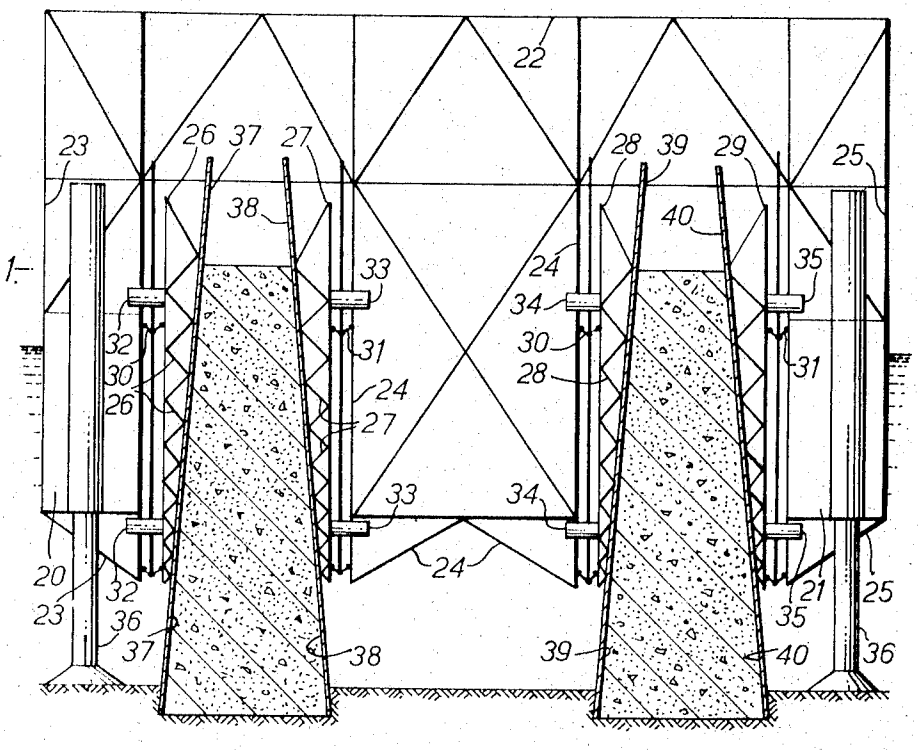
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SHUTTERING MEANS AND APPARATUS FOR THE CASTING OF UNDERWATER STRUCTURES

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FIG. 1



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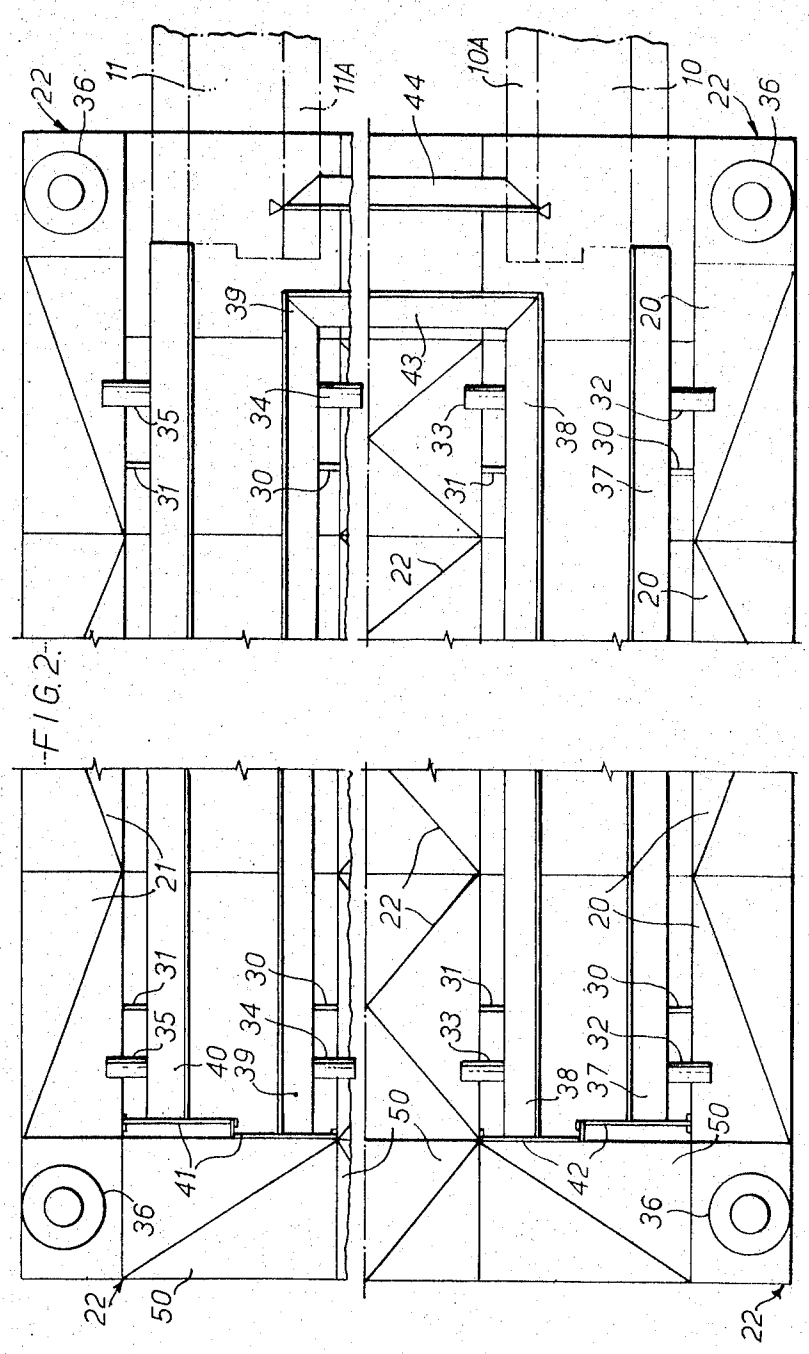


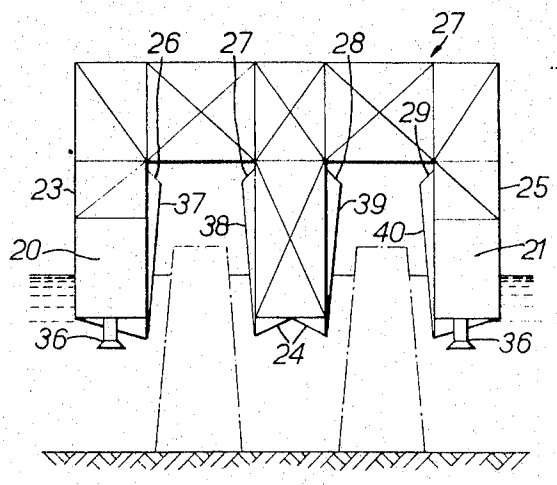
FIG. 2.

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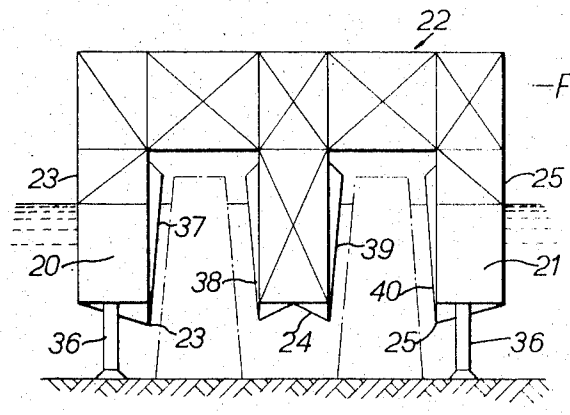
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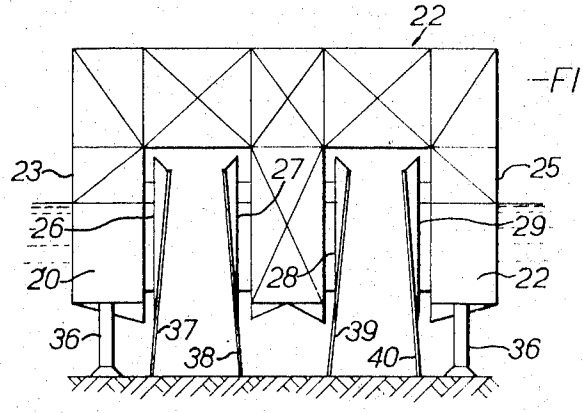
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-FIG. 3-



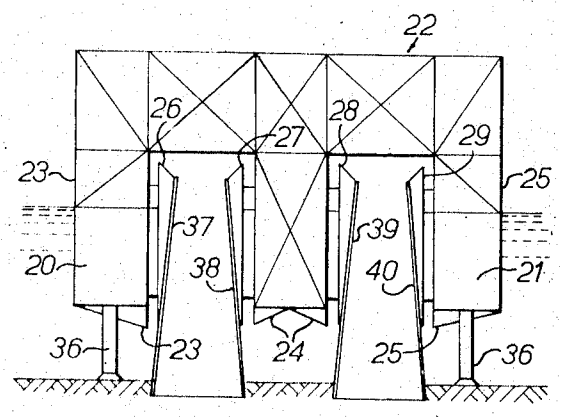
-FIG. 4-



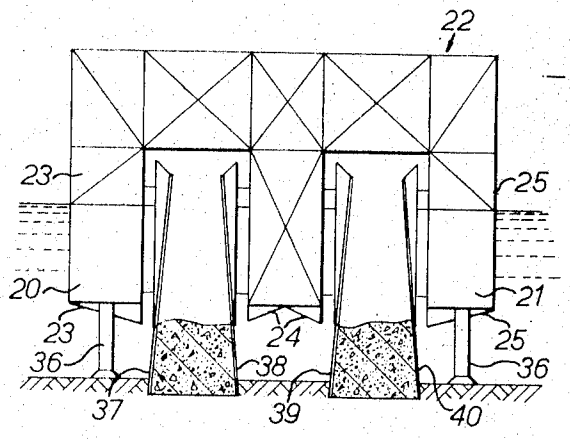
-FIG. 5-

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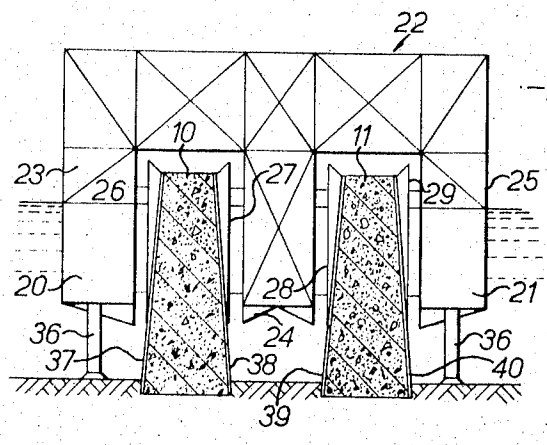
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-FIG.6-



-FIG.7-



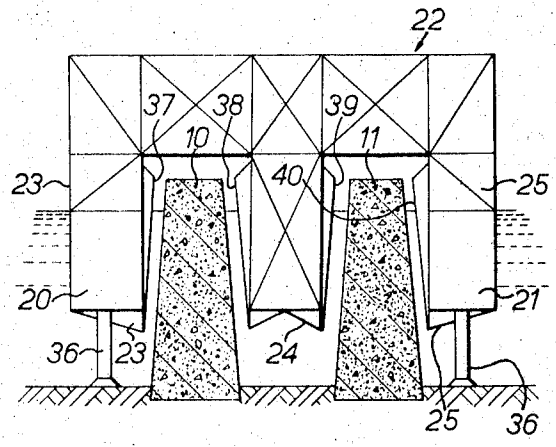
-FIG.8-

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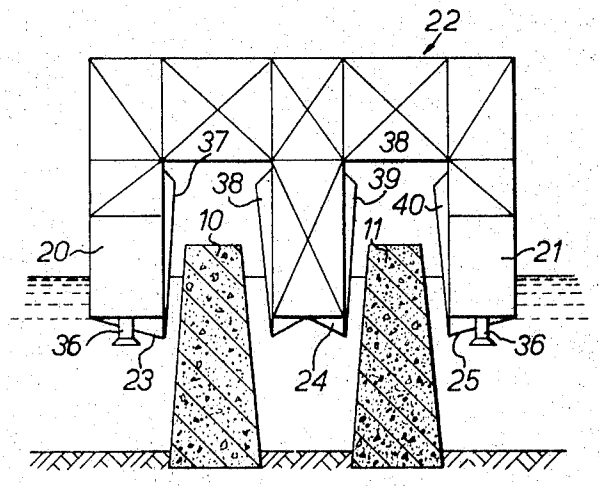
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SHUTTERING MEANS AND APPARATUS FOR THE CASTING OF UNDERWATER STRUCTURES

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-FIG. 9-



-FIG. 10-

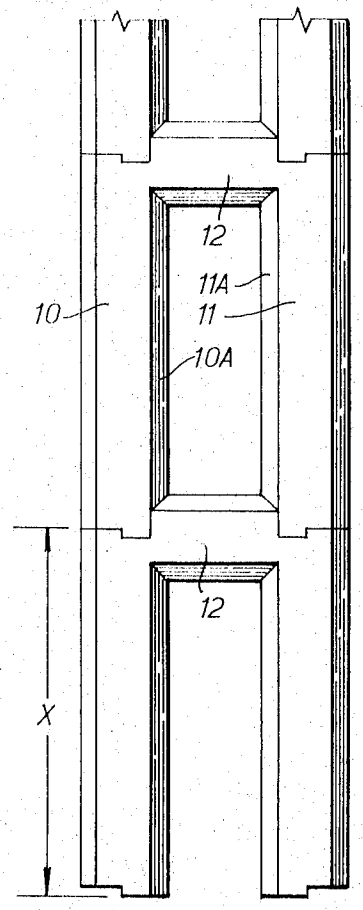
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FIG. 11.



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SHUTTERING MEANS AND APPARATUS FOR THE CASTING OF UNDERWATER STRUCTURES

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Claims priority, application Great Britain, June 2, 1965, 22,701/65
6 Claims. (Cl. 249—1)

ABSTRACT OF THE DISCLOSURE

The present apparatus is for use in the casting of underwater or partially submerged structures and for this purpose employs two buoyancy chambers arranged in spaced apart position, a superstructure connecting and supported by said buoyancy chambers which superstructure has downwardly extending sub-frames, carrier frames linked to opposed inner sides of said sub-frames. Main shuttering elements are mounted on said carrier frames and means are provided for advancing and retracting said carrier frames to move said shuttering into and out of operative position and there is also means for admitting and exhausting water to and from said buoyancy chambers.

Description

This invention relates to the construction of underwater, or partially submerged, structures, as for example sea walls, of concrete and the like, and has for its object to provide new or improved shuttering means and apparatus whereby the casting of concrete and the like below water will be expedited. A further object is to provide shuttering or apparatus which will enable an underwater structure to be constructed in a substantially continuous manner.

Broadly, according to the invention, shuttering apparatus for the purpose specified comprises a superstructure or frame supported by a series of buoyancy chambers or tanks, shuttering elements carried by said apparatus and adapted for movement into and out of operative position, and means for admitting and exhausting water to and from said buoyancy chambers. Thus arranged, the complete apparatus is adapted to be floated into required position and then ballasted by the admittance of water to the buoyant units thereof so that the lower edges of the moulding faces of the shuttering abut or may be abutted against the bed upon which the structure is to be cast. In this position concrete may be filled into the space between the shuttering of the apparatus and when sufficiently set, for example after twenty-four to forty-eight hours, the shuttering may be struck from the cast structure, the apparatus rendered buoyant by pumping water therefrom and then moved forward and re-settled for a subsequent casting operation in continuation of the already formed structure. The shuttering elements carried by the apparatus may be arranged so as to effect simple wall structures, duplex or cavity walls, piers or the like.

Reinforcement means for the concrete may be introduced to the moulding space between the shuttering and can be in the form of prefabricated units lowered into position within the moulding spaces and secured by guide means adapted for removal as the concrete is poured. The shuttering elements are of course configurated in accordance with the work to be carried out and may be of any required size commensurate with building and handling requirements.

The invention is further described with the aid of the accompanying explanatory drawings which illustrate diagrammatically, and by way of example only, one mode

of embodiment suitable for the construction of a duplex or cavity type sea wall.

In said drawings:

FIG. 1 is a cross sectional elevation of apparatus for the casting of an underwater or partially submerged sea wall structure, and

FIG. 2 is a plan view of same.

FIGS. 3 to 10 inclusive illustrate schematically eight stages in the casting of an underwater wall structure by means of the apparatus of FIGS. 1 and 2, and

FIG. 11 is a plan view of part of a sea wall structure constructed in accordance with the invention.

Referring now to said drawings, the apparatus illustrated is designed so as to permit the casting of a submerged or partially submerged structure of concrete, comprising (see more particularly FIG. 11) parallel wall parts **10**, **11** having battered sides and which are connected by webs **12** thereby to provide a duplex or cavity wall structure.

The apparatus comprises two series of buoyancy chambers or tanks **20**, **21** which are connected in spaced and parallel relationship by a girder frame or superstructure, generally designated **22**, and which comprises downwardly extending sub-frame portions **23**, **24**, **25** on the opposed inner faces whereof are mounted carrier frames **26**, **27**, and **28**, **29**. The said carrier frames **26**, **27** are connected to the sub-frames **23**, **24** by telescopic members **32**, **33** and are adapted to be advanced and retracted towards and away from each other by means of linkages **30**, **31** which may be operated in any suitable manner e.g. by fluid operable power means, screw-jacks, or the like. Similarly, the carrier frames **28**, **29** are supported by telescopic members **34**, **35** and are adapted to be advanced and retracted through the medium of linkages **30**, **31**.

At each corner of the superstructure there is provided a spud or leg **36** which is hydraulically extendable. Said legs are capable of supporting the entire structure on the sea bed as shown in FIG. 1.

Said carrier frames **26–29** carry shuttering elements respectively designated **37**, **38**, **39**, and **40** and these each may be of unitary or fabricated sheet metal construction of a length and breadth suited to the dimensions of the structure to be cast.

At one end of the apparatus stepped vertical shuttering elements are provided as at **41**, **42** (FIG. 2) adapted to close the space between the ends of the co-operating pairs of shuttering elements **37**, **38** and **39**, **40**. At the opposite end of the apparatus transverse shuttering elements **43**, **44** are provided, the element **43** being supported adjustably by the superstructure **22** so as to be extended between the opposed exterior faces of the shuttering elements **38**, **39**. The shuttering unit **44** is supported so as to be locatable removably between the internal battered sides **10A**, **11A** of an already cast structure as indicated.

To provide additional buoyancy, a series of buoyancy chambers or tanks **50** may be provided at the end of the structure carrying the transverse shuttering elements **41**, **42**.

The method of employing apparatus as above described is as follows:

The apparatus is floated into required position with its buoyancy chambers or tanks **20**, **21**, **50** empty (or partially so) and with its main shuttering elements **37–40** in retracted position as shown in FIG. 3. When in appropriate position the tanks are flooded to sink the apparatus to required depth (FIG. 4) and the feet **36** extended to support the structure at desired level. The shuttering carrier frames **26–29** are now extended (FIG. 5) by means of the linkages **30**, **31** and the main shuttering units **37–40** and transverse units **41–44** positioned so as to enclose the space to be filled with concrete. At this

stage, the sea bed is scoured to remove sediment and slurry (FIG. 6) by means of high pressure water jets and when this operation has been completed filling in of the space enclosed by the shuttering can be commenced as shown in FIG. 7.

When the space between the shuttering has been filled to required height (FIG. 8), and the concrete is sufficiently set, the shuttering is struck from the cast structure and raised clear of the now completed wall section (as X, FIG. 11). The tanks **20**, **21**, **50** are blown or pumped out, the legs **36** raised (FIG. 10) and the apparatus floated clear preparatory to being positioned for the casting of a subsequent wall section.

It will be seen that the apparatus can be employed simultaneously to cast two parallel wall portions **10**, **11** with a connecting web **12**, and may be moved forward step by step as each section X sets in order to permit of the casting of subsequent and mating continuations of said wall sections. The cavities of said sections may be filled with an inexpensive ballast material, or, if desired, piles may be driven into the sea bed within the areas defined by the wall sections **10**, **11** and **12** and be surrounded by a layer of concrete adapted to bond said piles to the wall sections. The use of large quantities of ballast to create a foundation prior to the casting of an underwater structure may thus be avoided.

The superstructure **22** connecting, and supported by, the buoyancy chambers or tanks **20**, **21** and **50** may be decked in and comprise or contain or house pump means for operating high pressure jets for scavenging and softening sea bed silt and soil preparatory to the pouring of the concrete; and sludge pumps, grabs or other equipment also may be provided for cleaning out and otherwise preparing the sea bed within the confines of the shuttering elements. Flexible or articulated chutes may be provided for directing concrete between the moulding faces of the shuttering and concrete mixing means also may be carried by said superstructure. If desired the apparatus may have means whereby it will be self-propelled and include living quarters or shelter for the operators.

In an alternative mode of embodiment, the inner opposed faces of the co-operating buoyancy chambers or tanks may be configurated and arranged so as to constitute moulding faces or shuttering means between which, in use, concrete may be poured and allowed to set. Such inner moulding faces may be arranged so as to extend below the bottoms of the buoyancy units.

What we claim as our invention and desire to secure by Letters Patent is:

1. Apparatus for use in the casting of underwater or partially submerged structures, comprising at least two buoyancy chambers arranged in spaced disposition, a superstructure connecting and supported by said buoyancy chambers and comprising downwardly extending sub-frames, carrier frames linked to the opposed inner sides of said sub-frames, main shuttering elements mounted on said carrier frames, means for advancing and retracting said carrier frames thereby to move said shuttering into and out of the operative position, and means for admitting and exhausting water to and from said buoyancy chambers.

2. Apparatus as claimed in claim **1**, wherein said superstructure is arranged adjustably to support transverse shuttering elements for cooperating with said main shuttering elements.

3. Apparatus as claimed in claim **2**, wherein the transverse shuttering elements at one end of the apparatus are of stepped configuration thereby to provide end surfaces in a cast structure adapted to mate with cooperating ends of succeeding cast structures in substantially continuous manner.

4. Apparatus as claimed in claim **3**, wherein said apparatus is adapted to be supported by extendable feet or legs.

5. Apparatus as claimed in claim **4**, wherein said superstructure is adapted so as to support pressure jets, pumps, grabs, concrete mixing means and chutes for use in the construction of underwater structures, and quarters for the operators.

6. Apparatus as claimed in claim **5**, wherein the means for advancing and retracting the shuttering carrier frames into and out of the operative position are power operated.

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