United States Patent [19]

Cole

[11] **3,931,608**

[45] **Jan. 6, 1976**

[54] **CABLE DEPTH CONTROL APPARATUS**

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[73] Assignee: **Syntron, Inc.**, Houston, Tex.

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[21] Appl. No.: **463,980**

[52] **U.S. Cl.** ..... **340/7 PC**; 114/235 B; 340/3 T

[51] **Int. Cl.²** **G01V 1/28**

[58] **Field of Search** ..... 340/7 PC, 3 T; 114/235 B

[56] **References Cited**

UNITED STATES PATENTS

3,412,704	11/1968	Buller et al.	340/7 PC
3,531,762	9/1970	Tickell	340/7 PC
3,673,556	6/1972	Biggs	340/7 PC

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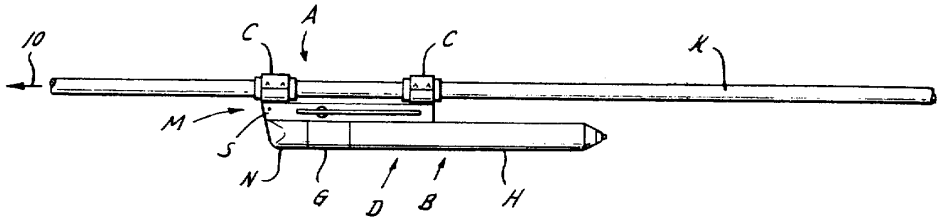
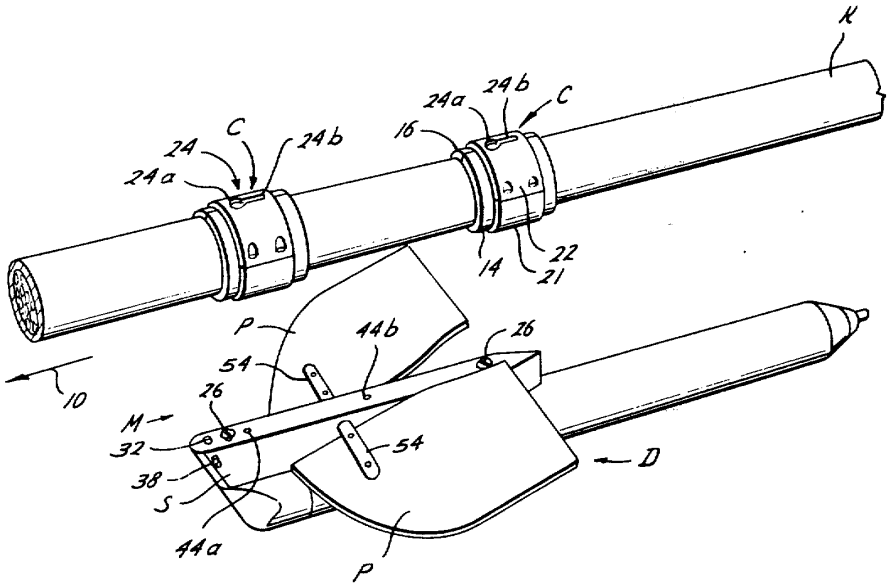
[57] **ABSTRACT**

An apparatus to control the depth in the water of a cable, such as a cable streamer of seismic geophones or hydrophones towed behind an exploration boat during seismic surveys of submerged formations, and maintain the cable at a desired depth while operating at reduced noise levels and with improved operating characteristics. The depth at which the cable is maintained may be adjusted for a range of selected depths.

12 Claims, 6 Drawing Figures





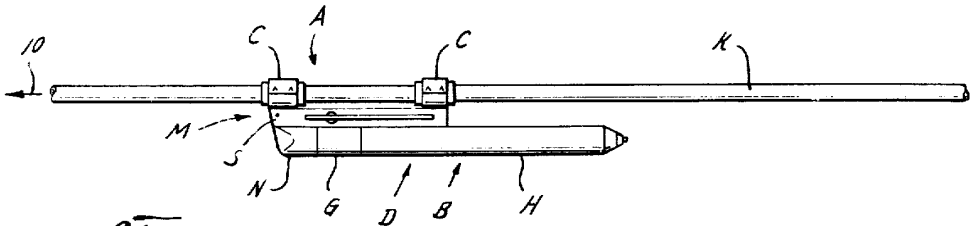


Fig. 1

Fig. 2

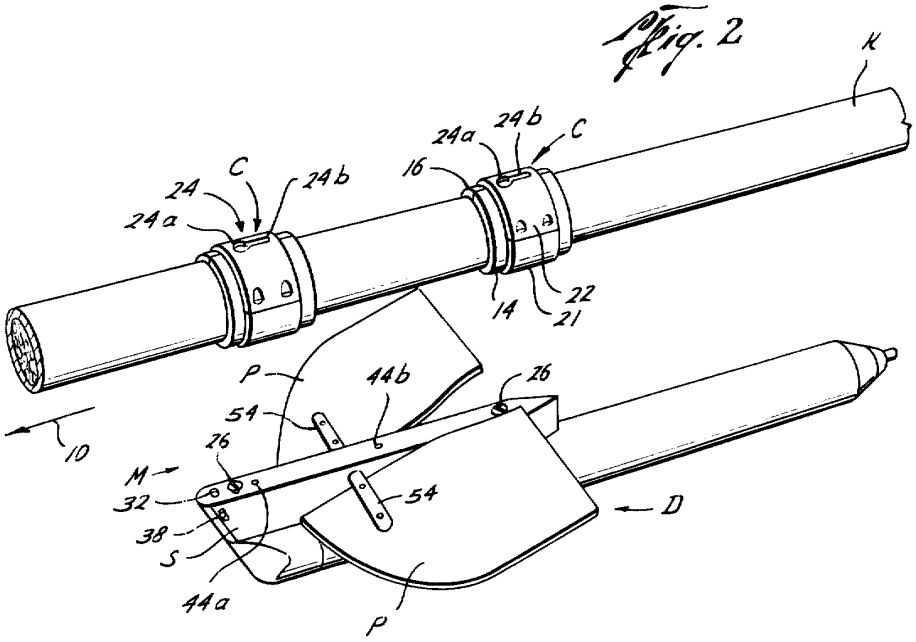
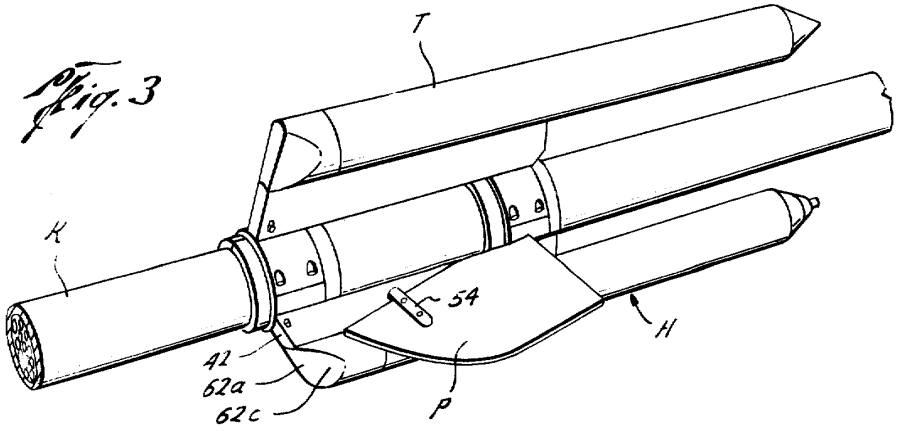


Fig. 3



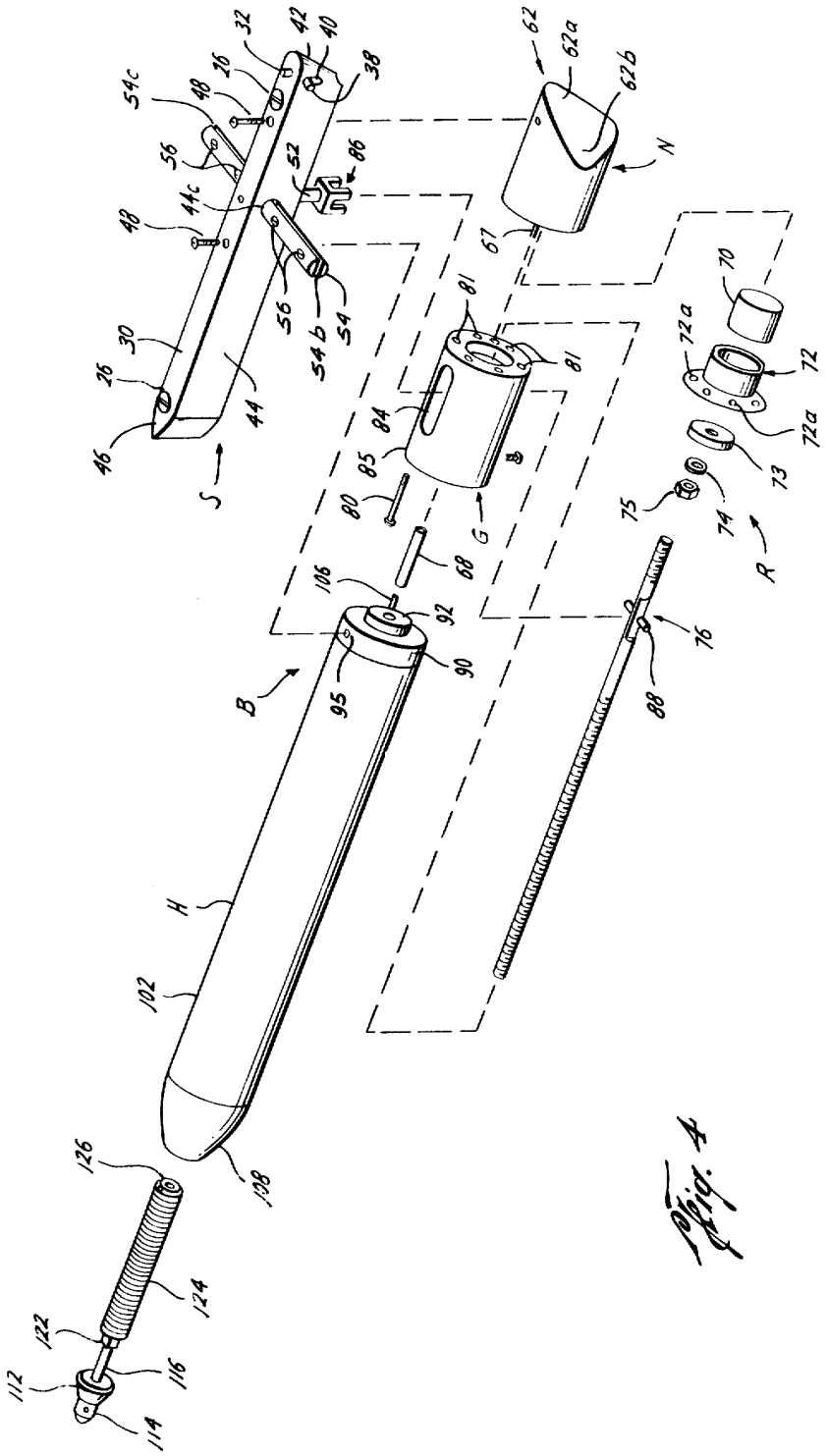


Fig. 4

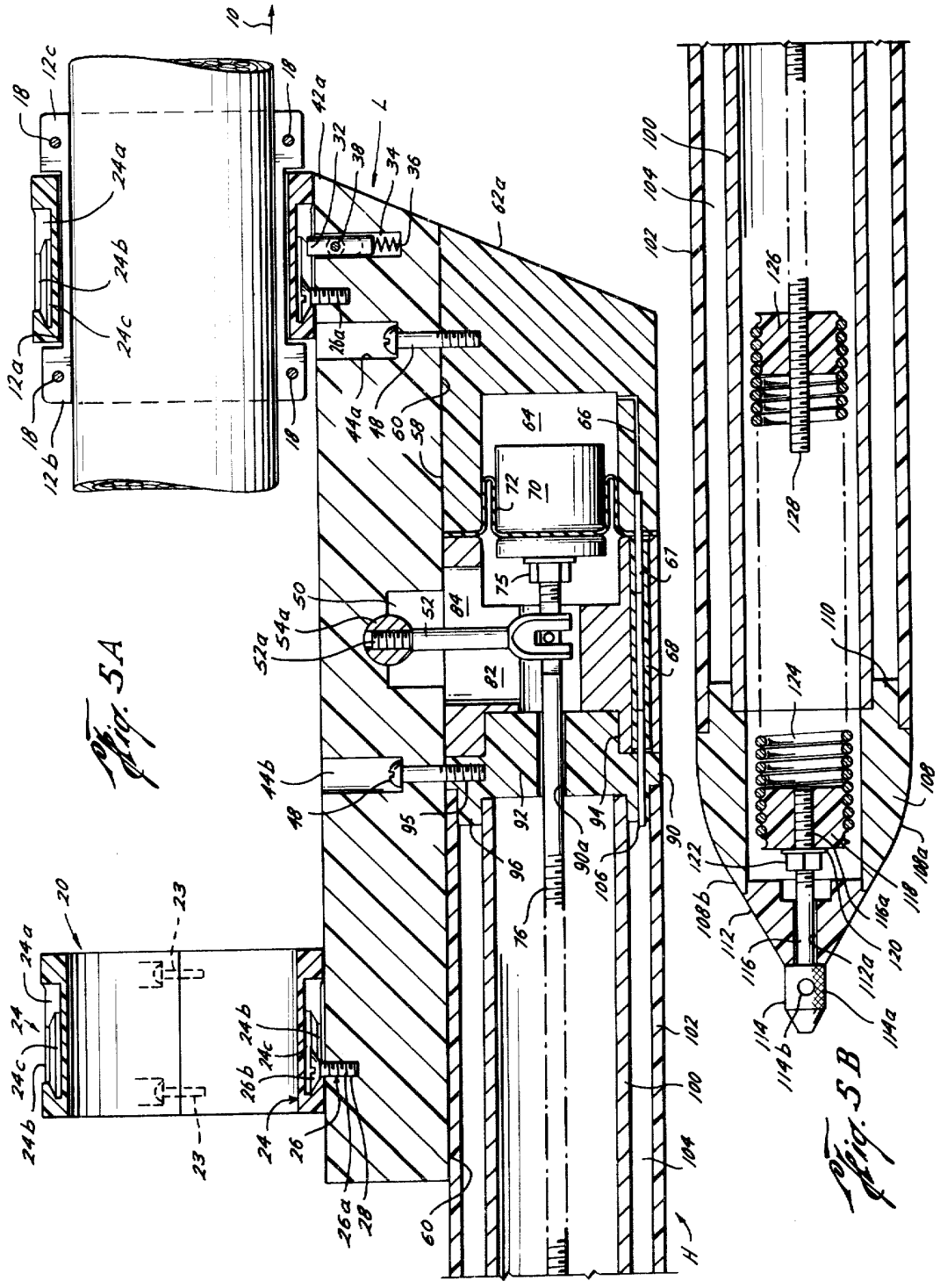


Fig. 5A

Fig. 5B

CABLE DEPTH CONTROL APPARATUS

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to an apparatus for controlling the depth of a cable, such as a seismic hydrophone streamer, in water.

2. Description of the Prior Art

Beginning with early attempts to control the depth of submerged seismic cables during exploration, such as a single drogue assembly drawn behind the cable in U.S. Pat. No. 2,465,696, or the spaced weights and floats of U.S. Pat. No. 2,729,300, considerable effort has been expended to accurately control the cable depth at a desired depth.

One approach, as exemplified by U.S. Pat. Nos. 3,375,800 and 3,434,446 (of which applicant is an inventor), and also in U.S. Pat. Nos. 3,412,704; 3,496,526; 3,541,989; and 3,605,674 has used plural apparatus, each mounted in a housing about the seismic cable at spaced positions along the length of the cable. With this approach, the housing surrounding the cable tended to confine undesirable noise in the area of the cable which could be sensed by the sensing geophones or hydrophones in the seismic cable. Further, with these apparatus, the depth controlling diving planes were mounted with the apparatus at the thickest portion thereof, increasing the width or cross-section span of the apparatus. Also, if the cable were overfilled with fluid, undesirable binding between the housing and the cable often occurred.

Other apparatus, such as in U.S. Pat. Nos. 3,372,66; 3,611,975; 3,531,762; and 3,531,761 have included even larger wing structure connected at a single connector to the cable and were comparatively hard to control and unwieldy. Further, the large wing structure frequently snared marine weeds and growth and other submerged objects. Still other apparatus, such as in U.S. Pat. No. 3,434,451 have used two control vehicles, one submerged with the cable, with the other at the water surface subject to wave action and thus generally undesirable.

Finally, other depth control apparatus, such as in U.S. Pat. Nos. 2,709,981; 3,492,962; 3,199,482; 3,260,232; 3,560,912; and 2,945,469 were intended for depth control of specialized structure and not, so far as is known, readily adapted to control the depth of seismic cables.

SUMMARY OF THE INVENTION

Briefly, the present invention provides a new and improved apparatus for controlling the depth of a seismic cable. The apparatus includes a depth control means for regulating the depth of the cable having a comparator which compares the force of ambient water pressure at the depth where the cable is operating with a reference force representing the desired cable depth, a control body for containing the comparator, and diving planes which respond to the comparator to move the cable to the desired depth. A connector which includes a support shank mounted between the control body and the cable, with the diving planes mounted to the support shank, and a connecting collar to attach the support shank to the cable, mounts the control body to the cable.

The connecting collar for each support shank is preferably in the form of plural collars mounted with the support shank at spaced portions thereof, so that the connecting collars are spaced from each other along the cable to stabilize the connection between the support shank and the cable.

It is an object of the present invention to provide a new and improved apparatus for controlling the depth of a cable.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is an elevation view of the apparatus of the present invention mounted with a cable;

FIG. **2** is an isometric view, partially exploded, of the apparatus of FIG. **1**;

FIG. **3** is an isometric view of an alternative embodiment of the present invention;

FIG. **4** is an exploded isometric view of portions of the apparatus of the present invention;

FIGS. **5A** and **5B** are elevation views taken in cross-section of front and rear portions, respectively, of the apparatus of the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENT

In the drawings, the letter A designates generally the apparatus of the present invention for controlling the depth of a seismic cable K of the conventional type, formed from vinyl or other suitable material, as the cable K is towed or pulled forward through a body of water in a direction indicated by an arrow **10** (FIG. **1**) behind a seismic exploration vessel of the conventional type. Typically, the cable K is filled with kerosene or suitable liquid for neutral buoyancy in the body of water and contains at spaced locations therein plural seismic signal sensing geophones or hydrophones which sense reflected seismic signals indicating the response of geological features of the area underlying the body of water to signals from a seismic source. The sensing hydrophones are connected through suitable conductors in the cable K to the vessel to permit the response of these geological features to be recorded by suitable instruments on the vessel.

Typically, the cable K is several thousand feet in length, and plural depth control apparatus A of the present invention are mounted at suitably spaced locations along the cable K to keep the cable K at substantially the same depth along its length, an important factor for accuracy in seismic surveying.

The apparatus A includes a depth control unit or assembly D, which includes a force comparator R (FIGS. **4**, **5A** and **5B**) which compares the force of ambient water pressure at the depth at which the cable is operating with a reference force representing the desired cable depth, a control body B for containing the comparator R, and plural diving planes P (FIGS. **1–3**) which respond to the comparator R and move the cable K to the desired depth.

A connector means M mounts the depth control unit D to the cable K and includes a support shank S mounted between the control body B and the cable K. The support shank S further has the diving planks P mounted therewith, for reasons to be set forth below. The connector means M further includes plural connecting collar assemblies C for attaching the support shank S to the cable K.

Considering the apparatus A more in detail, the connecting collar assemblies C (FIG. **5A**) each include a cylindrical inner race **12** formed of two half-cylinder members **14** and **16** which are semi-circular in cross-

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