

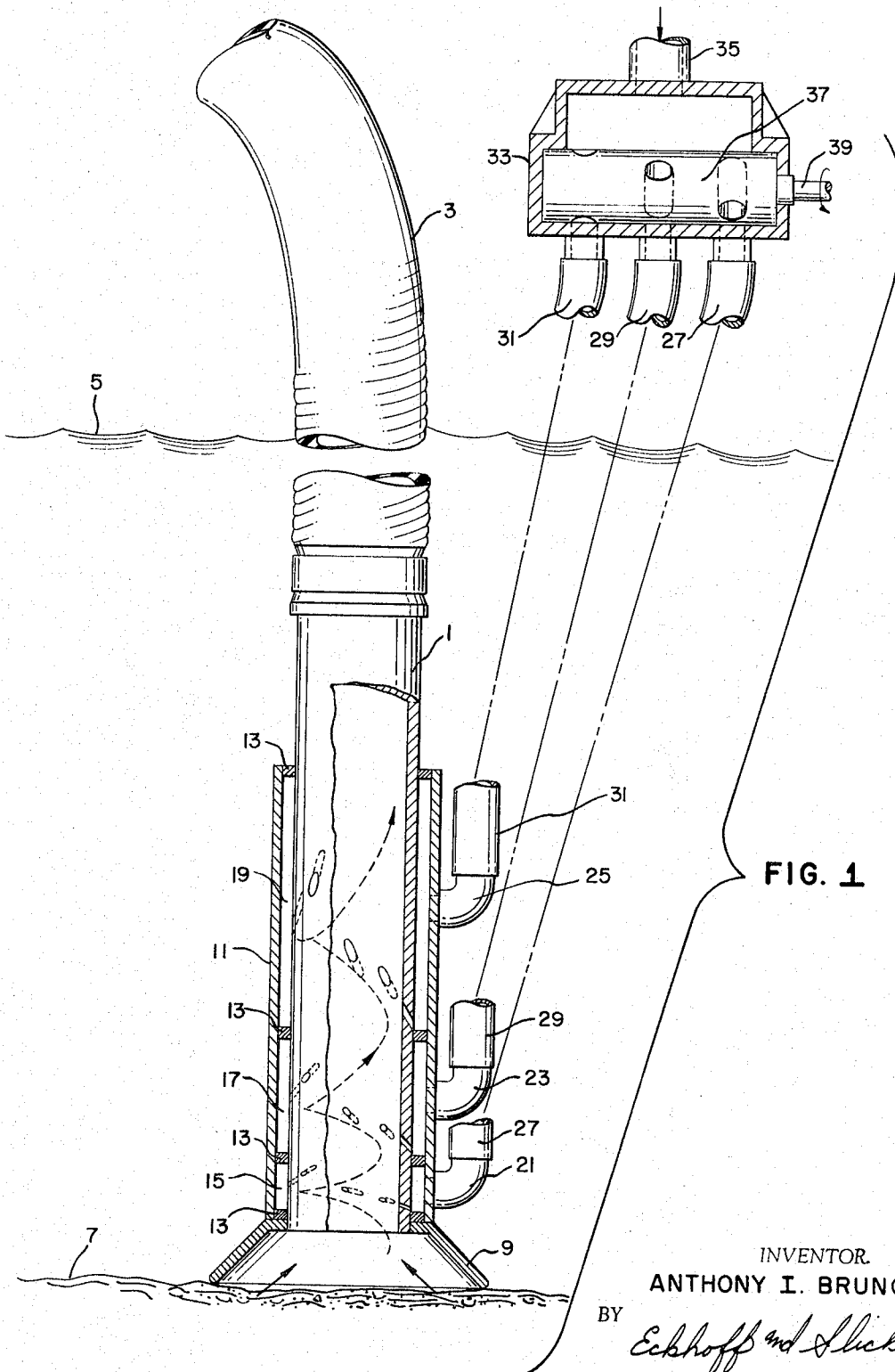
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A. I. BRUNO
CYCLONIC ELEVATOR

3,301,606

Original Filed July 19, 1965

2 Sheets-Sheet 1



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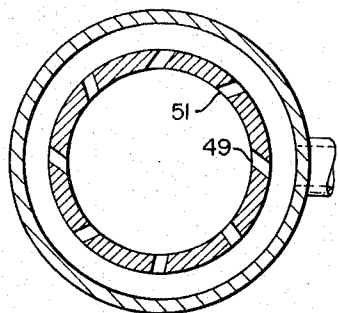


FIG. 2

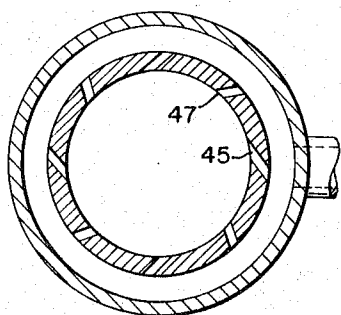


FIG. 3

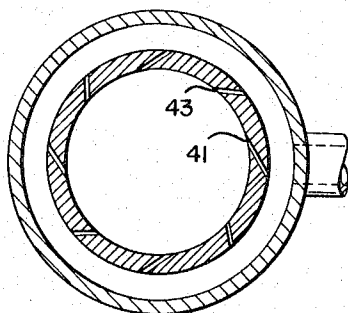


FIG. 4

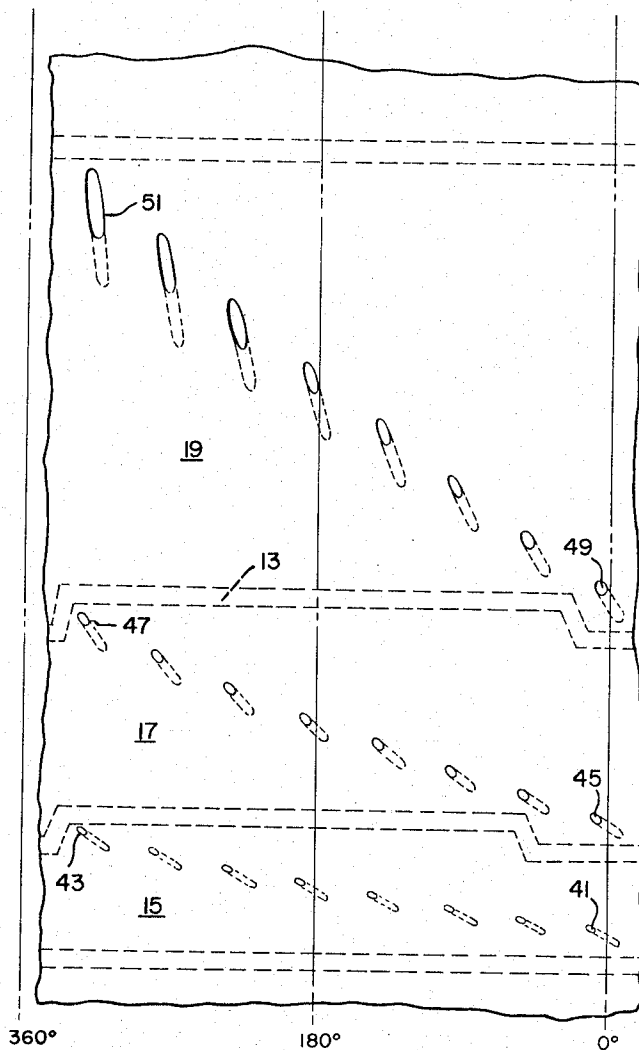


FIG. 5

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CYCLONIC ELEVATOR

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Continuation of application Ser. No. 472,805, July 19, 1965. This application June 23, 1966, Ser. No. 560,009
6 Claims. (Cl. 302—58)

This application is a continuation of application No. 472,805, filed July 19, 1965, and now abandoned.

This invention relates to a cyclonic elevator device wherein particulate material is raised by means of a rotating, pulsing air column.

The device of the present invention is primarily adapted to be used under water in which case it has a strong digging action so that it can dig into the bottom even of a fairly hard, consolidated marine formation. The device can be used to raise loose, particulate material in the absence of water such as wheat, oats, salt, dirt, gravel and the like.

Air lift devices have previously been proposed but they have not been wholly satisfactory due to their low lifting ability. Thus it is common practice to provide a tube for under water use wherein air is introduced near the bottom of the tube through one or more orifices and the air in rising carries entrained water and solids with it. However, such devices are relatively inefficient and are incapable of any actual digging action or of lifting large, particulate material, and are wholly inoperative for use in the absence of water.

In accordance with the present invention a lifting device is provided having an extremely strong sucking action so that when used under water it will actually dig its way into a solid bottom formation. When used in the absence of water, it will lift loose particulate material and may be used in loading or other operations. In the drawings and in the description of the device reference will largely be made to under water use but it will be understood that this is only for ease of description.

In general, the present invention is accomplished by providing a device having a plurality of chambers, preferably three, surrounding a tube with a plurality of apertures in spiral configuration leading from the chambers into the tube. Compressed air is fed into the chambers, through the apertures and thus into the tube, the air being supplied to the chambers in a pulsating form.

In the drawings forming part of this application:

FIGURE 1 is a view, partially in section of a device embodying the present invention.

FIGURE 2 is a sectional view through the upper chamber of the device shown in FIGURE 1, said section being taken on a spiral line to intercept the centers of the several apertures.

FIGURE 3 is a similar spiral view through the second chamber of the device shown in FIGURE 1.

FIGURE 4 is a similar spiral view through the bottom chamber of the device shown in FIGURE 1.

FIGURE 5 is a developed view of the inside of the tube of FIGURE 1 showing the tube as if it were flattened out.

Referring now to the drawing by reference character, the device includes a lifting tube 1 to which may be attached an upper flexible discharge tube 3. The device is shown submerged in water 5 and resting on a bottom 7. The lower end of tube 1 is preferably flared as at 9. Near the bottom of the tube is a series of plenum chambers formed by an outer concentric wall 11 having partitions as at 13 therein thus forming a lower chamber 15, a middle chamber 17 and a top chamber 19. The chambers 15, 17 and 19 thus formed preferably have a relationship wherein each chamber is twice as high as the chamber immediately below it. Thus if the lower cham-

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ber has height of one unit, the second chamber 17 has a height of two units and the third chamber has a height of four units. Leading to the plenum chambers are the connectors 21, 23 and 25 which lead to the chambers 15, 17 and 19 respectively. The upper ends of the connectors 21, 23 and 25 are attached by suitable tubes 27, 29 and 31 to a valve 33 which leads to a source of compressed air through a line 35, the source of compressed air not being illustrated. Valve 33 has a rotor 37 therein driven by shaft 39 so that air is supplied to each of the lines 27, 29 and 31, and thus to the plenum chambers 15, 17 and 19, in succession.

In each of the chambers 15, 17 and 19 is a series of apertures leading from the chamber into the tube. In each of the chambers the apertures start at the bottom and form a spiral to the top of the particular chamber over one complete revolution. Since the chambers increase successively in height, the angle or lead of the spiral increases as one goes up the tube. Furthermore, the aperture at the very bottom of the tube as at 21 is almost tangential to the tube and has a very slight upward slope. At the end of the spiral for that chamber aperture 45 has less of a tangential angle and more of a slope upwardly as can be seen by reference to FIGURES 4 and 5. Similarly, the lowest aperture in chamber 17, namely 45, has more of a tangential component and less of an upward component than the last aperture in this spiral 47. It will be seen that the same relationship prevails in the upper chamber 19 where the lowest aperture 49 continues this upward trend so that the last aperture 51 in this series lies almost straight upwardly with only a slightly tangential component.

In addition to the difference in angles of the various apertures it will also be noted that the apertures differ in size and the height relationship of the chambers is also maintained in the apertures in the same 1, 2, 4 order. Thus, in one specific embodiment of the invention, the apertures in the lowermost chamber have a diameter $\frac{1}{4}$ inch, in the second chamber $\frac{1}{2}$ inch and in the uppermost chamber $\frac{1}{6}$ inch. The angle of the slope of the bottom chambers goes from almost zero to 30°, in the second chamber to about 45° and in the upper chamber to about 75° or 80°.

In order to secure maximum efficiency and lift, it is preferred that the total area of the apertures leading from any chamber into the tubes be smaller than the area of the pipes 21, 23 and 25 leading into that particular chamber.

In operation, air is supplied through the line 35 at a suitable pressure and the rotor 37 of the valve is rotated so that the chambers are successively supplied with compressed air. Preferably the pulsing is done at relatively high rate and it has been found that if the pulsing is done so that each chamber is supplied with air from about every $\frac{1}{5}$ to about every $\frac{1}{10}$ of a second satisfactory results will be obtained. Pulsing the chambers in this way, a swirling action is produced within the tube 1 as is diagrammatically shown by the dotted line of FIGURE 1. Thus at the very bottom of the tube the material will be given very little lift but will be given a rapid swirling motion and as it rises through the tube, there will be less of the swirling component and more of the rising component, forming a cyclonic or whirlpool action within the tube which exerts a strong sucking force. When used in water this force is strong enough to not only raise large rocks and loose material but actually to cause the device to dig in to hard, consolidated formations under water. When used out of water, there is less of a digging action but the device is still highly useful and has many applications for handling loose, particulate material such as in loading grain or salt.

Although a preferred specific embodiment of the inven-

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tion has been illustrated, it will be understood that many departures can be made from the exact structure shown without departing from the spirit of this invention. Thus, although it is preferable to use three chambers, some action can be obtained from only two chambers and the number of chambers can be increased beyond three although the effect is not ordinarily increased proportionately. Although the exact relationship of 1, 2, and 4 in the height of the chambers and the size of the apertures has been found to be preferable, substantial departures can be made from these exact ratios and still have an operative device. Further, although the apertures have been shown as forming a complete 360° spiral within each chamber, it is not necessary that a complete spiral be made within each chamber, it only being important that each chamber be a continuation of the spiral of the chamber immediately below it. Thus, within any one chamber one might have a spiral of more or less than 360°.

It will be apparent that the device has many applications other than those specifically listed and that it is ideal for dredging, mining or loading operations either above or below water. The device is rugged and little subject to wear and it is easily transportable even into remote areas.

Although only one specific form of valve mechanism has been shown for successively supplying air to the several chambers, it will be obvious to those skilled in the art that other forms of valve mechanism can be substituted.

Many departures can be made from the exact structure shown without departing from the spirit of this invention.

I claim:

1. An air lift device comprising in combination:
 - (a) a tube for lifting material,
 - (b) at least one chamber surrounding the tube adjacent one end thereof,
 - (c) a plurality of passages leading from the chamber

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to the interior of the tube and arranged about the tube in a spiral pattern, and

- (d) means for supplying compressed air to said chamber and through said passages to said tube to impart a swirling motion to the material being lifted through the tube.

2. The combination according to claim 1, wherein a plurality of chambers are provided, each chamber starting with the lowermost chamber having a height less than the chamber next above.

3. The combination according to claim 2, wherein the spiral pattern of the passages in the lowermost chamber is continued in the chambers next above with the pitch of the spiral increasing in successive chambers.

4. The combination according to claim 3, wherein the passages near the bottom of the tube are substantially tangential to the tube and successive passages have a greater upward slant and less of a tangential component.

5. The combination according to claim 1, wherein said means for supplying compressed air supplies compressed air in pulses.

6. The combination according to claim 2, wherein said means for supplying compressed air supplies compressed air to each of the chambers successively.

References Cited by the Examiner

UNITED STATES PATENTS

1,039,958	10/1912	Kimball	302—24
1,232,393	7/1917	Piper	302—25
1,314,539	9/1919	Rust	103—232
1,465,269	8/1923	Horn et al.	302—24
2,794,686	6/1957	Anselman et al.	302—24

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