United States Patent [19]

Araoka

[11] **3,885,330**

[45] **May 27, 1975**

[54] **EXCAVATOR FOR DIGGING A HOLE BENEATH THE WATER**

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[22] Filed: **Mar. 7, 1973**

[21] Appl. No.: **339,017**

[52] **U.S. Cl.** **37/57**; 37/64

[51] **Int. Cl.** **E02f 3/92**; E02f 3/94

[58] **Field of Search** 37/64–67, 57

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Primary Examiner—Clifford D. Crowder

Attorney, Agent, or Firm—Brisebois & Kruger

[57] **ABSTRACT**

Apparatus for digging a hole beneath the water comprises a submarine motor connected to drive a shaft carrying a plurality of scoops provided with teeth along their cutting edges. The scoops are mounted beneath a stationary disc provided with a hole connected to a suction pipe through which sand displaced by the scoops may be sucked up.

3 Claims, 21 Drawing Figures

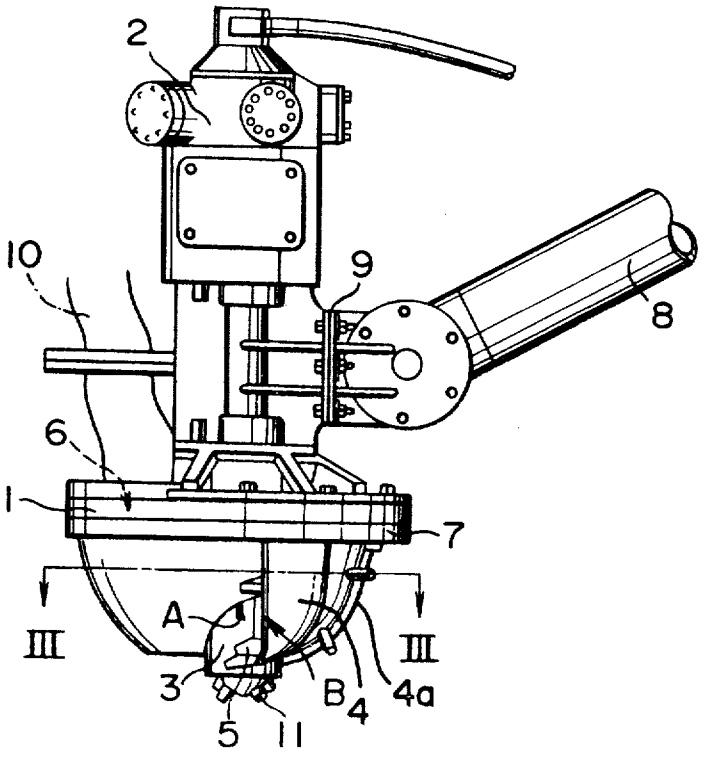


FIG. 1

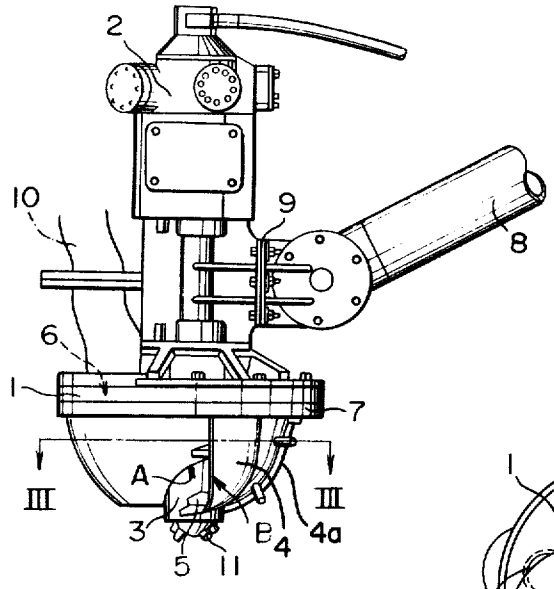


FIG. 2

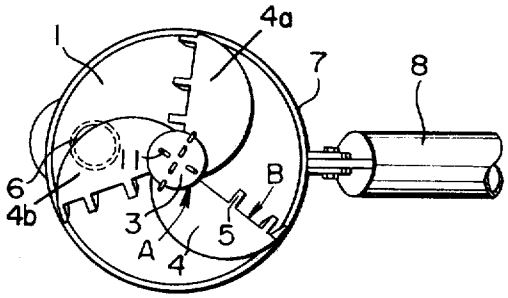


FIG. 4

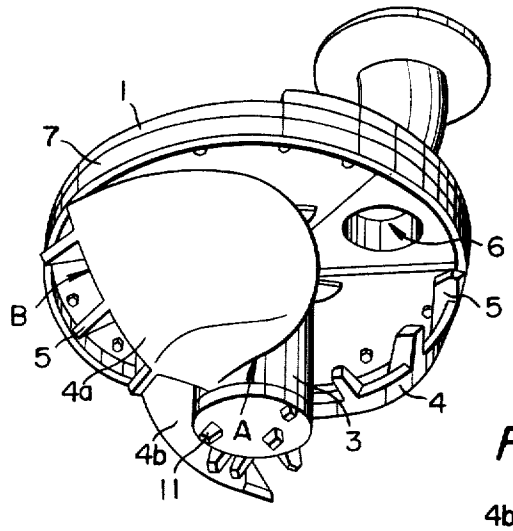
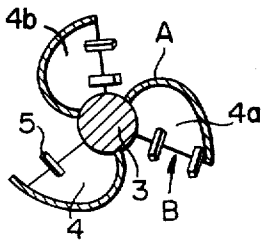


FIG. 3



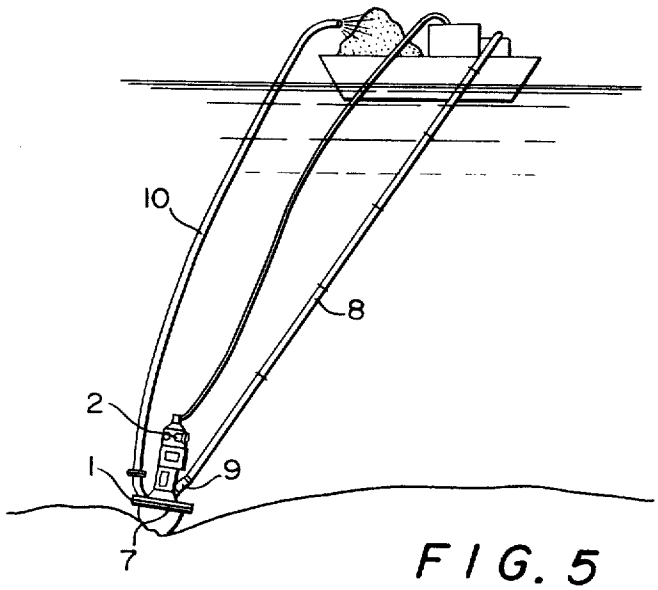


FIG. 5

FIG. 6

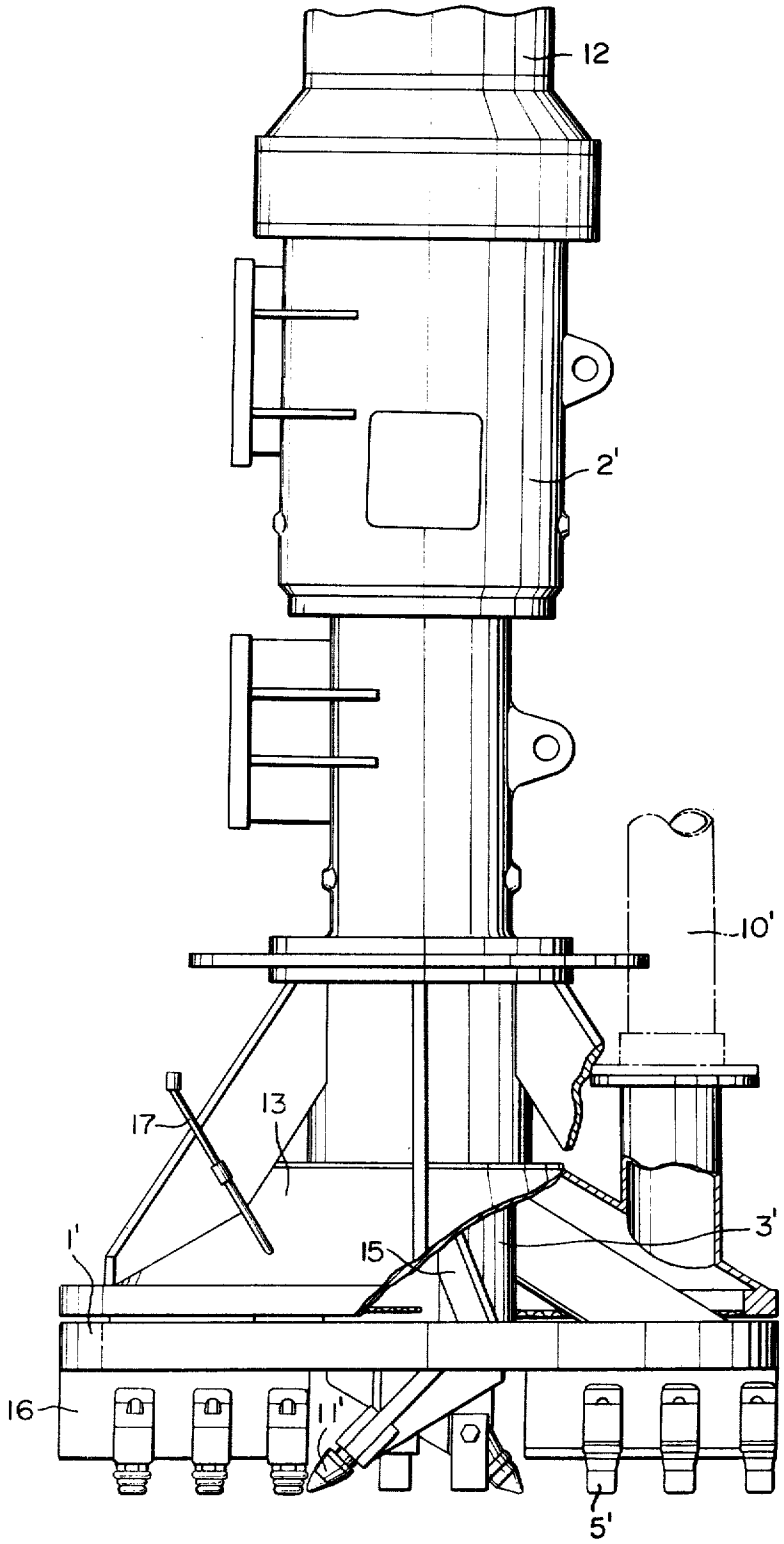


FIG. 7

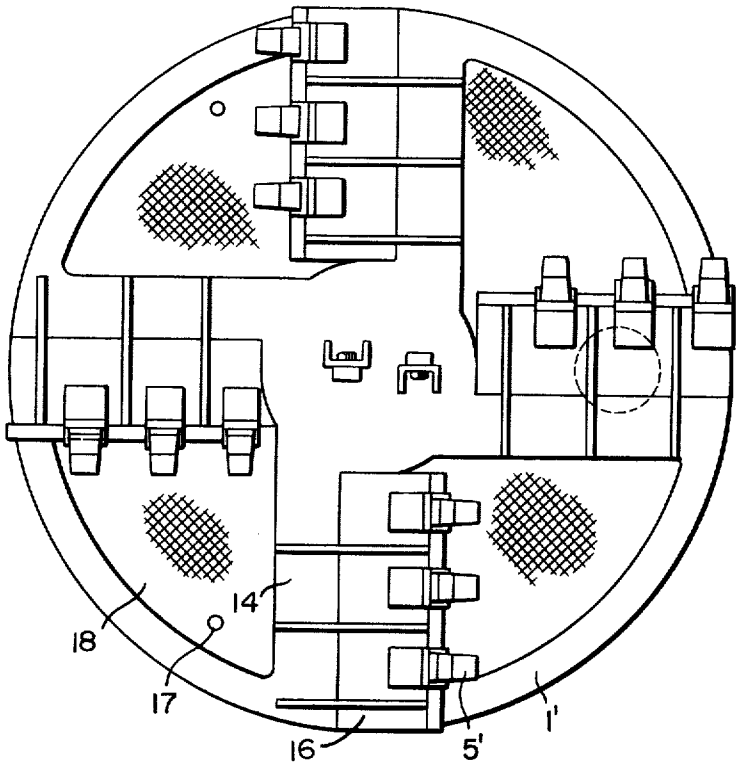


FIG. 8

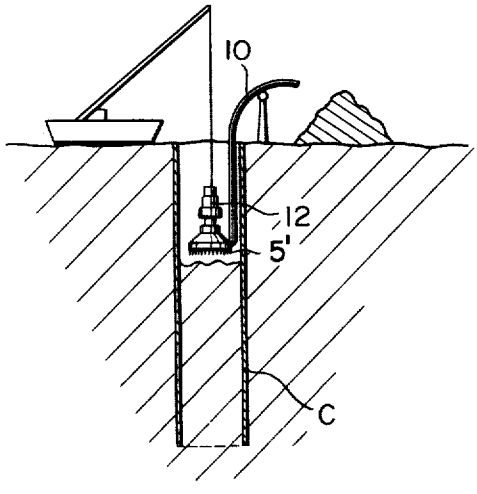


FIG. 9

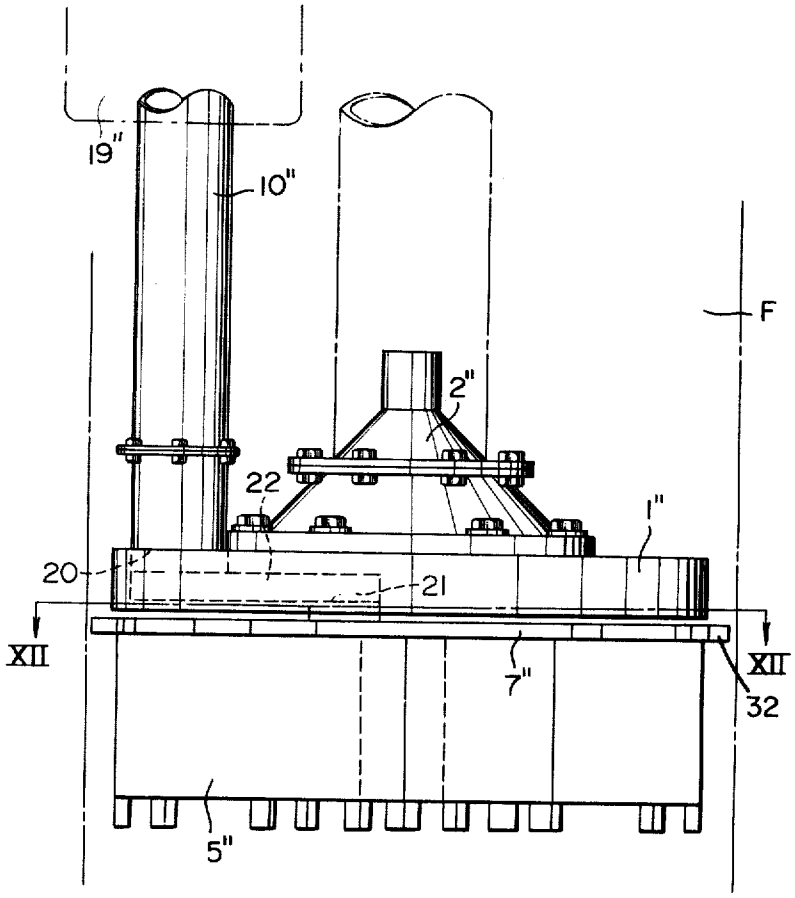


FIG. 11

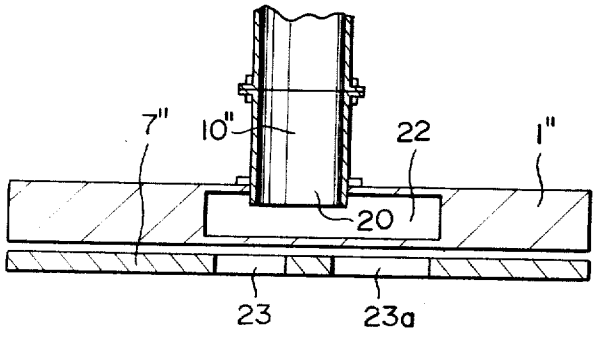
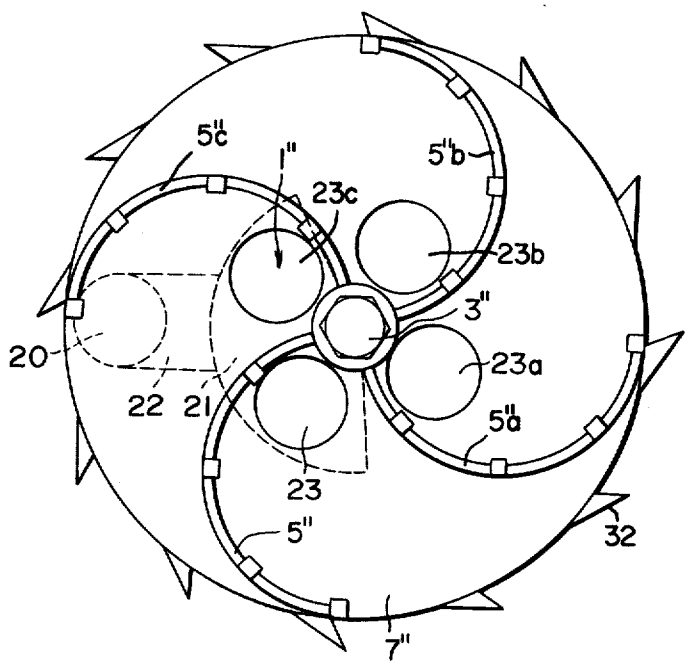


FIG. 10


5"c
1"
5"b
23c
23b
3"
20
23a
22 21
5"a
23
5"
32
7"

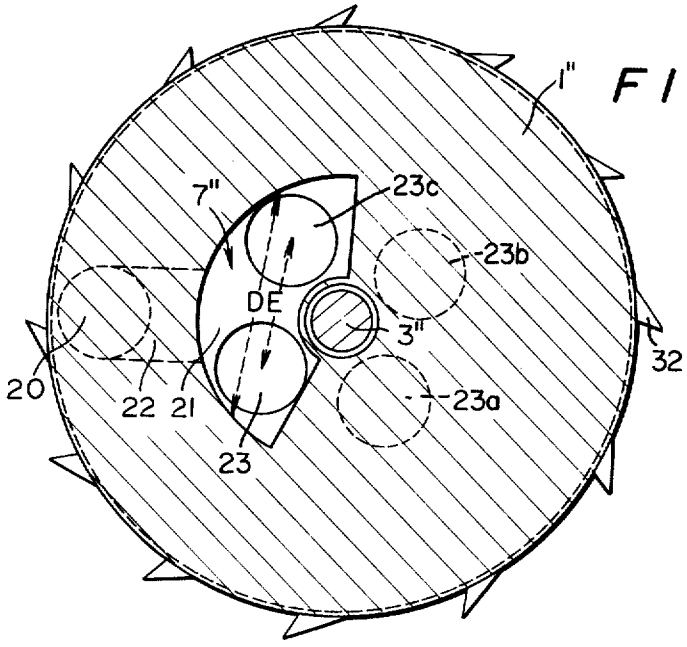

1"
7"
23c
23b
DE
3"
32
20
22 21
23a
23

FIG. 12

FIG. 13

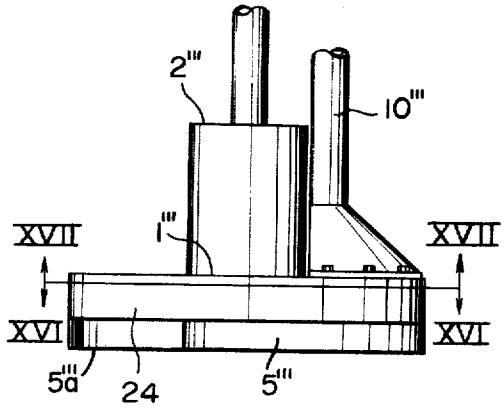


FIG. 15

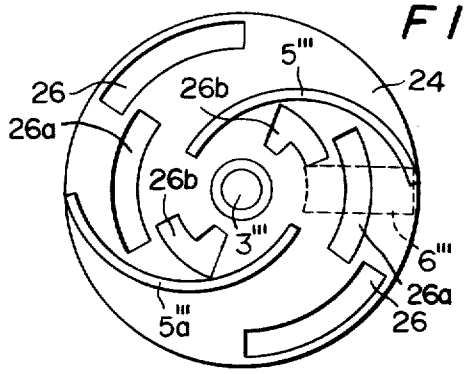


FIG. 14

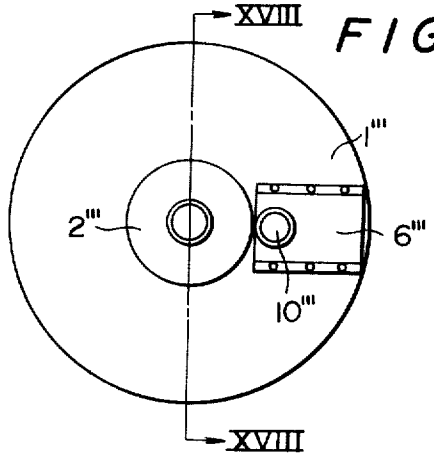


FIG. 16

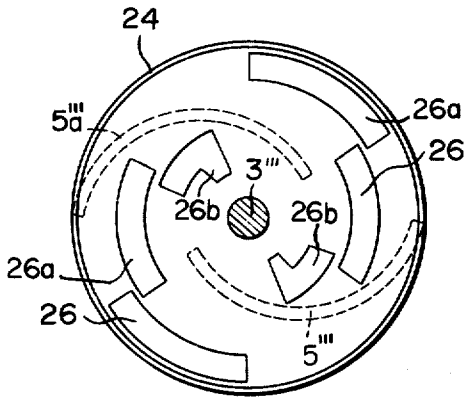


FIG. 17

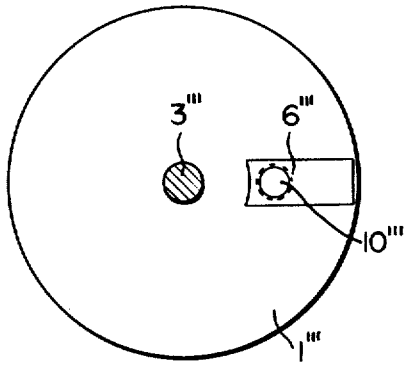


FIG. 18

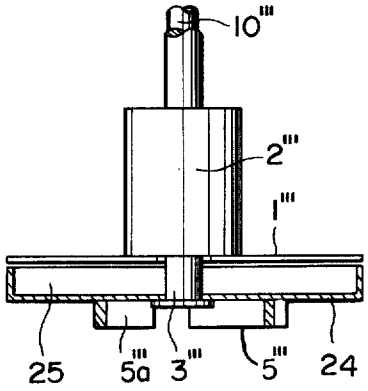


FIG. 19

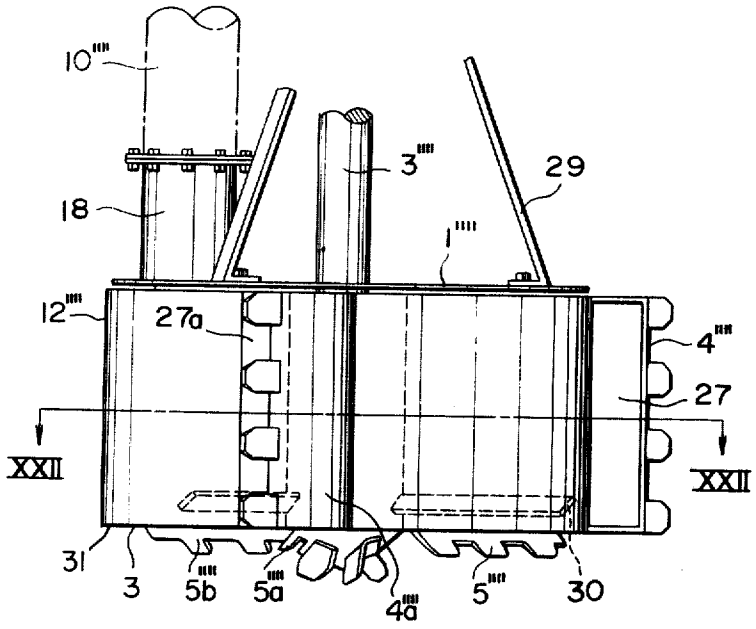

10''''
3''''
29
18
1''''
12''''
27a
4''''
27
XXII
XXII
31
3
5b
5a
4a
5''''
30

FIG. 20

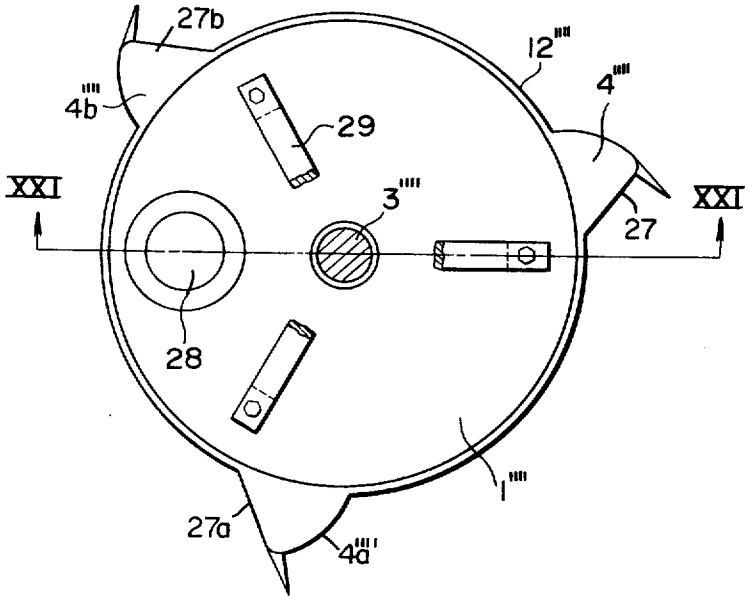
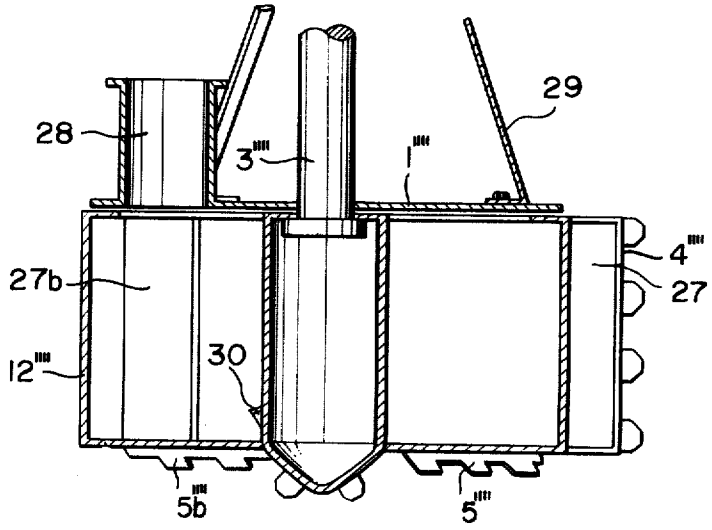

27b
12''''
4''''
4b''''
29
XXI
3''''
XXI
27
28
1''''
27a
4a''

FIG. 21



EXCAVATOR FOR DIGGING A HOLE BENEATH THE WATER

SUMMARY OF THE INVENTION

This invention relates to apparatus for stirring up and excavating sand, and thereby digging a hole beneath the water.

The first object of this invention is to provide durable apparatus which stirs up and excavates sand and thus digs a hole beneath the water with a high efficiency.

The second object of this invention is to provide apparatus which works efficiently even in narrow places and under bad conditions beneath the water.

The third object of this invention is to provide apparatus which operates smoothly without being affected by geographical conditions at the place of a pit and a side cave.

The fourth object of this invention is to provide a blade having a shape perculiarly adapted to pit digging.

The fifth object of this invention is to provide apparatus which digs a hole even with the ground.

Other objects and advantages of this invention will be better understood from the following description of several embodiments of the invention with reference to the accompanying drawings, in which:

FIG. 1 is a front view of a first embodiment of the apparatus according to the invention;

FIG. 2 is a bottom plan view of the first embodiment;

FIG. 3 is a cross sectional view taken along the line III—III of FIG. 1;

FIG. 4 is a perspective view showing the principal parts of the first embodiment;

FIG. 5 is a schematic view showing the apparatus according to the first embodiment in use;

FIG. 6 is a front view showing a second embodiment of the invention with a part broken away;

FIG. 7 is a bottom plan view of the second embodiment;

FIG. 8 is a schematic view showing the apparatus according to the second embodiment in use;

FIG. 9 is a front view of a third embodiment of the invention;

FIG. 10 is a bottom plan view of the third embodiment;

FIG. 11 is a longitudinal sectional view taken along the axis of the duct 10'';

FIG. 12 is a cross sectional view taken along the line XII—XII of FIG. 9;

FIG. 13 is a front view of a fourth embodiment of the invention;

FIG. 14 is a top plan view of the fourth embodiment;

FIG. 15 is a bottom plan view of the fourth embodiment;

FIGS. 16 and 17 are cross sectional views taken along the line XVI—XVI of FIG. 13, looking downwardly and upwardly respectively;

FIG. 18 is a longitudinal sectional view taken along the line XVIII—XVIII of FIG. 14;

FIG. 19 is a front view of a fifth embodiment of the invention;

FIG. 20 is a top plan view of the fifth embodiment;

FIG. 21 is a longitudinal sectional view taken along the line XXI—XXI of FIG. 20.

Referring first to FIGS. 1–5, this apparatus comprises an oil pressure motor 2 mounted on a stationary disc 1, the drive shaft 3 of which is extended through the center of the disc 1. A plurality of lateral and cup-shaped scoops 4, 4*a* . . . are spirally attached to the shaft along their bases A, and teeth or hooks 5 are mounted on the free edges B of each scoop in any suitable way. A hole 6 for sucking up sand is positioned at a suitable point on the disc. After this apparatus has been attached to the end of a ladder 8 slanting into the water from a quay or boat, it is sunk into the water. The motor 2 on the disc 1 is operated by remote control means positioned on the boat or quay to drive the rotary shaft 3 and the plurality of scoops spaced around the circumference of the shaft. As a result, the said scoops cut into the sand at the bottom of the water and sand stirred by this operation is thrown up along the line A. Therefore, when the motor and a suction pump in a sand suction pipe 10 are started, sand is expelled onto the barge after passing through the sand suction hole in the disc 1.

Reference numeral 7 indicates a rotating auxiliary ring underneath the disc 1. Reference numeral 9 indicates a frame carried by the disc 1 and to which the end of the ladder 8 is attached. Reference numeral 11 indicates a projection extending from the end of the rotary axis. According to the first embodiment, sand is stirred, excavated and expelled with a high efficiency.

In the second embodiment illustrated in FIGS. 6–8, a dome-shaped cover 13 is mounted at the lower part of a body 12, and a rotary shaft 3' driven by an electric motor 2' in said body extends through the central part of the said cover. A circular frame 1' having the same diameter as the cover is attached to the lower end of the rotary shaft by a cross bar 14. Sand stirrers 5', such as metal brushes or claws, are positioned under the cross bar. The lower end of suction pipe 10' is connected to the cover. After the steel caisson C is thrust into the ground, the apparatus is lowered, with the sand stirrers 5' being rotated by the cross bar and the suction pump being actuated to create suction in a suction pipe 10'. Then sand stirrers by the sand stirrers 5' is collected in the cover 13 and is expelled through the suction pipe 10' onto the ground. Consequently, sand and mud is taken out from the steel caisson and after this caisson is pulled out, a longitudinal hole is left.

Reference numeral 15 indicates a partition and rib for reinforcing the cross bar; 16 indicates a mounting frame for claws 5' which is used as a sand digger; 17 indicates a nozzle for supplying a jet of water, 18 indicates a screen and C is a steel caisson thrust into the earth.

In the third embodiment, illustrated in FIGS. 9–12, a suction hole 20 connecting the lower end of suction pipe 10'' is positioned at the circumference of the upper side of the disc 1'' and an additional suction hole 21 is provided in the inner part of its lower side. The disc 1'' is so constructed that the hole 21 opens into the hole 20 through a lateral connecting passage 22. A rotary disc 7'' having a suitable number of digging blades 5'', 5*a*'' . . . and teeth 32 is mounted directly beneath the disc 1'' and attached to the shaft of an electric motor 2'' passing through the center part of the said disc. Suction holes 23, 23*a*, 23*b* . . . are positioned between each blade and a suction hole 21 is positioned on the same circumference centering around the drive shaft. The aperture D of the hole 21 is larger than the distance E between the center of one suction hole 23 and the suction hole 23c nearest thereto.

When a hole is dug in the ground, this apparatus is down in the water. At the same time that the water-

tight motor 2'' and the suction pump connected to the suction pipe 10 are started, the rotary disc 7'' is pressed into the earth gradually, and the blades 5'' radially mounted beneath the rotary disc 7'' cut the earth. After the sand cut away by the blades is sucked in by the first suction holes 23, 23*a*, . . . positioned between each blade, it is led to the suction pipe 10'' from a suction hole 21 through a lateral connecting hole 22 to the hole or duct 20. Moreover, because the distance E between the centers of two adjacent suction holes 23 is smaller than the aperture D of the suction hole 21, each suction hole 23 and the second suction hole 21 in the bottom of the stationary disc 1'' is connected through at least one point irrespective of size. Consequently, the operation is carried out with an extremely high efficiency and the construction can be very strong, without being influenced by geological conditions.

In the fourth embodiment illustrated in FIGS. 13–18, a dish-shaped rotary body 24 is mounted beneath the stationary disc 1'''. Blades 5''', 5*a*''' . . . at the bottom of the rotary body 24 are connected directly or indirectly to the rotary axis 3'''. Sand coming up through holes 26, 26*a*, . . . and passing through the space 25 and the sand suction hole 6''' passes to an eccentric position on the disc 1''' and into the end of a suction pipe with a suction pump. When this apparatus is positioned at a suitable location, a rotary shaft 3''' is rotated by an electric motor 2''' which rotates only the dish-shaped rotary body 24 beneath the disc 1''' and sand dug out rolls into the central part of said rotary body because of the arrangement of the blades. Then when the suction pump is turned on, a strong suction power is produced at the suction hole 6''' eccentrically positioned on the disc 1'''. Accordingly sand is drawn into the space 25 from the holes 26, 26*a*, . . . and is discharged to the earth gradually from the suction hole 6''' through the suction pipe 10'''. Therefore a longitudinal hole in the ground is formed in due course.

According to this embodiment, a single apparatus can dig, suck up, and discharge the sand, in an extremely smooth manner to make a longitudinal hole, especially a hole of a small diameter. Furthermore, this apparatus is very durable.

In the fifth embodiment illustrated in FIGS. 19–21, a ladder 8'''' is sunk down from a wharf or barge and the blades 5'''', 5*a*'''' . . . mounted at the bottom 31 of the cylindrical body 12'''' at the end of the ladder are brought into contact with the bottom. When a water-tight motor which drives 3'''' is started by remote control, it rotates the cylindrical body 12''''. Therefore, first of all stirring and digging blades 5'''' and 5*a*'''' . . . dig up the bottom. After some time, the cylindrical body 12'''' enters the bottom, and each shovel 4'''', 4*a*'''' . . . projecting radially from the cylindrical body begins to dig sand. Sand dug up by these operations flows into the cylindrical body 12'''' through connecting holes 27, 27*a* . . . successively, and passes through a hole 28 eccentrically positioned on the disc 1'''' and is discharged from the through pipe 18 and suction pump 10'''' onto a suitable place. Reference numeral 29 indicates arms for connecting the stationary disc 1'''' to a ladder or motor, while 30 designates frame members reinforcing the body 12''''.

According to this embodiment, many operations such as smoothing the bottom of a body of water, leveling the slope and digging a longitudinal hole may be carried out efficiently, even in extremely narrow places.

I claim:

1. Apparatus for digging a hole beneath a body of water, said apparatus comprising a machine body, a cover mounted at the bottom of the body, a motor in said body connected to drive a shaft passing through the center of said cover, a circular frame having substantially the same diameter as said cover and attached to said drive shaft, said frame carrying cross bars and a screen positioned beneath said cover, metal claws mounted on said cross bars and the lower end of said drive shaft, and a suction pipe, having one end which is connected to a hole in said cover eccentrically of said drive shaft.

2. Apparatus for digging a hole beneath a body of water, said apparatus comprising:

a stationary disc provided with a suction passage therein,

a water-tight motor mounted on one side of said disc,

a drive shaft driven by said motor and passing through said disc,

a plurality of cup-shaped scoops projecting radially from said shaft beside said disc on the opposite side of said disc from said motor, said scoops being attached to said shaft along spiral lines at their bases and having free edges beginning at said bases and extending radially outward from said shaft,

a ring lying parallel and adjacent to said disc, and connecting the free edges of said scoops,

teeth on the free edges of said scoops, and

sand suction means connected to said suction passage on the same side of said disc as said motor.

3. Apparatus for digging a hole beneath a body of water, said apparatus comprising:

a stationary disc provided with a suction passage therein,

a water-tight motor mounted on one side of said disc,

a drive shaft driven by said motor and passing through said disc,

a plurality of cup-shaped scoops projecting radially from said shaft beside said disc on the opposite side of said disc from said motor, said scoops being attached to and extending radially outward from said shaft,

a rotating disc lying parallel and adjacent to said stationary disc, and connecting said scoops,

teeth on the free edges of said scoops, and

sand suction means connected to said suction passage on the same side of said disc as said motor,

said suction passage being defined by an opening in the side of the stationary disc carrying said motor and located eccentrically of said stationary disc, a second opening near the central part of the opposite side of the stationary disc, and a transverse duct within the stationary disc connecting said openings,

said rotating disc being carried by said shaft parallel to said stationary disc and on said opposite side thereof, and being provided with a plurality of holes between said scoops positioned to register successively with the opening in said opposite side of said stationary disc, and in which the width of said last mentioned opening is greater than the distance between the centers of adjacent holes in said rotating disc.

* * * * *