S. LAKE.

SUBMARINE BOAT.

APPLICATION FILED DEC. 26, 1908.

970,064.

Patented Sept. 13, 1910.

6 SHEETS—SHEET 1.

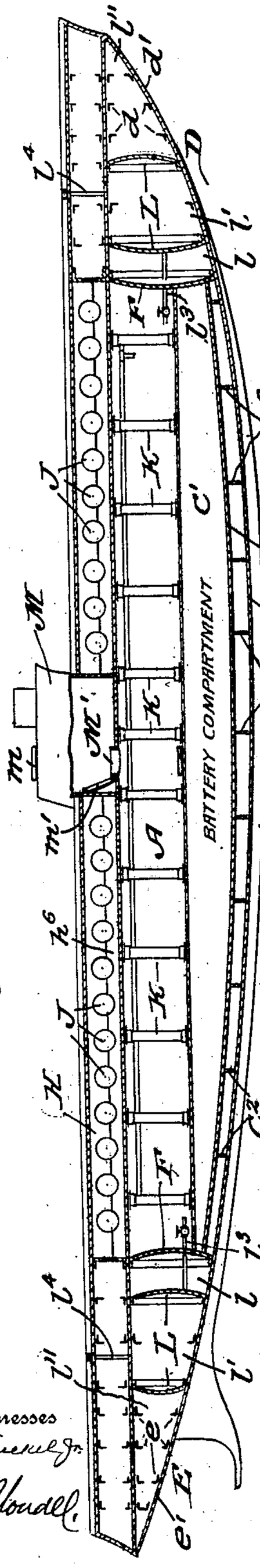

Fig. 1.

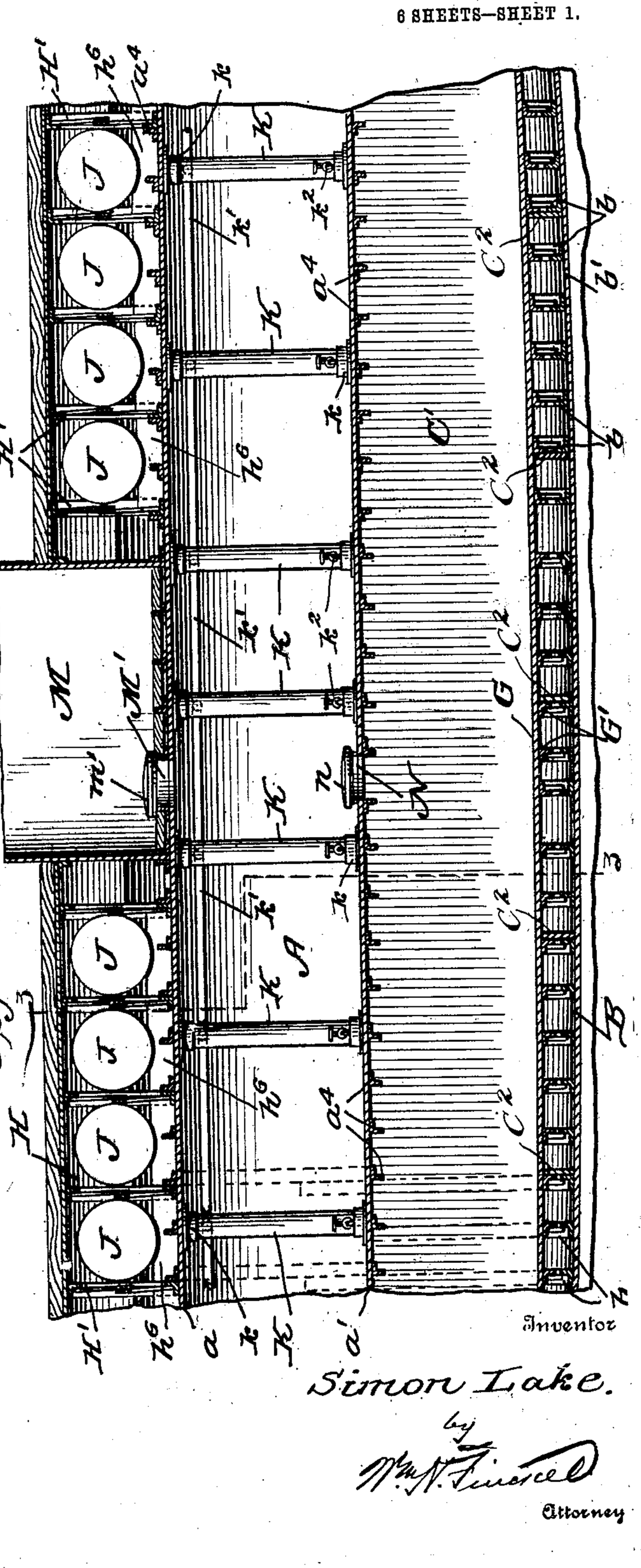

Fig. 2.

Witnesses

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6 SHEETS—SHEET 2.

Fig. 3.

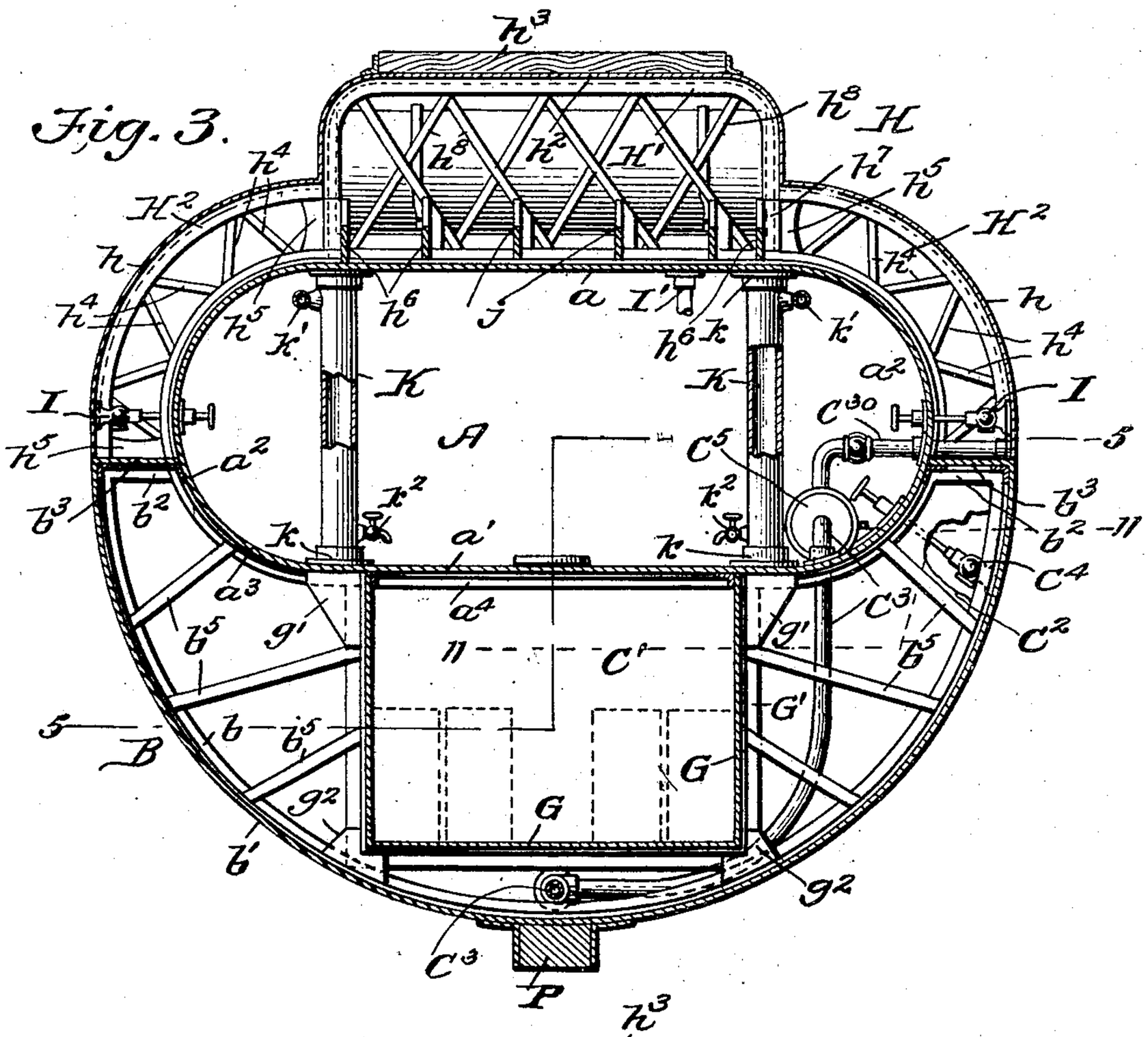
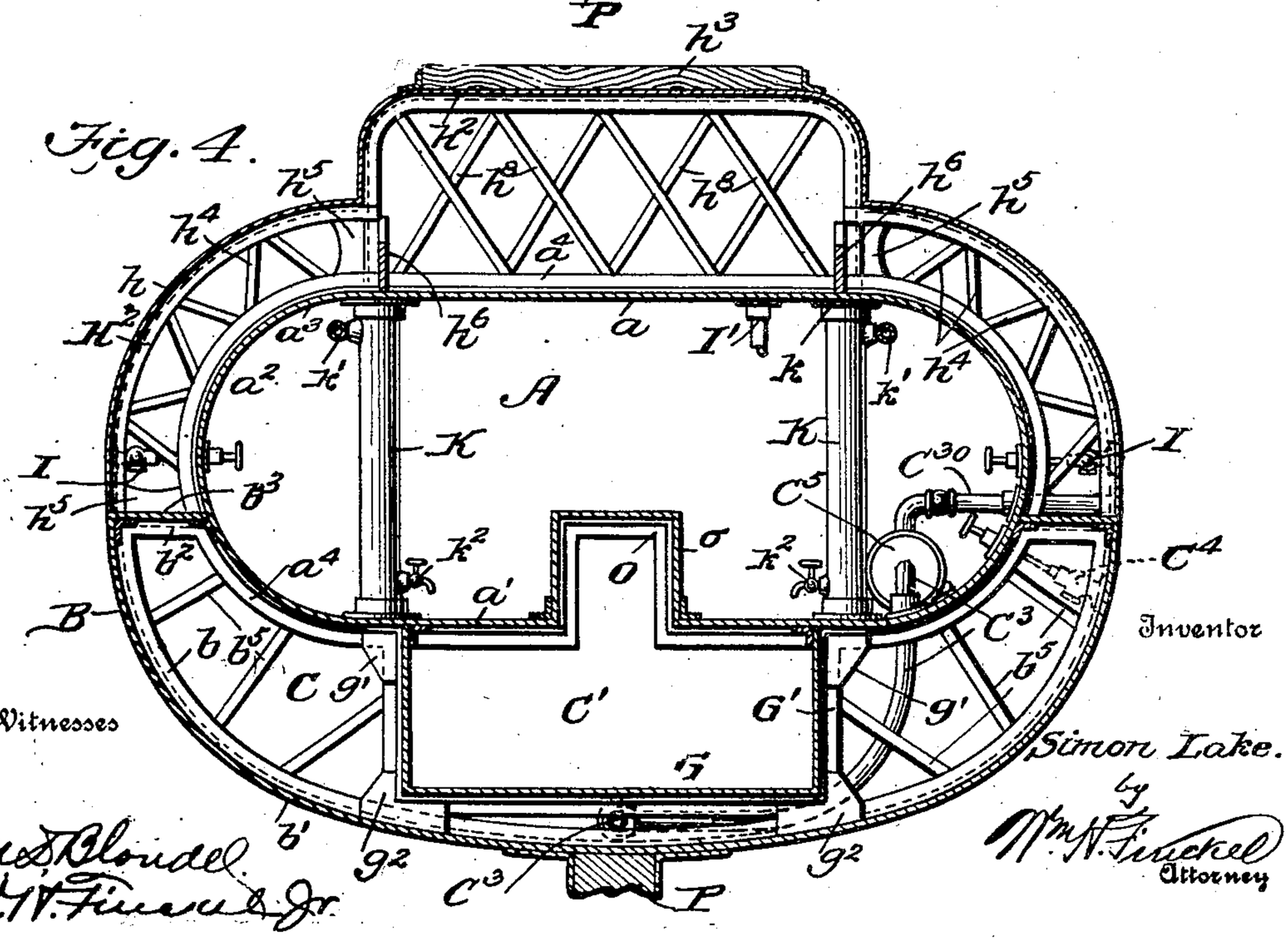


Fig. 4.



Witnesses

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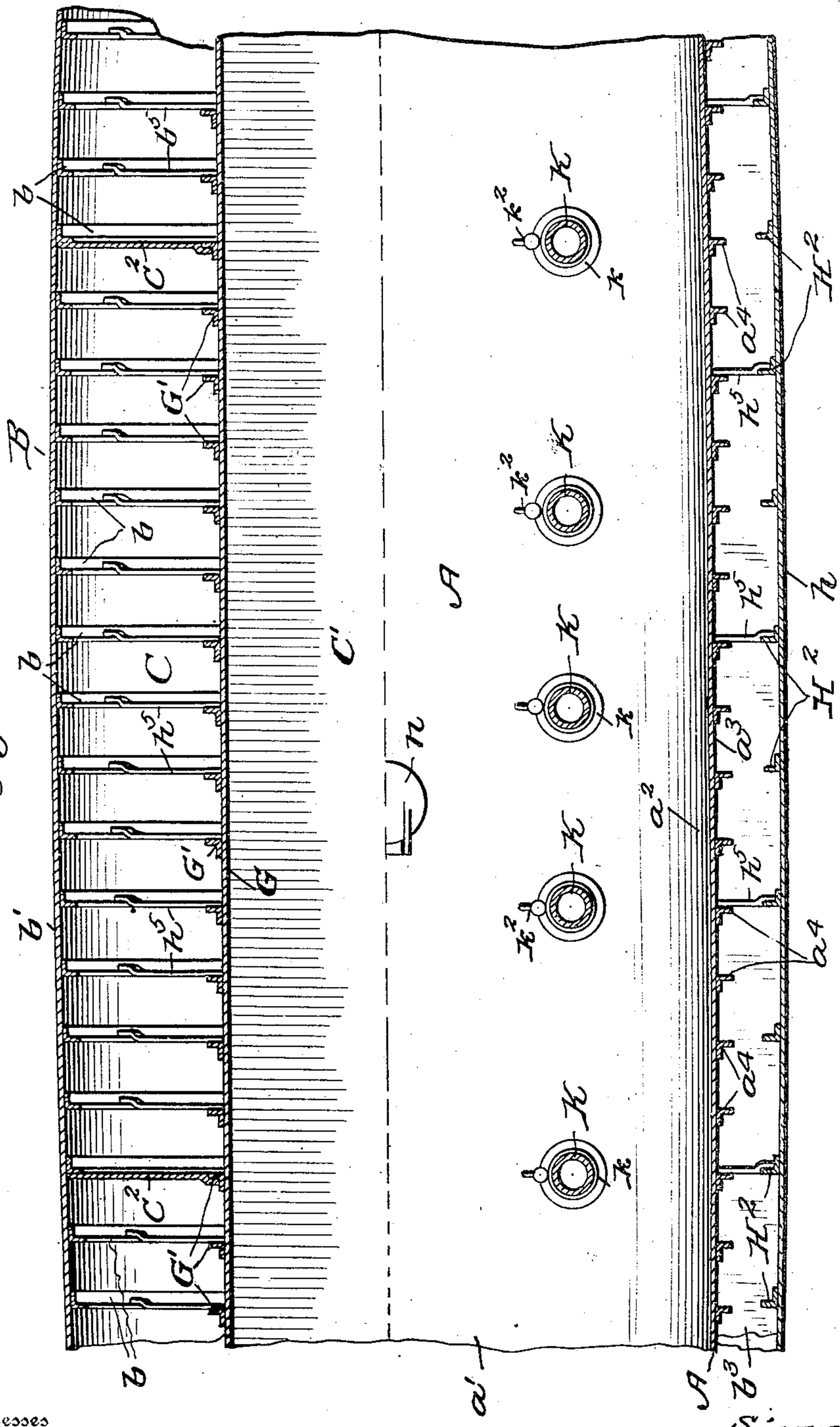
6 SHEETS—SHEET 3.

Fig. 5.



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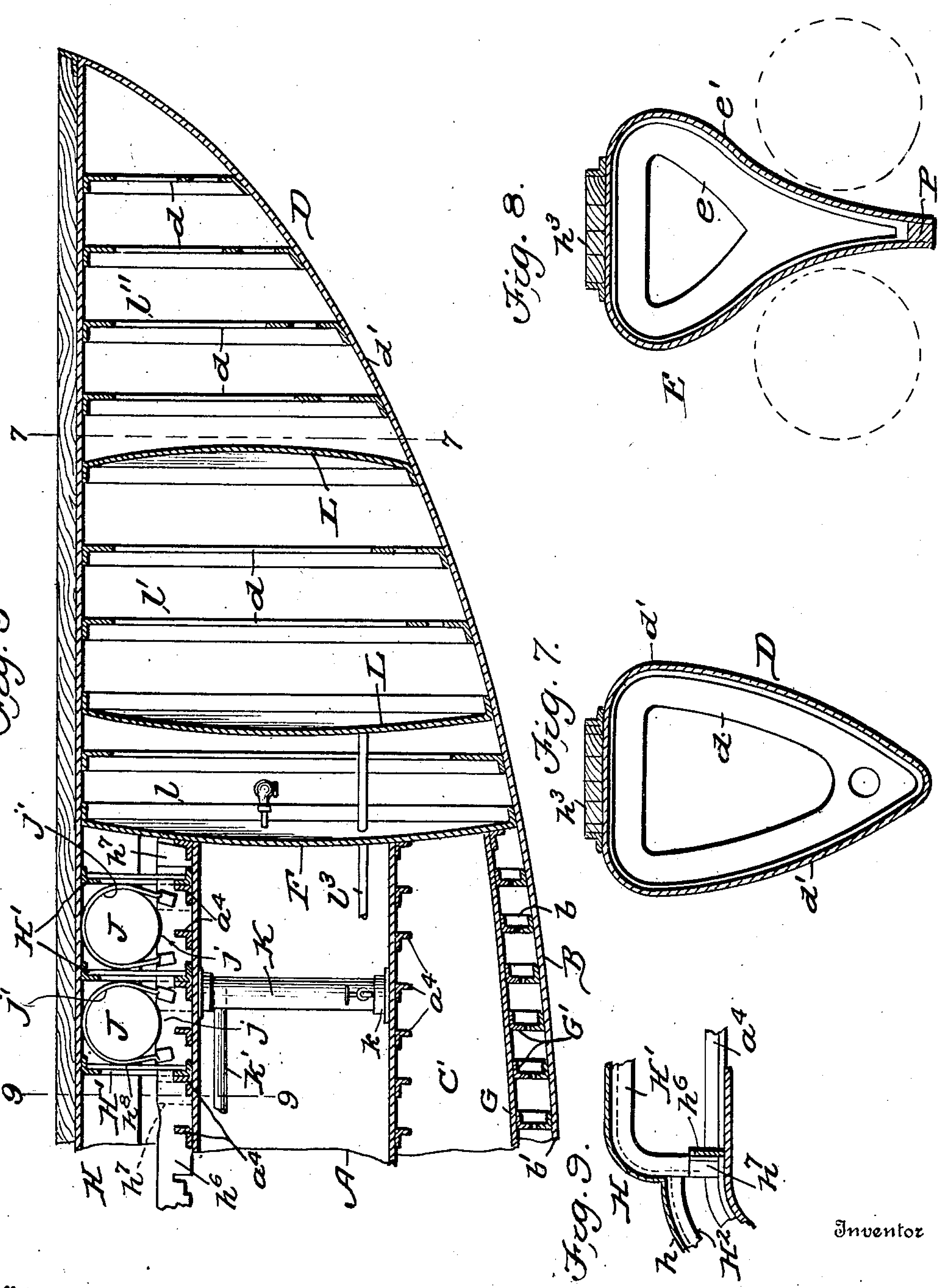
6 SHEETS—SHEET 4.



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6 SHEETS—SHEET 6.

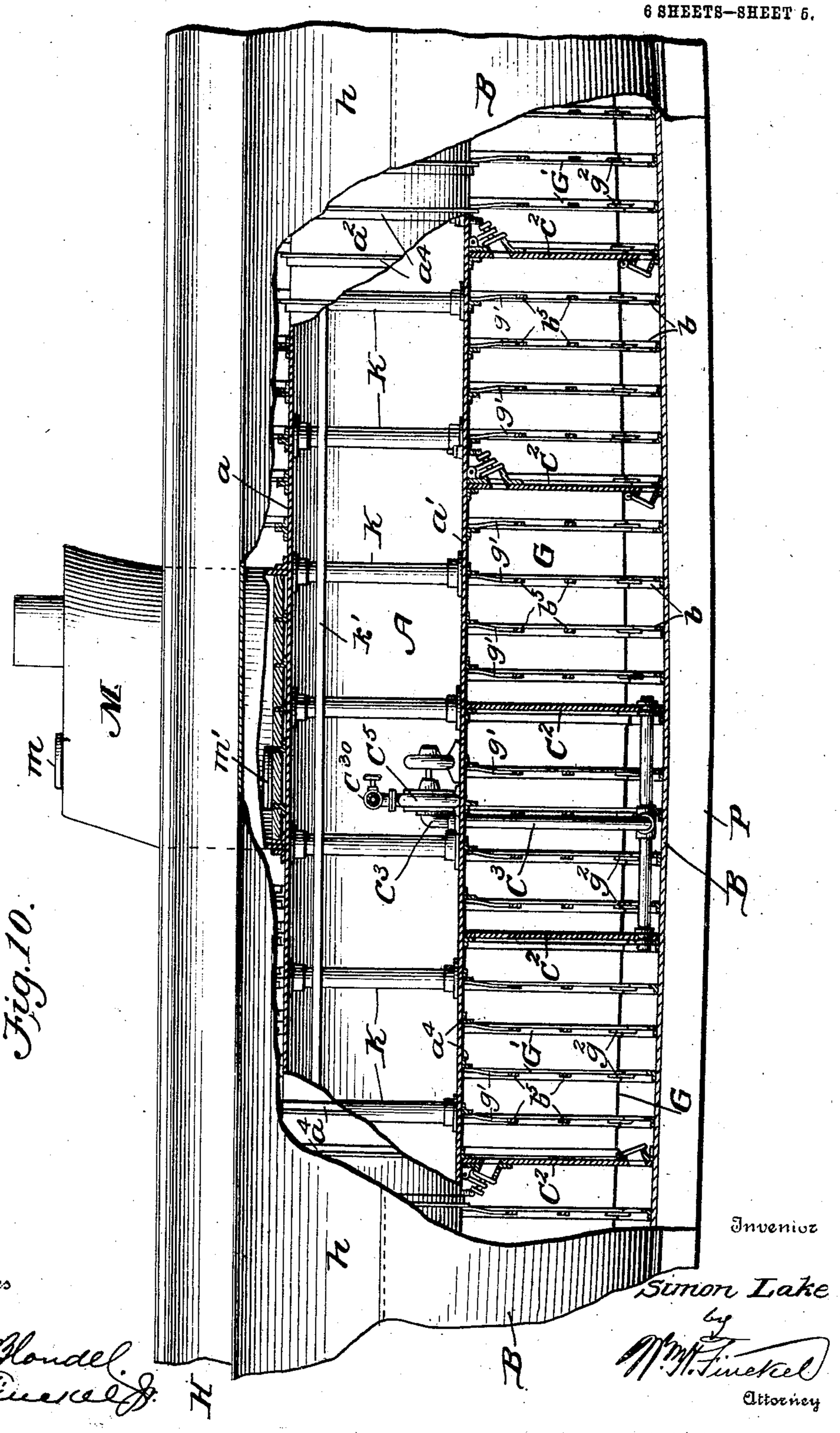

Fig. 10.

Witnesses

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6 SHEETS—SHEET 6.

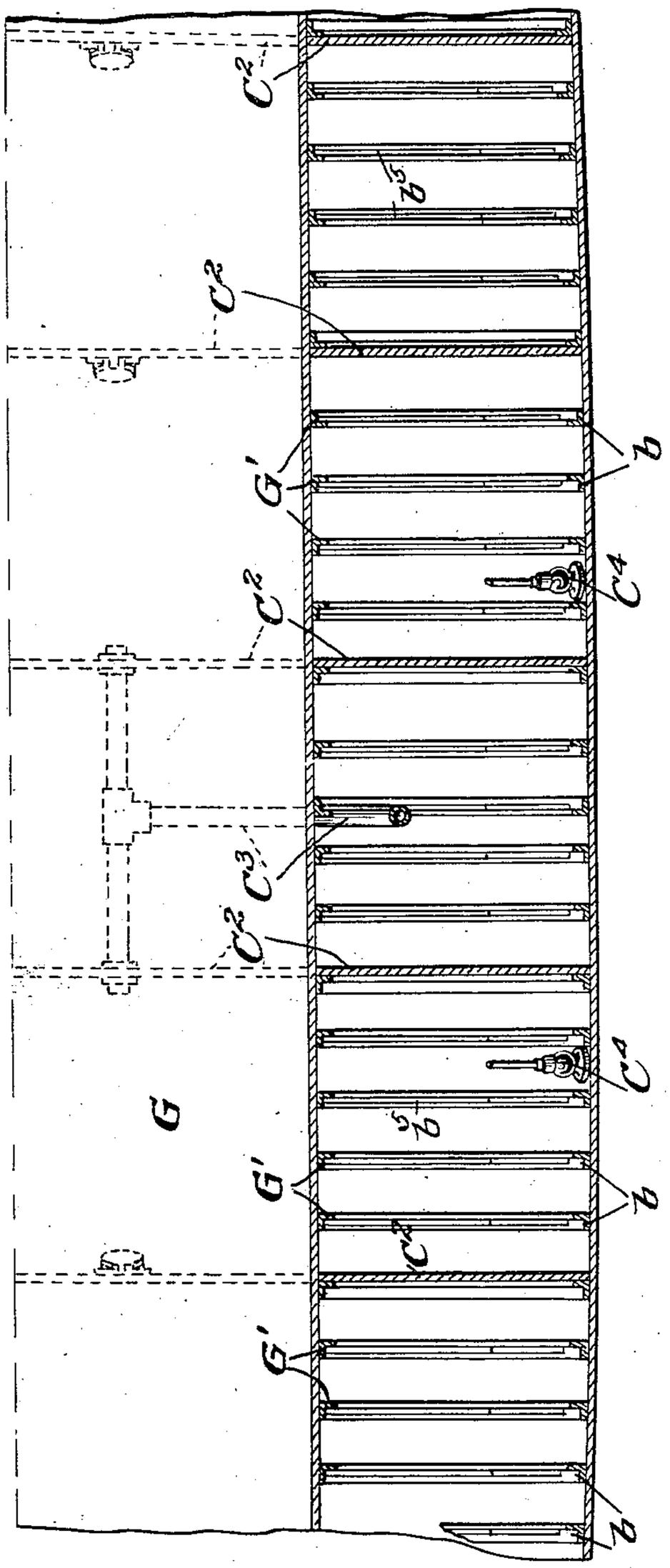

Fig. 11

Witnesses

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UNITED STATES PATENT OFFICE.

SIMON LAKE, OF MILFORD, CONNECTICUT.

SUBMARINE BOAT.

970,064. Specification of Letters Patent. Patented Sept. 13, 1910.

Application filed December 26, 1908. Serial No. 469,460.

To all whom it may concern:

Be it known that I, SIMON LAKE, a citizen of the United States, and a resident of Milford, in the county of New Haven and State of Connecticut, have invented a certain new and useful Improvement in Submarine Boats, of which the following is a specification.

The object of this invention is to provide a submarine boat of shallow draft, particularly adapted for use in rivers, harbors and comparatively shallow waters, and also adapted to resist the high external pressure imposed when submerged, and having a large reserve of buoyancy in surface cruising condition, a high center of buoyancy when submerged and a lower center of gravity than has been obtained in similar classes of vessels heretofore constructed.

The invention consists of a thoroughly rigid hull structure, having two independent hull sections, one arranged partly within the other and so separated as to provide a space below the inner hull section in which are arranged a central battery-cell compartment and a system of water-ballast tanks, combined with a superstructure arranged over the hull sections, with its sides extending from and forming continuations of the sides of the outer hull section, so as to provide a space above the hull sections which is to be filled with water when the boat is submerged, and which, when empty, serves to increase the boat's reserve of buoyancy for surface navigation and its general stability under all conditions; and to enchance these last-mentioned functions, the superstructure space may receive air- and water-tight tanks, which are capable of use for storage and other purposes.

The invention also consists of certain details of construction, and novel combinations, and arrangements of parts, each and all substantially as hereinafter described and claimed.

In the accompanying drawings, illustrating the invention, in the several figures of which like parts are similarly designated, Figure 1 is a diagrammatic vertical longitudinal section of a submarine boat constructed in accordance with my invention. Fig. 2 is a vertical longitudinal section, on a larger scale, drawn through the amidship section of the boat. Fig. 3 is a vertical transverse section on a slightly larger scale, drawn on the line 3—3 of Fig. 2. Fig. 4 is a similar view illustrating a slightly different form of the hull sections of the boat. Fig. 5 is a horizontal longitudinal section of the amidship section of the boat drawn on the irregular line 5—5 of Fig. 3. Fig. 6 is a vertical longitudinal section of one end of the boat illustrating a slightly modified construction, in which the end sections are made of sufficient strength to withstand the external pressure due to the maximum depth of submergence for which the boat is designed. Fig. 7 is a vertical transverse section of the bow end of the boat. Fig. 8 is a similar view of the stern end of the boat showing the position of the propellers in dotted lines. Fig. 9 is a detail transverse section drawn on the line 9—9 of Fig. 6. Fig. 10 is an elevation of the amidships section of a boat, showing parts of the inner and outer hull sections and parts of the superstructure broken away, in order to illustrate more in detail the arrangement of the water-ballast tanks and the means for emptying them. Fig. 11 is a horizontal section, drawn through the amidships section of a boat, on the irregular line 11—11 of Fig. 3.

A designates the inner hull section, extending throughout the major length of the boat, and having parallel top and bottom portions a and a' and semicircular sides a^2. The top, bottom and sides of this section are constructed of suitable shell plating a^3, surrounded by a plurality of L-shaped ribs or frames a^4 to which the plating is securely riveted, and the whole constructed to withstand the pressure of submergence without fear of collapsing.

B is the outer or lower hull section, which is substantially semicircular in cross-section, and of the same length as the section A but of greater width, and of the full beam of the boat. This section B is constructed of ribs or frames b and a covering of shell plating b', and is also of sufficient strength to withstand the external pressure incident to submergence. The ribs or frames b are of gradually diminishing radii from the center of the boat toward the ends so as to give a tapering form to the boat. The upper ends of the ribs or frames are arranged in the same horizontal plane and terminate in inwardly extending horizontal portions b^2 whose inner ends are connected to the ribs a^4 of the section A, and the spaces between the upper edges of the sides of the plating

b' and the sides of the section A are covered by plates b^3 whose longitudinal edges are joined to the platings to provide air-tight and water-tight joints. Strut or braces b^5 connect the ribs of the inner and outer sections, and similar struts or braces b^5 connect the ribs of said outer section with the frames of the trough G to firmly brace the said outer section and prevent its collapse from the external pressure incident to submergence.

Extending respectively from the forward and rear ends of the inner and outer hull sections are the bow and stern sections or ends D and E of the boat. These sections D and E are constructed of series of ribs or frames d and e, respectively, of varying size and contour, and diminishing in size toward the boat's extreme ends, but with their upper surfaces arranged in the same horizontal plane with the top of the inner hull section, and over these ribs are arranged shell platings d' and e', joined to the platings of the hull sections to form, practically, continuations thereof.

Arranged at the ends of the hull sections A and B are transverse partitions or bulkheads F, which are connected to the said hull sections by air-tight and water-tight joints. In the space C thus formed below the inner hull section A, is arranged a battery-compartment C', formed in and by a trough G that extends throughout the length of the said space C and has its ends connected air- and water-tight to the bulkheads F and the upper longitudinal edges of its side portions secured to the lower surface of the bottom a' of the inner hull section A, as shown. The trough G does not extend to the bottom of the space C, and it is supported in position by outside frames G' connected at their upper ends to the ribs or frames a^4 of the inner hull section A and strengthened by gussets g', and at the angles of their lower edges they are secured to the ribs or frames b of the lower hull section by gussets g^2. The space C is divided by a series of partitions C^2 into water-ballast tanks designed to be filled when the boat is to be submerged. Any suitable device may be employed for filling and emptying the tanks, but in practice I prefer to employ the apparatus shown and described in Letters Patent granted to me October 31, 1905, No. 803,175. As shown more in detail in Figs. 3, 4, 10 and 11, this emptying arrangement comprises a pipe C^3 leading from the pump C^5, and connected with the tanks in such way as to withdraw their water supply, and having a discharge pipe C^{30}.

C^4 are valves, preferably hand-controlled, and so shown, opening to the sea and used to admit water to the tanks to trim the boat, or to adjust it to an even keel. When the required quantity of water ballast is taken in, the valves are closed; and so also when the tanks are to be emptied, the valves are closed and the pump is set in operation and simultaneously withdraws all of the water from all of the tanks and discharges it overboard.

H designates a superstructure, extending throughout the full length of the boat, and comprising sides h, preferably concentric with the curved sides of the inner hull section, and which extend from the upper edges of the plating of the lower or outer hull section to points in vertical alinement with the centers of the curved sides of the inner hull sections, and from these points the sides extend vertically upward for a short distance and terminate in a flat deck portion h^2, which may be covered by planking h^3, as shown. The upper or deck portion of the superstructure and the short vertical side portions are supported by frames H', which are connected at their lower transverse portions to the upper horizontal portions of the ribs or frames a^4 of the inner hull section A, and the sides h of the superstructure are supported by frames H^2 which are arranged in alinement with the alternate ribs b of the lower hull section B and extend from the plates b^3 and are connected to the vertical portions of the frames H' in any suitable manner. The frames H^2 are braced to the ribs or frames of the inner hull section by struts h^4 and at their upper and lower ends by bracket plates h^5. The frames H' are braced by struts h^8 and longitudinal girders h^6 firmly connected to frames a^4 and also to the frames H' by angle irons h^7 shown most clearly in Fig. 9. The space formed by the superstructure may be opened to the surrounding water through valves I, which for the purpose of illustration, are shown as hand-operated, and air may be conducted into the space, to expel the water thus taken in, through a pipe I' which extends from a suitable pump (not shown). The sides of the superstructure taper or converge from amidships toward each end to conform to the outline of the sides of the boat.

In the space below the deck is arranged a series of tanks J, that may be employed as low-pressure air-tanks, or for storage of fuel, and they are held in cradles j (Fig. 3) and in the girders h^6 by suitable tie-bands j'. The tanks J are constructed of light-weight material and preferably of cylindrical form, and serve to increase the buoyancy of the boat, even when they are used as fuel tanks, since the gasolene is of less specific gravity than the surrounding water, and, therefore, under all conditions the said tanks tend to raise the center of buoyancy of the vessel when in submerged condition.

The top of the inner hull section A is braced by a series of hollow columns K, ar-

ranged along the sides of the interior of the hull section A in alinement with the sides of the trough G, and the sides of the superstructure H under the girders h^6, and have their ends secured in sockets k secured to the top and bottom plating of the said section A. In this connection the sides of the trough G serve as plate-girders to take the weight and thrust of these columns. These columns are made hollow for the double purpose of lightness of construction and for their utilization as storage-bottles for holding the highly compressed air which is employed in the operation of the various devices used in such boats. The columns are connected by pipes k', to which taps (not shown) may be connected, for supplying them with compressed air, and at their lower ends they are provided with drain-cocks k^2 for the purpose of drawing off any water that may collect therein.

The spaces in the ends D and E of the boat are divided by bulkheads or partitions L into three compartments l, l' and l'', the central compartments l' being designed as fuel tanks while the compartments l are intended to be filled with water when the boat is submerged which will act as a seal between the fuel-tanks and the interior of the boat to prevent the fuel or the gases arising therefrom from entering the boat in the event of leakage or injury to that portion of the boat adjacent to the tanks. A pipe l^3 leads from each fuel-tank to the interior of the hull section A for supplying the fuel to the engines (not shown), and the tanks are supplied with fuel through pipes l^4 extending through the deck and the superstructure of the boat.

In Fig. 1, the spaces between the ends of the boat and the superstructure are shown as continuations of the space over the inner hull section, and the tops of the said ends are arranged in parallel alinement with the top of the said inner hull section, but this construction may be modified, as shown in Fig. 6, by having the bulkheads or partitions F extended up beyond the ends of the inner hull section A and connected to the plating of the superstructure, thus providing larger spaces in the ends of the boat. In such modification, the ends of the boat are made of heavier plating than the superstructure, and braced by ribs or frames d and e and bulkheads L, so as to provide sufficient strength to withstand the pressure of water when the boat is submerged. This arrangement provides large air spaces at the ends of the boat which extend above the top of the inner hull section, thus adding to the buoyancy of the vessel and raising its center of buoyancy, as will be readily understood.

M designates the navigating turret of the boat, having a hatchway in its top provided with a suitable cover m, and M′ designates a hatchway through which access may be had to the interior of the hull section A from the turret, and m' is a cover for said hatchway M′ opening into the turret.

N designates a hatchway leading into the battery compartment and having a cover n.

P designates the keel of the boat.

In Fig. 4 is shown a slightly modified form of the outer hull section, which provides a shallower draft than the construction shown in Fig. 3. In this construction the trough forming the battery compartment is of less height than the form shown in Fig. 3, and the space between the inner and outer hull sections is correspondingly decreased; and in order that a high passageway may be provided in the compartment that will facilitate the handling and examination of the battery-cells, the ribs of the bottom of the inner hull section are made with central flat arches O, extending the full length of the said section, and the plating a^3 of the section is also bent upwardly, as indicated at o, to conform to the shape of the arches.

From the foregoing it will be seen that I provide an exceedingly compact and rigid construction; and by the location of the battery-cells (which are the heaviest feature of this class of boats) well down toward the keel of the vessel, the provision of a large water-ballast space below the center of the inner hull section, and the arrangement of the water space in the superstructure, I provide a boat of exceptionally shallow draft, with a lower center of gravity, a high center of buoyancy, and with a larger reserve of buoyancy than has been possible in such class of boats heretofore constructed. By the arrangement of the braces b^5 the outer hull section B is securely braced to the inner section A, which enables it to withstand the high external pressure of the water without fear of collapse.

What I claim is:—

1. A submarine boat, comprising an inner hull section of sufficient strength to resist the pressure incident to submergence and constituting a living and a machinery compartment, a battery compartment suspended below said inner hull section, the sides of which provide longitudinal girders, a lower hull section also of sufficient strength to resist the pressure incident to submergence, the space formed by said hull sections providing a water-ballast compartment which extends upon both sides of the said battery compartment, an upper section of light weight construction arranged over said inner hull section which is adapted to be made water-tight for surface navigation only, and braces connecting said inner hull section with said lower hull section and said upper section.

2. A submarine boat, comprising an inner hull section of sufficient strength to resist

the pressure due to submergence and constituting a living compartment and a machinery compartment, a battery compartment suspended below said hull section, the sides of which form longitudinal girders, a lower hull section also of sufficient strength to resist the pressure incident to submergence, the space formed by said hull sections providing a water-ballast compartment, means for admitting water into said ballast compartment, means for displacing the water taken in, an upper section of light weight construction arranged over said hull sections and connected air and water-tight to said lower hull section to provide an air-tight compartment for surface navigation only, and means for admitting water to said last mentioned compartment upon submergence.

3. A submarine boat, comprising an inner hull section, an outer hull section connected to the inner hull section air and water-tight, braces arranged between and connected to the hull sections, a central storage battery compartment having sides forming longitudinal girders by which the compartment is suspended from the inner hull section, partitions arranged in the space formed by the hull sections and forming a plurality of water-ballast tanks, means for controlling the admission of water to said tanks, means for emptying said tanks, a superstructure fixed to the hull sections air and water-tight and cut off from communication with the water-ballast tanks and having its sides connected to the sides of the outer hull sections, and means for admitting water to the space formed by said superstructure.

4. A submarine boat, comprising an inner hull section adapted to resist external pressure when the boat is submerged, and an outer hull section connected to the inner hull section and of sufficient strength to resist external pressure when the boat is submerged, braces connecting the hull sections, a trough forming a storage battery compartment suspended centrally from the lower side of the inner hull section, water-ballast tanks surrounding the trough, means for controlling the admission of water to said tanks, means for emptying said tanks, a superstructure arranged over the hull sections, tanks held in the space formed by the superstructure, and means for admitting water into the superstructure space to counterbalance the external water pressure when the boat is submerged.

5. A shallow draft submarine boat, comprising an inner hull section substantially oblong in transverse section, and an outer hull section substantially semicircular in cross-section arranged below and connected to said inner hull section, braces connecting said sections, strengthening columns arranged in the inner hull section, a storage battery compartment arranged in the space formed by the hull sections, water-ballast tanks also arranged in said space, means for controlling the admission of water to the tanks, and means for emptying said tanks, a superstructure of light weight construction arranged over the inner hull section, and means for admitting water into the superstructure space to counterbalance the external pressure when the boat is submerged.

6. A submarine boat, comprising an inner hull section, and an outer hull section of the same length, constructed to resist external pressure when the boat is submerged, bow and stern portions extending from the hull sections, a storage battery compartment arranged centrally in the space formed between the hull sections, ballast tanks formed in the said space, means for admitting water to the said tanks, means for emptying said tanks, a superstructure of light weight construction arranged over the hull sections and means for admitting water into the superstructure space.

7. A submarine boat, comprising an inner hull section, and an outer hull section spaced from and connected to said inner hull section, braces connecting the hull sections, bow and stern portions extending, respectively, from the ends of the said hull sections, bulkheads arranged within the bow and stern portions, a superstructure arranged upon the hull sections and including supporting frames, transverse struts and longitudinal girders connected to said frames, buoyancy tanks held in the space formed by the superstructure, means for admitting water to said space when the boat is submerged, a storage battery compartment arranged in the space formed between the hull sections, partitions arranged in the hull space to form a plurality of water-ballast tanks, and means for admitting water into the tanks and for emptying said tanks.

8. A submarine boat, comprising an inner hull section, and an outer hull section connected to said inner hull section air and water-tight, both of said sections being of sufficient strength to resist external pressure due to submergence, braces connected to said hull sections, bow and stern sections connected to the said hull sections, bulkheads arranged at the ends of said hull sections, partitions in the bow and stern sections to form compartments therein, a superstructure of light weight construction arranged over said hull sections and bow and stern sections, frames for supporting the superstructure, braces connecting the frames, buoyancy tanks arranged in the space formed by the superstructure, means for admitting water to said space to counterbalance the external pressure incident to submergence, ballast-tanks arranged below the inner hull section, means for filling and for emptying said ballast-

tanks, a trough forming a battery compartment suspended centrally from said inner hull section and spaced from the outer hull section, and a hatch and cover for same controlling admission to the battery compartment.

9. A submarine boat, comprising an inner hull section, and an outer hull section connected to said inner hull section, bow and stern sections extending respectively from opposite ends of the hull sections, bulkheads arranged at the ends of the hull sections, partitions arranged in said bow and stern sections and dividing them into compartments for the purpose specified, a centrally arranged trough suspended from the bottom of the inner hull section and extending the full length thereof, partitions dividing the space between the hull sections into a plurality of water-ballast tanks, columns arranged in the inner hull section between the ends of the frames and the sides of the trough, means for admitting water to the said ballast tanks, means for emptying said tanks, a superstructure arranged over the full length of the boat and having supporting frames and means for admitting water into the space formed by the said superstructure.

10. A submarine boat, comprising an inner hull section substantially oblong in transverse section, and an outer hull section substantially semicircular in cross-section connected to said inner hull section, the tops of the sides of said outer hull section being arranged below the horizontal center of the inner hull section and closed, braces connecting the hull sections, end sections forming the bow and stern portions of the boat comected to the ends of the hull sections, a superstructure arranged over the inner hull section and whose sides extend from the top of the said outer hull section and spaced from the sides and top of said inner hull section, buoyancy tanks arranged in the space formed by the superstructure, water ballast tanks arranged in the space between the inner and outer hull sections, means for admitting water into said water-ballast tanks and for emptying them, and means for admitting water into the space formed by the superstructure when the boat is submerged.

11. A submarine boat, comprising an inner hull section substantially oblong in transverse vertical section and tapering in horizontal transverse section from amidships toward each end, an outer hull section substantially semicircular in cross-section and of gradually diminishing radii from amidships toward each end and connected to said inner hull section, tapering end sections forming the bow and stern portions of the boat and extending from the ends of said hull sections, bulkheads connected to the ends of said hull sections, partitions arranged in the said end sections for the purpose specified, a trough suspended from the bottom of said inner hull section and having its ends connected to said bulkheads and whose sides thereby form longitudinal girders, transverse braces connected to said hull sections and to the outer hull section and trough, hollow bracing columns arranged in the inner hull section, partitions arranged in the space formed by the hull sections providing a plurality of water-ballast tanks, means for controlling the admission of water to said tanks, means for emptying said tanks, a superstructure arranged over the inner hull section and connected to the outer hull section and to the end sections, air and water-tight tanks held in the space formed by said superstructure, and means for admitting water into said space when the boat is submerged.

12. A submarine boat, comprising an inner hull section substantially oblong in transverse section and having semicircular sides, an outer hull section substantially semicircular in cross-section arranged below and connected to the inner hull section, end sections connected to the hull sections, bulkheads arranged at the ends of the hull sections, a trough suspended from the inner hull section and having its ends connected to the bulkheads and whose sides form longitudinal girders, transverse braces connecting the outer and inner hull sections and trough, partitions arranged in the space formed between the hull sections for the purpose specified, a superstructure fixed air and water-tight to the hull sections and to the end sections and having supporting frames and longitudinal girders and transverse braces connected to the frames, vertically arranged hollow columns arranged in the inner hull section and extending along the sides thereof between the sides of said trough and the longitudinal girders in the superstructure, and means for admitting water to the space formed by the superstructure when the boat is submerged.

13. A submarine boat, comprising an inner hull section substantially oblong in vertical transverse section and having rounded end portions, an outer hull section arranged below said inner hull section and connected thereto air and water-tight, ballast-tanks formed in the space between said hull sections, means for admitting water to said ballast-tanks, means for emptying said tanks of the water taken in, a normally closed superstructure arranged over said hull sections, said superstructure having a central raised portion providing a deck, and curved sides conforming to the ends of said inner hull section, means for admitting water to

said superstructure, and vertical hollow bracing columns arranged in said inner hull section.

14. In a submarine boat, an inner hull section, an outer hull section beneath the former, and a superstructure above both hull sections, in combination with hollow columns arranged within the inner hull section and serving to brace said inner hull section and as storage bottles.

15. A submarine boat, comprising an inner hull section substantially oblong in vertical transverse section at the center and of gradually diminishing width toward its ends, an outer hull section substantially semicircular in cross-section and of gradually diminishing size from the center toward each end, and its upper longitudinal edges arranged in the same horizontal plane, tapering end sections forming the bow and stern portions of the boat extending from the ends of said hull sections, water-tight bulkheads arranged at the ends of the hull sections, a trough suspended from the bottom of the inner hull section and connected to said bulkheads air and water-tight, the sides of said trough serving as longitudinal girders, transverse braces connected to the hull section and to the trough and the outer hull section to brace and assist the latter to resist external pressure when the boat is submerged, a superstructure of light weight construction fixed to the said outer hull section and to said bow and stern sections air and water-tight and having supporting frames, longitudinal girders and transverse braces connecting the frames and the inner hull section, means to admit water to the space formed by said superstructure when the boat is submerged to counterbalance the external pressure thereon, and hollow columns arranged in the inner hull section as shown and described.

16. A submarine boat, comprising an inner hull section substantially oblong in cross-section and having its sides substantially semicircular and converging from amidships toward each end, an outer hull section substantially semicircular in cross-section and of gradually diminishing size from amidships toward each end, braces connecting the hull sections, outwardly tapering bow and stern sections extending from the ends of the hull sections and whose tops are extended above the top of said inner hull section and arranged in horizontal planes, a superstructure of light weight construction fixed to the air and water-tight outer hull section and to the bow and stern sections and having supporting frames, tanks arranged in the space formed by the superstructure, longitudinal girders connected to the frames and to the top of the inner hull section and forming cradles for said tanks, tie-bands for holding the tanks in position, hollow columns arranged in the inner hull section below the longitudinal girders, and means for admitting water to the space under said superstructure when the boat is submerged.

17. A shallow draft submarine, comprising an inner hull section substantially oblong in transverse vertical section, an outer hull section substantially semicircular in cross-section connected to said inner hull section, both of said sections being of sufficient strength to withstand external pressure incident to submergence, end sections forming the bow and stern portions of the boat and whose tops are arranged above the top of said inner hull section, water-tight bulkheads arranged in said end sections, a superstructure connected to said outer hull and end sections air and water-tight and having means for supporting and means for bracing it, tanks arranged in the space formed by the superstructure to raise the center of buoyancy when the boat is submerged, and means to admit water into the said space to counterbalance the pressure thereon incident to submergence.

In testimony whereof I have hereunto set my hand this 24 day of December, A. D. 1908.

SIMON LAKE.

Witnesses:
WM. H. SCHOLZ,
FRED B. WHITNEY.