

May 26, 1942.

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2,284,459

SUBMARINE HYDRAULIC CONCENTRATOR FOR PRECIOUS METALS

Filed Jan. 30, 1939

3 Sheets-Sheet 1

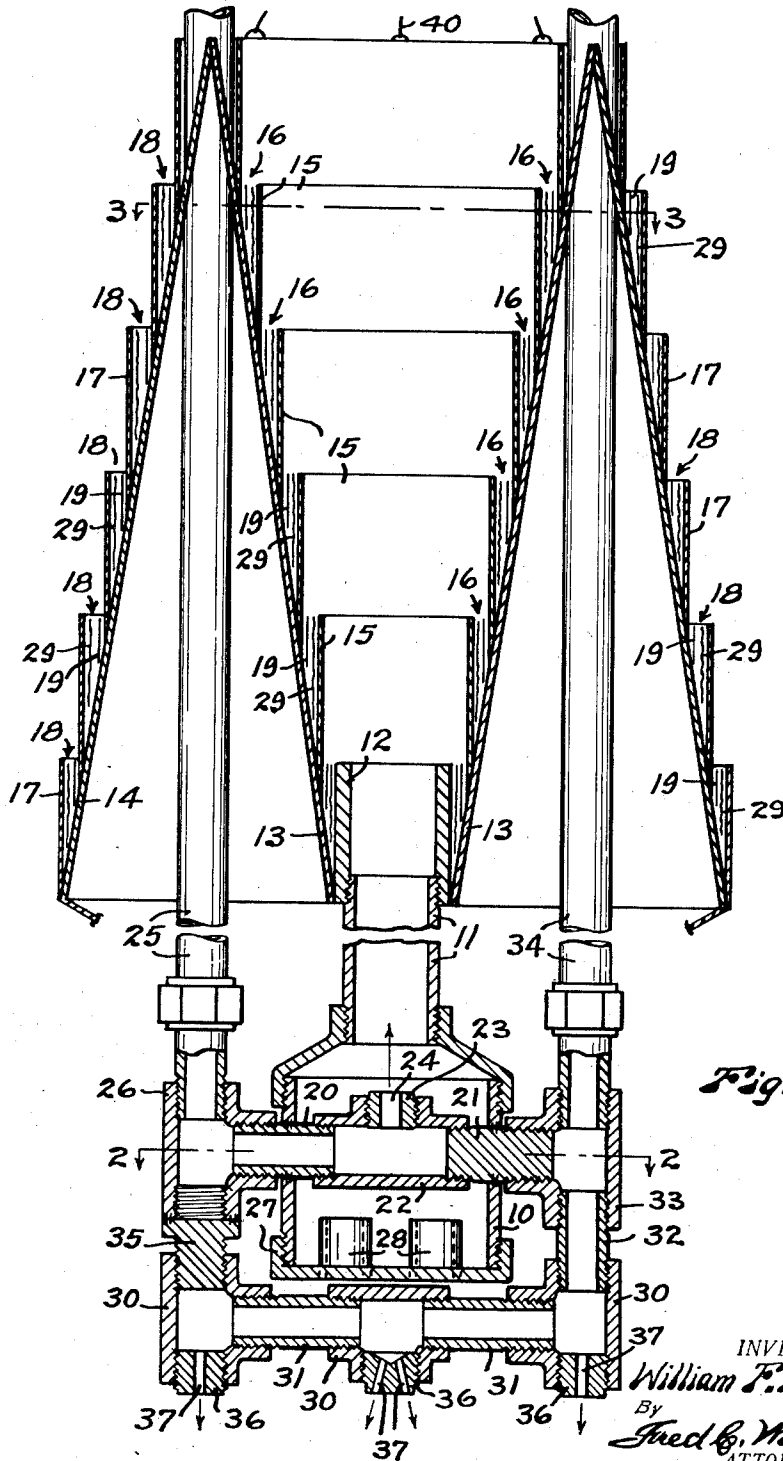


Fig. 1

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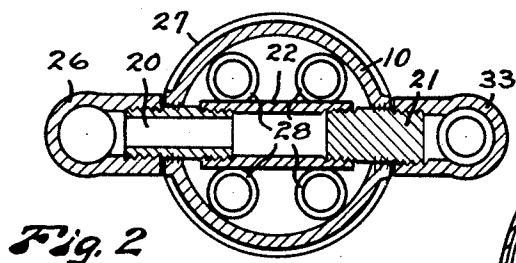
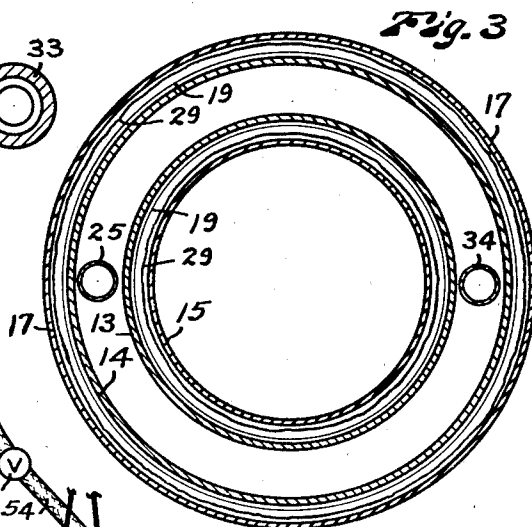
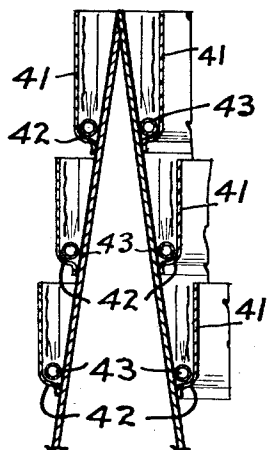
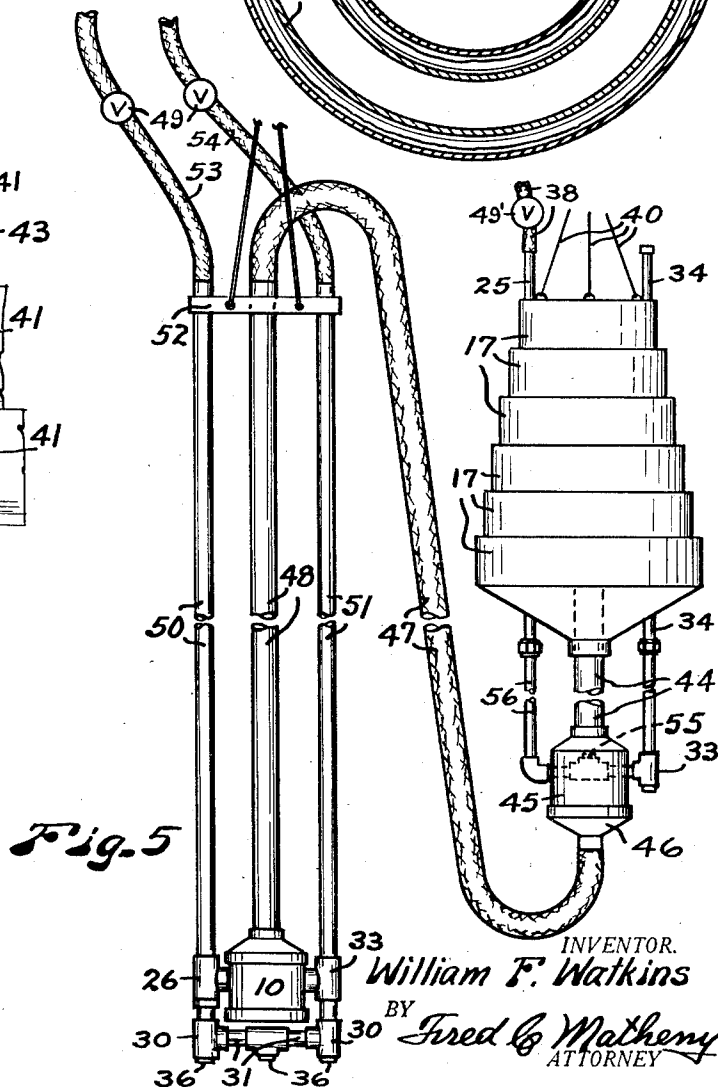
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3 Sheets-Sheet 2



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3 Sheets-Sheet 3

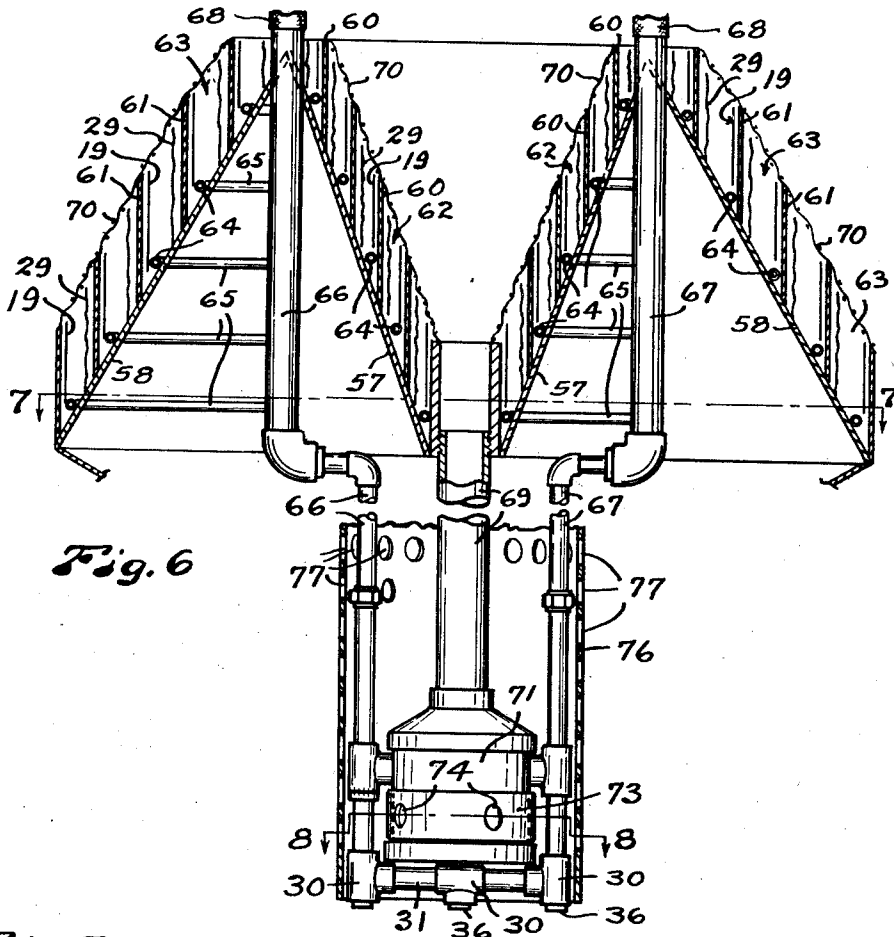


Fig. 6

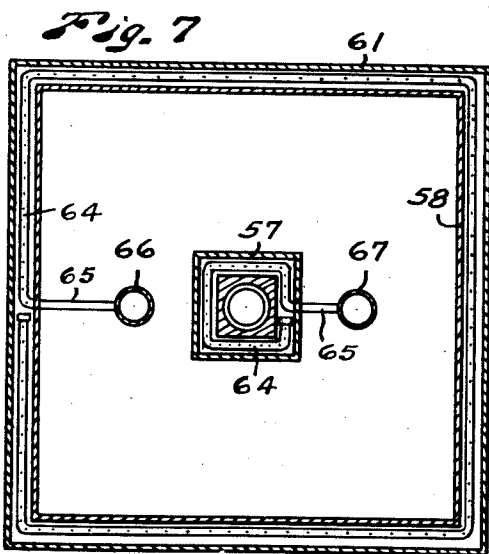


Fig. 7

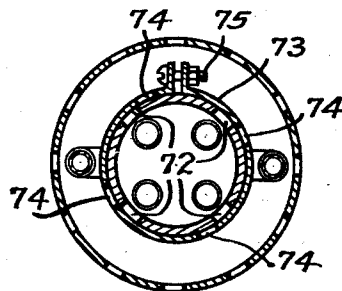


Fig. 8

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2,284,459

SUBMARINE HYDRAULIC CONCENTRATOR
FOR PRECIOUS METALS

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Application January 30, 1939, Serial No. 253,481

8 Claims. (Cl. 262—2)

This invention relates to material pick up and concentration devices and an object of this invention is to provide highly efficient and practical means for picking up material either in a wet or dry state and for concentrating or classifying the same with respect to its specific gravity.

Another object of the invention is to provide a device which is operated by fluid pressure and may use either water, air or steam as an operating medium.

Another object of this invention is to provide a device of this nature which combines pressure, suction and a surging and jetting action to tear loose and displace and pick up material containing coarse gold, nuggets and like minerals of high specific gravity.

Another object is to provide a machine which makes use of suction, pressure, and jet and surge action to rapidly sink itself down into earthy material, such as packed earth, gravel, sand, clay or a mixture of the same and which is capable of dislodging and picking up and trapping heavy nuggets and mineral bearing material off of bed rock and out of crevices and depressions in rock and out of other places where it is hard to reach, this apparatus being capable of operation in either wet or dry material and being capable of operation entirely submerged and under water and being adapted to recover and save both finely divided mineral values and coarse heavy mineral values and being adapted to subject all of the material which passes therethrough to a concentrating process.

Another object of this invention is to provide a device which will rapidly sink itself through an overlying strata of earthy material to bed rock and will pick up gold and like values off of the bed rock and out of crevices in the bed rock without requiring the uncovering of the bed rock or the movement of the major portion of the overlying earthy material.

The high specific gravity of gold, platinum and the like makes it very difficult to pick up coarse particles of these metals by suction processes. My device combines suction with the jetting and surging action of pressure jets in such a manner as to make it possible to pick up and trap and recover these coarse heavy particles.

Another object of this invention is to provide a mineral separator and concentrator of simple and efficient construction which effectively separate values from material passed therethrough.

Another object of this invention is to provide a device which may be successfully operated at

relatively great depths under water to pick up mineral values.

Other and more specific objects of the invention will be apparent from the following description and accompanying drawings.

In the accompanying drawings, Fig. 1 is a vertical sectional view of a device constructed in accordance with this invention, parts being broken away.

Fig. 2 is a sectional view on broken line 2—2 of Fig. 1.

Fig. 3 is a sectional view on broken line 3—3 of Fig. 1.

Fig. 4 is a fragmentary view showing a modified form of trap means which may be used.

Fig. 5 is an elevation, with parts broken away, of devices constructed in accordance with this invention showing a flexible connector interposed between the material pick up unit and the material separating or concentrating unit.

Fig. 6 is a vertical sectional view of another device constructed in accordance with this invention.

Fig. 7 is a sectional view, on a reduced scale, taken substantially on broken line 7—7 of Fig. 6.

Fig. 8 is a sectional view taken on broken line 8—8 of Fig. 6.

Like reference numerals designate like parts throughout the several views.

Referring to Figs. 1, 2 and 3, I show a fluid tight housing 10 connected by a pipe 11, with a fitting 12 in the lower end portion of an inner material separator or concentrator member 13 which is shaped like a frustum of a cone. An outer concentrator member 14, shaped like the frustum of an inverted cone and larger than the member 13, is positioned externally of the member 13. The smaller upper end of the outer member 14 is substantially the same size as the larger upper end of the inner member 13 and the two members are secured together with these two upper end portions in engagement with each other. The inner member 13 thus provides an upwardly expanding chamber and the outer member provides a downwardly expanding or outwardly inclined wall over which material may pass downwardly. A plurality of trap forming members 15 are secured within the inner member 13 with the bottom end of each trap forming member 15 positioned against and secured to the member 13. Each trap forming member 15 is preferably of larger size than the one below it, as shown in Fig. 1. This provides an annular space or trap 16 between the external wall

of each trap forming member 15 and the adjacent wall of the member 13.

The outer frustro-conical member 14 has trap forming members 17 secured thereto to provide a plurality of traps 18, one above another, on the exterior of the member 14, each trap 18 being positioned further outwardly from the center of the machine than the trap next above it so that material descending over the outer member 14 will tend to fall into the traps 18.

It will be understood that the several members 13, 14, 15 and 17 may be made plane instead of curved if desired to provide a structure having a plurality of straight sides, such as shown in Fig. 7, instead of the curved sides shown in Fig. 3.

Amalgamated plates 19 preferably of corrugated shape are preferably provided in the traps 16 and 18 to assist in the recovery of fine gold and strips of matting material 29 of the form commonly used in sluice boxes are also preferably provided in these pockets to help retain the values.

The material pick up housing 10 preferably has a pipe 20 and a plug 21 extending through its walls and positioned in alignment with each other diametrically of the housing. A T fitting 22 forms a connection between the two pipes 20 and 21. A plug 23 in the T fitting 22 has a jet opening 24 therein positioned in axial alignment with the pipe 11 and a short distance below the lower end of said pipe 11. This jet opening 24 is adapted to direct a fluid stream at high velocity into the pipe 11 to produce a suction in the pipe 11 and housing 10. The suction thus produced will draw solid matter and fluid into the housing 10 and force the same up through the pipe 11 and through the concentrator. A fluid pressure supply pipe 25 is connected by a T 26 with the pipe 20. The plug 21 is provided to give strength and rigidity to the structure. Preferably a removable cover plate 27 is provided on the bottom end of the housing 10 and a plurality of inlet tubes 28 are provided in this cover plate. Each tube 28 provides an inlet opening through which material may enter the housing 10. I have shown four of these tubes 28 in Fig. 2, but obviously this number may be varied. The tubes 28 extend upwardly a substantial distance into the housing 10 and cooperate with the housing to form within said housing a trap for catching and retaining coarse particles of heavy metal such as gold nuggets. I find that substantially all coarse particles of gold and like heavy metal will remain within this trap. If the tubes 28 are omitted and holes provided in member 27 material will be drawn in substantially in the same way but heavier particles may drop out and be lost. Preferably the tubes 28 are positioned out of vertical alignment with the T member 22, as shown in Fig. 2. The tubes 28 are of small enough diameter so that no gravel large enough to become wedged or lodged in any of the passageways above the tubes 28 will be allowed to enter the machine.

A jetting device is provided external to the housing 10 and in close proximity to the bottom cap 27 for the purpose of delivering jets of fluid into the material which is to be loosened up and drawn by suction through the tubes 28. The jetting device shown in Fig. 1, comprises three T members 30 connected together by pipe nipples 31. The T member 30, at one end of the jetting device, is connected by a nipple 32 with a T 33 which connects with the plug 21 and with a fluid

supply pipe 34. The T member 30 at the other end of the jetting device is preferably connected by a plug member 35 with the T member 26 to provide a strong and rigid construction. The plug member 35 may be welded to the T member 26. Preferably the pipe 20 and plug 21 are welded into the housing 10. By connecting the several pipes, plugs and fittings with the housing 10 in the manner shown a very strong and substantial construction is provided which will withstand the rough usage to which a device of this nature is sometimes subjected.

Each T member 26 is provided with a downwardly directed plug 36 which has one or more holes 37 therein through which fluid under pressure may be emitted to loosen up the material around the jetting device. In Fig. 1, I have shown one hole 37 in each of the end plugs 36 and a plurality of holes 37 in the medial plug 35.

Preferably the pipes 25 and 34 extend upwardly through the spaces between the cone shaped members 13 and 14 and terminate above the members 13 and 14 at a suitable location where flexible conduit members 38, see Fig. 5, may be connected therewith. Any suitable suspension means 40 is connected with the upper end portion of the members 13 and 14. Pipes 11, 25 and 34 are shown partly broken away in Fig. 1, and these pipes may be of any desired length. A cone shaped bottom member 39 is preferably provided at the lower ends of members 13 and 14. A fragment only of this bottom is shown in Fig. 1.

Fig. 4, shows a fragmentary view of a concentrating device which is similar to the device shown in Fig. 1, except that the trap forming members 41 thereof are curved at the bottom as indicated by 42 to afford ample room for the reception of fluid discharge pipes 43.

Fig. 5, shows a concentrator of the type disclosed in Fig. 1, connected by a pipe 44 with a housing 45. The bottom member 46 of the housing 45 is connected by a flexible conduit member 47, such as a suction type hose, with the upper end of a pipe 48. The lower end of the pipe 48 is connected with the housing 10 of a suction producing and jetting device similar to the one shown in Fig. 1, and in which corresponding parts are similarly numbered. Two fluid pressure supply pipes 49 and 51 similar to pipes 25 and 34 respectively in Fig. 1, are provided. The pipes 48, 49 and 51 may be of any desired length and are preferably connected with a yoke 52 at their upper ends. Flexible fluid conduits 53 and 54 respectively, are connected with the upper ends of pipes 49 and 51. Jet means 55, similar to the jet means 23 and 24 in Fig. 1, is provided within the housing 45 and is connected with a fluid supply pipe 56 which corresponds to pipe 25 of Fig. 1. The bottom member 46 in Fig. 5, is liquid tight except for its connection with the hose 47 so that a suction may be exerted through the hose 47 when fluid under pressure is discharged from the jet 55. Hose 47 is capable of withstanding suction without collapsing.

In the use of the device shown in Fig. 5, the concentrator may be supported at any desired location and the material pick up device may be used at a location remote therefrom to pick up material to be passed through the concentrator. Obviously more than one suction device like that provided by the housing 45 may be used between the concentrator and the material pick up device.

Figs. 6, 7 and 8 show devices similar to those shown in Figs. 1, 2 and 3 except that the concentrating device is made with a plurality of flat

sides instead of being round. Also the angles of these sides differ from those shown in Fig. 1. I have shown this concentrating device to be of square cross section but obviously it may be made with three or more sides. Also Figs. 6, 7 and 8 show screens over the pockets and jetting pipes within the pockets of the concentrating device. These figures further show a tubular guard member around the material pick up device and an adjustable means for controlling the inlet of material through the sides of the material pick up device.

Referring to Figs. 6, 7 and 8, the numerals 57 and 58 designate an inner expanding member and an outer expanding member respectively both of which are shaped like the frustum of a pyramid. The upper end portions of the two members 57 and 58 are of substantially the same size and are joined. The angles at which these members are positioned relative to the vertical may be varied, in the construction of the device, depending on the work for which the device is designed. The angle of one of these members relative to the vertical may differ from the angle of the other member relative to the vertical.

Upright trap forming members 60 and 61 are provided on the respective inclined members 57 and 58 to form traps 62 and 63. Jetting pipes 64 are positioned in the bottom portions of the traps 62 and 63 to jet fluid under pressure up through the material in these traps. Branch pipes 65 connect the several jetting pipes 64 with fluid pressure supply pipes 66 and 67. Flexible fluid pressure supply conduits 68 are connected with the upper end portions of pipes 66 and 67. Inclined screens 70 are supported above the traps 62 and 63 so that all of the material must pass over or through these screens. The screens 70 prevent coarse material, which usually carries very little values from entering the traps 62 and 63. Amalgamated plates 19' and matting strips 29' are also preferably provided in the traps 63.

The pipes 66 and 67, shown in Fig. 6, and also a pipe 69 which corresponds to the pipe 11, extend downwardly to, and connect with, a material pick up device which is similar to the material pick up device shown in Fig. 1, except that the housing 71 thereof is longer and is provided with material inlet openings 72 and has an adjustable band 73 on the exterior thereof. The band 73 is provided with openings 74 and said band may be rotatively moved on the housing 71 to position the openings 74 in the band in registration or partial registration with the openings 72 in the housing or to completely close the openings 72. A bolt 75 adjustably holds the band 73. This band 73 constitutes a means of regulating both the inlet of material and the suction within the housing 71. The inlet of material at the sides of the housing makes it possible to pick up material for a predetermined distance above bed rock while the housing 71 rests on bed rock.

A cylindrical guard member 76 having openings 77 therein is provided around the material pick up device shown in Figs. 6 and 8. This guard member 76 protects the pick up device and pipes connected therewith against cave in of material and against being wedged or trapped between large rocks and the like. It also keeps the coarser material away from the pick up device and makes it possible to pick up a larger percentage of fine material which is more liable to carry the values. When water is being used with this device the coarse material external to

the guard member 76 will be washed and values that tend to adhere thereto will be loosened. The guard member 76 is shown partly broken away in Fig. 6. It may be of any desired length.

It will be understood that the screens 70 and jetting pipes 64 and guard member 76 and all other features shown in Figs. 6, 7 and 8 may be used in the devices shown in Fig. 1 to 5 inclusive.

It is also of advantage to be able to vary the pressure of the fluid used for operation to produce a surging action, or in some cases, to intermittently admit and shut off the flow of this fluid. This may be accomplished in many ways. One means for accomplishing this is shown in Fig. 5, where a valve 49 is provided in each of the flexible conduits 53 and a similar valve 49' is provided in the flexible conduit connected with the pipe 56. By manipulating these valves it is possible to obtain substantially any desired surging action irrespective of whether air, water or steam is used as a motive agent. Obviously valves, not shown, may control the flow of fluid to pipes 25 and 34 of Fig. 1, and to pipes 66 and 67 of Fig. 6, in a similar way. Variation of fluid pressure in pipes 66 and 67 of Fig. 5, will provide for applying a surge to the material in the traps 63 and this may be used to advantage in concentrating the material in these traps.

In the operation of this apparatus the material pick up device is supported in an upright position at the location of the material to be picked up and fluid under pressure is admitted through the fluid supply pipes. The fluid under pressure from one of these pipes discharges at high velocity into the material on which the pick up device rests thus loosening up and agitating this material. This puts this material in a better shape to be picked up. The fluid under pressure from the other pipe discharges at high velocity upwardly within the pipe which is centrally connected with the pick up device housing thus creating a suction within the pick up device housing. This suction draws in the material which has been loosened up by the jetting device and forces this material upwardly through the pipe which is centrally connected with the pick up device housing thus causing the pick up device to rapidly sink itself into any material that it can tear loose and pick up. If the pick up device is connected with the concentrator, as shown in Figs. 1, 5 and 6, then the material picked up is forced upwardly into the central expanding chamber of the concentrator. In this expanding chamber the upward velocity of the material is rapidly decreased and the heavier particles, such as precious metals, that have been carried this far will tend to settle in the traps 16 or 62. The material not caught in traps 16 or 62 will discharge over the top edge of the concentrator and pass by gravity down over the outside of the same and the heavier particles thereof will be caught in the outer traps 18 or 63. If the device is positioned on sand or fine gravel which overlies bed rock and operated it will quickly penetrate to bed rock and will then surge loose and pick up heavier particles of ore and metal resting on the bed rock. The jets external to the pick up housing tend to create a pressure around the pick up housing. This pressure is relieved chiefly through the pick up housing and the fluid discharging from the external jets and rushing toward the inlet tubes, such as the tubes 28 in Fig. 1, will develop sufficient boosting power and lifting power to pick up coarse particles of gold or nuggets resting on the

bed rock. After these coarse particles have been drawn into the pick up housing they will be trapped there and may later be removed by inverting the machine or dis-assembling the pick up device.

Obviously this material pick up device may be used independently of the concentrator herein disclosed and may deliver material at any desired location or into any desired receptacle.

The tubes 28 which extend from the bottom closure member 27 of the housing 10 upwardly into such housing cooperate with the housing 10 to form a trap in the lower portion of said housing within which trap any heavier particles of metal, such as gold nuggets or coarse gold will be trapped. I find that coarse particles of gold will be jetted loose and drawn into the housing 10 along with lighter material but that such coarser particles will substantially all remain within the housing 10.

The device may be operated fully submerged or partially submerged in water, using water under pressure as the fluid for operation. It may also be operated in dry sands using air under pressure as the fluid for operation. It is also possible to operate the device by the use of steam.

This device may be successfully operated at a substantial depth under water. If the concentrator is submerged the pressure of the water in which the device is submerged will be exerted with equal force inside and outside of the device. If the concentrator is positioned above the level of the water then the water in which the device is submerged will have a tendency to help lift the material.

The foregoing description and accompanying drawings clearly disclose what I now regard as a preferred embodiment of my invention but it will be understood that this disclosure is merely illustrative and that such changes in the invention may be made as are fairly within the scope and spirit of the following claims.

I claim:

1. In a device of the class described, an upright cylindrical housing; a convergent upper cap on the upper end of said housing; an outlet pipe connected with said upper cap coaxially of said housing; a flat bottom cap on the bottom end of said housing; a first fluid conduit member extending diametrically into said housing adjacent said upper cap; fluid discharge jet means connected with said first fluid conduit member and positioned to deliver a jet of fluid under pressure axially of said outlet pipe; a second fluid conduit member extending diametrically across said flat bottom cap in close proximity thereto and external to said housing; a plurality of downwardly directed fluid discharge jet members connected with said second fluid conduit member to direct jets of fluid outwardly from said housing; fluid pressure supply conduits connected with both said first and said second fluid conduit members; and a plurality of material inlet conduits provided in said bottom cap in positions transversely offset relative to both said first and said second diametrically extending conduit members.

2. In a device of the class described, an upright cylindrical housing; a convergent upper cap on the upper end of said housing; an outlet pipe connected with said upper cap coaxially of said housing; a flat bottom cap on the bottom end of said housing; a first fluid conduit extending diametrically through said housing adjacent said upper cap and functioning as a

structural member in the assembly; two fluid pressure supply pipes securely connected with the opposite end portions of said first fluid conduit with one of said pipes communicating with said first fluid conduit and the other pipe shut off from communication with said first fluid conduit; fluid discharge jet means connected with said first fluid conduit and positioned in said housing to deliver a jet of fluid under pressure axially of said outlet pipe; a second fluid conduit extending diametrically across the bottom of said housing external thereto and in close proximity to said flat bottom cap; fittings external to said housing securely connecting both end portions of said second fluid conduit with corresponding end portions of said first fluid conduit providing a rigid built up structure, one of said fittings providing a fluid passageway between said last fluid conduit and the fluid pressure supply pipe that is shut off from communication with said first fluid conduit; a plurality of downwardly directed fluid discharge jet members connected with said second fluid conduit to direct jets of fluid downwardly and outwardly from said housing; and a plurality of material inlet conduits provided in said bottom cap in positions transversely offset relative to both said first and said second fluid conduits.

3. A device of the class described comprising a material pick up housing; material inlet tube means in the bottom portion of said housing extending into said housing and projecting above the bottom of said housing to form in the bottom portion of said housing a trap for the reception of heavy metal; an outlet pipe connected with the upper portion of said housing, said outlet pipe and said tube means being the only openings in said housing whereby a maximum suction through said tube means is provided for; jet means operable by fluid pressure and positioned to create a suction within said housing; other jet means positioned external to said housing in close proximity to said material inlet tube means; and fluid pressure supply means connected with each of said jet means.

4. A device of the class described comprising a housing; an outlet pipe connected with the upper portion of said housing; a fluid discharge member positioned within said housing in axial alignment with said outlet pipe adapted to direct a jet of fluid under pressure into said pipe to produce a suction within said housing; fluid pressure supply means connected with said fluid discharge member; and material intake tubes in the bottom portion of said housing extending above the bottom of said housing and a substantial distance into the housing to provide in the bottom of the housing a trap for heavy metal, said intake tubes terminating a short distance below said discharge member and being offset sidewise as respects said discharge member, said outlet pipe and said tubes being the only openings in said housing whereby a maximum suction through said tubes is provided for.

5. A device of the class described comprising a housing; an outlet pipe connected with the upper portion of said housing; a fluid discharge member positioned within said housing in axial alignment with said outlet pipe adapted to direct a jet of fluid under pressure into said pipe to produce a suction within said housing; fluid pressure supply means connected with said fluid discharge member; another fluid discharge member extending across the bottom end of said housing in close proximity thereto and having down-

wardly directed jet means; material intake conduit means in the bottom of said housing offset to the side of both of said fluid discharge members; and fluid pressure supply means connected with said last mentioned fluid discharge member. 5

6. A device of the class described comprising a housing having an intake opening in the bottom portion thereof; suction creating fluid jet means in said housing; other fluid jet means positioned adjacent the bottom portion of said housing; a plurality of conduits extending upwardly from said housing connected with said jet means and said housing; and a perforated guard tube encircling said housing and said conduits and extending a substantial distance above said housing, said guard tube shielding said housing and shielding said conduits for a substantial distance above said housing against contact with large and heavy boulders and the perforations in said guard tube providing passageways through which fine material will pass to said housing. 10 15

7. A device of the class described comprising a cylindrical material pick up housing; main intake openings in the bottom of said housing; other intake openings in the cylindrical wall of 20 25

said housing; a cylindrical band rotatively adjustable on the exterior of said housing positioned over said other intake openings and having ports movable into and out of registration with said other intake openings to vary the suction through said main intake openings; fluid pressure operated jet means in said housing adapted to create a suction in said housing; and a discharge conduit connected with said housing.

8. A device of the class described comprising a fluid pressure jet actuated suction pick up means including a housing; suction creating jet means internal to the housing; material agitating jet means external to the housing, said suction pick up means being operable to pick up material from the bottom of a body of water; and a material separating and concentrating device connected with said material pick up means in close proximity to said material pick up means and operable under water to receive and concentrate the material that is picked up by said material pick up means irrespective of the depth of the water and without elevating the material any higher in deep water than in shallow water.

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