J. M. & V. E. THORP.

DREDGE.

APPLICATION FILED MAY 4, 1909.

1,055,371.

Patented Mar. 11, 1913.

4 SHEETS—SHEET 1.

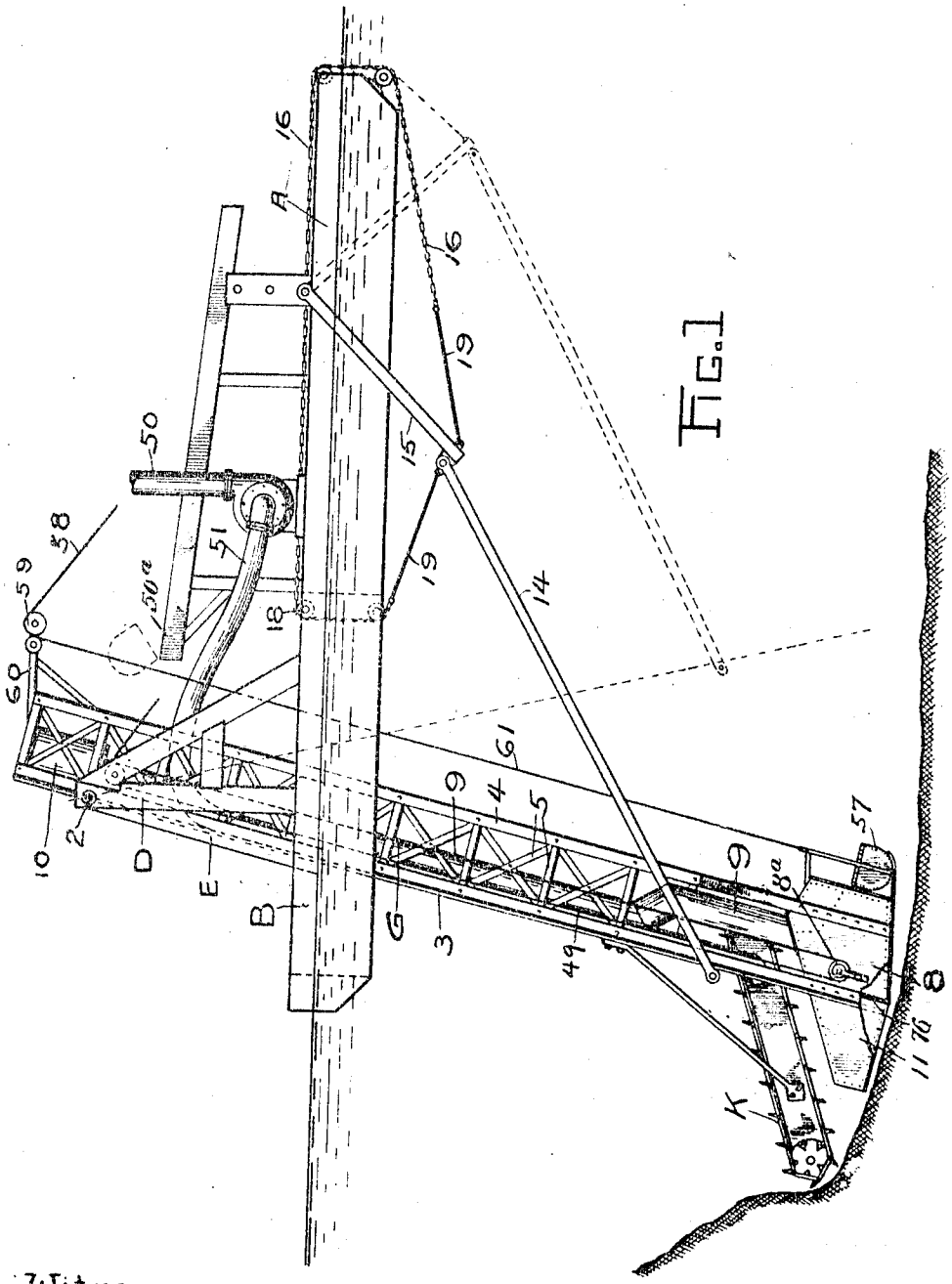

FIG. 1

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4 SHEETS—SHEET 2.

FIG. 2

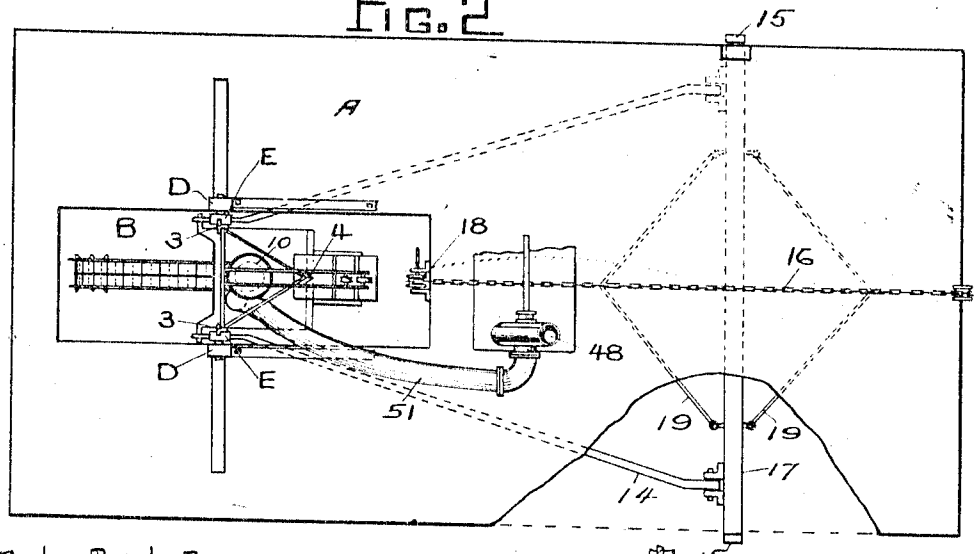


FIG. 3

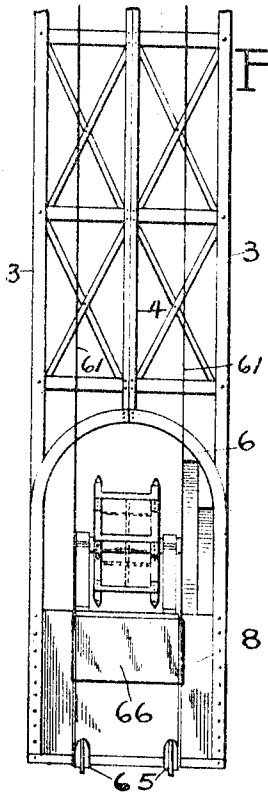


FIG. 4

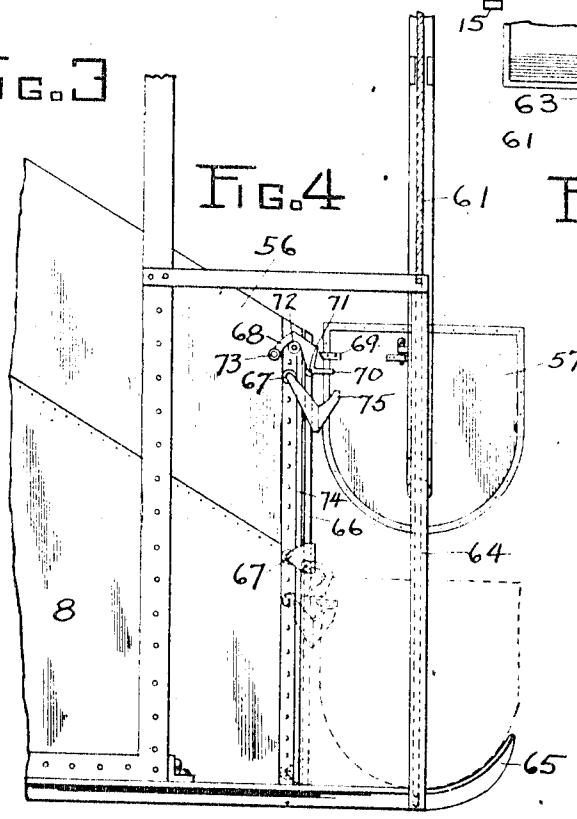
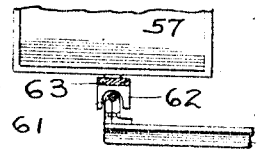


FIG. 5



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4 SHEETS-SHEET 3.

FIG. 6

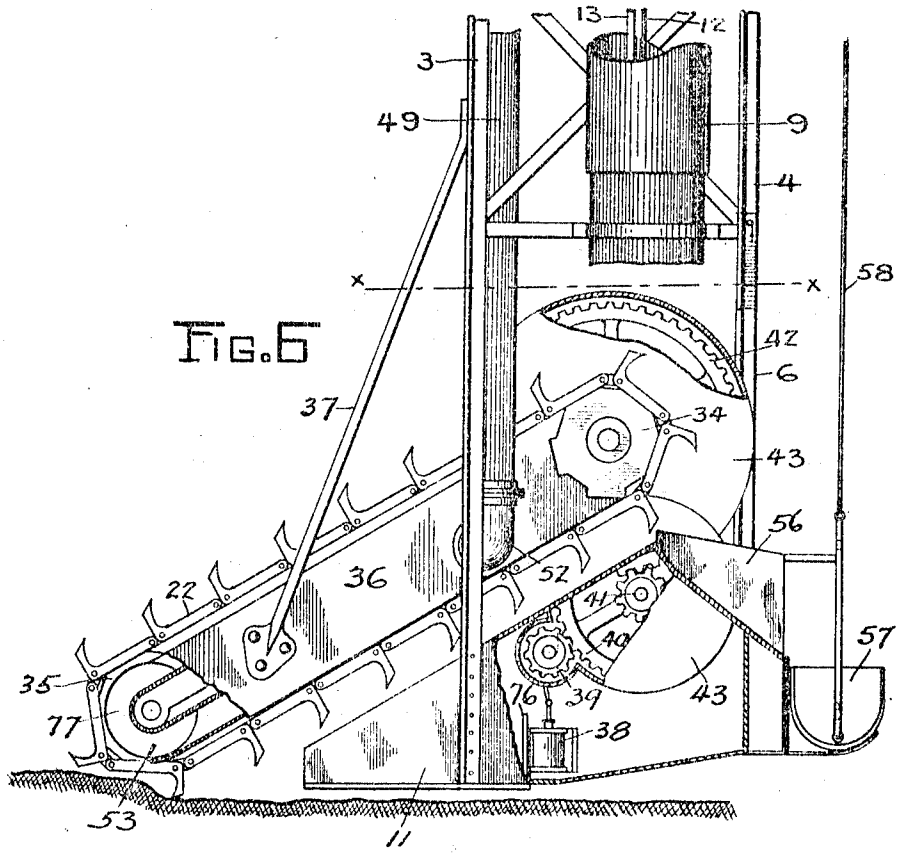
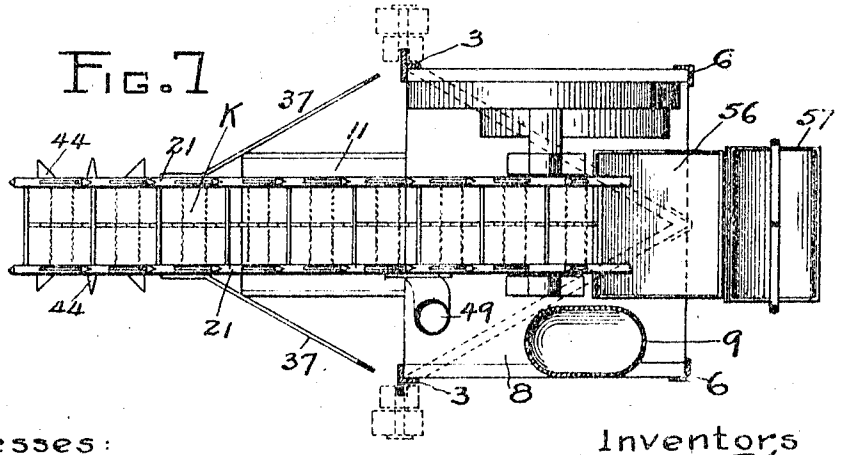


FIG. 7



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4 SHEETS—SHEET 4.

FIG. 8

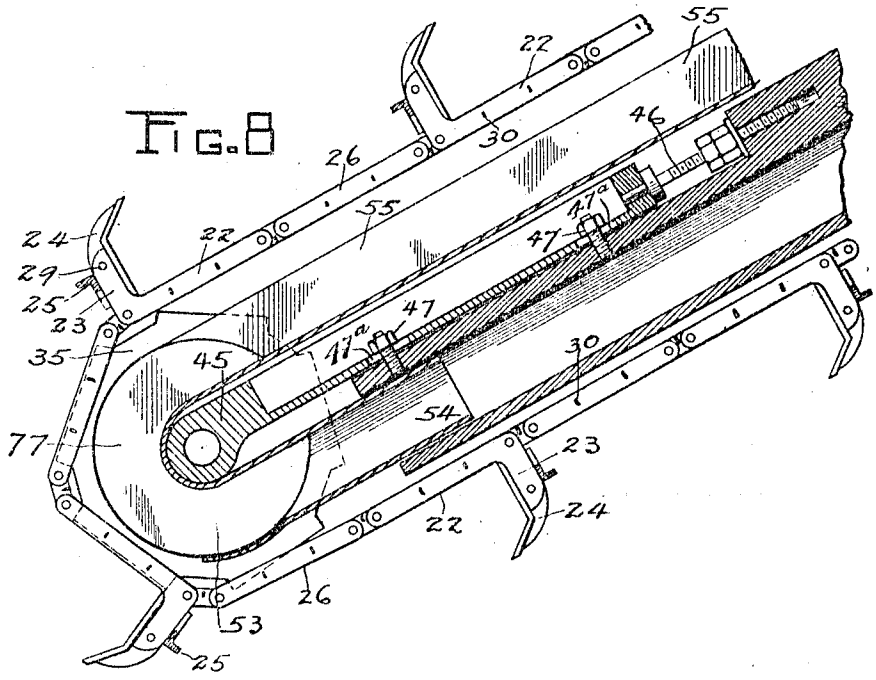
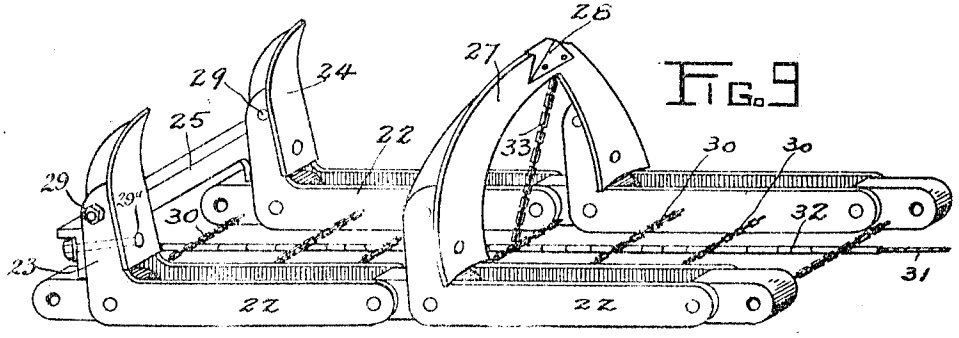


FIG. 9



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UNITED STATES PATENT OFFICE.

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DREDGE.

1,055,371. Specification of Letters Patent. Patented Mar. 11, 1913.

Application filed May 4, 1909. Serial No. 493,976.

To all whom it may concern:

Be it known that we, JAMES M. THORP and VERNOR E. THORP, citizens of the United States, residing at Alameda, in the county of Alameda and State of California, have invented new and useful Improvements in Dredges, of which the following is a specification.

The invention relates to a machine for dredging and especially to a machine adapted for dredging intermixed fine and coarse material.

Heretofore difficulty has been experienced in the operation of suction dredges in material in which a large percentage of stones or boulders are encountered intermixed with the finer materials, by reason of the tendency of the boulders to lodge or pack in or against the face of the suction inlet mouth and obstruct the inflowing current carrying the finer material. Devices have heretofore been constructed to remove such obstructions, but have proven impractical where the boulders form a large percentage of the material to be removed. Under such conditions, the inlet mouth is again clogged almost immediately after the removal of the previous obstruction. As any obstruction lodging but for an instant in the mouth will reduce the cross-sectional area thereof and prevent the proper flow of water into the suction pipe, the efficiency of the machine is destroyed until such time as the obstruction is removed by the devices arranged for that purpose. In connection with suction dredges of the prior art, it has been proposed to use chain bucket elevators to carry the oversized boulders to the surface, where they are conveyed to any desirable point by other suitable means. The use of such elevators is objectionable by reason of their great length and the large amount of power required for their operation, which must be continuous in order to keep the suction mouth clear of obstruction. In material where the percentage of boulders is small, it is evident that the bucket elevator will perform useful work only at irregular intervals, but nevertheless will require practically the same amount of power for its operation, as would be necessary where the boulders were numerous.

In the excavating means employed in this invention, it is preferable to use isolated teeth instead of the bucket forms heretofore used, as the isolated teeth will enter into the interstices between the boulders and dislodge them, while the broad face of the bucket forms rides over the boulders, forcing them into a more secure position.

The object of the present invention is to provide in one machine an effective device to operate with a high degree of efficiency and with the least expense in ground of any percentage of intermixture of fine and coarse material.

More particularly stated, the object of the invention is to provide a dredging machine for the purpose stated, in which the clogging of the suction inlet mouth is anticipated and prevented by a screen moving in close relation thereto, carrying away the oversized boulders from the path of the inlet mouth, but permitting the finer material to be drawn thereinto.

Another object is to provide means operating intermittently to raise to the surface the oversize boulders only as they are encountered.

Further objects of the invention are to provide improved means for excavating or agitating the material to be dredged and means for advancing the excavating devices through such material independent of the movement of the supporting barge.

With these and other objects in view, as will more fully hereinafter appear, the invention consists in certain novel features of construction and arrangement of parts hereinafter more fully described, illustrated in the accompanying drawings, and particularly pointed out in the claims, it being understood that various changes in the form, size and minor details of the structure may be made without departing from the spirit or sacrificing any of the advantages of the invention.

Figure 1 is a side view of the principal parts of the invention mounted on a floating vessel, the dotted lines showing the position of the frame and moving levers in the position of the greatest backward movement thereof. Fig. 2 is a plan view showing the arrangement of some of the parts on a floating vessel, part of the vessel being broken away to show the frame shifting levers. Fig. 3 is a rear elevation of the lower end of the frame. Fig. 4 is a side elevation of a portion of the lower end of the frame showing the hopper, the bucket elevator and means for lowering and raising

the hopper gate, the dotted lines showing the bucket descended and the gate open. Fig. 5 is a detail of a portion of the bucket and means for holding it to the guides. Fig 6 is a side elevation, partly in section of the lower portion of the frame, showing means for driving the agitating and screening mechanism. Fig. 7 is a section taken through Fig. 6 at x—x. Fig. 8 is a detailed section of the suction inlet mouth, the endless chain screen, the agitator teeth and means for adjusting the tension on the chain screen. Fig. 9 is a perspective view of the chain screen, showing different forms of digger teeth.

The devices herein described are usually mounted on a floating vessel or barge A, but they may be placed on tracks, skids or any other foundation suitable to the location, material, or conditions of operation. A well B in the barge, preferably of rectangular shape and located on the longitudinal center line thereof is provided to allow the apparatus to be lowered to the bed of material to be worked, and also to allow the material to be raised to the deck.

The uprights D, arranged at opposite sides of the well B and suitably braced to the deck are provided to carry the grooved guides E for the sliding frame G. The guides E are preferably formed of timber, pivoted to the uprights by the pins 2, and extend downward into the well B, the lower ends bearing against the sides thereof and preventing any lateral swaying of the frame G, as the apparatus operates. The guides E are grooved to receive the legs of the T-irons 3, forming the corner members of the frame G which is preferably formed of triangular section, consisting of the T-irons 3, the angle iron 4 and the straps and braces 5 binding the three corner members together to form a light, strong and rigid frame. The T-irons working in the grooves guide the frame in its vertical movement which is accomplished by means of cables and pulley 8^a. The lower end of the frame G is formed rectangular in section to accommodate the various devices located at that point. The angle irons 6, riveted to the angle iron 4, are arranged to form a rectangular base and to allow an open passage through the frame from front to rear, as shown in Fig. 3. The caisson working chamber 8 at the base of the frame contains the necessary mechanism to drive the agitator screen K, indicated in the drawings, as a steam engine. Access is had to the caisson through the latter tube 9, extending to the upper part of the frame G and provided on the upper end with an air lock 10 to allow access thereto from the exterior. The forward part 11 of the caisson is open at the bottom to allow direct access to the bed of material being worked and the air lock is, therefore, necessary to maintain the necessary pressure and prevent the water from rising into the caisson as the workmen enter or leave the same. An air pump, not shown, is also provided to maintain the necessary pressure therein. The ladder tube 9 is situated within the triangular frame, but is offset near the base so that the entrance into the caisson occurs at the side thereof.

The steam for operating the engine is formed in a suitable generator on the deck of the barge and conducted to the engine through the pipe 12, suitably packed, passing through the ladder tube. The exhaust steam passes to the atmosphere through the pipe 13 in the ladder tube.

The longitudinal swinging motion of the frame G, by which the agitator screen K is fed into the material to be dredged, is preferably accomplished by the levers 14—15 and the chain drive 16 therefor, although other means can be used to perform this same function. The lever 14 is attached to the frame G at one end and to the cross bar 17 at the other and the lever 15 is attached to the barge A and also to the cross bar 17. The chain 16 passes across the deck of the barge, over the drive wheel 18 and is fastened to the cross bar 17 underneath the barge by the cables 19. It will be seen from the drawings that when the frame G is in the backward position, the angle between the levers 14—15 is smaller than when the frame is in the forward position. Therefore, as the frame starts its forward movement it is evident that it will swing farther for a given displacement of the cross-bar 17 than it will in the forward position for the same displacement. In other words, for a constant movement of the chain drive 16, the frame will move faster at the beginning of the stroke than it will at the end thereof. As a corollary thereto, for a constant amount of power applied to the chain, a greater force will be exerted on the frame at the end of the swing than at the beginning. In dredging material, this feature is very desirable as it allows a quick movement of the agitator and excavator over the bed of the stream or water-way being worked, where the deposit is light and easily handled, and a much slower movement at the bank, where the deposit is much greater and more difficult to handle. The means described herein for accomplishing this purpose may be varied, as it is evident many other forms of mechanism could be used to perform the same function.

The agitator screen K consists of two endless chains 21 formed of links bearing teeth which agitate or excavate the material and chains or cables connecting said endless chains to form a screen. The endless chain 21 is composed of links and couplings, the links 22 being provided at one end with a

shoulder 23 designed to form a seat for the tooth 24. The teeth are formed T-shaped in section, the leg of the T lying between the shoulders 23 of the link and securely held thereto by the bolt 29, which is removable to allow the tooth to be removed. The angle iron 25, bolted to the back of opposite teeth on the two chains by bolts 29ª, acts as a spacing and bracing member for the agitator screen, holding the endless chains at the proper distance apart. It also supports and carries any large boulder which may have been dislodged by the teeth. One leg of the angle iron is partly cut away between the opposite teeth to allow the small stones which the teeth have picked up to drop away. In ground where very large boulders occur, the space between the teeth may not be great enough to accommodate them, in which case the chain may be formed as shown in Fig. 8. By placing a blank link 26 between every two tooth links 22, the teeth would be much farther apart and larger boulders could be picked up and carried. Another form of tooth is shown in Fig. 9, in which the two teeth are joined in one piece 27, forming an arched or open shovel device. This tooth is provided with a removable point 28, which sustains most of the wear and can be readily replaced when worn. In the application of our invention, we find that better results are obtained by the two styles of teeth shown in Fig. 9, used alternately, as shown, but any other arrangement may be used depending upon the condition of operation.

The endless chain links 22 on opposite sides of the agitator screen are preferably connected by the chains 30 which are spaced apart equally along the length of the chain to act as screens to prevent oversized boulders from passing through. A cable 31 passes through the center links of the chains 30 and the spacing members 32 thereon hold the chains 30 at a constant distance apart and prevent them from spreading to allow any oversized boulders to pass through. A screen formed in this manner is of a flexible nature and is subjected to repeated shocks and vibrations during its operation, which have the quality of dislodging any boulders which may become wedged in the mesh.

The chain 33 in the bucket tooth 27 is provided to reduce the size of the opening therethrough. It is evident that the screen members 30—31—33 could either be all formed of cable or of chain, and we do not restrict ourselves to the precise arrangement shown.

The endless chains are driven by the sprocket wheels 34 and are returned over the sprocket wheels 35, journaled at the outer end of the arm 36. The sprocket wheels 35 are also provided with clearance teeth 44 to cut side clearance as they are fed into the material and to assist in agitating and excavating the material to be dredged. The arm 36 is stationary with regard to the frame G, being attached thereto at the inner end and braced by the rods 37 at the outer end. The sprocket wheels 34 are driven by the engine 38, through the gears 39 40—41—42 inclosed in the casing 43 which is preferably filled with oil to facilitate the operation of the gears. Provision is made for adjusting the tension of the chain drivers of the agitator screen, by journaling the sprocket wheels 35 in the adjustable bearing block 45, at the outer end of the arm 36. The screw 46 is adapted to shift the bearing block 45, and the bolts 47 to hold it in any desired position. The bolts 47 engage in slots 47ª in the bearing block.

An exhausting apparatus, shown in the drawings as a centrifugal pump 48, is arranged to cause the necessary flow through the suction pipe 49, which passes down through the frame G and the arm 36 to a point in close relation to the operating agitator teeth. The pump 48 is preferably connected to the suction pipe 49 by a flexible connection 51, to allow the frame G to readily swing or be raised and lowered, without interfering with its operation. The delivery pipe 50 is provided to convey the dredged material to any desired point. The suction pipe 49 passes down through the frame G, enters the arm 36 on a smooth curve at the elbow 52 and extends therefrom to the nozzle or inlet mouth 53 at the lower end of the arm. The inlet mouth of the suction pipe is preferably a rectangular opening approximating in area the cross-section of the suction pipe. The pipe is preferably of such form that its area at every point is substantially the same, thereby causing a constant speed of the liquid moving therein and thus preventing any of the suspended material settling out and obstructing the passage. The suction pipe is also preferably formed with a telescopic mouth piece 54 to allow the inlet mouth to remain in the same position relative to the digger teeth when the bearing block 45 is moved to adjust the tension of the chain drives of the agitator screen.

It will be seen that the inlet mouth 53 is guarded by the agitator screen K and the material passing into the suction pipe inlet 53 must pass through such screen. The size of the material capable of passing through is determined by the area of the openings in the screen, which are formed of various sizes in various machines, depending upon the size of the exhausting apparatus and suction pipe and other conditions of operation. Disk liners 77, attached to the inside of the sprocket wheels 35 form the side walls of the inlet mouth 53 and the revolu-

tion thereof will break and dislodge any pack or jam of smaller boulders that may lodge therein. The axis of the sprocket wheels lies above the inlet mouth 53 so that the side walls thereof are formed by the lower portion of the disk liners 77. During the operation of the machine, as shown in the drawings, disk liners 77 revolve in a clockwise direction, the lower portion adjacent to the suction inlet moving in a direction generally opposite to the direction of the inflowing water. This motion will expel any jam that may form, break it up and allow the material to be drawn into the suction pipe. The side walls of the telescopic mouth piece 54 are cut away flush with the circumferential face of the disk liners 77, forming an inlet mouth with moving sides and with stationary top and bottom. It is evident that a small portion of the undersized boulders will be held with the large boulders on the agitator screen by the force of the suction at the inlet mouth and will be carried by the screen away from the mouth. When the screen has traveled a sufficient distance to remove the force of suction from the boulders, the smaller ones will fall through the meshes of the screen on account of the vibration thereof, and be caught by the trough or gutter 55, provided for that purpose, and carried down to the inlet-mouth of the suction pipe.

It is desirable in some instances to carry the suction pipe inlet very close to the point of excavation and also to maintain the full speed of the inflowing current without diminution of intensity at any point in the suction pipe. The construction herein shown and described secures these conditions by placing the inlet mouth in close relation to the cutting implements and by preventing the inlet mouth from being clogged, which would reduce the speed of the inflowing current.

The large oversize boulders which are retained by the screen K are dumped into the hopper or bin 56 at the rear of the caisson 8 and removed therefrom by the bucket 57, which is operated by the cable 58 passing over the sheave 59, on the bracket 60. The bucket is guided in its path in the ascending and descending movements by the cables 61 which are engaged by brackets 62 on the bucket bail 63. At the lower end, the cables 61 are held by the guides 64 to restrict the motion of the bucket to a straight path as it passes the hopper 56. Curved angle-irons 65 are arranged at the base as a stop and support for the bucket. The hopper bin 56 is preferably provided with a drop gate 66 held thereto by the straps and rollers 67, and provided with latches 68 to lock the gate in the closed position. The lugs 69 on the descending bucket engage the projection 70 of the latches 68 causing them to rotate about the center 71 and disengage themselves from the rollers 72 on the bin. The roller 73 on the latch runs along the face of the angle iron 74 holding the latch 68 in such position that the lug 69 is held between it and the bracket 75 causing the gate to move in unison with the bucket 57. As the bucket ascends the roller 73 on the latch 68 passes over the roller 72 on the bin, thereby securing the latch and allowing the bucket to be raised. A trough or receptacle 50^a of any desirable description is arranged on the deck of the barge to receive the boulders as they are brought up and discharged by the bucket.

In the operation of the apparatus, the movement of the agitator screen, of the advancing levers 14—15 and of the bucket hoist are under the control of the operator in the caisson, who, being in such close relation to the work, is best able to direct such operations.

In gold dredging a large percentage of the fine gold and rich deposit clings to the bed rock and is not removed by the agitator screen and suction pipe as they pass over. To facilitate the recovery of this rich deposit, the forward end of the caisson is provided with an open bottom, so that an operator therein can clean up the surface of the bed rock with a hand suction tool. A bulkhead 76 is provided between the open caisson and the engine caisson to prevent the water from flowing into the latter compartment when the frame G is at the forward part of the swing.

When it becomes necessary to repair any of the working parts of the apparatus, the frame G is raised through the well until the caisson is above the deck; the frame may then be tilted to any desired angle to afford ready access to the parts to be repaired.

We claim:

1. In a dredge, the combination of a swinging frame, means to swing the frame, and intermediate connecting mechanism adapted to reduce the rate of motion of the frame during its forward movement, said intermediate mechanism consisting of the arm 15 pivoted to the barge and connected with swinging means and the arm 14 connecting the arm 15 with the swinging frame.

2. In a dredge, the combination of a vertically adjustable swinging frame, a suction pipe having an inlet mouth at the lower portion thereof, an excavator and conveyer mounted at the lower end of said frame and working in close relation to the inlet mouth, means inherent in the conveying means for preventing the clogging of the suction inlet, a hopper to receive the material from the

conveyer and an independently operating bucket elevator to raise the material collected in the hopper.

3. In a dredge, the combination of a barge, a vertically adjustable pivoted frame mounted thereon, means for swinging the frame, a suction pipe having an inlet mouth extending from the lower portion of said frame, agitating and conveying means operating in close relation to the inlet mouth, an endless screen to prevent the coarse material from obstructing the inlet mouth, a storage hopper close to the inlet mouth and arranged to receive the coarse material from the conveying means and an intermittently operating elevator to raise said coarse material to the surface.

4. In a dredge, the combination of a barge, a frame mounted thereon and extending to the material to be dredged, an open bottom chamber at the lower end of the frame, means for entering the chamber from the barge, means external and in advance of the opening for agitating and removing the material to be dredged and a conveyer above the chamber for depositing the coarse material behind the chamber.

5. In a dredge, the combination of a barge, a pendulum frame mounted thereon, a caisson at the lower end thereof having an open bottom, excavating means external to and in advance of the caisson, conveying means above the caisson a hopper behind the caisson to receive the material from the conveying means and means within the caisson for driving the excavating and conveying means.

6. In a dredge, the combination of a pivoted guide frame, a frame slidable longitudinally therein, a forwardly projecting arm at the lower end of the slidable frame, means arranged on the arm for agitating the material to be dredged and a suction pipe in said forwardly projecting arm having its mouth at the forward end thereof.

7. In a dredge, the combination of a vertically adjustable pendulum frame, a caisson on the lower end of said frame, a forwardly projecting arm attached to the frame above the caisson, and means on the arm for removing large stones from the path of the caisson.

8. In a dredge, the combination of a barge, a pivoted frame depending therefrom, means to swing the frame comprising a reciprocating element moving at a constant speed, and means connecting such element to the frame to produce a decreasing rate of motion thereof during the forward stroke.

9. In a dredge, the combination of a barge, a frame supported thereon and depending therefrom, a gravity-dumping bin supported at the lower end of said frame, a combined excavator and conveyer supported at the lower end of said frame and arranged to dump into said bin, a bucket, means for raising and lowering said bucket, means for guiding said bucket into position to receive material from said bin, means actuated by said bucket for causing said bin to dump into said bucket, and means for actuating said combined excavator and conveyer.

10. In a dredge, the combination of a barge, a frame supported thereon and depending therefrom, a bin supported at the lower end of said frame, a combined excavator and conveyer supported at the lower end of said frame and arranged to dump into said bin, a bucket, means for raising and lowering said bucket, means actuated by said bucket for causing said bin to dump into said bucket, and means for actuating said combined excavator and conveyer.

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