Aug. 24, 1954

B. C. GERWICK

2,687,017

SUBMARINE SUPPORT COLUMN

Filed March 11, 1949

2 Sheets-Sheet 1

FIG_1_

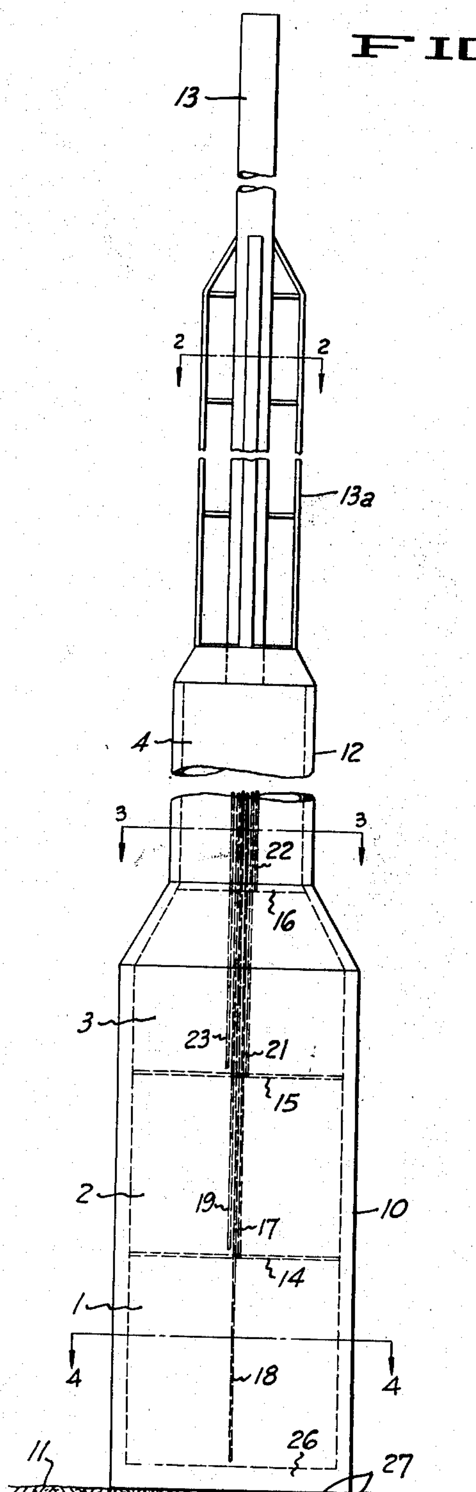


FIG_2_

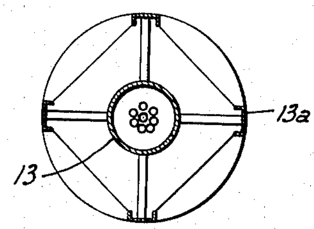


FIG_3_

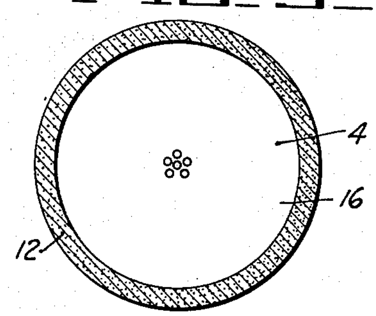
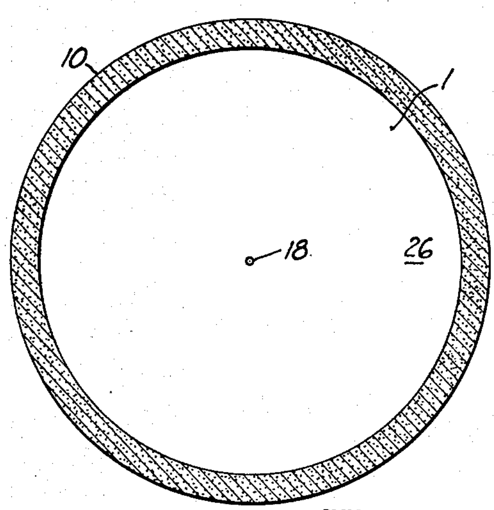


FIG_4_



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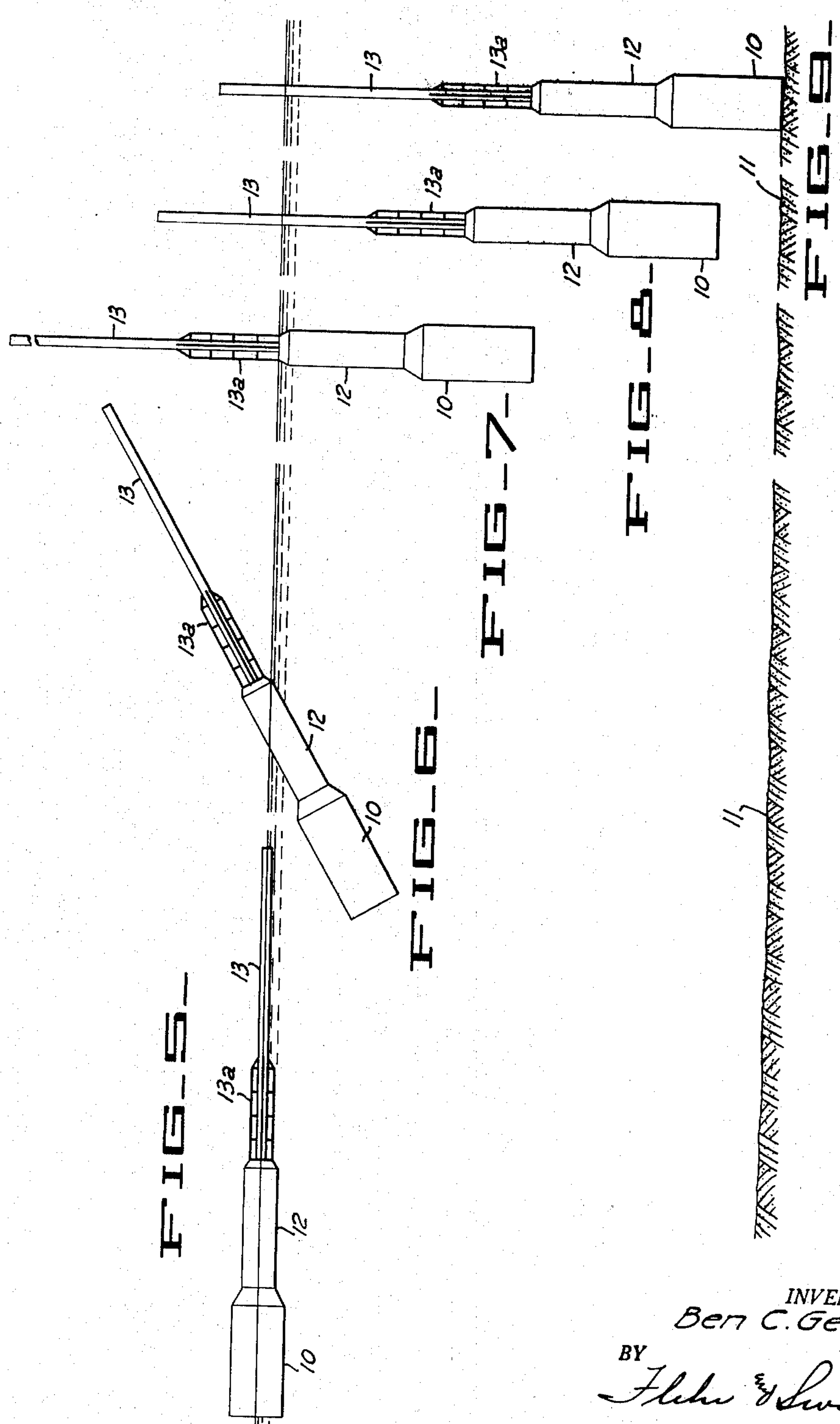
2 Sheets-Sheet 2



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UNITED STATES PATENT OFFICE

2,687,017

SUBMARINE SUPPORT COLUMN

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Application March 11, 1949, Serial No. 81,008

1 Claim. (Cl. 61—46)

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This invention relates generally to submarine supporting columns, and to methods which can be employed for positioning such columns where desired.

In many instances it is desirable to erect stable support columns at offshore locations where the water may for example range in depth from 100 to 250 feet or more. Conventional structures and methods for this purpose involve great expense, and are permanent in character, requiring great expense in the event it is necessary to effect their removal. In addition conventional structures and methods are time consuming, particularly in that a great deal of time consuming labor is required on location to form the necessary foundation structures on the bottom formation, and to erect supporting columns upon the foundations. The difficulties involved become more serious and hazardous as the water increases in depth. In many instances the cost of conventional structures and methods make projects, such as offshore oil and gas drilling, uneconomical, particularly when very little, if any, of the structure can be salvaged in the event the project is to be abandoned.

It is an object of the present invention to provide a submarine support column and method for using the same, which will greatly facilitate the erection of such structures, particularly with respect to the time and labor involved.

Another object of the invention is to provide a structure and method of the above character which will greatly facilitate removal and salvaging operations when the structure is no longer desired in place, and which in particular will enable the support columns to be readily shifted from one locality to another.

Additional objects and features of the invention will appear from the following description in which the preferred embodiment of the invention has been set forth in detail in conjunction with the accompanying drawing.

Referring to the drawing:

Figure 1 is a side elevational view illustrating a column construction incorporating the present invention.

Figure 2 is a cross-sectional view taken along the line **2—2** of Figure 1, and on an enlarged scale.

Figure 3 is a cross-sectional view taken along the line **3—3** of Figure 1, on an enlarged scale.

Figure 4 is a cross-sectional detail taken along the line **4—4** of Figure 1.

Figures 5, 6, 7, 8 and 9 serve to illustrate the method employed to locate and position one of my support columns, starting with the column in horizontal position and floating in the water, and ending with the column in stable vertical position on a bottom formation.

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The column construction illustrated particularly in Figures 1 to 4 inclusive of the drawing consists of a foot structure including the section **10** which is adapted to rest upon a ground formation **11**. Section **10** carries an upper extension **12**, which in turn is attached to the relatively long column section **13**, the latter being of sufficient length to extend to a point above the surface of the water.

The section **10** and its extension **12** are preferably formed of integral cast concrete walls, with suitable steel reinforcement to provide proper strength. The cross-sectional contour can be cylindrical as illustrated in Figures 3 and 4. This section **10** is of sufficient diameter and weight to provide the required stability when resting on the formation **11**.

The section **13** is preferably made in such a manner as to provide proper strength while minimizing the forces of wave action. In the design illustrated section **13** is a welded steel conduit having its lower portion reinforced by the bracing **13***a*.

By way of example in one instance the section **10** has been designed to be 20 feet in diameter, and the extension **12** about 12 feet in diameter. In the same design the over-all height of section **10** and extension **12** was about 100 feet, and the over-all length of the column was about 225 feet, to enable the top of the section **13** to extend about 25 feet out of water 200 feet deep. Section **13** was a steel conduit about 3 feet in diameter.

The foot section **10** and its extension **12** are made hollow, and the interiors of these sections have sufficient volume whereby when filled with air, there is sufficient buoyancy to float the entire column. However when these hollow interiors are filled with water, the weight of the complete column is sufficient to hold it in stable erect position upon the bottom formation **11**. As will be presently explained, by controlling the flooding of the interior of sections **10** and extension **12**, I position the column in any location desired, and likewise the column can be raised from the bottom formation and floated to a new location.

In order to facilitate the control of flooding operations, the interiors of section **10** and extension section **12** are divided into a plurality of compartments **1**, **2**, **3** and **4**, by the bulkheads **14**, **15** and **16**. Each of these bulkheads are shown connected to air and water pipes. Thus pipes **17** and **18** connect with compartment **1**, **19** and **21** connect with compartment 2, 22 and 23 connect with compartment 3, and like pipes (not shown) connect with the upper compartment 4. All of these pipes may extend through the column section 13, and may have their ends provided with suitable fittings for making connection with auxiliary equipment. The auxiliary equipment may include pumping means for selectively flooding or removing water from the compartments, and pneumatic means for permitting escape of air from the compartments, or for introducing air under pressure to expel or aid removal of water.

The method which I employ in connection with use of the column structure described above, is as follows: Assuming that it is desired to erect the column in a location where the water is of considerable depth, air and water pipes are seated, and the column is floated in horizontal position substantially as illustrated in Figure 5. The column now has horizontal buoyant stability, and it can be readily towed to the position where it is to be erected. During this time the interior of the section 13 may be flooded.

When the column is in the general location desired the water and air pipes 17 and 18 are connected to the auxiliary surface equipment and while air is being vented from compartment 1, water is pumped into the same.

About the time the first compartment is fully flooded, the column commences to turn from its horizontal position to an inclined position as shown in Figure 6. One now proceeds to flood compartment 2 in the same manner. As this compartment fills with water the column takes a vertical position as shown in Figure 7. It will be noted that the column takes this vertical position while it is still buoyant. This facilitates locating the column over the position desired, before it is lowered upon the bottom formation. Flooding of the next compartment 3 causes the entire column to lower to final position upon the bottom formation. Finally the column comes to rest upon the bottom formation as shown in Figure 9. Finally flooding of compartment 3 is completed and compartment 4 is flooded to provide maximum weight.

It will be evident that the procedure described can be carried out in a minimum amount of time, and with a comparatively small amount of labor. After a number of such columns have been placed in proper position, a suitable platform or like structure can be erected upon the projecting upper ends.

The upper section 13 affords a minimum amount of wave resistance and therefore the column is capable of withstanding wave action without loss of stability.

The bottom wall 26 of foot section 10 may be varied in accordance with the character and slope of the bottom formation 11. Thus where the bottom formation is clay and relatively flat the bottom 26 can be substantially planar. Where the bottom formation has a perceptible slope, the bottom wall can be sloped accordingly, thus enabling the column to be erected in vertical position. Any tending toward side slippage can be avoided by the use of projecting teeth or plows 27, or a cutting edge. Posts can extend from the bottom wall for softer formations.

It will be evident that the number of compartments may vary in different instances and that a variety of auxiliary equipment can be employed to control flooding or removal of water as desired.

The proportioning of the compartments and the distribution of weight should be such that one can provide horizontal floating buoyancy for movement to the desired location, a gradual shift from horizontal to vertical buoyancy as the flooding proceeds, and a final maintenance of vertical stability as the column is lowered into final position.

In the event it becomes necessary to remove a column, this can be done without difficulty and the column can be completely salvaged or moved to another location. Thus after detaching and removing any platform or like structure which has been secured to the upper end of the column, one commences to remove water from the compartments, beginning with compartment 4. This can be done by pumping out water coupled with application of air under pressure. As the compartments are progressively emptied, the column first lifts from the bottom formation and then gradually tilts until it reaches a horizontal floating position. The column may now be reused, after possible reconditioning which may appear desirable.

I claim:

A submarine support column comprising a relatively heavy rigid foot structure and a conduit-like column section rigidly secured to the foot structure, said column section being of sufficient length to extend above the surface of the water and being laterally dimensioned to present minimum wave resistance, the lateral dimensioning of the foot structure being many times the diameter of the column section to have stable bearing on a bottom formation, the foot structure having an axis of symmetry which is coincident with the axis of the column and having a length which is substantially greater than its lateral dimensioning, said foot structure including upright rigid side walls enclosing a hollow interior, and a plurality of bulkheads spaced longitudinally of the column and extending between the side walls, said bulkheads serving to divide the interior of the foot structure into a series of adjacent compartments which are distributed over substantially the entire length of the foot structure, the support column having horizontal stable buoyancy when all of the compartments are empty, and means serving to effect progressive flooding of the compartments with water, commencing with the lowermost compartment, the distribution of said compartments being such that upon admission of water into the lowermost of the compartments of the foot structure, there is a gradual change from horizontal to vertical stable buoyancy and whereby upon further progressive flooding of the compartments vertical buoyancy is maintained with lowering of the column against a bottom formation.

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