No. 687,830. Patented Dec. 3, 1901.

J. A. KIRK.

SUBMARINE DREDGER AND GOLD SAVING MACHINE.

(Application filed May 2, 1900.)

(No Model.) 6 Sheets—Sheet 1.

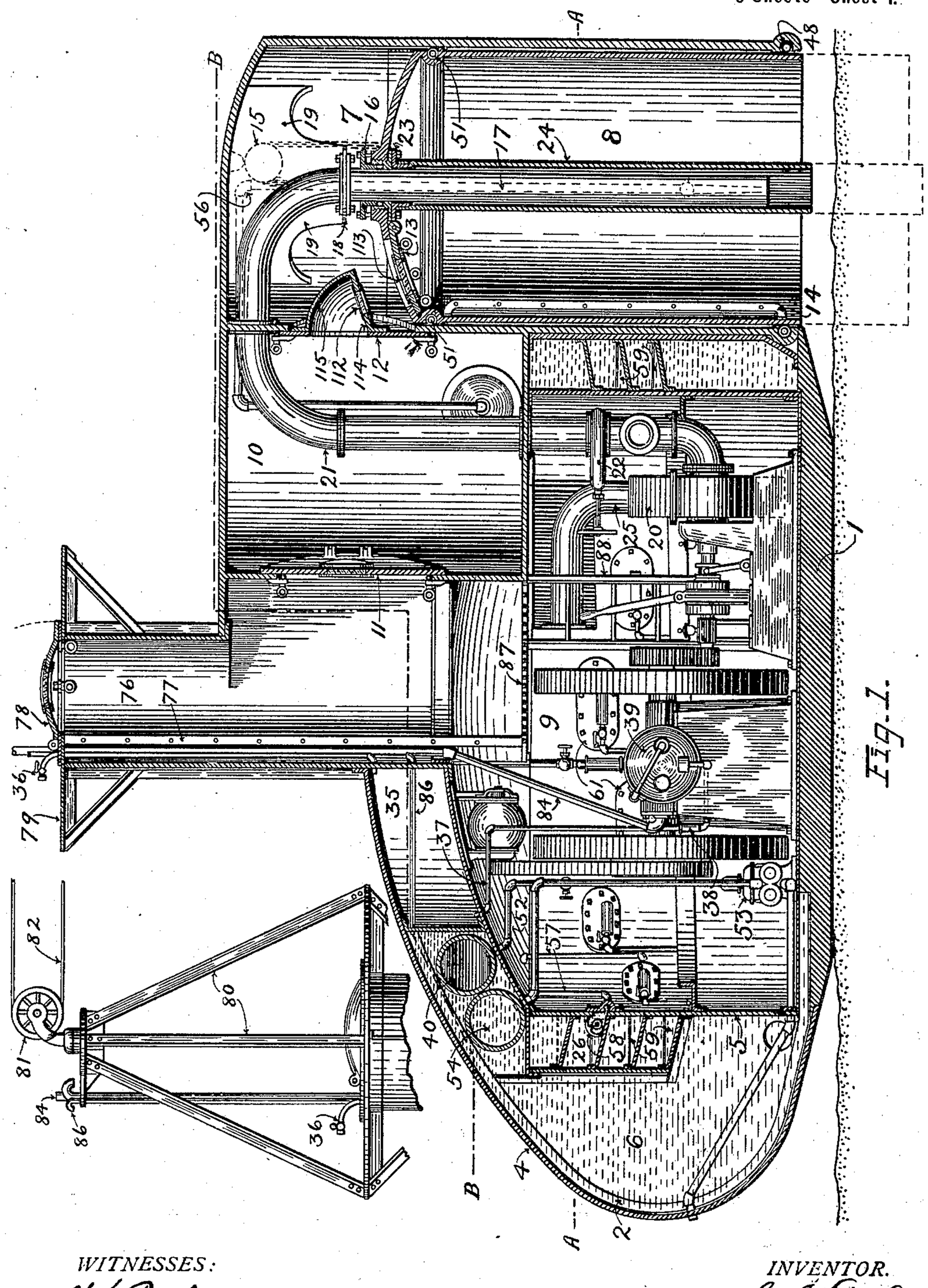

FIG. 1.

WITNESSES:

J. W. Roberts

Francis M. Wright.

INVENTOR.

Jno. A. Kirk

No. 687,830. Patented Dec. 3, 1901.

J. A. KIRK.

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(No Model.) 6 Sheets—Sheet 2.

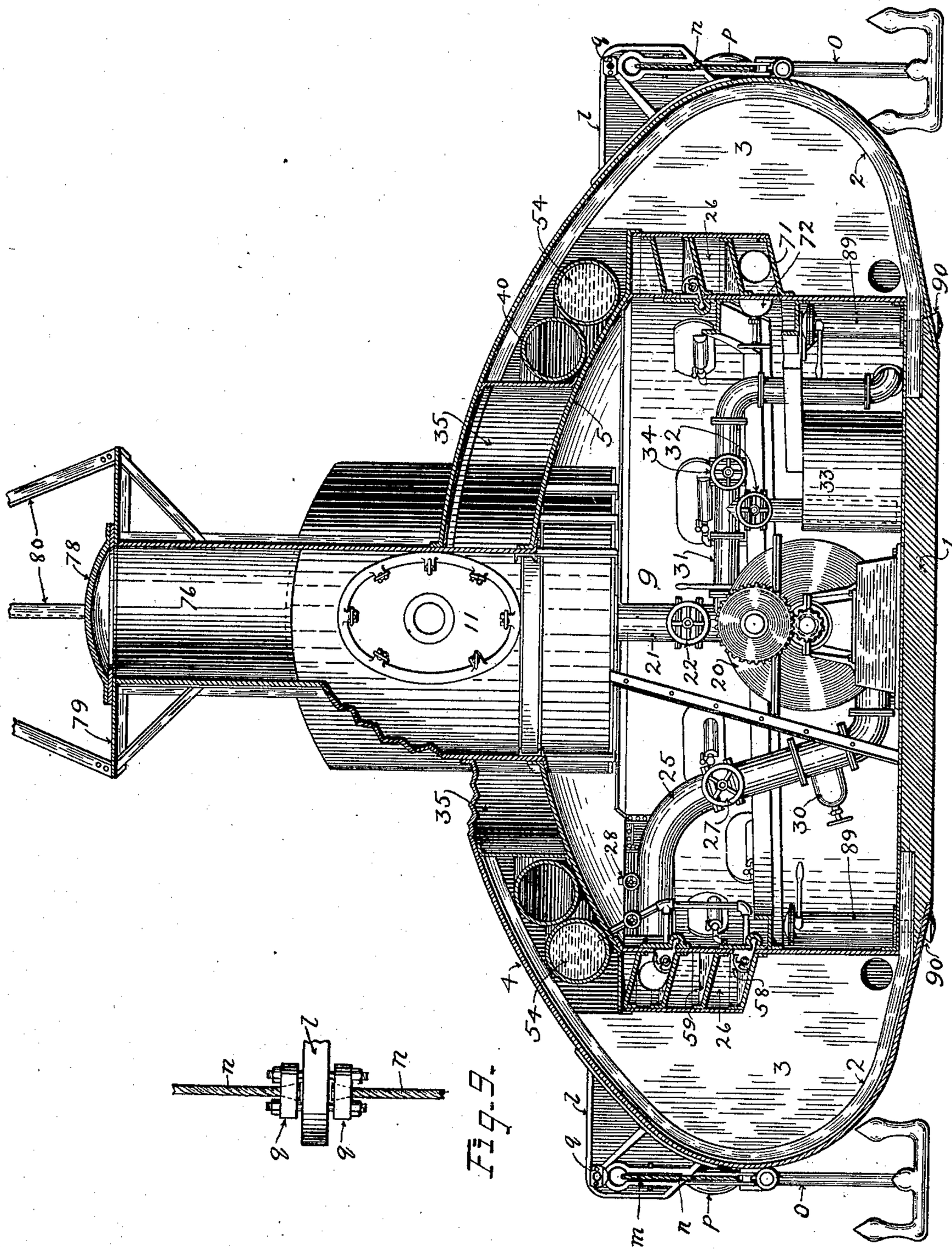

Fig. 2.

Fig. 3.

WITNESSES:

J. W. Roberts

Frances M. Wright

INVENTOR.

Jno. A. Kirk

No. 687,830. Patented Dec. 3, 1901.

J. A. KIRK.

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(No Model.) 6 Sheets—Sheet 3.

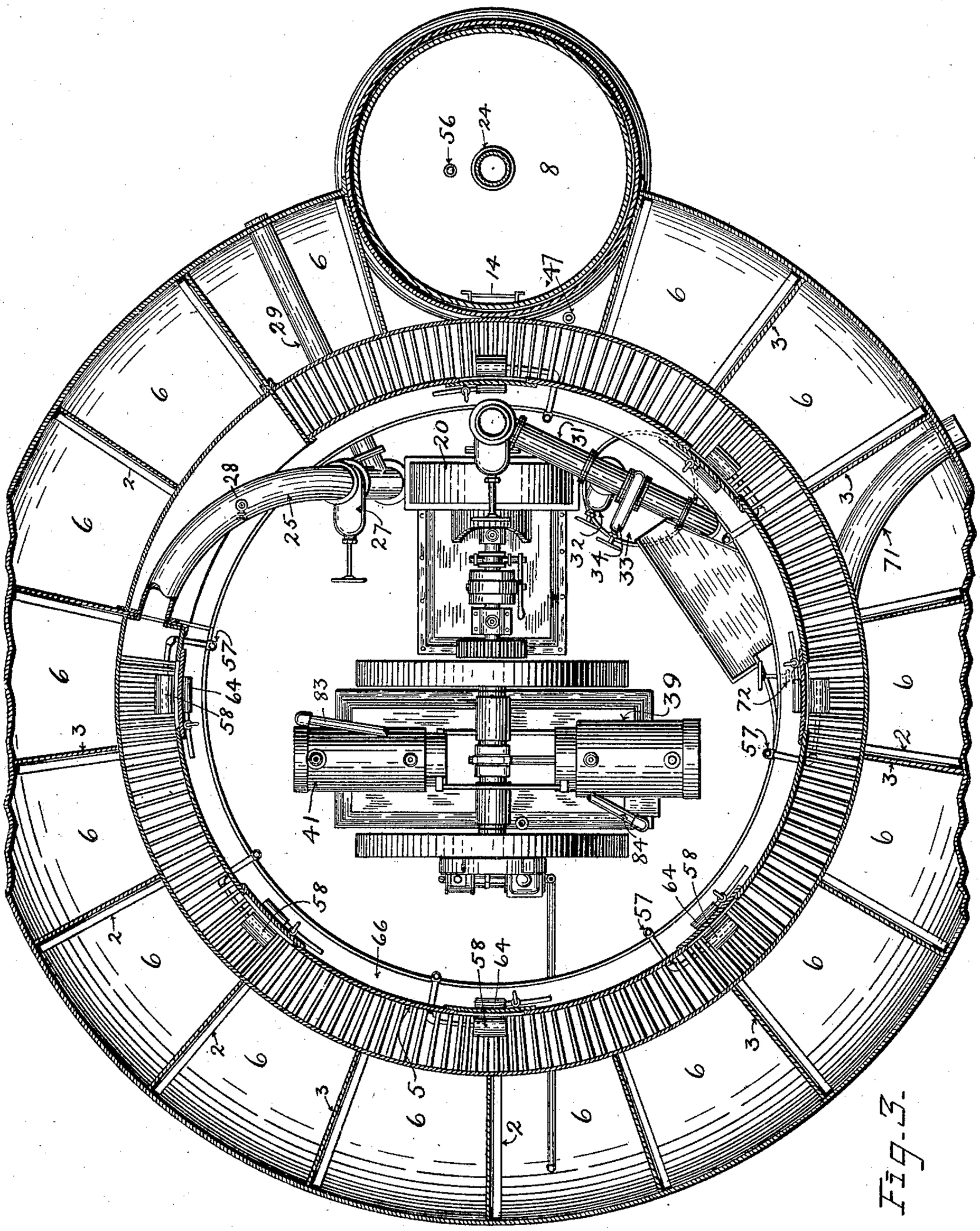

Fig. 3.

WITNESSES:

J. W. Roberts

Francis M. Wright

INVENTOR.

Jno. A. Kirk

No. 687,830. Patented Dec. 3, 1901.

J. A. KIRK.

SUBMARINE DREDGER AND GOLD SAVING MACHINE.

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(No Model.) 6 Sheets—Sheet 4.

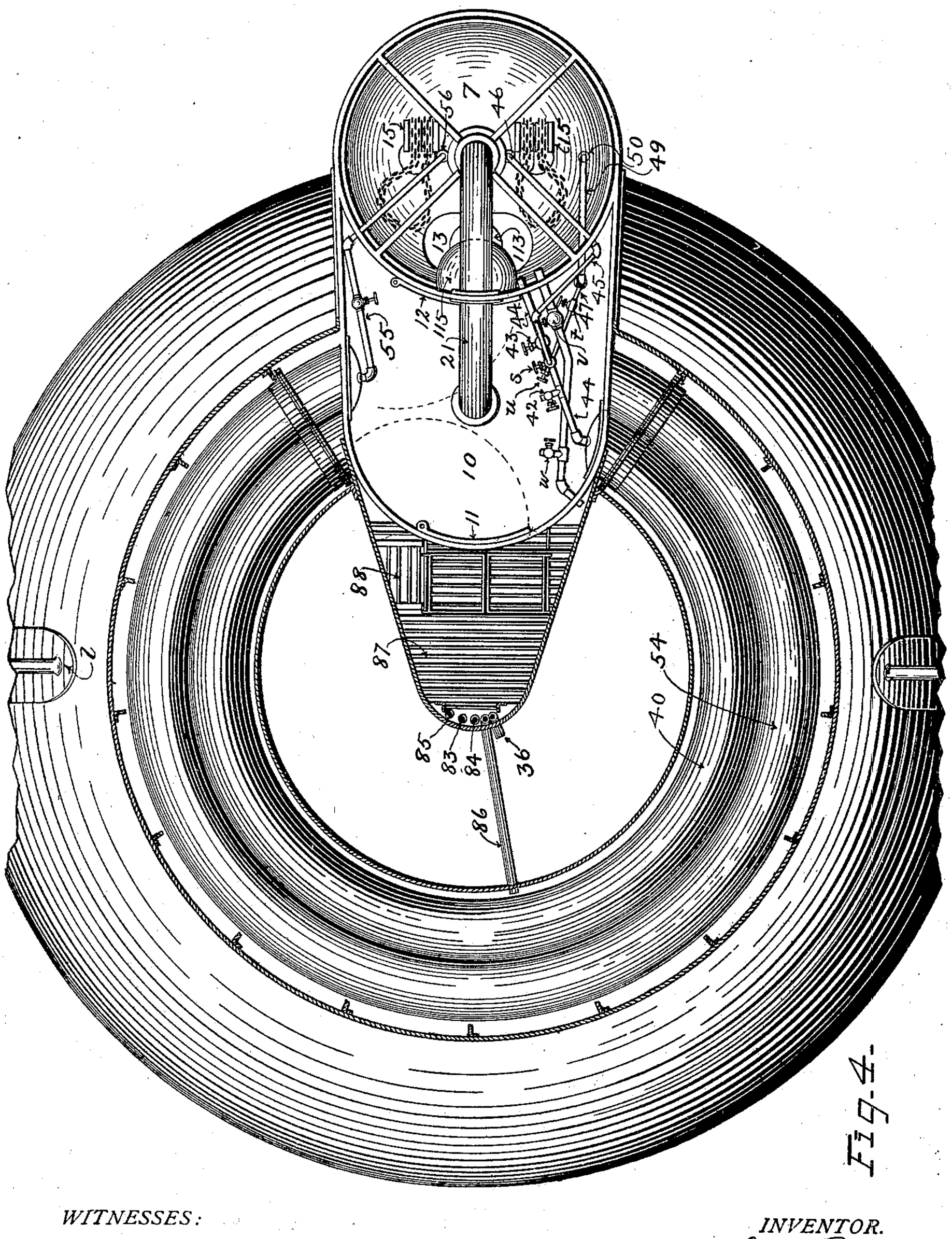

Fig. 4.

WITNESSES:

J. W. Roberts

Francis M. Wright.

INVENTOR.

Jno. A. Kirk

No. 687,830. Patented Dec. 3, 1901.

J. A. KIRK.

SUBMARINE DREDGER AND GOLD SAVING MACHINE.

(Application filed May 2, 1900.)

(No Model.) 6 Sheets—Sheet 5.

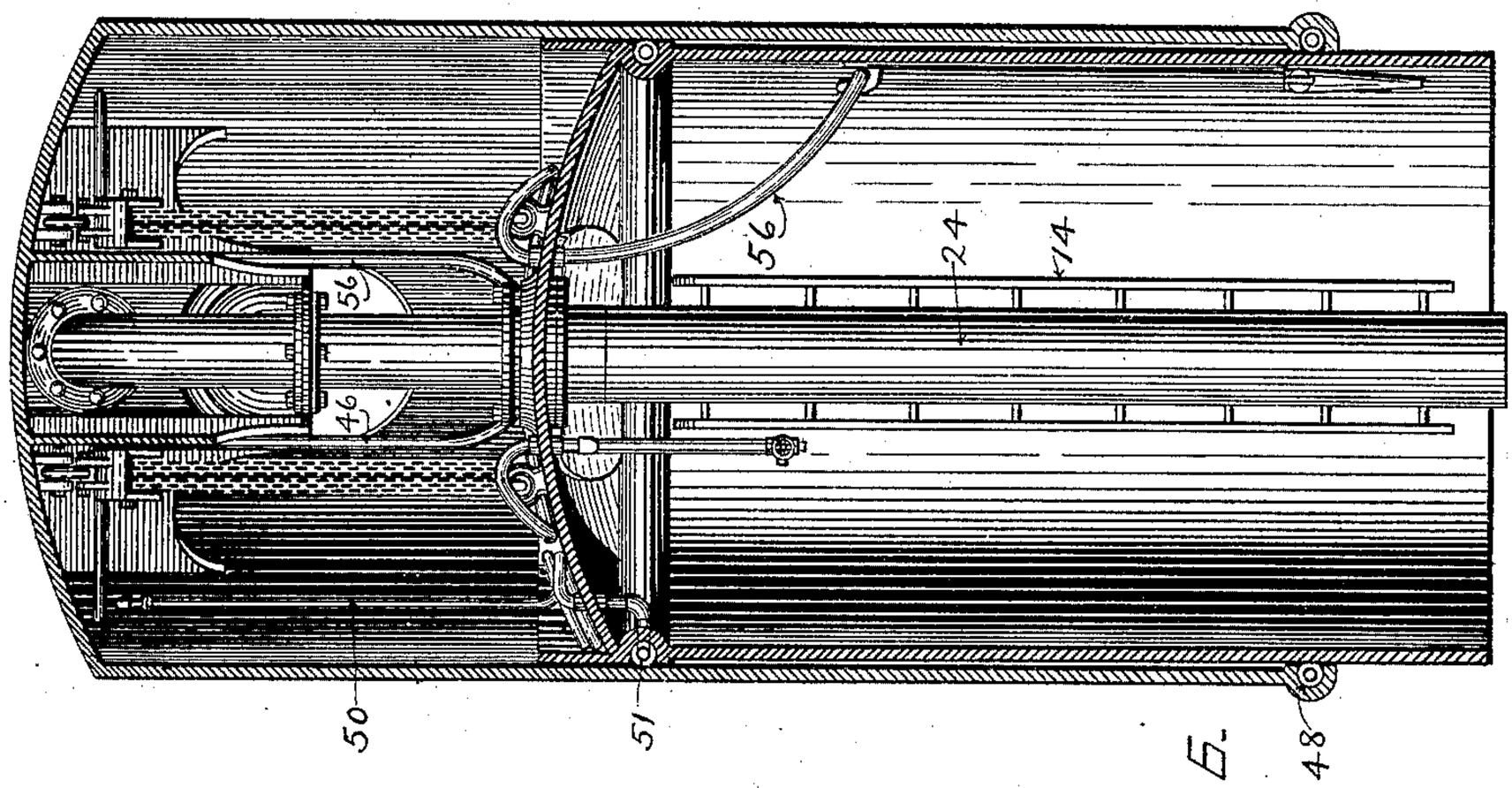

FIG. 6.

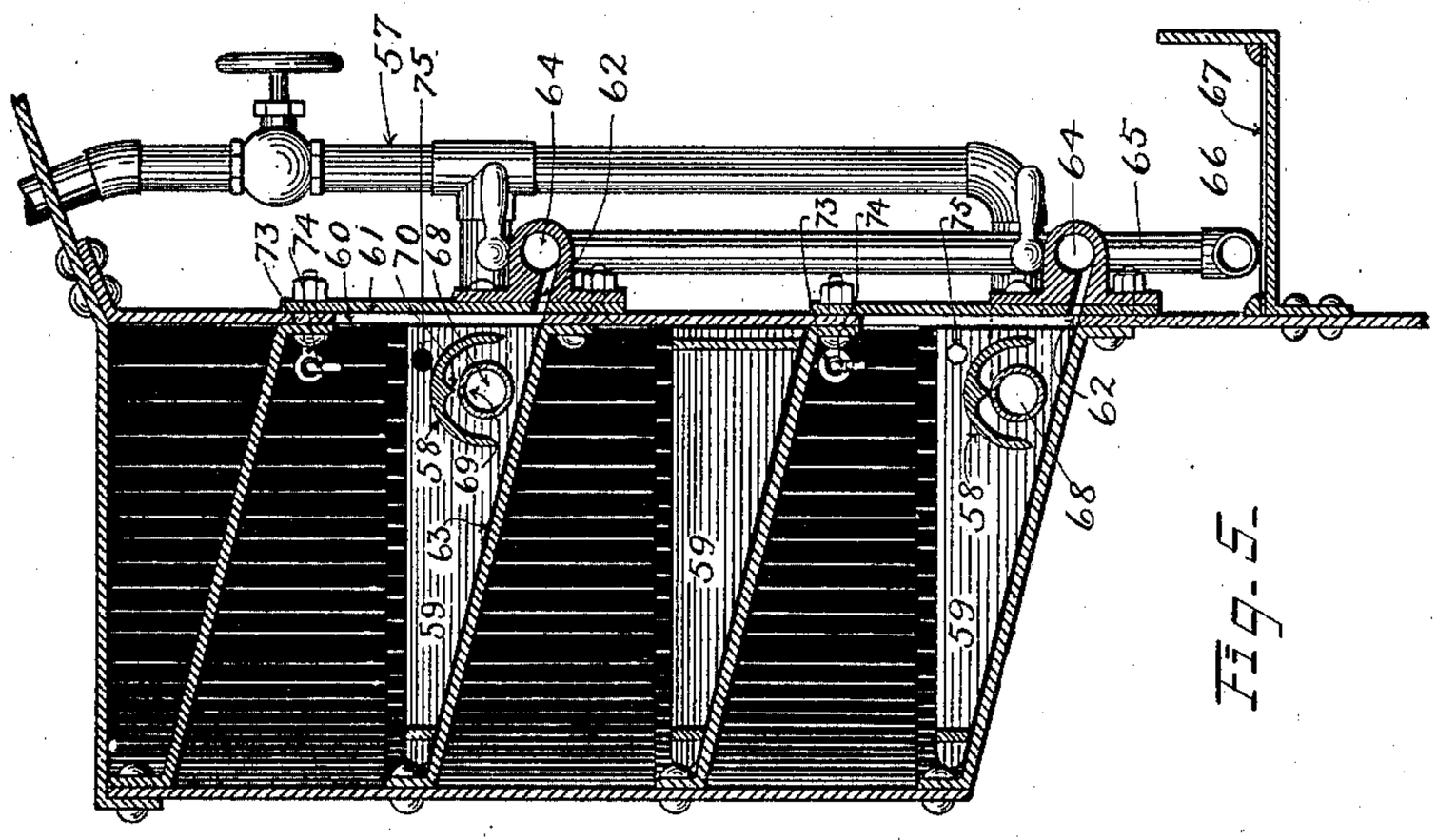

FIG. 5.

WITNESSES:

J. W. Roberts

Francis M. Wright.

INVENTOR.

Jno. A. Kirk

No. 687,830. Patented Dec. 3, 1901.

J. A. KIRK.

SUBMARINE DREDGER AND GOLD SAVING MACHINE.

(No Model.) (Application filed May 2, 1900.)

6 Sheets—Sheet 6.

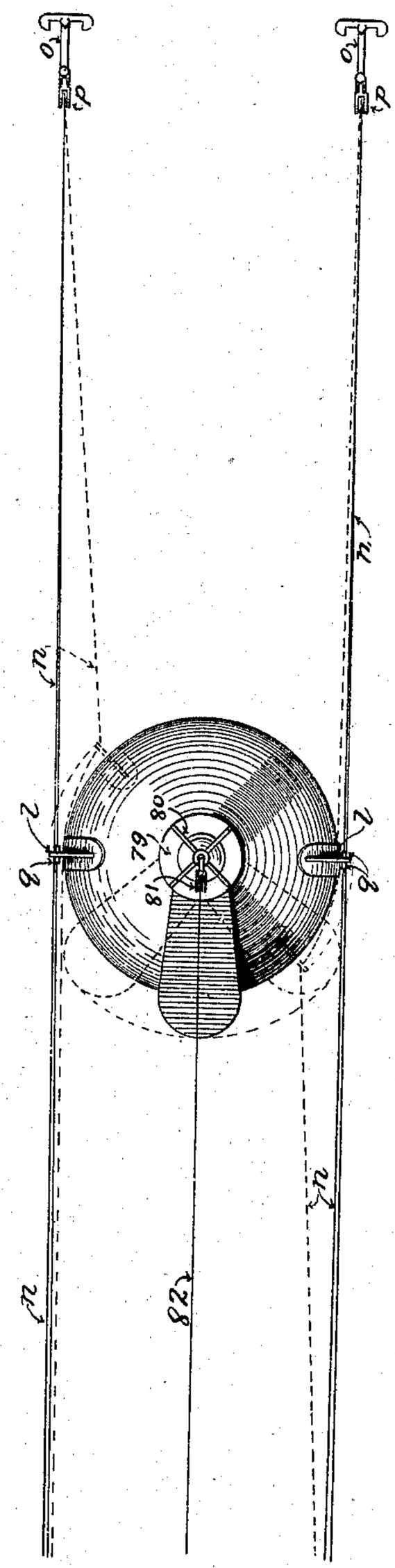

Fig. 7.

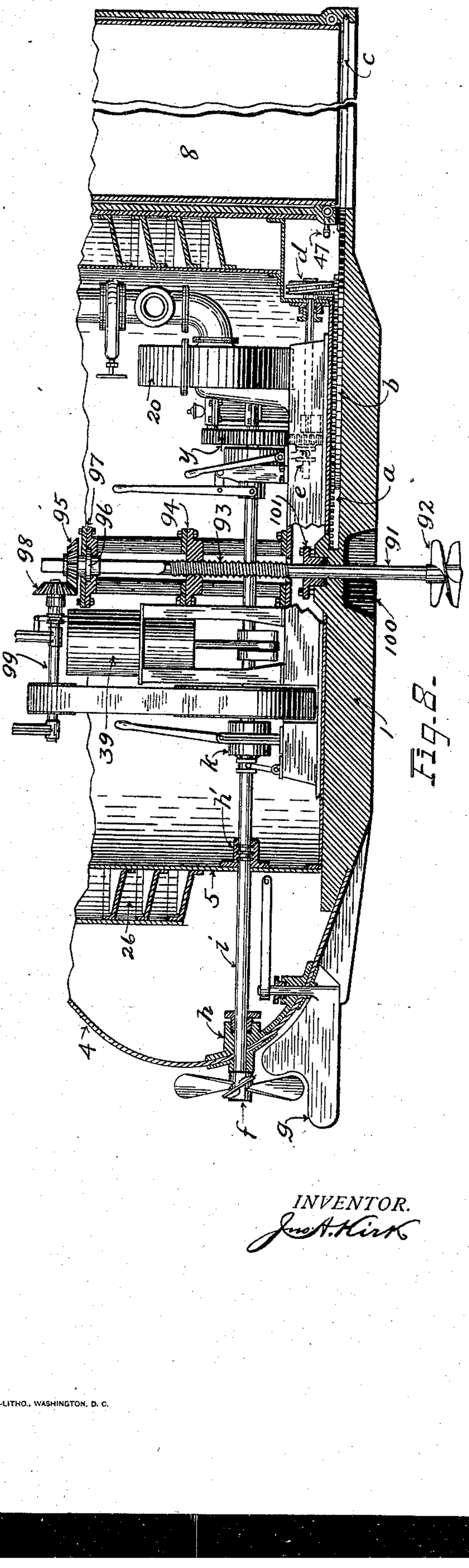

Fig. 8.

WITNESSES:

J. W. Roberts

Bruce W. Wright.

INVENTOR.

Jno. A. Kirk

UNITED STATES PATENT OFFICE.

JOHN A. KIRK, OF SAN FRANCISCO, CALIFORNIA, ASSIGNOR OF ONE HALF TO J. W. ROBERTS, OF SAN FRANCISCO, CALIFORNIA, AND W. T. S. KIRK, OF ALAMEDA, CALIFORNIA.

SUBMARINE DREDGER AND GOLD-SAVING MACHINE.

SPECIFICATION forming part of Letters Patent No. 687,830, dated December 3, 1901.

Application filed May 2, 1900. Serial No. 15,271. (No model.)

To all whom it may concern:

Be it known that I, JOHN A. KIRK, a citizen of the United States, and a resident of the city of San Francisco, in the county of San Francisco and State of California, have invented certain new and useful Improvements in Submarine Dredgers and Gold-Saving Machines; and I do hereby declare that the following is a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

My invention relates to improvements in submarine and gold dredging machines, and is particularly designed, as will be seen from its flattened dome shape, to dredge auriferous sea-sands where there is a liability of heavy current, swells, and rolling sea, and has for its objects, first, to provide a submarine vessel with means for submerging or raising the vessel, for leveling it or anchoring it to the water-bed, the vessel having free communication with the surface of the water through an air-shaft and with the water-bed through a series of air-pressure chambers for the purpose of excavating auriferous sands and gravel therefrom, also with means for imparting either a rocking movement or a to-and-from-shore movement transmitted from a power plant stationed on shore; second, to provide the vessel with a caisson so constructed as to be raised or lowered within the caisson-chamber by means of air-pressure, the caisson and caisson-chamber being provided with pneumatic packing to confine the compressed air within the caisson-chamber, also with an adjustable suction-pipe extending from the center of the caisson to the auriferous sand, access being had to the caisson from the operating-room by means of air-tight doors and the operating-room being connected to the general interior of the vessel by an air-tight door; third, to provide a pumping apparatus for the purpose of raising the sand and delivering it to and carrying it through a novel spiral-shaped sluiceway, and, fourth, to provide a novel gold separating and saving device in connection with the sluiceway, all contained within the interior of the vessel hereinafter fully described.

To these ends my invention consists in the features and in the novel construction, combination, and arrangements of parts hereinafter described and particularly pointed out, reference being had to the accompanying drawings, forming part of this specification, wherein—

Figure 1 is a vertical longitudinal sectional view, on the central line of the shell, of my submarine gold-dredger and gold-saving machine, showing the machinery in elevation. Fig. 2 is a vertical transverse sectional view on the central line of the shell. Fig. 3 is a plan view taken on line A A of Fig. 1. Fig. 4 is a plan view taken on line B B with the shell above the caisson-chamber and the operating-room removed. Fig. 5 is a detailed section through the spiral sluiceway. Fig. 6 is a section through the caisson and the caisson-chamber. Fig. 7 is a plan showing the anchorage of the dredger and connecting-cables running toward the shore. Fig. 8 is a sectional view showing a modified form of my invention embodying means for self-propulsion, for anchoring to the water-bed, and for closing the caisson-chamber at the bottom; and Fig. 9 is a detail of the connection with the shore cables.

Referring to the drawings, the numeral 1 indicates the base-plate or keel, of cast metal, from which radiate the angle-iron framing 2 and stiffening-plates 3, forming the ribs, to which are secured the outer dome-shaped shell 4 and the inner shell 5, the latter inclosing the machinery and together with an outer shell forming the water-ballast space 6.

At one side of the vessel is arranged the caisson-chamber 7, containing the caisson 8, and adjacent thereto and separated by air-tight partitions from the caisson-chamber and machinery-room 9 is the air-lock or operating-room 10, access being had to the water-bed through these chambers by means of air-tight doors 11, 12, and 13 (having port-lights 112 113) and ladder 14. The port-light 112 is formed in a wall 114 of an extension 115 into the caisson-chamber and is substantially parallel with the port-light 113 on the top of the caisson, so that the caisson operator located outside the caisson-chamber can observe the miner within the caisson and take signals therefrom. At the top of the

caisson-chamber are located differential pulleys 15, designed to lift and support the caisson when not in operation.

Extending into the caisson through the stuffing-box 16 is a suction-pipe 17, rigidly supported from the top of the caisson-chamber by means of a cast-iron gasket 18 and ribs 19. Said suction-pipe 17 is connected to a pump 20 by a pipe 21, provided with a cut-off valve 22. On the inside of the caisson, secured to the top thereof by a flanged connection 23, is a flexible suction-pipe 24, and since said caisson is movable vertically in the caisson-chamber, as will be presently described, said pipe 24 forms an adjustable extension to the rigid suction-pipe 17. From the pump 20 the water and auriferous sand are discharged through a pipe 25 to the upper run of a closed spiral sluiceway 26, this pipe 25 being provided with a cut-off valve 27 and air-inlet valve 28, also with a branch pipe 29, continued to and through the outer shell and having a cut-off valve 30. Extending from suction-pipe 21 is an auxiliary suction-pipe 31, with a valve 32, adapted to empty the tailings-tank 33, the latter located at the end of an auxiliary spiral sluiceway hereinafter described, the suction-pipe 31 being extended into and adapted to empty the water-ballast space 6 and having a cut-off valve 34.

In the upper portion of the space 6 between the inner and outer shells is located a gasolene-tank 35, supplied by a pipe 36 from a platform 79 and having also a discharge-pipe 37 leading to a pump 38, which in turn supplies a gasolene-engine 39 of ordinary construction. Within this space is also located a compressed-air receiver 40, connected with and filled by an air-compressor 41 of any usual construction, said receiver being designed to supply air under pressure through a pipe 44 and valve 42 to the air-lock or operating-room 10 and by means of valve 43 and pipe 44 to the caisson-chamber 7 and by means of valved pipe 45 to the caisson 8 through the flexible air-hose 46, also to supply air under pressure through a valved pipe 47 to a flexible pneumatic packing 48 and through pipe 49 to a flexible air-supply pipe 50 and thence to the pneumatic packing 51. The compressed-air receiver 40 is also designed to supply air through a pipe 52 to a pump 53 of the usual construction, which in turn supplies a hydraulic-pressure receiver 54, the latter being intended to supply water under pressure through a valved pipe 55 (see Fig. 4) to a flexible hose 56, extending into the caisson and terminating with a nozzle for the purpose of disintegrating clayey substances and driving the material to the suction-pipe, also through a pipe 57 to supply water under pressure through spreaders 58 for the purpose of agitating the material deposited on the bottom of the closed spiral sluiceway 26 between the riffles 59. Since the water discharged from the closed sluiceway into the water-bed has to overcome the pressure due to the depth of water at the point of emergence, the pressure in the closed sluice must be yet higher than at the point of emergence, and the pressure necessary in the pipe 57 must therefore be still higher.

The closed spiral sluiceway is arranged within the water-ballast space and designed to be of greater capacity than the discharge-pipe of the pump. In the sides of the sluiceway are cut hand-holes 60, (see Fig. 5,) opening into the machinery-room and adapted to be closed by hand-hole plates 61, having ports 62, which ports are adapted to coincide with the inclined bottom-plates 63 of the sluiceway. Said ports open into a cast-metal chamber 64, riveted to the hand-hole plates, said chambers being connected by valved pipes 65, which are designed to empty the separated material from the closed spiral sluiceway into the auxiliary open sluiceway 66, in which are placed the amalgamating-plates 67.

Within the closed sluiceway and directly in front of each hand-hole is an extension 68 of a pipe 57, having a narrow port or slit 69 at its upper side arranged to coincide with the V-shaped rib 70 on the under surface of the spreader 58, the object being to separate and spread the hydraulic-pressure jet and cause it to flow downward, passing under the edge of the spreader and forcing the lighter particles of material to flow upward into the current above the riffles 59 and be carried along with the water, while the heavier particles gradually settle down into the space under the pipe and are forced through the ports 62 into the chamber 64 and thence into the auxiliary open sluiceway, where a further separation of the gold from the sand and other material takes place by amalgamation, the bulk of the debris being forced through the various coils of the sluiceway and discharged to the water-bed through pipe 71, having valve 72. Above the hand-hole is arranged an eyebolt 73, having hooks 74, adapted to engage holes 75 in the top of the riffles to hang them up during the process of a thorough cleaning up.

The vessel is provided with an air-shaft 76, extending upward and above the surface of the water for ingress and egress by means of a ladder 77. The top of the shaft has a watertight storm-door 78, and at the top of the air-shaft and attached thereto is a platform 79 for landing supplies to the vessel. Upon this platform and secured thereto by means of a suitable framework 80 is a swivel-sheave 81, through which sheave passes an endless cable 82, connected with the shore power plant, said cable being for the purpose of obtaining safe communication from the shore to the vessel in rough weather.

Extending up from the interior of the vessel through the top of the air-shaft is the air-compressor intake-pipe 83, the engine exhaust-pipe 84, the cold-air-inlet pipe 85, and

the vent-pipe 86 to the water-ballast space. At the bottom of the air-shaft is a grille-platform 87, with a ladder 88 going down to the keel, which forms the floor of the machinery-room 9. Arranged around the machinery-room under the auxiliary sluiceway are three or more hydraulic jack-spuds 89, designed to be firmly fastened to the bottom of the vessel, having elevating-pistons 90 passing through the bottom of the vessel to engage the water-bed, the object being to adjust the vessel horizontally when on an inclined or uneven bed.

In the modification of the invention shown in Fig. 8 an anchoring-spud 91 is arranged at the center of the vessel adapted to pass through a stuffing-box 101 in the bottom of the vessel, its lower end terminating in an auger-shaped bit 92, having at its middle portion a long screw-thread 93, passing through the frame 94, said frame being solidly fastened to the bottom of vessel or engine-bed. The upper portion of spud is of square section and has loosely fitted thereon a beveled gear-wheel 95, constructed with a shouldered bearing 96 on its under side, fitted into and adapted to be revolved in the journal-box 97 by the bevel-gear 98, connected to the pulley-shaft 99, the action being when the gear is revolved to cause the spud to be screwed down into the water-bed for safe anchorage in rough water and the reverse motion to raise and house the auger-shaped bit in the pocket 100.

Arranged in a pocket *a*, formed in the keel-plate, is a sliding door *b*, designed to fit into a packed groove *c*, constructed in the shell of the caisson-chamber, and thus close the open bottom of said chamber, making it water-tight when it may be desired to self-propel the vessel. This sliding door is operated by the worm-gear *d*, connected by clutch-gear *e* to cog-gear *y* of engine 39.

For the purpose of self-propulsion there are arranged a screw-propeller *f* and rudder *g*, the propeller being connected to the engine through the journal *h* and thrust-journal *h'* by means of a shaft *i*, having a clutch-gear *k*.

On diametrically opposite sides of the vessel are brackets *l*, having sheaves *m*, over which pass cables *n* from the shore power plant. These cables connect with anchors *o* by means of sheaves *p*, thence back to brackets *l*, where they are rigidly fastened by means of clamps *q*, and thence to power plant on shore. The object of this device is to move the vessel in a direction to and from shore, also to change the position of the caisson in a semicircular direction for the purpose of excavating the full width of the diameter of the dredge, as best shown in Fig. 7.

Having detailed the mechanical parts of my invention, it remains now to describe its operation. Assuming that the dredge is in position over a point which it is desired to excavate and that the dredge is ready for submersion, the anchors also being in position, as shown in plan in Fig. 7, the operation is as follows: Open the valves 30 and 34. The water then flows by gravitation through the pipe 25, rotary pump 20, and auxiliary suction-pipe 31 to the water-ballast space 6, gradually filling said space and settling the vessel to the water-bed. This having been accomplished, the valves 30 and 34 are closed. The miner and operator of the caisson then enter the operating-room 10, the air-tight door 12 having been previously closed. After entering the operating-room the air-tight door 11 is closed and the valve 42 is opened, admitting air from compressed-air receiver 40 through pipe 44 to the operating-room until the pressure between the caisson-chamber and the operating-room is equalized, as indicated by a pressure-gage of usual construction, but not shown on the drawings, thus permitting the opening of the door 12, through which entrance is effected into the caisson through door 13, which is normally open. The miner is now within the caisson and the operator in the operating-room. The operator then lowers the caisson by means of the differential pulleys 15 until the bottom edge of the caisson rests on the water-bed and the full slack of the differential pulley-chains rests on top of caisson. The flexible suction-hose projecting below edge of caisson being in proper position for pumping, the engineer in the machinery-room is signaled by the operator in the operating-room by means of an electrical or other call device of the usual construction, but not shown in the drawings, to start pumping. The miner now closes the door 13, and the operator closes the door 12, air being supplied to the miner in caisson through the pipe 45 and flexible hose 46 by the operator opening the pressure-reducing valve *s*. The miner now proceeds to shovel the auriferous sand and gravel toward suction-pipe, and as the material is taken up by the pump the caisson gradually sinks into the bed of material until the weight of the caisson is equalized by the external pressure of the surrounding water. Air is then admitted into the pneumatic packing 48 and 51 through pipe 47 and pipe 49 by opening valve *u* for the purpose of preventing the escape of air from caisson-chamber down between the shell of caisson and caisson-chamber, after which additional air-pressure is placed on the head of the caisson through the pipe 44 by opening the valve 43 for the purpose of driving down the caisson its full depth as the material is excavated. When the material beneath the caisson has been excavated to the proper depth and it is desired to excavate the adjacent ground, the miner signals the operator by visible hand-signal through the port-lights in the doors 12 and 13 or by other suitable means. The operator gradually exhausts the air in the flexible pneumatic packing 48 and 51 by means of valve *t* and in the caisson-chamber by means of the valve *v*, thus allowing the caisson to rise to its nor-

mal position. The operator then signals the engineer at the power plant on shore for a change of position by electric call-bell connected to vessel and power plant by electric cable, whereupon the engineer winds in and lets out the necessary cables to effect the desired change. If the miner desires to leave the caisson while in its normal position, described above, he passes through doors 13 and 12 into the operating-room, after which the door 12 is closed. The valve *w* is then opened, (valve *v* being closed,) exhausting air from the operating-room. Then the door 11 is opened and access is had to the interior of the vessel. The excavated material passing through the pump is forced through the pipe 25 to the summit of the spiral sluiceway 26 and along the sluiceway at a rapid rate. The circular and inclined shape of the sluiceway is designed to impart a more rapid movement of the excavated material and water along its outer perimeter than that of the inner, thus causing the heavier portions of the material to slide down and along the inner side of the sluiceway, where the hydraulic jets and spreader still further separate the lighter material from the heavier, the latter eventually passing through the ports and into the cast-metal chamber, thence to the auxiliary open sluiceway having the amalgamating-plates which separate the precious metal from the baser material, the latter being delivered to the tailings-tank, which tailings are removed by the auxiliary suction-pipe 31 and deposited on the exterior of the vessel.

I claim—

1. In a submarine dredger, the combination of the caisson-chamber, the caisson vertically movable therein, the fixed suction-pipe extending from the chamber into the caisson, the suction-pipe carried by the caisson and telescoping over the fixed pipe, and a pump for lifting the excavated material through said suction-pipes, substantially as described.

2. In a submarine dredger, the combination of the caisson-chamber, the caisson movable therein, the fixed suction-pipe carried by the chamber, the flexible suction-pipe carried by the caisson and telescoping over the fixed pipe, and a pump for lifting the excavated material through said suction-pipes, substantially as described.

3. In a submarine dredger, the combination of the caisson-chamber, the caisson vertically movable therein, the fixed suction-pipe extending from the chamber into the caisson, the suction-pipe carried by the caisson and telescoping over the fixed pipe, a pump for lifting the excavated material through said suction-pipes, an air-compressor, and a connection therefrom to the caisson-chamber above the caisson to depress the latter, substantially as described.

4. In a submarine dredger, the combination of a caisson-chamber, a caisson vertically movable therein, a port-light in the top of the caisson, an extension into the caisson-chamber from the outside thereof, and a port-light in a wall of said extension substantially parallel with the port-light in the top of the caisson, substantially as described.

5. In a submarine dredger, the combination of a caisson-chamber, a caisson vertically movable therein, a port-light in the top of the caisson, a door for closing the entrance to the caisson-chamber, said door having an extension into said chamber, and a port-light in said extension, above said port-light in the top of the caisson, substantially as described.

6. In a submarine dredger and gold-saving machine, the combination with the shell or body of the dredger, of a caisson, a suction-pipe therein, a pump within the shell connected with said pipe, and a spiral sluiceway within the shell around the pump, into which said pump discharges, substantially as described.

7. In a submarine dredger and gold-saving machine, the combination with the shell or body of the dredger, of a caisson, a suction-pipe therein, a pump in the shell connected with said pipe, an engine for operating said pump, and a tortuous sluiceway within the shell around the engine and pump into which said pump discharges, substantially as described.

8. In a submarine dredger and gold-saving machine the combination with the shell or body of the dredger of a water-ballast chamber, a caisson, a suction-pipe therein, a pump in the shell connected with said pipe, a spiral sluiceway within the shell around the pump into which said pump discharges, a tailings-tank for receiving the concentrated material passed from the sluiceway, branch suction-pipes from said ballast-chamber and tank to said pump, and a branch discharge-pipe from said pump to the exterior of the dredger, substantially as described.

9. In a submarine dredger and gold-saving machine, the combination with the shell or body of the dredger, of a water-ballast chamber within the shell, a tailings-tank within the shell for receiving the concentrated material passed from the sluiceway, and means for carrying water from the suction-pipe to the sluiceway and from the tailings-tank to the exterior of the shell, substantially as described.

10. In a submarine dredger, the combination of an annular water-ballast chamber, an annular fluid-fuel chamber above the water-ballast chamber, a suction-pipe, a pump therefor, and an engine in the space surrounded by the water-ballast chamber, supplied from said fuel-chamber and operating said pump, substantially as described.

11. In a submarine dredger and gold-saving machine, the combination with the shell or body of the dredger of an annular water-ballast chamber within the shell, a spiral sluiceway within the shell, a caisson-chamber and cassion, a suction-pipe therein, a pump for conveying water from said pipe to said

sluiceway, an annular compressed-air receiver and a pipe therefrom to the caisson-chamber, substantially as described.

12. In a submarine dredger and gold-saving machine, the combination with the shell or body of the dredger, adapted to float in the water, of a suction-pipe having a downwardly-extending and vertically-movable end, a pump for lifting the material from the water-bed through said pipe, and a closed tortuous sluiceway within the shell, into which sluiceway said pump discharges, said sluiceway discharging at its lower end through the body of the dredger into the surrounding body of water, all of said elements being carried by said floating body, substantially as described.

13. In a submarine dredger and gold-saving machine the combination with the shell or body of the dredger, adapted to float in the water, of a suction-pipe having a downwardly-extending end, a pump within the shell for lifting the material from the water-bed through said pipe, and a closed sluiceway within said shell into which said pump discharges, said sluiceway discharging at its lower end through the body of the dredger into the surrounding body of water, all of said elements being carried by said floating body, substantially as described.

14. In a submarine dredger or gold-saving machine the combination with the shell or body of the dredger, adapted to float in the water, of a suction-pipe having a downwardly-extending and vertically-movable end, a pump within the shell for lifting the material from the water-bed through said pipe and a closed sluiceway within the shell into which said pump discharges, said sluiceway being provided at intervals with means for removing the heavier material carried therealong, substantially as described.

15. In a submarine dredger, the combination of a caisson-chamber, a caisson vertically movable therein, pneumatic packing between said caisson and chamber, an air-compressor, a compressed-air receiver, a pipe therefrom to the pneumatic packing, and a connection from said receiver to the chamber outside said caisson, substantially as described.

16. In a submarine dredger, the combination of an annular water-ballast chamber, a caisson-chamber, a caisson therein, an annular compressed-air receiver, an air-compressor, and a pipe from the receiver to the caisson-chamber, substantially as described.

17. In a submarine dredger, the combination of an annular water-ballast chamber, an annular compressed-air receiver, an annular hydraulic-pressure receiver, a caisson-chamber and caisson therein, a pipe from the compressed-air receiver to the caisson-chamber, a pipe from the hydraulic-pressure chamber to the interior of the caisson and terminating in a nozzle, and a suction-pipe in said caisson, substantially as described.

18. In a dredger and gold-saving machine the combination with the shell or body of the dredger, of means for submerging the dredger, means for excluding water therefrom when so submerged, an excavator, a spiral sluiceway, means for forcing excavated material and water under pressure along said sluiceway and a series of spreaders arranged at the inner side of the sluiceway, and means for injecting fluid under pressure against said spreaders, substantially as described.

19. In a dredger and gold-saving machine the combination with the shell or body of the dredger, of means for submerging the dredger, means for excluding water therefrom when so submerged, an excavator, a closed spiral sluiceway, means for forcing excavated material and water under pressure along said sluiceway, an auxiliary open spiral sluiceway, connections from said closed sluiceway to said open sluiceway and amalgamating-plates in the bottom of the open sluiceway, substantially as described.

20. In a dredger and gold-saving machine the combination with the shell or body of the dredger, of means for submerging the dredger, means for excluding water therefrom when so submerged, an excavator, a closed spiral sluiceway having hand-holes in its side, means for forcing excavated material and water under pressure along said sluiceway, and hand-hole plates closing said holes, said plates having ports adapted to aline with the inclined bottom plates of the sluiceway for conducting the material from said sluiceway, substantially as described.

21. In a dredger and gold-saving machine the combination with the shell or body of the dredger, of means for submerging the dredger, means for excluding water therefrom when so submerged, an excavator, a closed sluiceway having hand-holes in its side, means for forcing excavated material and water under pressure along said sluiceway, and hand-hole plates closing said holes, said plates having ports adapted to aline with the inclined bottom plates of the sluiceway for conducting the material from said sluiceway, substantially as described.

22. In a dredger and gold-saving machine the combination with the shell or body of the dredger, of means for submerging the dredger, means for excluding water therefrom when so submerged, an excavator a closed spiral sluiceway having hand-holes in its side, means for forcing excavated material and water under pressure along said sluiceway, hand-hole plates closing said holes, said plates having ports for conveying the material from said sluiceway, and an open spiral sluiceway into which the material so conveyed is discharged, substantially as described.

23. In a dredger and gold-saving machine the combination with the shell or body of the dredger, of means for submerging the dredger, means for excluding water therefrom when so submerged, an excavator, a closed sluiceway having hand-holes in its side, means for forc-

ing excavated material and water under pressure along said sluiceway, hand-hole plates closing said holes, said plates having ports for conveying the material from said sluiceway, and an open sluiceway into which the material so conveyed is discharged, said open sluiceway having amalgamating-plates therein, substantially as described.

24. In a dredger and gold-saving machine the combination with the shell or body of the dredger, of means for submerging the dredger, means for excluding water therefrom when so submerged, an excavator, a closed spiral sluiceway having hand-holes in its side, means for forcing excavated material and water under pressure along said sluiceway, hand-hole plates closing said holes, said plates carrying chambers, pipes leading from said chambers and an open spiral sluiceway into which said pipes discharge, substantially as described.

25. In a dredger and gold-saving machine the combination with the shell or body of the dredger, of means for submerging the dredger, means for excluding water therefrom when so submerged, an excavator, a closed sluiceway having hand-holes in its side, means for forcing excavated material and water under pressure along said sluiceway, hand-hole plates closing said holes, said plates carrying chambers, pipes connecting upper and lower chambers and an open sluiceway into which said pipes discharge, substantially as described.

26. In a dredger and gold-saving machine the combination with the shell or body of the dredger, of means for submerging the dredger, means for excluding water therefrom when so submerged, an excavator, a closed sluiceway, means for forcing excavated material and water under pressure along said sluiceway, a spreader therein concaved downwardly and having a central V-shaped rib on its under side, the sluiceway having a narrow port or slit opposite to said V-shaped rib, and means for discharging fluid under pressure through said port, substantially as described.

27. In a submarine dredger, the combination with the body of the dredger, of a caisson-chamber, a caisson therein, a suction-pipe in the caisson, a pump therefor, a sluiceway into which said pump elevates the material from the suction-pipe, a hydraulic-pressure receiver, and means for supplying pressure-water thereto, and a plurality of hydraulic jack-spuds in the bottom of the dredger-body, for leveling said dredger, substantially as described.

28. In a submarine dredger, the combination with the body of the dredger of a suction-pipe, a pump therefor, a sluiceway into which said pump elevates the material from the suction-pipe, a hydraulic-pressure receiver, and means for supplying pressure-water thereto, and a plurality of jack-spuds in the bottom of the dredger-body, for leveling said dredger, substantially as described.

29. In a submarine dredger, the combination with the body of the dredger, of a caisson-chamber, a caisson therein, a suction-pipe in the caisson, a pump therefor, a sluiceway into which said pump elevates the material from the suction-pipe, an anchoring-spud terminating in an auger-shaped bit, and means for producing a screw motion in said spud to anchor the dredger or release the same, substantially as described.

30. In a submarine dredger, the combination with the body of the dredger of a suction-pipe, a pump therefor, a sluiceway into which said pump elevates the material from the suction-pipe, an anchoring-spud terminating in an auger-shaped bit, and means for producing a screw motion in said spud to anchor the dredger or release the same, substantially as described.

31. In a submarine dredger, the combination with the body of the dredger, of a caisson-chamber, a caisson therein, a suction-pipe in the caisson, a pump therefor, a sluiceway into which said pump elevates the material from the suction-pipe, an anchoring-spud terminating in an auger-shaped bit, and means for producing a screw motion in said spud to anchor the dredger or release the same, the bottom of the dredger-body being suitably recessed to receive said bit when not in use, substantially as described.

32. In a submarine dredger, the combination with the body of the dredger of a suction-pipe, a pump therefor, a sluiceway into which said pump elevates the material from the suction-pipe, an anchoring-spud terminating in an auger-shaped bit, and means for producing a screw motion in said spud to anchor the dredger or release the same, the bottom of the dredger-body being suitably recessed to receive said bit when not in use, substantially as described.

33. In a dredger and gold-saving machine, the combination with the shell or body of the dredger, of means for submerging the dredger, means for excluding water therefrom when so submerged, an excavator, a sluice for concentrating precious metals, of circular curvature, and having its bed inclined downward in the direction of the center of curvature, and means for forcing excavated material and water under pressure along said sluiceway substantially as described.

34. In a dredger and gold-saving machine, the combination with the shell or body of the dredger, of means for submerging the dredger, means for excluding water therefrom when so submerged, an excavator, a spiral sluice for concentrating precious metals having its bed inclined downward toward the inner side, and means for forcing excavated material and water under pressure along said sluiceway, substantially as described.

35. A submarine dredger comprising the dredger-body, means for submerging the same, means for excluding water therefrom

when so submerged, an excavator, a closed spiral sluiceway having its bed inclined downward on the inner side, and movable doors at intervals on the inner side for removing the concentrates, and means for forcing excavated material and water along said sluiceway, substantially as described.

In witness whereof I have hereunto set my hand in the presence of two subscribing witnesses.

JNO. A. KIRK.

Witnesses:
FRANCIS M. WRIGHT,
J. W. ROBERTS.