Oct. 26, 1965 C. D. RAMSDEN ETAL 3,213,807

JET PUMP ASSEMBLY

Filed Sept. 20, 1963 2 Sheets-Sheet 1

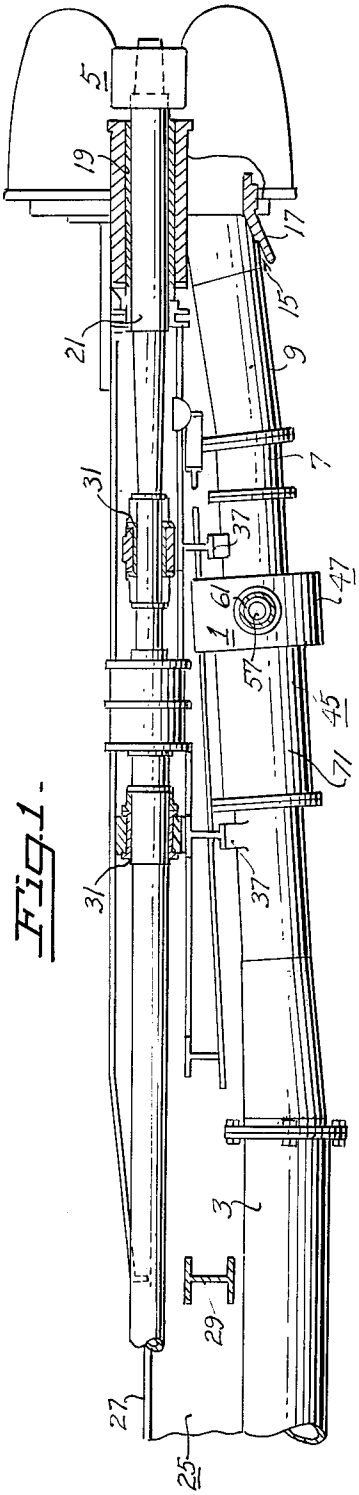


Fig. 1.

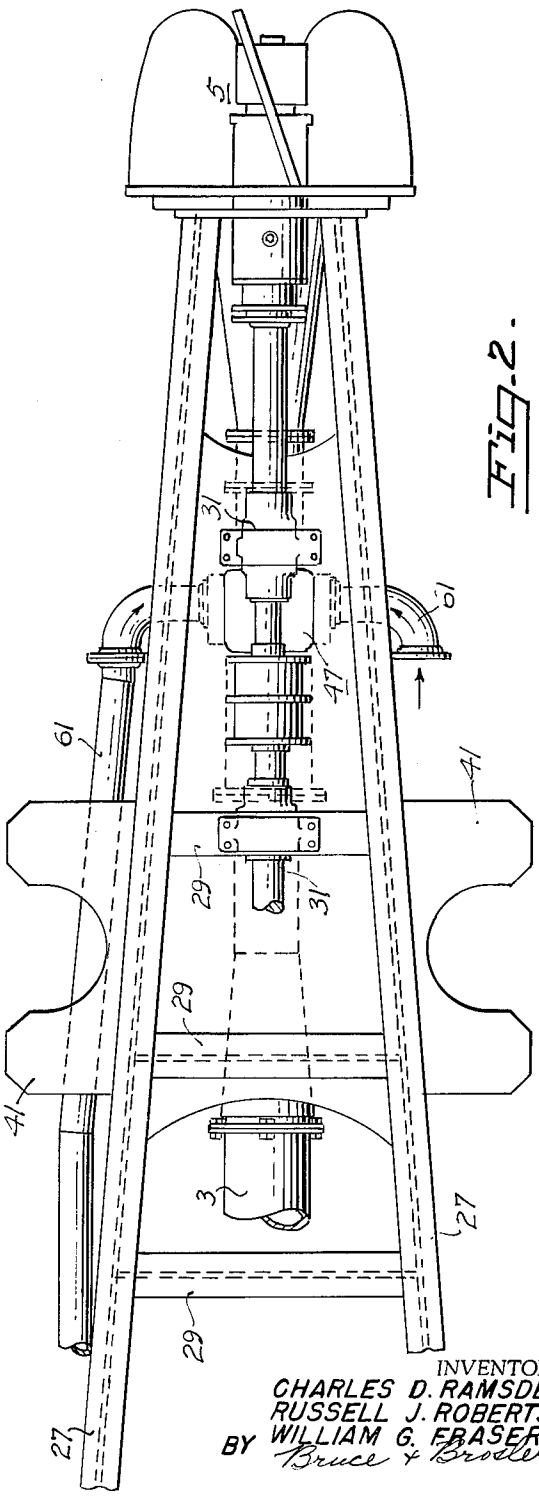


Fig. 2.

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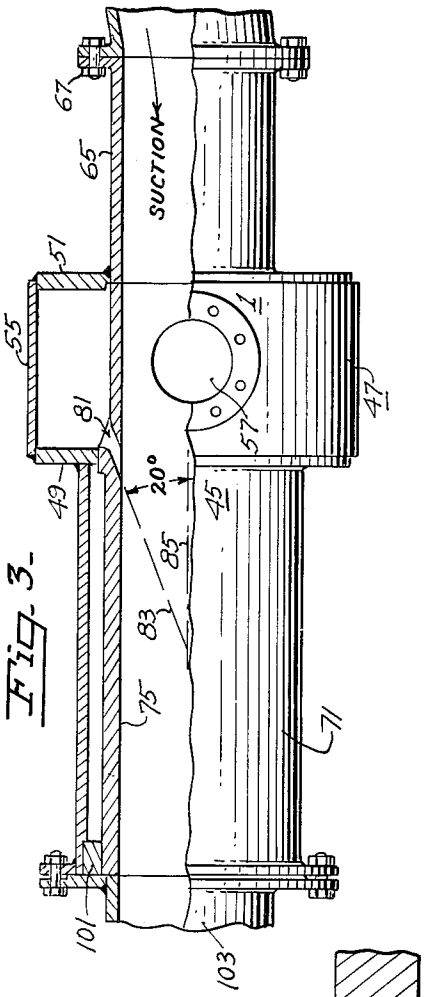


Fig. 3.

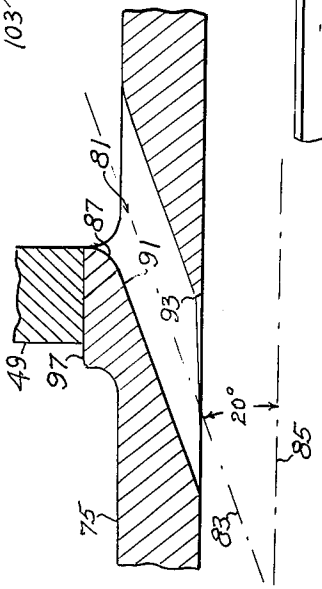


Fig. 4.

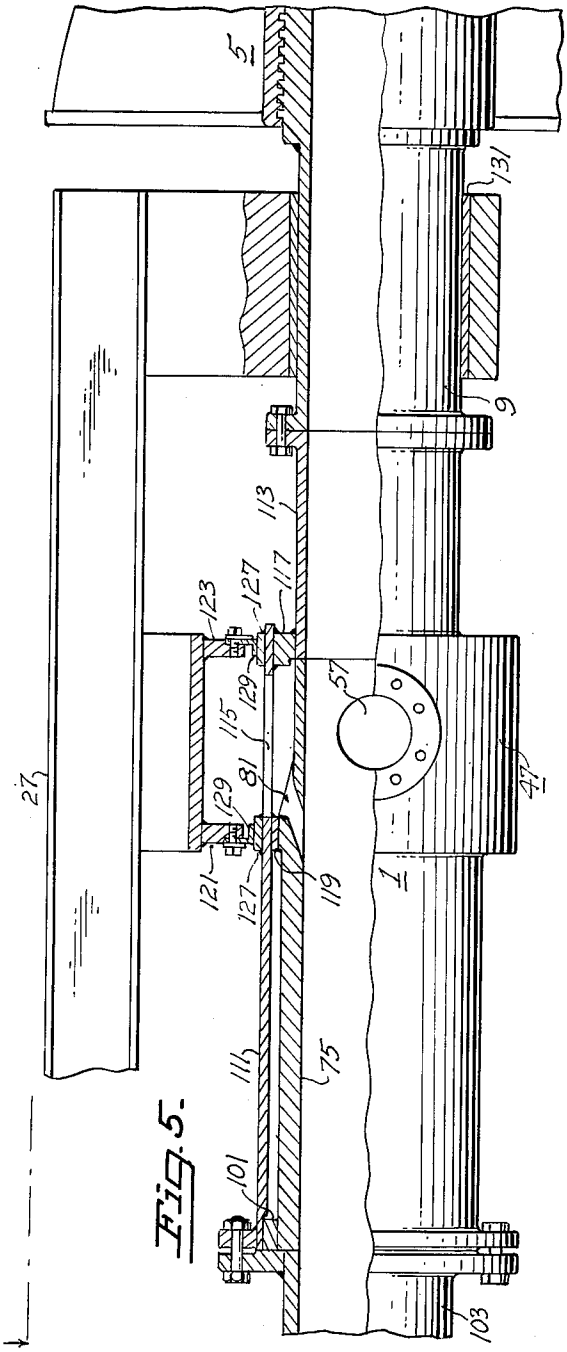


Fig. 5.

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JET PUMP ASSEMBLY

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7 Claims. (Cl. 103—262)

Our invention relates to a jet pump assembly and more particularly to one adapted for use in hydraulic dredging, and will be described in connection with such use.

In hydraulic dredging, operations are controlled from a barge. A digging ladder is adapted to be lowered from the barge to the point of dredging, where it terminates in a rotatable cutter head. The "cuttings" are carried up through the suction line of an impeller pump installed on the barge, for disposal at some other location.

A jet pump may be fabricated to the suction line at the entrance thereto as disclosed in the patent to neveling, No. 1,759,490, where the cutter head is driven by a drive shaft from the barge, and the suction line of the impeller pump is supported along side the shaft; or as an alternative, the jet pump assembly may be included in an arrangement such as disclosed in the co-pending application of Ramsden et al. for Dredging Equipment, Serial No. 211,493, filed July 23, 1962, now Patent No. 3,152,409, where the suction line is rotatably mounted and performs the added function of a drive shaft for the cutter head.

The jet pump assembly of the present invention is adaptable for use in either of the foregoing types of installations.

Among the objects of our invention are:

(1) To provide a novel and improved jet pump assembly;

(2) To provide a novel and improved jet pump assembly adaptable for use in hydraulic dredging equipment;

(3) To provide a novel and improved jet pump assembly which may be readily and economically serviced;

(4) To provide a novel and improved jet pump assembly which can efficiently pump liquid contaminated with solid matter;

(5) To provide a novel and improved jet pump assembly of great structural simplicity and ruggedness; and

(6) To provide a novel and improved nozzle construction for a jet pump assembly.

Additional objects of our invention will be brought out in the following description of a preferred embodiment of the same, taken in conjunction with the accompanying drawings wherein:

FIGURE 1 is a side view, partly in section, of the lower end of a digging ladder of a hydraulic dredge, and depicting therein, the installation of a jet pump assembly of the present invention;

FIGURE 2 is a plan view of the apparatus of FIGURE 1;

FIGURE 3 is a longitudinal view, partly in section, of the jet pump assembly of the present invention;

FIGURE 4 is an enlarged fragmentary view of that portion of the jet pump assembly of FIGURE 3 depicting details of construction of each of the nozzles therein; and

FIGURE 5 is a side view depicting a different arrangement of a digging ladder of a hydraulic dredge, wherein the cutter head is driven by the suction line, functioning as a drive shaft, and depicting the manner of installation therein, of the jet pump assembly of the present invention.

Referring to FIGURE 1 of the drawings, the jet pump assembly **1** embodying the features of the present invention, is coupled at one end to the suction line **3** of the

power pump, while its intake end is flow coupled with the cutter head **5** by means of one or more coupling sections **7**, **9** etc., terminating in an opening **15** provided in a fitting **17**, in the hub of which is a bearing **19** for the shaft **21** of the cutter head. The suction line **3**, jet pump assembly **1**, and drive shaft **21** for the cutter head, are supported by the framework of a digging ladder **25** which may be formed of longitudinal I-beams **27** connected by transverse beams **29**. These transverse beams carry bearings **31** for the drive shaft **21** to the cutter head, and any suitable means **37** for supporting the suction line **3** and jet pump assembly **1**.

Extending laterally to either side of the digging ladder from the two upper corner beams **27**, are sheave mounting supports **41** for connecting the swinging sheaves which are used to haul the dredge ladder to the left and to the right, pivoting about the dredge stern to accomplish dredging operations.

Referring to FIGURES 3 and 4 of the drawing for details of the jet pump assembly **1** of FIGURE 1, the same comprises an open end housing **45** including an enlarged section **47**, this enlarged section having end walls **49**, **51** with a main flow opening through each, and an outer wall **55** is preferably cylindrical in character, and is provided with one or more flanged openings **57** for connection to each, of a pressure line **61**, which in an installation of the character under description, would carry water under high pressure from a pressure pump on the barge, thus constituting the enlarged section a pressure chamber.

On the low pressure side of the housing, the pertinent end wall **51** of the enlarged section may be welded or otherwise affixed to a cylindrical section **65** of the housing **45**, which terminates in a bolting flange **67**. On the high pressure discharge side of the housing, a cylindrical section **71** may may likewise be welded to the proximate end wall **49** of the pressure chamber, this cylindrical section however, being of somewhat larger diameter than the cylindrical section **65** on the intake or low pressure side, to permit of installation of a jet sleeve **75**, of an internal diameter corresponding to that of the first cylindrical section **65**.

This jet sleeve is basically a cylinder adapted to be slipped through the discharge end of the housing **45**, to abut against the proximate end of the cylindrical section **65** of the housing, and in that region of the sleeve lying within the enlarged section or pressure chamber **47** of the housing and preferably adjacent the end wall **49** thereof on the discharge side, the sleeve is provided with at least one, and preferably a plurality of jets, which in the preferred form of the invention, take the form of passageways **81** through the wall of the sleeve and having the proper characteristics for performing the function of jets. We have found that most efficient functioning of these jets is realized when the characteristics of the passageways meet certain rather definite requirements.

In FIGURE 4 of the drawings, we have attempted to depict the rather critical nature of these characteristics. One of the most important of these requirements, is that the axis **83** of the passageway with respect to the longitudinal axis **85** of the housing should be closely controlled between 15° and 25°, and may be stated as being of the order of 20°. The diameter of the jet passageway will depend on the type of installation to be serviced by the jet pump assembly, but the entrance to such passageway should be flared, with the upper edge portion of the entrance conforming to an arc **87** having a radius of curvature equal to approximately one-half the diameter of the passageway, though a somewhat larger radius of curvature could be tolerated.

The length of the jet passageway as measured between the diameter at the point of mergence between the upper entrance arc **87** and the cylindrical portion of the pas-

sageway, and the diameter at the lower edge **93** of the exit end of the passageway, should be approximately one-half of the diameter of the passageway. Preferably, the lower edge of the exit end of the jet passage is ground flat to approximately one inch, whereupon the length of the jet passage will be measured to this point.

To obtain the necessary length of jet passageways without unduly thickening the walls of the jet sleeve, the sleeve is preferably provided with a wide rib **97** at the location of the jet nozzles, and for installation purposes, the proximate end wall **49** of the pressure chamber will have a receiving opening such as to snugly receive this ribbed portion of the jet nozzle sleeve.

At the discharge end of the housing, the housing may be slightly recessed to receive a centering supporting ring **101** which may be removably but snugly fitted into position about the discharge end of the nozzle sleeve, following insertion of the sleeve to its proper position in the housing. The jet nozzle sleeve **75** and supporting centering ring **101** will be maintained in proper assembled position by the adjacent section **103** of the suction line, which is bolted to the housing at this point.

The simplicity and ruggedness of the jet pump assembly as thus described will become readily apparent. In operation, water at high pressure is directed from the pressure pump on the barge, through the pressure lines **61** to the pressure chamber **47**, from where it will flow through the jet nozzles **81** at high velocity and create a region of low pressure adjacent the exit end of the jet nozzles, which will serve to suck in water with the "cuttings" from the cutter head and discharge the same into the suction line of the impeller pump, which may then take over to elevate such material to the barge where it may be disposed of as desired.

In FIGURE 5 of the drawings, we have illustrated a jet pump assembly of the present invention, adapted for use in dredge equipment, wherein the suction line of the impeller pump performs the added function of a drive shaft for the cutter head.

The jet pump assembly will be similar to that of FIGURE 3 previously described, except in that the pressure chamber **47** will be rotatably mounted so that it may be held stationary while the rest of the jet pump assembly may be rotated with respect thereto.

Toward this end, the cylindrical section **111** of the housing, on the discharge side, extends to and slightly overlaps the cylindrical section **113** of the housing on the intake side, and that portion spanning the region of the pressure chamber, has openings **115** exposing the jet nozzles to high pressure liquid from the pressure chamber.

Where it overlaps the cylindrical section of the intake side of the pump assembly, the cylindrical section **111** has welded thereto, an internal ring **117** of sufficient thickness to snugly receive the cylindrical section **113** on the intake side of the pump assembly to which it may be welded.

In alignment with the ribbed portion of the jet nozzle sleeve, the cylindrical section of the housing has welded thereto, an internal ring **119** adapted to snugly receive the jet nozzle sleeve **75** at this point.

The pressure chamber, unlike the pressure chamber of FIGURE 3, does not become an integral part of the jet pump assembly housing, in that the end walls **121** and **123** of the pressure chamber corresponding to the end walls **49** and **51** of FIGURE 3, are, in this embodiment, not welded to the cylindrical sections of the housing as in the embodiment of FIGURE 3. Instead, these end walls are each provided with an enlarged opening of a diameter assuring substantial clearance between the rim of such opening and the outer surface of the cylindrical section **111** of the housing.

Such clearance space is sealed by a rotary seal involving a seal bearing ring **127** surrounding the cylindrical section of the housing in alignment with each end wall of the pressure chamber, and an inwardly flanged seal **129** of flexible material bolted to each end wall, with the inwardly directed flange in pressure contact with the proximate bearing ring **127**. The inwardly directed flange of the sealing ring is of significance in the present construction, in that the water entering the pressure chamber through the pressure lines from the pressure pump on the barge, being of greater pressure than the static pressure of the water surrounding the jet pump assembly during a dredging operation, will discourage entrance of sediment and gravel or other foreign matter into the pressure chamber via the rotary seals.

Because of the somewhat different construction of the overall housing of the jet pump assembly in the embodiment of FIGURE 5 under consideration, the manner of supporting the same from the digging ladder will be somewhat different, in that the manner of support must permit of rotation of the suction line along with the jet nozzle sleeve and the coupling sections connecting the jet pump assembly to the cutter head.

Accordingly, the pressure chamber **47** which will be maintained stationary, may be directly supported from proximate members of the digging ladder, while the coupling sections and the suction line, which are to rotate, are supported in bearings, such as bearing **131**, suspended from or otherwise supported by the members of the digging ladder.

In either embodiment of the invention described, the jet nozzles will take the brunt of the wear. Being that these nozzles are formed in the nozzle sleeve, the entire set of nozzles may be replaced simply by removing the old sleeve and replacing it with a new one and this can be accomplished economically both as to time and labor.

From the foregoing description of our invention, it will be apparent that the same fulfills all the objects thereof, and while we have illustrated and described the invention in considerable detail, it will be apparent that the same is subject to alteration and modification without departing from the underlying principles involved, and we accordingly do not desire to be limited in our protection to the specific details illustrated and described, except as may be necessitated by the appended claims.

We claim:

1. A jet pump assembly comprising

an open end housing including

an enlarged section forming a pressure chamber having end walls, and an outer connecting wall,

said outer connecting wall having peripherally spaced openings for connection of a pressure line to each,

and a jet nozzle assembly removably installed in said housing, said jet nozzle assembly including

a sleeve removably insertable through an end of said housing and adapted to be supported therein,

said sleeve having a plurality of inwardly directed nozzles spaced circumferentially thereabout in the region of said pressure chamber, to place said nozzles in flow communication with said pressure line openings,

each of said nozzles having its axis at an angle of the order of 20 degrees to the longitudinal axis of said sleeve, and an effective length approximately one-half the diameter of the nozzle,

and means substantially sealing the nozzle region of the sleeve to said pressure chamber.

2. A jet pump assembly comprising

a pressure chamber having end walls with a flow opening through each and an outer wall connecting said end walls,

said outer connecting wall having an opening for connection of a pressure line thereto,

a jet nozzle assembly removably installed in said pressure chamber, said jet nozzle assembly including

a sleeve removably insertable through an end of said pressure chamber and adapted to be frictionally supported therein,

said sleeve having at least one inwardly directed noz-

zle in flow communication with said pressure line opening,
and means providing for relative rotational movement between said jet nozzle assembly and said pressure chamber.

3. A jet pump assembly comprising
a presusre chamber having end walls with a flow opening through each and an outer wall connecting said end walls,
said outer connecting wall having an opening for connection of a pressure line thereto,
a jet nozzle assembly removably installed in said pressure chamber, said jet nozzle assembly including
a sleeve removably insertable through an end of said pressure chamber and adapted to be supported therein,
said sleeve having at least one inwardly directed nozzle in flow communication with said pressure line opening,
and means providing for relative rotational movement between said jet nozzle assembly and said pressure chamber, said means including
a rotary pressure seal means between each of said end walls and said jet nozzle assembly.

4. A jet pump assembly comprising
an open end housing including
an enlarged section forming a pressure chamber having end walls, and an outer connecting wall,
said outer connecting wall having peripherally spaced openings for connection of a pressure line to each,
a jet nozzle assembly removably installed in said housing, said jet nozzle assembly including
a sleeve removably insertable through an end of said housing and adapted to be supported therein,
said sleeve having a plurality of inwardly directed nozzles spaced circumferentially thereabout in the region of said pressure chamber, to place said nozzles in flow communication with said pressure line openings,
and means providing for relative rotational movement between said jet nozzle assembly and said pressure chamber, said means including
each of said end walls having an opening of a diameter to assure substantial clearance between said chamber walls and the proximate wall of said housing,
and a rotary seal between each of said chamber walls and said proximate wall,
said rotary seal including a flexible sealing ring having an inturned flange.

5. A jet pump assembly comprising
an open end housing including
an enlarged section forming a pressure chamber having end walls, and an outer connecting wall,

said outer connecting wall having peripherally spaced openings for connection of a pressure line to each,
a jet nozzle assembly removably installed in said housing, said jet nozzle assembly including
a sleeve removably insertable through an end of said housing and adapted to be supported therein,
said sleeve having a plurality of inwardly directed nozzles spaced circumferentially thereabout in the region of said pressure chamber, to place said nozzles in flow communication with said pressure line openings,
each of said nozzles having its axis at an angle of the order of 20 degrees to the longitudinal axis of said sleeve, and an effective length approximately one-half the diameter of the nozzle,
and means providing for relative rotational movement between said jet nozzle assembly and said pressure chamber, said means including
each of said end walls having an opening of a diameter to assure substantial clearance between said chamber walls and the proximate wall of said housing,
and a rotary seal between each of said chamber walls and said proximate wall,
said rotary seal including a flexible sealing ring having an inturned flange.

6. A component for a jet pump assembly comprising
a sleeve having at least one inwardly directed nozzle integrally formed in the wall thereof,
said nozzle having an axis at an angle of the order of 20 degrees to the longitudinal axis of said sleeve, and an effective length approximately one half the diameter of the passage through said nozzle.

7. A component for a jet pump assembly comprising
a sleeve having a plurality of inwardly directed circumferentially spaced nozzles integrally formed in the wall thereof,
each of said nozzles having an axis at an angle of the order of 20 degrees to the longitudinal axis of said sleeve, and an effective length approximately one half the diameter of the passage through said nozzle.

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