No. 785,263. PATENTED MAR. 21, 1905.

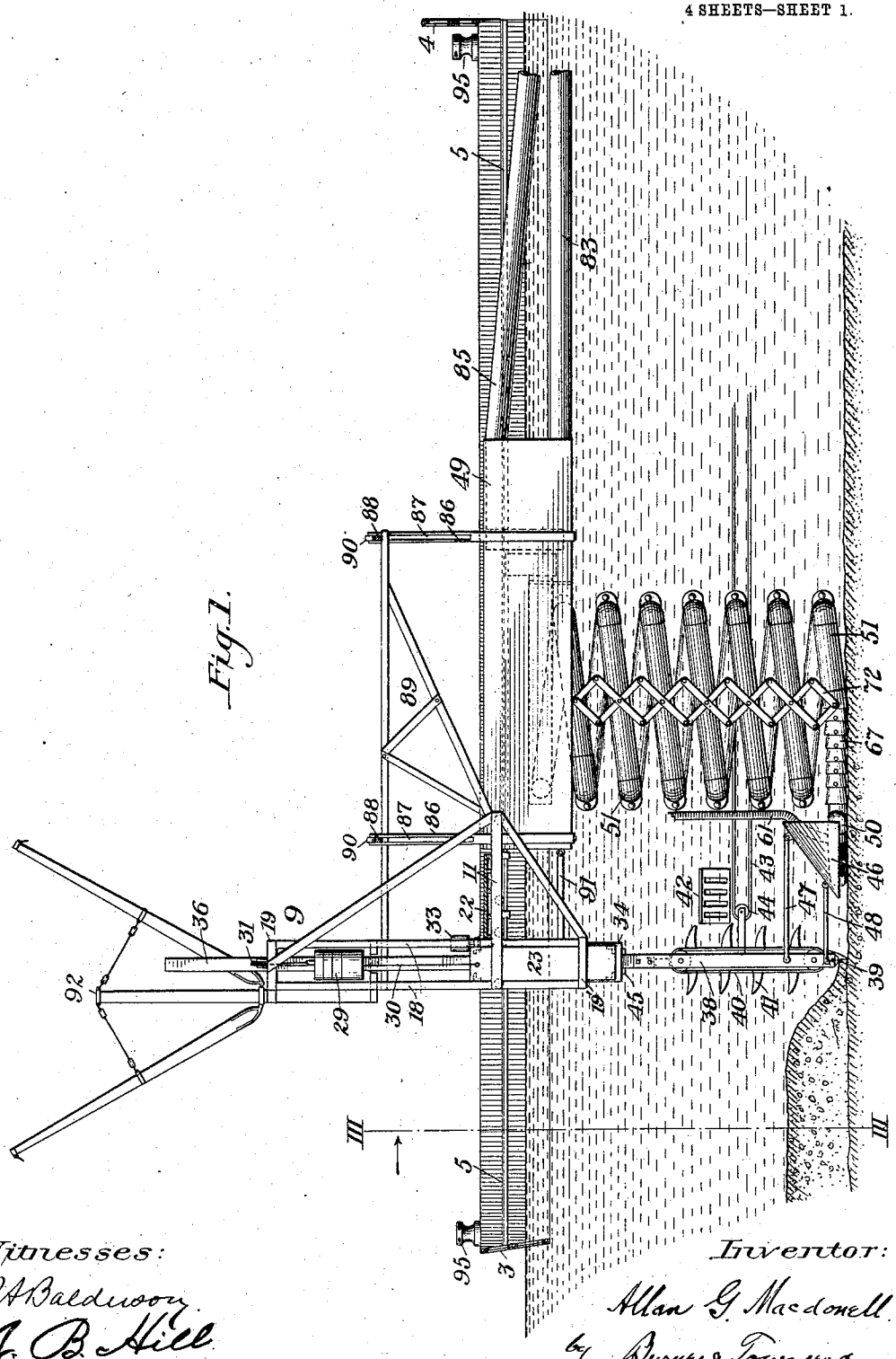
A. G. MACDONELL.

MINING DREDGE.

APPLICATION FILED JUNE 4, 1903.

4 SHEETS—SHEET 1.

Fig. 1.




Witnesses:

R. A. Baldwin

J. B. Hill

Inventor:

Allan G. Macdonell

by Byrnes & Townsend,

Attys.

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4 SHEETS—SHEET 2.

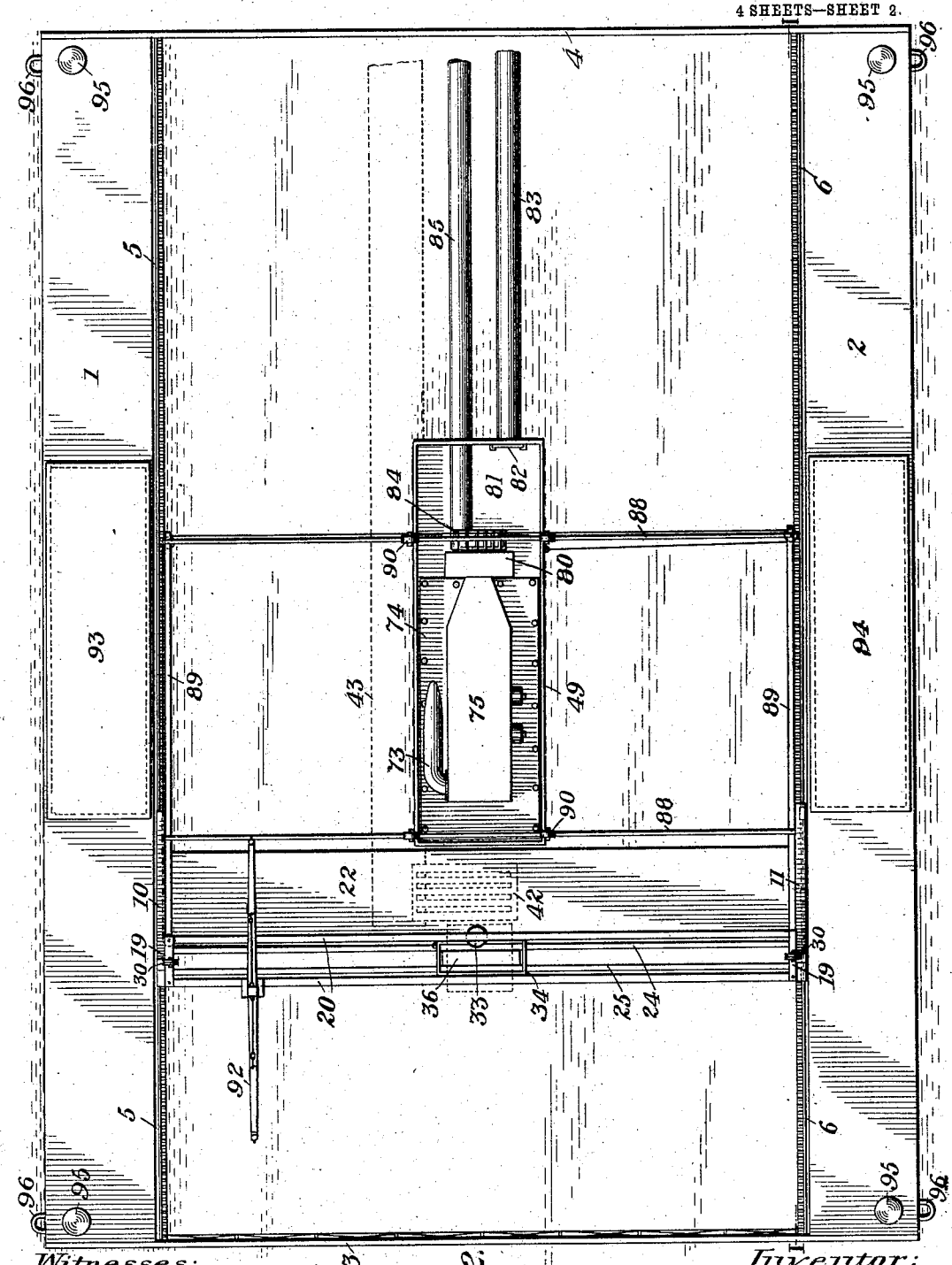



Fig. 2.

Witnesses:

R. A. Baldwin.

J. B. Hill.

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by Byrnes & Townsend,

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4 SHEETS—SHEET 3.

Fig. 3.

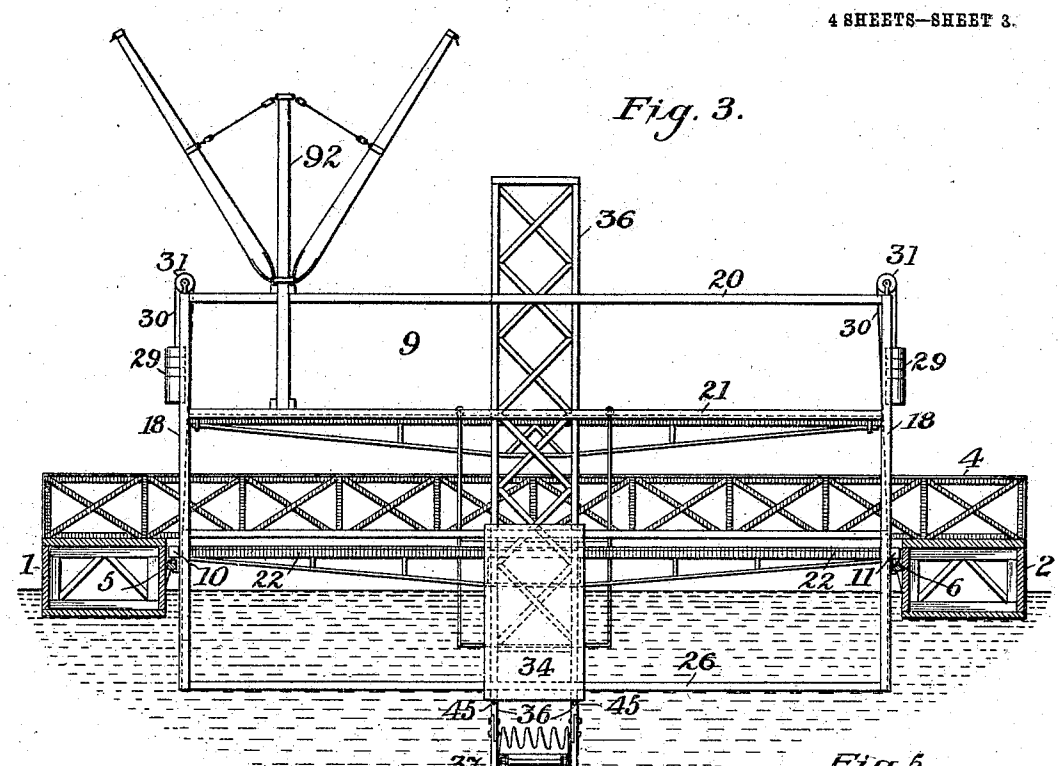



Fig. 5.

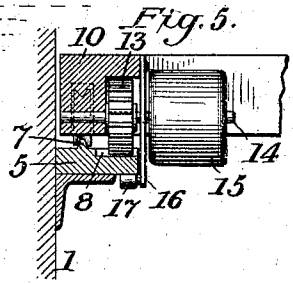



Fig. 4.

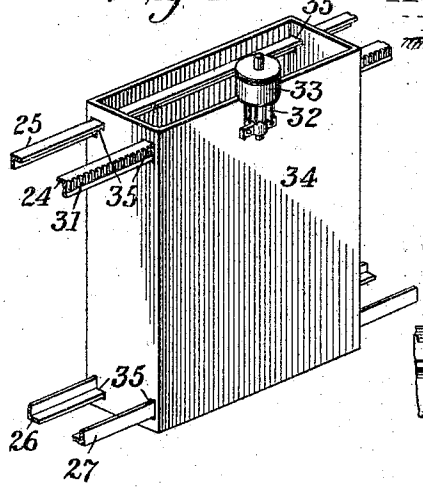
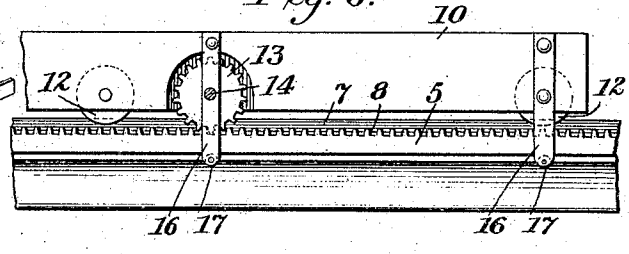



Fig. 6.




Witnesses.

R. A. Baldwin.

J. B. Hill.

Inventor:

Allan G. Macdonell,

by Byrnes & Townsend,

Attys.

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No. 785,263. PATENTED MAR. 21, 1905.

A. G. MACDONELL.

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APPLICATION FILED JUNE 4, 1903.

4 SHEETS—SHEET 4.

Fig. 7.

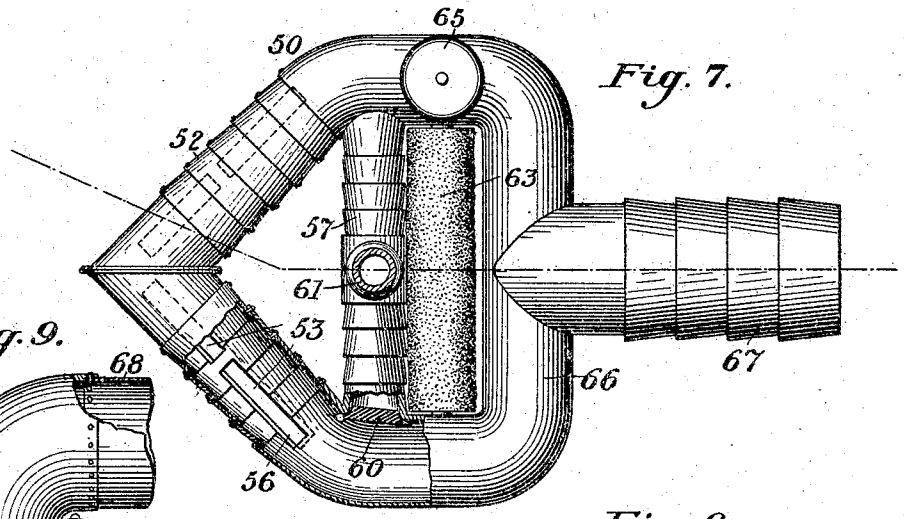



Fig. 9.

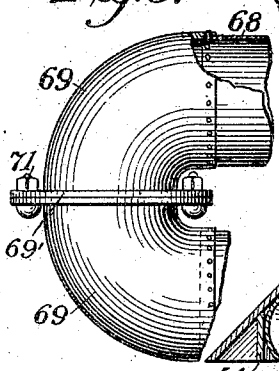



Fig. 8.

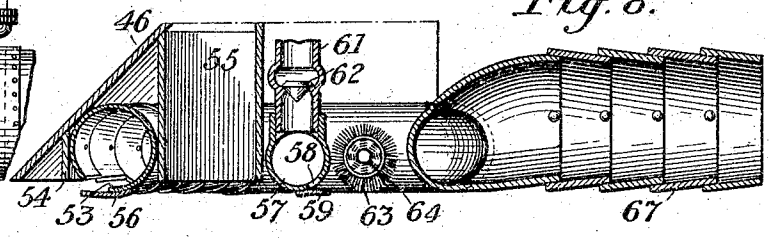



Fig. 10.

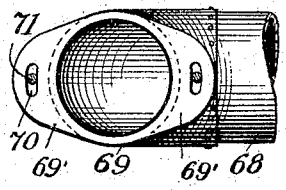



Fig. 11.

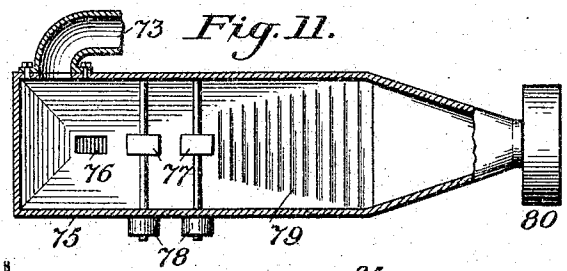
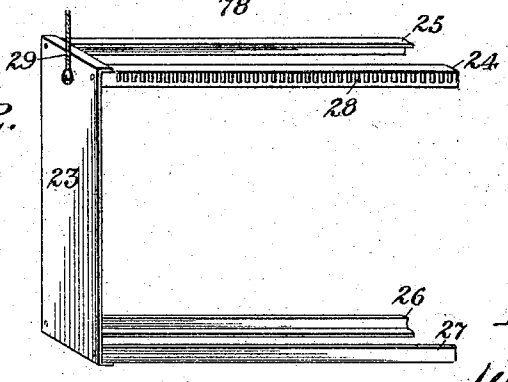



Fig. 12.




Witnesses:

R. A. Baldwin.

J. B. Hill

Inventor:

Allan G. Macdonell,

by Byrnes & Townsend,

Att'ys.

PHOTO-LITHOGRAPHED BY SACHETT & WILHELMS LITHO. & PTG. CO. NEW YORK.

No. 785,263. Patented March 21, 1905.

# UNITED STATES PATENT OFFICE.

ALLAN G. MACDONELL, OF CHEVY CHASE, MARYLAND.

## MINING-DREDGE.

SPECIFICATION forming part of Letters Patent No. 785,263, dated March 21, 1905.

Application filed June 4, 1903. Serial No. 160,125.

*To all whom it may concern:*

Be it known that I, ALLAN G. MACDONELL, a citizen of the United States, residing at Chevy Chase, in the county of Montgomery and State of Maryland, have invented certain new and useful Improvements in Mining-Dredges, of which the following is a specification.

This invention is a mining-dredge for the recovery of gold and other metallic values from subaqueous deposits, especially those which lie upon bed-rock at the bottom of a river. The dredge is provided with a chain of cutting and lifting devices for breaking up the deposits and removing large rocks and other obstacles and with a collapsible suction-pipe consisting of a zigzag series of superposed sections for collecting the auriferous sand and gravel and delivering it to the amalgamators or other devices for recovering the gold. A revolving brush is provided to scour the surface of the bed-rock and loosen the fine particles of gold which lie in the depressions of the rock, so that they will be drawn into the suction-pipe. It is well known that particles of gold which are not extremely fine cannot be raised through the vertical suction-pipe of a lift-pump, while the percentage of loss occasioned by the use of a chain of bucket-conveyers is so great that in many cases its use is not profitable. The suction-pipe of this dredge consists of a plurality of inclined sections, and the construction is based on the discovery that while particles of gold will not ascend a vertical tube they may be caused to travel up an inclined tube when carried by a stream of water moving at a moderate speed.

The invention will be more readily understood by reference to the accompanying drawings, in which—

Figure 1 is a vertical longitudinal section taken on line I I of Fig. 2. Fig. 2 is a plan view. Fig. 3 is a transverse vertical section on line III III of Fig. 1, and Figs. 4, 5, 6, 7, 8, 9, 10, 11, and 12 are detail views.

The body of the dredge consists of two parallel pontoons 1 2, of wood or metal, each of which is shown rectangular in plan and cross-section. These pontoons are secured to each other, with a considerable space between them, by transverse trusses 3 4. The truss 3 is secured to the front ends of the pontoons, and the truss 4 is secured upon the rear ends of the pontoons to leave a clear space between them at the rear. Parallel tracks 5 6 are secured to the inner faces of the pontoons 1 2, respectively, at some distance above the water-line. Each of these tracks comprises a vertical rib or rail 7 and a series of transverse teeth 8, constituting a rack parallel to the rail. These tracks support a movable transverse vertical bridge 9, which carries the excavating-ladder. This bridge is carried by a pair of longitudinal beams 10 11, each of which has three guide-wheels 12, resting upon the corresponding track-rail, and a pinion 13, carried by the shaft 14 of an electric or other motor 15 and engaging the corresponding track-rack. These driven pinions serve to move the bridge forward or backward between the pontoons. A number of depending arms 16 are secured to the inner face of each beam 10, and each arm carries at its lower end an antifriction-roll 17, which bears against the lower surface of the track, thus preventing the guide-wheels 12 from being accidentally raised from the track.

To each of the horizontal beams 10 11 is fixed a pair of vertical uprights 18, which are secured to each other at their upper and lower ends by short horizontal pieces 19 19′, respectively. Between the pairs of upright members extend two pairs of horizontal members 20 21.

A horizontal platform 22 is supported between the beams 10 11. This platform constitutes a floor for the workmen and may carry the power plant, such as a steam-engine and dynamo, (not shown,) for driving various electric motors.

Each pair of uprights 18 serves as a guide for a vertical metal plate 23, which fits smoothly between the uprights. The two metal plates 23 are connected by four rails, of angle-iron, 24 25 26 27, one end of each rail being secured to one corner of each plate. The metal plates and their connecting-rails constitute a vertically-adjustable frame which is counterpoised by two weights 29, one between each pair of uprights 18, secured to the ends of wire cables 30, which run over pulleys 31

on the top of the bridge and thence extend down to the plates 23, to which they are secured.

The rail 24 has a series of teeth 31 at one side, constituting a rack. A pinion 32, which may be driven by an electric motor 33, engages the rack-rail 24, and thus serves to shift the sleeve and ladder transversely along the rails and across the well between the pontoons. These rails carry a ladder-guide consisting of a rectangular metal sleeve 34, having angular slots 35 at each end to receive the rails, so that it can slide freely upon them. Through this sleeve runs the rigid excavator-ladder, the upper portion 36 of which consists of a pair of vertical members joined by lattice-work. The lower portion of the ladder consists of two uprights 37 38, which are removably bolted at their upper ends to the lower ends of the upper portion 36 of the ladder. A small antifriction-roller 39 is journaled in the lower end of each of these uprights. Shafts carrying sprocket-wheels extend between the uprights 37 38, and upon these sprocket-wheels run chains 40, which carry the excavators 41. Each of these excavators is preferably a single steel casting having a series of strong teeth or cutters. The excavator-chains are driven by any suitable motor or gearing (not shown) engaging one of the sprocket-wheel shafts. A transversely-inclined grizzly or heavy grating 42 is suitably supported behind the upper part of the chain of excavators, so that the excavated material will be emptied onto it. This grizzly has two-inch slots between its bars, so that the gravel and sand will fall through it, while its inclination will cause the rocks and large pebbles which do not pass through to be thrown to one side. Beneath the lower end of the grizzly is an endless-belt conveyer 43, carried by a roller 44, which is secured in suitable bearings on the ladder-upright 37 and extending rearwardly to and over another roller. (Not shown.) This conveyer carries all material thrown upon it from the grizzly backward toward the end of the dredge, where it is deposited. By operating the motor 33 the sleeve 34 and excavating-ladder may be shifted laterally into any desired position to make either the initial or any subsequent cut. By then operating the motors 10 11 the entire bridge 9, with its vertically-adjustable frame, laterally-adjustable ladder-sleeve, and the ladder itself, with the chain of excavators, may be forced forward toward the deposit to be mined. The sleeve 34 serves as an effective means for forcing forward the lower portion of the rigid ladder carrying the excavators without bringing an undue leverage upon the bridge 9, such as would otherwise derail it. The downward movement of the ladder-sleeve and frame by which it is carried is limited by removable pins 45, which project from the lower ends of the ladder-uprights 36.

Beneath the grizzly 42 and behind the excavating-ladder, though preferably somewhat out of direct alinement with it, is a plow 46. Draft-bars 47 48 extend between the lower end of the excavator-ladder and the plow, being loosely coupled to each by pins, so that the plow is free to adjust itself vertically, but is positively drawn forward as the excavators cut their way into the deposit. Beneath the plow is the suction-head 50 of the main suction-tube 51. The suction-head is constructed to lie closely upon the bed-rock, and the material which is not pushed aside by the plow is drawn in through it and delivered in part through the main suction-pipe 51 and in part through a supplemental suction-pipe 61 to the devices for recovering the gold. The plow rests directly upon this suction-head and is usually supported at such height that its lower edge is about one and one-half inches above the surface on which the suction-head rests. The plow thus serves to push aside all stones which are over one and one-half inches in diameter, while the finer material passes under the plow and into the suction-head. The suction-head is of the form shown in Fig. 7 and consists of a series of short conical nested rings 52, preferably of sheet-steel, having a thickness of about one-eighth inch. The rings are slotted to provide apertures 53 in the bottom of the suction-head and opening toward the plow. These apertures may be one and one-half inches wide and six inches long, and their combined area should be equal to that of the suction-tube. The front portion of the suction-head is loosely held between walls 54 55, which depend from the inner face of the plow. A leather lip 56 is secured to the ridgs 52 just back of the slot in each and extends forward some distance beneath the openings 53. The suction-head is thus given flexibility and is enabled to conform accurately to the bed-rock over which it is drawn. A cross-tube 57, also constructed of nested and slotted steel rings, extends between the side tubes of the suction-head. The slots of this cross-tube provide an aperture 58, having a width of about one-half inch and opening rearwardly. A leather lip 59, similar to the one already described, is secured to cross-tube 57 beneath the opening 58. Check-valves 60 open outwardly from each end of the cross-tube 57 into the side tubes of the suction-head. A small independent suction-tube 61, containing an upwardly-opening check-valve 62, is connected to the middle of the cross-tube 57. Directly behind the cross-tube is a horizontal cylindrical steel-wire brush 63, journaled at each end in the suction-head. This wire brush is preferably constructed of a series of longitudinal sections each carried by radial springs 64, as shown in Fig. 8, to permit the brush to yield vertically as it passes over the irregular surface of the rock. The brush may be driven

by an electric motor 65, inclosed in a water-tight casing, by bevel-gears within the suction-head. (Not here shown.) This brush serves to thoroughly scour the surface of the bed-rock and remove the fine particles of gold which would otherwise remain in the crevices of the rock. This fine gold is drawn into the cross-pipe 57 by suction intermittently applied to a hose leading down to the pipe 61. A suction-pump is employed which will carry a stream of water upward through the pipe 61 at much greater velocity than that passing through the main suction-pipe 51, so that the check-valves 60 will then be closed. When the operation of the pump is discontinued, the suction through the main pipe 52 will open the check-valves 60, while the check-valve 62 will close. The water and fine material passing into the cross-tube 57 will then be carried into the main suction-tube. Any particles of gold dislodged by the brush and drawn in through the opening 58 which are too heavy to be carried vertically upward through the pipe 61 will thus be carried up the main suction-pipe with the other material. The pump connected to the pipe 61 may operate for periods of five minutes and then stop for intermediate periods of one minute. The length of the revolving brush should be equal to the width of the cut made by the excavators. The suction-head 50 and the plow thereover being somewhat wider than the excavators the plow is offset sufficiently to move in the cut made by the excavators. As the excavators move forward slowly, it is unnecessary to revolve the brush at a high speed. If the surface of the bed-rock is very irregular, the brush may be journaled in yielding bearings, as will be understood without special illustration. The transverse discharge-tube 66 of the suction-head 50 is connected to the main suction-pipe 51 by a series of nested rings 67, which permit the plow and suction-head to move vertically independent of the suction-pipe 51.

The main suction-pipe 51 consists of a zig-zag series of sections 68, usually one foot in diameter and of sheet-steel one-eighth of an inch thick. Each tube is riveted at each end to an elbow 69. The opposing ends of the elbows have matched flanges or flanged extensions 69′, in which are registering slots 70, receiving bolts 71. The nuts on these bolts are so adjusted as to draw the flanges closely together, but allow them to slide upon each other, thus permitting the coupled sections to assume any angular relation. A lazy-tongs 72 is pivotally secured at its intersections to alternate members of the suction-pipe and serves to maintain them at equal distances from each other, while permitting the vertical height of the tube to be suited to the depth of the water in which the dredge is operating. The weight of the tube-sections and suction-head is sufficient to overcome the friction of the various joints, both of the tube and lazy-tongs, so that the suction-head at all times lies on the bed-rock, the height of the suction-pipe accommodating itself to the depth of the water. The uppermost section 73 of the suction-pipe 51 passes through and is rigidly secured in an opening in a rectangular plate 74, which is removably bolted over an opening in the bottom of a box 49, floating between the pontoons. The section 73 opens into one side of the end of a conduit 75, supported in box 49, in which conduit the separation of the gold is effected. This conduit is of the same vertical height as the tube 73, but about three and one-half times wider, so that the speed of the stream of water which enters it is much decreased to permit the separation to be more easily effected. The bottom of the conduit at the receiving end slopes downwardly to a central pocket 76, containing mercury, which serves to receive and hold the larger particles of gold which are heavy enough to sink in the mercury. The finer gold, together with the black iron-sand, moves on underneath magnetic separators 77, driven by electric motors 78, which remove the iron from the gold. The bottom of the conduit gradually flattens out from the pocket 76 to its outlet end. The fine particles of gold pass on to a series of riffles 79, by which they are caught, while the water, sand, and gravel are discharged into and through a centrifugal pump 80. This pump is secured to the discharge end of the conduit and is driven at sufficient speed as to produce the desired vacuum in the main suction-pipe 51. The tailings pass into a well 81 in the end of the floating box 49, from which the sand and water escape through an outlet covered by a removable screen 82 of about thirty mesh to the discharge-pipe 83. The fine tailings may be delivered from this pipe to a second amalgamator, if desired. The gravel and other particles which are too large to pass the screen 82 are lifted from the well 81 by an elevator 84 and delivered at the rear of the dredge through an inclined pipe 85. The material lifted by the elevator-buckets may be sprayed with water from a hose to wash light particles of gold back into the well.

To maintain the floating box 49 in a horizontal position directly behind the excavating-ladder, it is provided at each side with a pair of standards 86, which extend upward and have slots 87, receiving cross-bars 88, which are carried by brackets 89, extending rearwardly from each end of the bridge 9. Rollers 90, journaled in the upper end of each slot, run on the cross-bars 88, serving as rails. The box may also be coupled directly to the ladder-sleeve 34 by a pivoted link 91. (Shown in Fig. 1.)

The bridge 9 is provided with a derrick 92, which may be secured at any desired point on the transverse members 20 21. This derrick may be used to remove and replace the lower

section 38 of the excavating-ladder, as well as the suction-pipe 51, with the plate 74, to which its uppermost section 73 is secured. It is desirable that the dredge be provided with several sets of suction-pipes of different length, which may be stored in compartments 93 94 in the pontoons.

In operating the dredge it is secured in position by chains leading from anchors to windlasses 95 on the ends of the pontoons. In shallow water it will often be sufficient to drive spuds down through the eyes 96 on the sides of the pontoons into the bottom of the stream. In making the first cut the bridge carrying the excavating-ladder is moved toward the rear of the dredge, and the ladder is shifted to one end of the bridge. The excavators are then set in motion, and forced downward by the weight of the ladder cut their way to the bed-rock. The bridge is then urged forward by means of the motors driving the pinions 13, and the excavating proceeds until the bridge has reached the front end of the dredge. The ladder is then lifted slightly, the bridge returned to the rear end of the dredge, and the ladder shifted sidewise into position for the second cut. The floating box 49 is at all times maintained directly behind the excavating-ladder. The pontoons may be maintained on an even keel, whatever the position of the bridge and ladder, by the use of water ballast, pumped into or from separate compartments therein.

The use of a chain of excavators which discharge all of the material beneath the surface of the water in connection with the screen and conveyer for separating and carrying to the rear all material which will not pass through the two-inch slots of the screen enables the dredge to be operated by an engine which is much smaller than that required in previous dredges, in which all of the material is lifted above the surface of the water in order to be thrown into scows and discharged at some other point.

I claim—

1. A dredge, comprising spaced floats and a transverse bridge carrying a rigid ladder-excavator, the bridge being longitudinally movable in the space between the floats, and means for moving the ladder forward and thereby forcing the excavator against the material to be dredged, as set forth.

2. A dredge, comprising spaced floats and a transverse bridge carrying a rigid ladder-excavator, the bridge being longitudinally movable in the space between the floats and the excavator being vertically movable on the bridge, and means for moving the ladder forward and thereby forcing the excavator against the material to be dredged, as set forth.

3. A dredge, comprising spaced floats and a transverse bridge carrying a rigid ladder-excavator, the bridge being longitudinally movable in the space between the floats and the excavator being transversely movable on the bridge, and means for moving the ladder forward and thereby forcing the excavator against the material to be dredged, as set forth.

4. A dredge, comprising spaced floats and a transverse bridge carrying a rigid ladder-excavator, the bridge being longitudinally movable in the space between the floats and the excavator being vertically and transversely movable on the bridge, and means for moving the ladder forward and thereby forcing the excavator against the material to be dredged, as set forth.

5. A dredge, comprising spaced floats having rails on their adjacent faces, a transverse bridge longitudinally movable on said rails, a rigid ladder-excavator vertically and transversely movable on the bridge, and means for moving the ladder forward and thereby forcing the excavator against the material to be dredged, as set forth.

6. A dredge, comprising spaced floats, a transverse bridge longitudinally movable in the space between the floats, a frame having transverse rails and vertically movable on the bridge, a rigid ladder-excavator transversely movable on said rails, and means for moving the ladder forward and thereby forcing the excavator against the material to be dredged, as set forth.

7. A dredge, comprising spaced floats, a transverse bridge longitudinally movable in the space between the floats, a frame having transverse rails and vertically movable on the bridge, a sleeve transversely movable on said rails, and an excavator-ladder vertically movable in said sleeve, as set forth.

8. A dredge, having a rigid ladder-excavator which is movable longitudinally, transversely and vertically on the dredge, and means for moving the ladder forward and thereby forcing the excavator against the material to be dredged, as set forth.

9. A dredge, having a ladder carrying a chain of excavators, said ladder being movable longitudinally, transversely and vertically on the dredge, as set forth.

10. A dredge, having an excavator arranged to lift and discharge excavated material beneath the surface of the water, and means, beneath the surface of the water, for receiving and discharging the material delivered by the excavator, as set forth.

11. A dredge, having an excavator arranged to lift and discharge excavated material beneath the surface of the water, and a conveyer, beneath the surface of the water, for receiving and discharging the material delivered by the excavator, as set forth.

12. A dredge, having an excavator arranged to lift and discharge excavated material be-

neath the surface of the water, an inclined screen beneath the surface of the water in position to receive the material delivered by the excavator, and a conveyer in position to receive and discharge the coarse material thrown from the screen, as set forth.

13. A dredge, having an excavator arranged to lift and discharge excavated material beneath the surface of the water, a screen beneath the surface of the water in position to receive the material delivered by the excavator, and a suction-pipe arranged to withdraw the fine material which passes through the screen, as set forth.

14. A dredge, having an excavator arranged to lift and discharge excavated material beneath the surface of the water, an inclined screen beneath the surface of the water in position to receive the material delivered by the excavator, a conveyer in position to receive and discharge the coarse material thrown from the screen, and a suction-pipe arranged to withdraw the fine material which passes through the screen, as set forth.

15. A dredge, having a suction-pipe with a suction-head, and a plow over the suction-head and having its lower edge above the bottom of the suction-head, as set forth.

16. A dredge, having a suction-pipe with a flexible suction-head, as set forth.

17. A dredge, having a suction-pipe with a flexible suction-head comprising nested and slotted metal rings, as set forth.

18. A dredge, having a suction-pipe with a flexible suction-head comprising nested and slotted metal rings, and a flexible lip extending from one edge of the slots, as set forth.

19. A dredge, having a suction-head consisting of two connected members, each member having an inlet and an independent suction-pipe, and a one-way valve closing the passage between the two members, as set forth.

20. A dredge, having a suction-head and a brush adjacent to said head, as set forth.

21. A dredge, having a suction-head and a revoluble brush adjacent to said head, as set forth.

22. A dredge, having a suction-pipe consisting of a series of superposed sections connected at alternate ends by adjustable joints, as set forth.

23. A dredge, having a suction-pipe consisting of a series of superposed sections with matched flanges at alternate ends, and means for coupling the flanges together but permitting them to slide on each other, as set forth.

24. A dredge, having a suction-pipe consisting of a series of superposed sections connected at alternate ends by adjustable joints, and a lazy-tongs having its points of intersection pivoted to the alternate sections, as set forth.

25. A mining-dredge, having an inclined suction-pipe extending downward to a mouth in position to receive the deposit, and means for recovering gold from material delivered from said pipe, as set forth.

26. A mining-dredge, having an inclined, vertically-adjustable suction-pipe extending downward to a mouth in position to receive the deposit, and means for recovering gold from the material delivered from said pipe, as set forth.

27. A mining-dredge, having an inclined, collapsible suction-pipe extending downward to a mouth in position to receive the deposit, and means for recovering gold from the material delivered from said pipe, as set forth.

28. A mining-dredge, comprising an inclined suction-pipe extending downward to a mouth in position to receive the deposit, a conduit connected to said pipe and containing a gold-saving device, and a pump connected to the discharge end of said conduit, as set forth.

29. A mining-dredge, comprising an inclined suction-pipe, a conduit connected to said pipe and containing a mercury-pocket, a magnetic iron-separator and a gold-saving device, and a pump connected to the discharge end of said conduit, as set forth.

30. A mining-dredge, comprising a collapsible suction-pipe, a floating box receiving the upper end of said pipe, and a conduit containing a gold-saving device, said conduit supported in said box and connected to said pipe, as set forth.

31. A mining-dredge, comprising an excavator, a collapsible suction-pipe, a floating box receiving the upper end of said pipe, said box movable with said excavator and on transverse guides, and a conduit containing a gold-saving device, said conduit supported in said box and connected to said pipe, as set forth.

32. A mining-dredge, comprising a collapsible suction-pipe, a floating box receiving the upper end of said pipe, a conduit containing a gold-saving device, said conduit supported in said box and connected to said pipe, a pump connected to the discharge end of said conduit, a well to receive the material from said pump, and means for separating and separately delivering the coarser and finer portions of said material, as set forth.

In testimony whereof I affix my signature in presence of two witnesses.

ALLAN G. MACDONELL.

Witnesses:

EUGENE A. BYRNES,

C. A. NEALE.