turn helix designed to give 12 db gain. The antenna can be designed to cover L and X band frequencies. The number of turns can be increased to give more gain. The antenna can bc used in various configurations such as tri-helix or quad-helix.

While a preferred embodiment of the invention has been described using specific terms, such description is for illustrative purposes only, and it is to be understood that changes and variations may be made without departing from the spirit or scope of the following claims.

I claim:

1. A collapsible helical antenna comprising:
   - A. an elongated cylindrical housing,
   - B. said elongated cylindrical housing having an elongated bore therein,
   - C. an enlarged housing carried adjacent an outer end of said elongated cylindrical housing communicating with said elongated bore,
   - D. an elongated rod carried in said elongated bore with an outer end of said elongated rod extending out an outer end of said elongated bore into said enlarged housing,
   - E. a piston carried on an inner end of said rod having a diameter substantially equal to the internal diameter of said elongated bore,
   - F. an antenna element consisting of a normally collapsed helical wire coil carried in said enlarged housing,
   - G. one end of said helical wire coil being coupled to said outer end of said elongated rod,
   - H. an electrical connector coupled to the other end of said helical wire coil,
   - I. a gas producing means normally carried in said elongated cylindrical housing adjacent said piston,
   - J. means for activating said gas producing means for producing gas in said elongated bore to push said piston and said elongated rod outwardly so as to expand said helical wire coil, and
   - K. latch means for holding said helical wire coil in an expanded position.

2. The collapsible helical antenna as set forth in claim 1 wherein:
   - A. said gas producing means includes a pyrotechnic device that generates expanding gas when activated by an electrical signal.

3. The collapsible helical antenna as set forth in claim 1 wherein:
   - A. said latch means includes an expandible spring member carried by a lower end of said elongated rod which expands to hold said helical wire coil in said expanded position.

4. The collapsible helical antenna as set forth in claim 1 wherein:
   - A. said enlarged housing is cup-shaped, and
   - B. a disc-shaped cap is carried on the outer end of said elongated rod for providing a cover for said enlarged housing when said helical wire coil is collapsed in said enlarged housing.

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