United States Patent [19]

Punton

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[54] **COMPRESSED GAS MACHINE**

[76] Inventor: **George C. Punton,** 10977 Horizon Hills, El Cajon, Calif. 92020

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[21] Appl. No.: **471,335**

[52] **U.S. Cl.** **415/5;** 60/496; 415/7; 417/337

[51] **Int. Cl.²** **F03B 9/00**

[58] **Field of Search** 415/5, 7; 60/495, 496; 417/337

[56] **References Cited**

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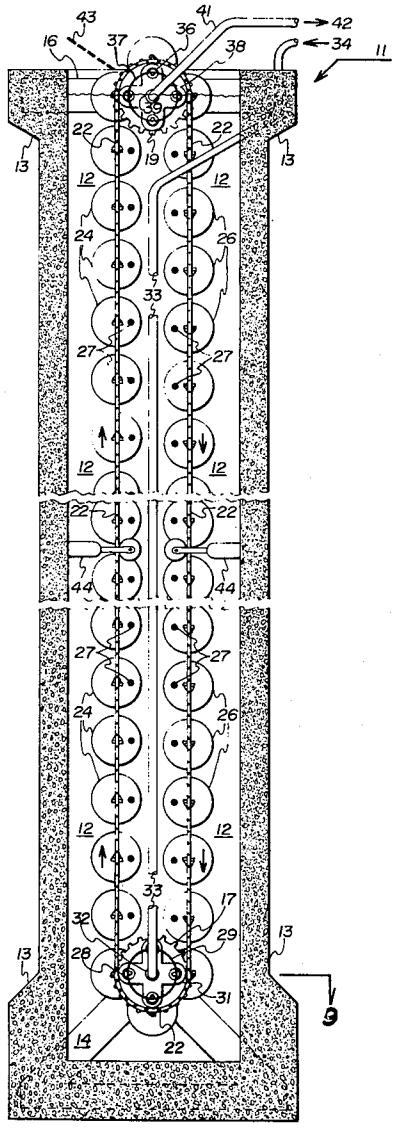
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Primary Examiner—C. J. Husar
Assistant Examiner—Edward Look

[57] **ABSTRACT**

A compressed gas machine in which a plurality of inflatable and deflatable bladders are attached between a pair of chain loops which are carried each by a pair of sprockets vertically disposed above the other to form a line of ascending and descending buoyancy bladders. As the buoyancy bladders pass the top sprocket, a dump valve communicates with the buoyancy bladders, exhausting the gas therein, and as the buoyancy bladders pass around the bottom sprockets, a filler valve is brought into engagement with the bladders and compressed gas is applied thereto, causing the bladders on one side to lift and continue rotation of the chain sprocket assembly. The output is taken through a shaft coupled to the top sprocket axle.

3 Claims, 11 Drawing Figures



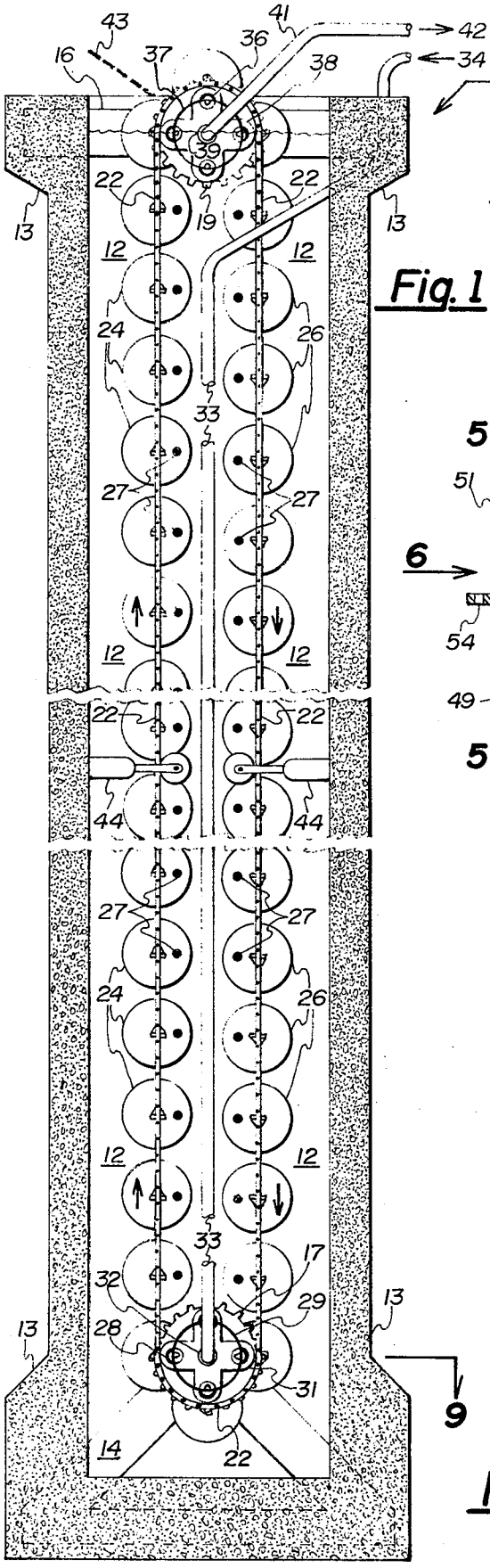


Fig. 1

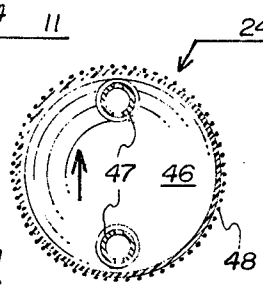


Fig. 2

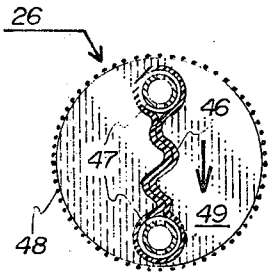


Fig. 3

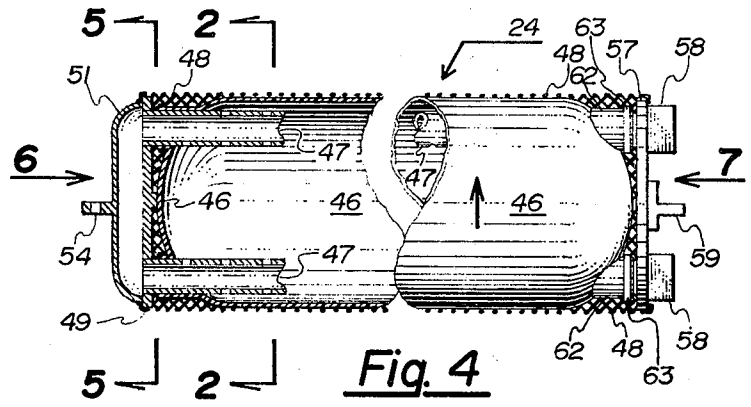


Fig. 4

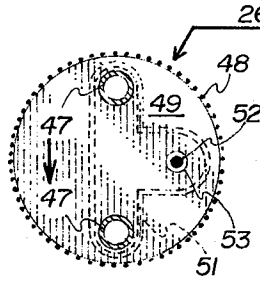


Fig. 5

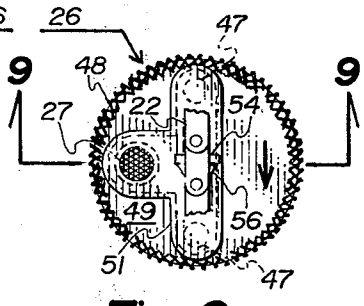


Fig. 6

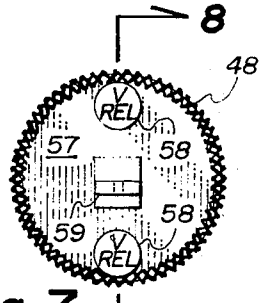


Fig. 7

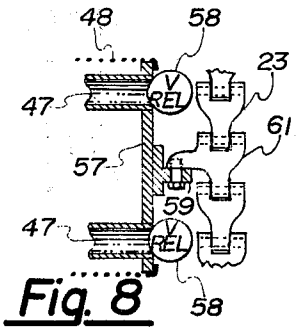


Fig. 8

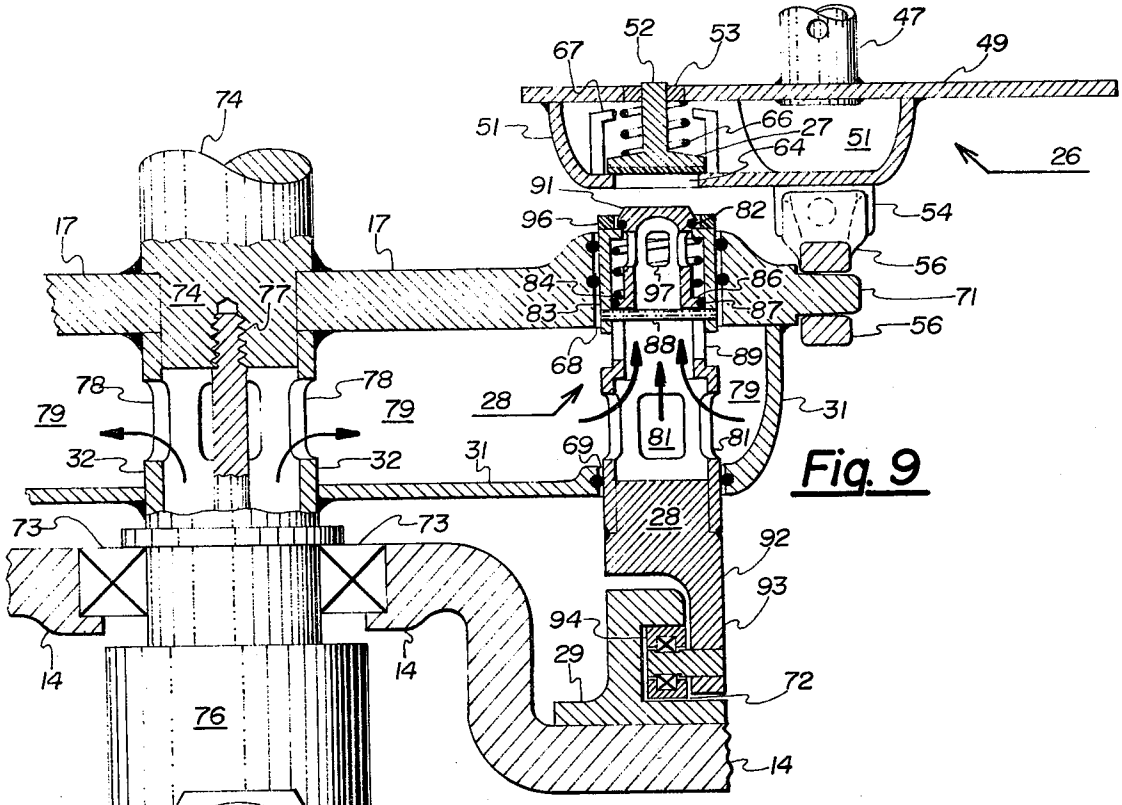


Fig. 9

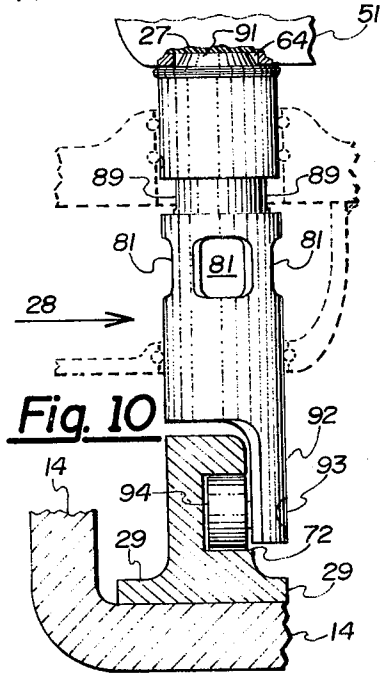


Fig. 10

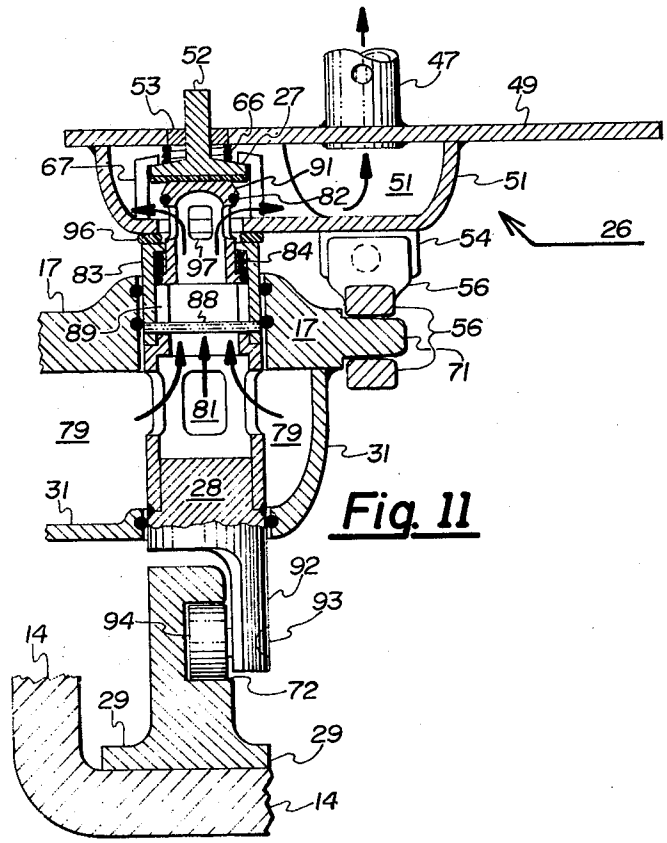


Fig. 11

COMPRESSED GAS MACHINE

BRIEF DESCRIPTION OF THE INVENTION

The present invention relates to a compressed gas machine and more particularly to a compressed gas machine utilizing inflatable and deflatable buoyancy units in a column of liquid.

According to the invention, a vertical chamber is provided rotatably carrying a pair of sprockets at the top and bottom portions thereof. A pair of chain loops is coupled between each pair of top and bottom sprockets and a plurality of inflatable buoyancy bladders is coupled between the chains, resulting in two vertical columns of inflatable buoyancy bladders. A source of compressed air is coupled to a projectable filler valve which is carried by the bottom sprocket assembly. The projectable filler valves are each cammed into a filler valve of a buoyancy bladder as they encircle the bottom sprocket assembly, filling the bladder with compressed gas as it rotates around the sprocket assembly. As the buoyancy bladder leaves the sprocket assembly in an upward direction, the projectable filler valve is withdrawn and the gas pulls the chain assembly upwardly through the fluid medium that immerses the entire assembly within the chamber. As the buoyancy bladders reach the top sprocket assembly, a projectable dump valve is cammed into the filler dump valve of the bladder and exhausts the compressed gas, allowing the bladder to descend on the other side of the chain loop.

An object of the present invention is to provide an improved compressed gas machine.

A further object of the invention is the provision of a compressed gas machine which is relatively inexpensive in manufacture and reliable in operation. Other objects and many of the attendant advantages of the 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 in which like reference numerals designate like parts throughout the Figures thereof and wherein:

FIG. 1 is a schematic representation of the preferred embodiment of the present invention;

FIG. 2 is a cross sectional view of one of the buoyancy units of FIG. 1 in an inflated condition;

FIG. 3 is a cross sectional view of one of the buoyancy units of FIG. 1 in a deflated condition;

FIG. 4 is a side elevational view partially broken away of one of the buoyancy units of FIGS. 2 and 3;

FIG. 5 is a cross sectional view taken along lines 5—5 of FIG. 4;

FIG. 6 is an end view of the buoyancy unit of FIG. 4 looking from the arrow 6;

FIG. 7 is another end view of the buoyancy unit of FIG. 4 looking from arrow 7;

FIG. 8 is a cross sectional view taken along lines 8—8 of FIG. 7;

FIG. 9 illustrates the filler and dump mechanism, partially sectioned, of FIG. 1;

FIG. 10 illustrates the projectable filler valves of FIG. 1 together with their camming mechanism; and

FIG. 11 illustrates the projectable filler valve assembly of FIG. 9 in an engaged position.

DETAILED DESCRIPTION OF THE DRAWING

Referring to FIG. 1, the entire assembly of the compressed gas machine is shown generally at 11 having a liquid filled chamber 12 defined by an impervious chamber lining 13 which anchors a bottom support and tensioning structure 14 and a top support structure 16. A bottom near sprocket 17 and a bottom far sprocket (not shown) disposed directly behind bottom near sprocket 17 are carried between two vertical members of bottom support 14 and are paralleled with corresponding top near sprocket 19 and a top far sprocket (not shown) disposed between two horizontal members of top support structure 16. The top and bottom sprockets are respectively interconnected by a near chain loop 22 and a far chain loop (not shown) disposed directly behind near chain loop 22 between which are suspended ascending buoyancy units 24 and descending buoyancy units 26.

Ascending buoyancy units 24 are filled with a gas through filler dump valves 27 which for a portion of a motion cycle circle around the bottom near sprocket 17 and are momentarily contacted by projectable filler valves 28 which are activated as the sprocket rotates by filler valve cam circle 29 which is fixed and which communicate with the gas chamber (not shown) of a bottom sprocket manifold 31 which is supplied with gas through bottom hollow axle 32. Bottom hollow sprocket axle 31 communicates through a compressed gas conduit 33 with a compressed gas input 34.

Descending buoyancy units are purged of gas through filler dump valves 27, which for a portion of the motion cycle circle around the top near sprocket 19, and are momentarily contacted by projectable dump valves 36. Projectable dump valves 36 are activated as the sprocket rotates by dump valve cam circle 37 which is fixed and which communicates with the vacuum chamber of a top sprocket manifold 38. Top sprocket manifold 38 is exhausted through a top hollow sprocket axle 39 which in turn communicates through a conduit 41 to exhaust outlet 42.

A power drive shaft output 43 is coupled to the top hollow sprocket axle 39. Anti-vibration snubbers 44 prevent whipping of the chain loops as they rotate.

Referring to FIGS. 2 through 8, the buoyancy units will be described in detail. Within each ascending buoyancy unit 24 (FIG. 2) is an inflated buoyancy bladder 46 encircling perforated inlet/outlet pipes 47 and surrounded by a free-flooding cylindrical wire mesh bladder retainer 48 which is attached at one end to a manifold end plate 49 contiguous with pipes 47 and with the buoyancy unit manifold 51 which contains the filler dump valve 27 sealing against the hidden inside flat surface with a filler dump valve stem 52 projecting through a slip bearing 53 in the manifold end plate 49. The buoyancy unit manifold is also contiguous with a chain attachment bracket 54 which cooperates with a bracket mating chain link 56 of near chain loop 22.

The opposite end of the wire mesh bladder retainer 28 is attached to a release valve end plate 57 which is contiguous with pipes 47 and with pressure release valves 58 which protect the bladder 46 from bursting as the ascending buoyancy units 24 rise.

Chain mounting bracket 59 contiguous with end plate 57 cooperates with a bracket mounting chain link 61 of the far chain loop 23 (FIG. 8). Cuffs 62 protrude at each end of buoyancy bladder 46 around inlet/outlet pipes 47 and are held in leak-proof contact with pipes 47 by cuff clamps 63.

Referring to FIGS. 9 through 11, filler dump valve 27 seats against the inner surface of buoyancy unit manifold 51 adjacent to filler dump valve port 64, seating bias being supplied by filler dump valve spring 66. The opening motion of valve 27 is limited by limit rod 67 which are contigous with manifold 51. Projectable filler valves 28 slide within and between near sprocket aperture 68 in near sprocket 17 and sprocket manifold aperture 69 in manifold 31 and are within the circle of revolution of sprocket teeth 71 which engage the links of near chain loop 22 and position the filler dump valve port 64 of descending buoyancy unit 26 in line with projectable filler valve 28. The filler valve cam circle 29 is fixedly mounted to the bottom support structure 14 and contains a valve projection roller slot 72 which may vary in position relative to support structure 14.

Bottom support structure 14 also contains main sprocket axle bearing 73. Near sprocket 17 and the far sprocket (not visible) are inner-connected by a sprocket standing shaft 74 which is contiguous with both of said sprockets and with the bottom hollow sprocket axle 32 which rides in bearings 73.

Compressed gas from input 34 travels down conduit 33 to a rotary gas transfer seal 76 which is held by a rotating retainer fitting 77 against the end of the hollow sprocket axle 32. This allows transfer of the gas within transfer seal 76 into hollow shafts 32 and through hollow shaft exit ports 78 into manifold chambers 79 and through projectable valve entry ports 81 into the body of projectable filler valve 28. Here it is restrained by a bull nose backing seal ring 82 seating against the inner lip of a captive sealing sleeve 83 surrounding the inner end of projectable filler valve 28. The gas is restrained by a bull nose backing seal ring 82 seating against the inner lip of a captive sealing sleeve 83 which surrounds the inner end of projectable filler valve 28 and is held seated by a sleeve spring 84. Sleeve spring 84 is coaxially positioned around the inner end of projectable filler valve 28 and bears on a spring driving shoulder 86 of that valve which contains inner sealing ring 87 bearing against the inner diameter of the captive sealing sleeve 83. Sealing sleeve 83 is held captive by a sleeve pin 88 passing through pin slots 89 in the body of projectable filler valve 28. A bull nose cap 91 terminates the inner end of projectable filler valve 28. The opposite end of projectable filler valve 28 comprises a cam roller mounting bracket 92 through which passes a cam roller axle 93 which holds captive the projectable valve cam roller 94 oriented between the inner and outer surfaces of valve projection roller slot 72.

The position of projectable valve 28 in FIG. 9 is typical of the largest segment of rotation sprocket 17. When any bracket mating link 56 of near chain loop 22 tangentially engages a sprocket tooth 71 of sprocket 17, a projectable valve 28 is thereby aligned with filler dump valve port 64 of a descending buoyancy unit 26. In this regard, it is pointed out that the peripheral tooth count of sprocket 17 is an even multiple of the number of links separating the buoyancy units to insure proper alignment of the projectable filler valves with the valve openings of the buoyancy units.

After this tangential arrangement a filler valve cam circle 29 fixed to bottom support structure 14 is mechanically programmed to move slot 72 toward rotating sprocket 17, thereby causing valve 28 to project toward and into filler dump valve port 64 without releasing bull nose backing seal ring 82. In this action illustrated at the FIG. 10 cross section of cam circle 29, the bull nose cap 91 enters valve port 64, displacing the majority of fluid therein and a compressible annular seal 96 mounted on sleeve 83 is compressed against the outer surface of buoyancy unit manifold 51. At this time, valve roller slot 72 is programmed to move further toward rotating sprocket 17, thereby releasing seal ring 82 and allowing bull nose cap 91 to press valve 27 open and enter manifold 51. Compressed gas then passes through bull nose ports 97, enters manifold 51 and tubes 47 and thereby changes a descending buoyancy unit 26 (FIG. 3 deflated) into an ascending buoyancy unit 24 (FIG. 2 inflated) by inflation of buoyancy bladder 46. The filler valve cam circle 29 is then programmed to move slot 72 away from rotating sprocket 17 thereby closing seal ring 82 and removing bull nose cap 91 before the ascending buoyancy unit 24 leaves its tangential relationship with sprocket 17.

It is pointed out that the ascending buoyancy unit 24 is not completely filled with gas to allow for expansion as it rises through areas of decreasing pressure. Relief valves 58 meter off any excess gas pressure preventing the buoyancy bladders from bursting as they rise through these areas of decreasing pressure. As the ascending buoyancy units 24 reach a tangential relationship with top sprocket 19, they are contacted by projectable dump valves 36 which are identical in construction and operation to projectable filler valves 28 and allow the vacuum within dump valve 36, top sprocket manifold 38, top hollow sprocket axle 39, and vacuum conduit 41 to exhaust the gas in bladder 46 and convert an ascending buoyancy unit 24 into a descending buoyancy unit 26. In all respects other than vacuum, the operation of the upper valves, cam guides, etc., are identical to those of the lower valves and mechanisms previously described in detail. Hence, a redundant further description is deemed unnecessary. Moreover, it is pointed out that to begin the cycle of operation, a priming motor which is also not illustrated nor described, can be conveniently coupled to the axle of the upper sprocket assembly. To stop the operation the compressed gas inlet 34 can be merely shut off.

It should be understood, of course, that the foregoing disclosure relates to only a preferred embodiment of the invention, and that it is intended to cover all changes and modifications of the example of the invention herein chosen, for the purposes of the disclosure, which do not constitute departures from the spirit and scope of the invention.

The invention claimed is:

1. A compressed gas machine comprising:
- an endless belt loop, said belt loop carried by and coupled to at least first and second sprocket members;
- at least one support means rotatably carrying said first and second sprocket members;
- a plurality of inflatable buoyancy bladders carried by said belt loop;
- said first sprocket members rotatably disposed within a liquid medium;
- a majority of said inflatable buoyancy bladders being disposed within said liquid medium;
- said second sprocket means rotatably disposed vertically above said first sprocket member;
- a compressed gas source coupled to a gas supply line;
- a filler valve coupled to said gas supply line;

a cam coupled to said first sprocket means in operable proximity with said filler valve, said filler valve being adapted for axial reciprocating movement;

each of said inflatable buoyancy bladders having a filler dump valve positioned for cooperation with said filler valve;

a dump valve cam coupled to said second sprocket member;

a dump valve disposed in operable relationship with said dump valve cam and being adapted for axial reciprocating movement and further disposed for cooperation with said filler dump valves; and

an exhaust line coupled to said dump valve.

2. The compressed gas machine of claim **1** and further including:

a free-flooding retainer carrying each of said inflatable buoyancy bladders.

3. The compressed gas machine of claim **1** and further including:

a pressure release valve in each of said inflatable buoyancy bladders operable for releasing gas pressure of a predetermined amplitude.

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