This invention is titled “Vibrating Agitator Attachment for Toyo Dredge Pumps” and is for use with Toyo submersible dredge pumps. The invention is for use in subsea dredging operations. The invention is easily attachable when needed and detachable when not needed. It uses vibrating technology to move an agitator unit, which touches the seafloor, in the X, Y, and Z planes in a rapid and powerful motion. The agitator unit has “blades” with vertical surfaces and pointed at the bottom for easy penetration in hard clay. These “blades” are attached to the bottom of a jet ring that uses pressurized water spraying through jet nozzles aimed at the pointed edge of the vertical surface blades. The vibrating motion moves the horizontal column of water between the vertical blade surfaces agitating the seafloor material, and breaking it loose for removal by the Toyo dredge pump. The idea of using vibrating technology with a Toyo dredge pump is new. The idea of using vertical vibrating surfaces with pointed bottom ends and water spraying at the bottom of them to break up a hard clay seabed is new.
Fig 11

2 / 3

Dimensions and angles are shown in the diagram.
VIBRATING AGITATOR ATTACHMENT FOR TOYO DREDGE PUMPS

[0001] This invention is for use in subsea and civil dredging operations where Toyo dredge pumps are used.

[0002] Historically, Toyo dredge pumps have used a system of pressurized water jets, placed at the bottom of the pump, to disturb and liquefy the muddy and sandy material on the sea floor. The suspension of material by the jet systems, make it possible for the Toyo dredge pump to pick it up and remove it. These systems work well to the point where the material begins to have more of a clay consistency. The more clay in the dredge material, the less effectively the jet systems can act to disturb and liquefy it.

[0003] This invention is intended to improve on the effectiveness of using the Toyo dredge pumps where clay is an issue as far as production is concerned.

DETAILED DESCRIPTION OF THE INVENTION

[0004] Toyo dredge pumps are used in subsea and civil dredging operations. The pumps come from the manufacturer with a guard component called a pump skirt. This pump skirt is bolted to the bottom of the pump and a jet ring is typically attached by welds or bolts to this pump skirt. The jet ring uses pressurized water spraying from jet nozzles welded around the jet ring to disturb and liquefy the dredge material of the sea floor. This disturbance of the dredge material suspends the material so the dredge pump can suck it up and move it. When the material to be dredged is mud and sand this jetting system is adequate. When the dredge material becomes a hard clay layer, this jetting system becomes ineffective in disturbing the material and production drops off substantially. This point of production loss is the time to attach the Vibrating Agitator Attachment to the Toyo dredge pump.

[0005] Toyo makes a variety of sizes of submersible pumps used in the dredging industry and this invention can be fabricated to attach to any Toyo dredge pump. For the purpose of this non provisional patent application, the Toyo model TO 400 dredge pump was chosen to illustrate the invention with the drawings submitted.

[0006] The invention uses vibrating technology to move the Agitator Unit (see drawing 1/3 FIG. 4) in the X, Y and Z planes with a rapid and powerful motion. The motion of the blades moves the horizontal column of water between them, disturbing the sea floor for removal by the Toyo dredge pump.

[0007] The Agitator Unit is equipped with horizontal agitator blades arranged generally perpendicular with flat vertical surfaces and welded to the bottom center of the jet ring pipes. These blades are tapered at the bottom for easier penetration into the sea floor. The jet ring has jet nozzles placed on either side of the agitator blades. The jet nozzles are generally pointed to the bottom of adjacent agitator blades. The Jet Skirt is centered below the pump and welded to the jet ring pipe and agitator blades. The vibrating motor is mounted to the motor mounting base welded to the jet pipe and agitator blade below it. The pump is attached to the Pump Support Unit. The Pump Support Unit consists of the Top Isolator Support Brackets welded to the Pump Skirt and the Support Ring welded to the Top Isolator Support Brackets. The pump is attached to the Pump Support Unit by bolting the flange of the pump skirt to the bottom of the pump and bolting the support ring to the lugs around the pump bowl. The Pump Support Unit and the Agitator Unit sandwich the Isolators between them by bolting the isolators to the top and bottom Isolator Mounting Flanges. Refer to drawing 1/3 FIG. 4.

[0008] To get a better idea of the three main parts of this machine refer to drawing 1/3 FIG. 4. This drawing illustrates the Agitating Unit which is composed of the jet ring and jets, the agitating blades, the bottom isolator brackets, the motor mounting base and the vibrator motor with power supply lines. The pump support unit consists of the top isolator brackets, and the support ring. The Isolators’ are rubber mounts sandwiched between the agitator unit and the pump support unit to separate the vibration from the pump. The orientation of the pump skirt, the top isolator support brackets and the support ring is critical and is illustrated in drawing 3/3 FIG. 2 and FIG. 3.

[0009] This invention is easily fabricated by anyone with the skills and the discipline of steel fabrication and access to the tools to cut, weld and roll or bend steel. The other components of this machine such as the vibrating motor and the rubber isolation mounts are readily available in the market place. No specialty items need to be manufactured.

[0010] Fabrication should begin with the jet ring. Refer to drawing 2/3 FIG. 3. Care should be taken when welding the jet ring together to keep it flat and square. When fabrication of jet ring is complete, fabrication on the agitator blades should begin. Refer to drawing 2/3 FIG. 4. It’s recommended to fit the agitator blades to the bottom of the jet ring and fit the jet skirt into place before welding begins. The welding should be 100% for all the blades, blades to the jet ring, blades to the jet skirt and jet skirt to the jet ring. This is the basic structure for the agitator unit. Refer to drawings 2/3 FIGS. 6 and FIG. 7. For jet skirt fabrication information, refer to drawings 2/3 FIG. 8 and FIG. 9.

[0011] The bottom and top Isolator Support Brackets should be fabricated as pairs (top and bottom) with the Isolators attached. Refer to drawings 1/3 FIG. 5, 2/3 FIG. 14-15-16, 3/3 FIG. 6-7-8.

[0012] The support ring fabrication drawing is 3/3 FIG. 3.

[0013] The Pump Skirt, as it comes from the manufacturer, needs to be slighted modified to use as a permanent part of the Vibrating Agitator Attachment. See drawing 3/3 FIGS. 4 and 3/3 FIG. 5. The Pump Skirt comes with six vertical legs. It needs to be modified with eight vertical legs.

[0014] Jet assemblies are a combination of "1" pipe collars and 1" hexagon pipe plugs with a 1/4" hole drilled in the center. Refer to drawing 2/3 FIG. 17.

[0015] The Jets assemblies are arranged on the jet ring at 8" apart and pointed at the bottom of the adjacent blade, 30 to 60 degrees below the horizontal. In the inside of the jet ring where jets are facing each other they are staggered. Refer to drawing 2/3 FIG. 6.

[0016] The Top and Bottom Isolator Support Brackets are bolted together at the respective isolator mounting flanges. Refer to drawing 1/3 FIG. 5.

DESCRIPTIVE LEGEND

<table>
<thead>
<tr>
<th>Component</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Toyo TO-400 Pump Volute</td>
</tr>
<tr>
<td>2</td>
<td>Jet Ring Water Intake Line</td>
</tr>
<tr>
<td>3</td>
<td>Vibrating Motor Power Supply (Hyd.)</td>
</tr>
<tr>
<td>4</td>
<td>Vibrating Motor</td>
</tr>
<tr>
<td>Component</td>
<td>Description</td>
</tr>
<tr>
<td>-----------</td>
<td>-------------</td>
</tr>
<tr>
<td>5</td>
<td>Vibrating Motor Mounting Base Assembly</td>
</tr>
<tr>
<td>6</td>
<td>Vibrating Motor Mounting Plate</td>
</tr>
<tr>
<td>7</td>
<td>Vibrating Motor Mounting Base Supports</td>
</tr>
<tr>
<td>8</td>
<td>Pump Skirt</td>
</tr>
<tr>
<td>9</td>
<td>Jet Nozzle Assembly</td>
</tr>
<tr>
<td>10</td>
<td>Pump Support Ring</td>
</tr>
<tr>
<td>11</td>
<td>Isolator</td>
</tr>
<tr>
<td>12</td>
<td>Top Isolator Support Bracket</td>
</tr>
<tr>
<td>13</td>
<td>Top Isolator Support Bracket Web</td>
</tr>
<tr>
<td>14</td>
<td>Top Isolator Support Bracket Flanges</td>
</tr>
<tr>
<td>15</td>
<td>Top Isolator Mounting Plate</td>
</tr>
<tr>
<td>16</td>
<td>Jet Ring Skirt</td>
</tr>
<tr>
<td>17</td>
<td>Bottom Isolator Support Bracket</td>
</tr>
<tr>
<td>18</td>
<td>Bottom Isolator Support Bracket Web</td>
</tr>
<tr>
<td>19</td>
<td>Bottom Isolator Support Bracket Flange</td>
</tr>
<tr>
<td>20</td>
<td>Bottom Isolator Mounting Plate</td>
</tr>
<tr>
<td>21</td>
<td>Jet Ring</td>
</tr>
<tr>
<td>22</td>
<td>Agitator Blades</td>
</tr>
<tr>
<td>23</td>
<td>Jet Nozzle</td>
</tr>
<tr>
<td>24</td>
<td>Jet Collar</td>
</tr>
</tbody>
</table>

**DRAWING LIST AND DESCRIPTIONS**

- **0008** Page Number 1/30
- **0009** Drawing Number—1/3 FIG. 1
- **0010** Description—Side view of invention with component listings. Not all components are shown or listed in this drawing. This drawing also shows the bottom section of the Toyo TO 400 dredge pump volute in its position when invention is attached to the pump. This is the only drawing that shows the dredge pump volute as it is sits in relationship to the invention.
- **0011** Page Number 2/30
- **0012** Drawing Number—1/3 FIG. 2
- **0013** Description—Side view of invention with component listings.
- **0014** Page Number 3/30
- **0015** Drawing Number—1/3 FIG. 3
- **0016** Description—Top view of invention with component listings.
- **0017** Page Number 4/30
- **0018** Drawing Number—1/3 FIG. 4
- **0019** Description—End view exploded illustrating the three separate units of the invention with component listings. The agitator unit, the isolators and the pump support unit are individually shown in brackets.
- **0020** Page Number 5/30
- **0021** Drawing Number—1/3 FIG. 5
- **0022** Description—Perspective view of the top (12) and bottom (17) isolator support brackets with the isolators (11) are shown in brackets. The parts of each isolator support bracket are listed.
- **0023** Page Number 6/30
- **0024** Drawing Number—2/3 FIG. 1
- **0025** Description—This end view shows the complete agitator unit portion of the invention with component listings. See drawing 4/29 FIG. 4—drawing page number 4/29. The isolators are not shown.
- **0026** Page Number 7/30
- **0027** Drawing Number—2/3 FIG. 2
- **0028** Description—Top view of agitator unit portion of invention with component listings. The isolators are not shown.
- **0029** Page Number 8/30
- **0030** Drawing Number—2/3 FIG. 3
- **0031** Description—Top view of the agitator blades arrangement with dimensions and component listing in brackets.
- **0032** Page Number 9/30
- **0033** Drawing Number—2/3 FIG. 4
- **0034** Description—Cross section view of agitator blade with dimensions and listing.
- **0035** Page Number 10/30
- **0036** Drawing Number—2/3 FIG. 5
- **0037** Description—Cross section view of agitator blade with dimensions and listing.
- **0038** Page Number 11/30
- **0039** Drawing Number—2/3 FIG. 6
- **0040** Description—Bottom view of jet ring, agitator blades, jet assembly’s and jet ring skirt. These components are fit and welded together. The arrangement of adjacent jets are staggered and generally aimed at the bottom of the adjacent agitator blade.
- **0041** Page Number 12/30
- **0042** Drawing Number—2/3 FIG. 7
- **0043** Description—Cross section view of jet ring, agitator blade and jet assembly with component listings. The 60 degree angle is for the outer ring of the jet ring the lateral jet pipe jets will be aimed at the bottom of the adjacent blade.
- **0044** Page Number 13/30
- **0045** Drawing Number—2/3 FIG. 8
- **0046** Description—Top view of jet ring skirt with component listing. This drawing shows the ID and OD of the skirt.
- **0047** Page Number 14/30
- **0048** Drawing Number—2/3 FIG. 9
- **0049** Description—Side view of jet ring skirt shows the dimensions and placement of the holes and the height of the skirt.
- **0050** Page Number 15/30
- **0051** Drawing Number—2/3 FIG. 10
- **0052** Description—Perspective view of the vibrator motor mounting base assembly with listings.
- **0053** Page Number 16/30
- **0054** Drawing Number—2/3 FIG. 11
- **0055** Description—Plan view of vibrating motor mounting base supports with dimensions and listings. 4 are required but this drawing illustrates the relationship of two halves.
- **0056** Page Number 17/30
- **0057** Drawing Number—2/3 FIG. 12
- **0058** Description—Side view of vibrating motor mounting base assembly with dimensions and listings.
- **0059** Page Number 18/30
- **0060** Drawing Number—2/3 FIG. 13
- **0061** Description—Perspective view of vibrating motor mounting plate. Drawing shows dimensions and listings. The hole pattern dimensions have yet to be determined.
- **0062** Page Number 19/30
- **0063** Drawing Number—2/3 FIG. 14
- **0064** Description—Plan view of the bottom isolator support bracket web with dimensions and listing.
- **0065** Page Number 20/30
- **0066** Drawing Number—2/3 FIG. 15
- **0067** Description—Perspective view of bottom isolator support bracket flange with dimensions and listing.
- **0068** Page Number 21/30
- **0069** Drawing Number—2/3 FIG. 16
- **0070** Description—Perspective view of bottom isolator support bracket flange with dimensions and listing.
Description—Perspective view of the bottom isolator support mounting plate.

Description—Plan view of jet nozzle assembly with listings and dimension of hole drilled. The collar is a 1 inch stainless steel pipe coupling and the jet nozzle is a 1 inch hexagon black pipe plug with a 3/4" hole drilled into the top, through the plug. The collar is welded to the jet ring.

Description—Side view of pump support unit with listings.

See drawing 1/3 FIG. 4—drawing page number 4/29. Isolators are not shown.

Description—Top view of pump support unit with listings.

Description Top view of pump support ring with dimensions and listing. This drawing shows the orientation of the ring, the mounting hole pattern and the opening in the ring for the pump discharge elbow.

Description—Top view of pump skirt with radius dimensions and listing.

Description—Side view of pump skirt with dimensions and listing. The pump skirt comes from the manufacture with the pump and must be modified for use as a permanent part of the pump support unit.

Description—Side view of the top isolator support bracket web with dimensions and listing.

Description—Perspective view of top isolator flanges with dimensions and listing.

Description—Perspective view of the top isolator mounting plate with dimensions and listing.

1. This invention can easily be manufactured to fit any size submersible dredge pump.
2. This invention uses vibrating vertical “blades” to move the horizontal water column between these blades causing the sea floor to break up for removal by the dredge pump.
3. This invention uses a pressurized water jetting system, with the jet nozzles specifically aimed at and in conjunction with vibrating vertical blades increasing productivity in subsea dredging operations where hard clay has slowed production because conventional jetting systems have proven ineffective.

* * * * *