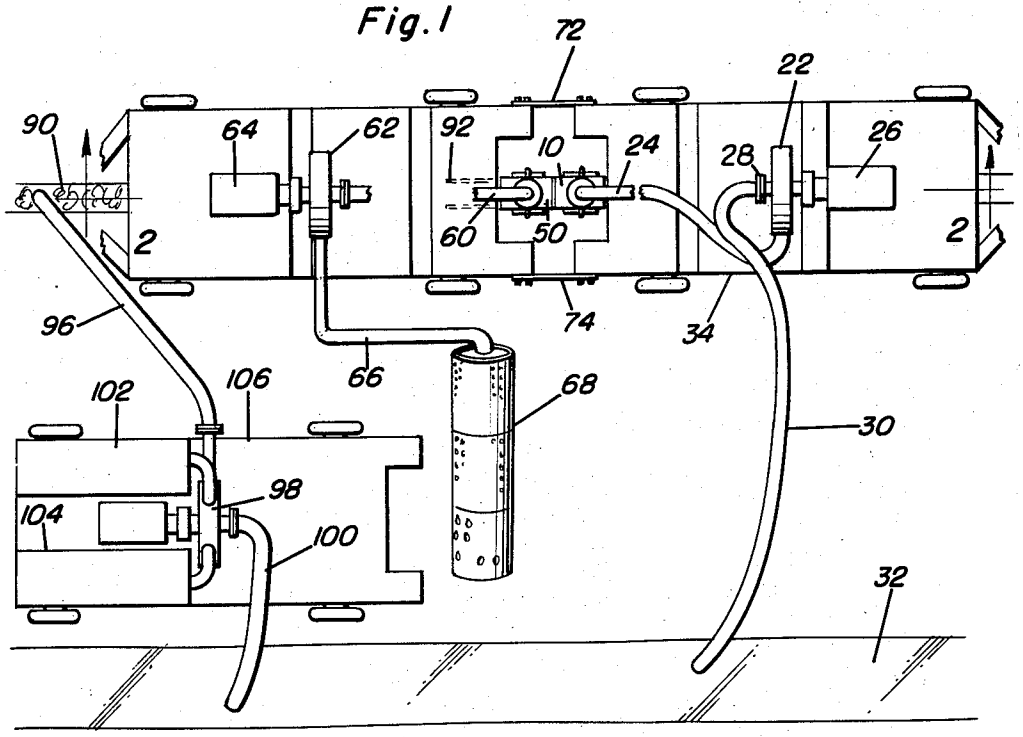
July 2, 1957 P. P. LIVINGSTON 2,797,503

TRENCH CUTTING TOOL

Filed July 31, 1953 3 Sheets-Sheet 1

Fig. 1



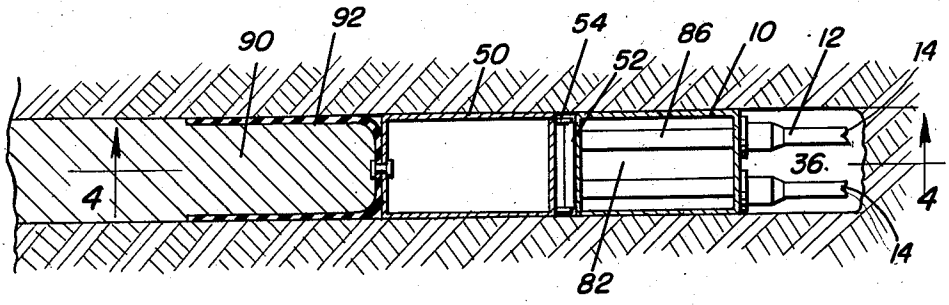


Fig. 3

Penn P. Livingston
INVENTOR.

BY Thomas A. O'Brien and Harvey B. Jackson
Attorneys

July 2, 1957 P. P. LIVINGSTON 2,797,503

TRENCH CUTTING TOOL

Filed July 31, 1953 3 Sheets-Sheet 2

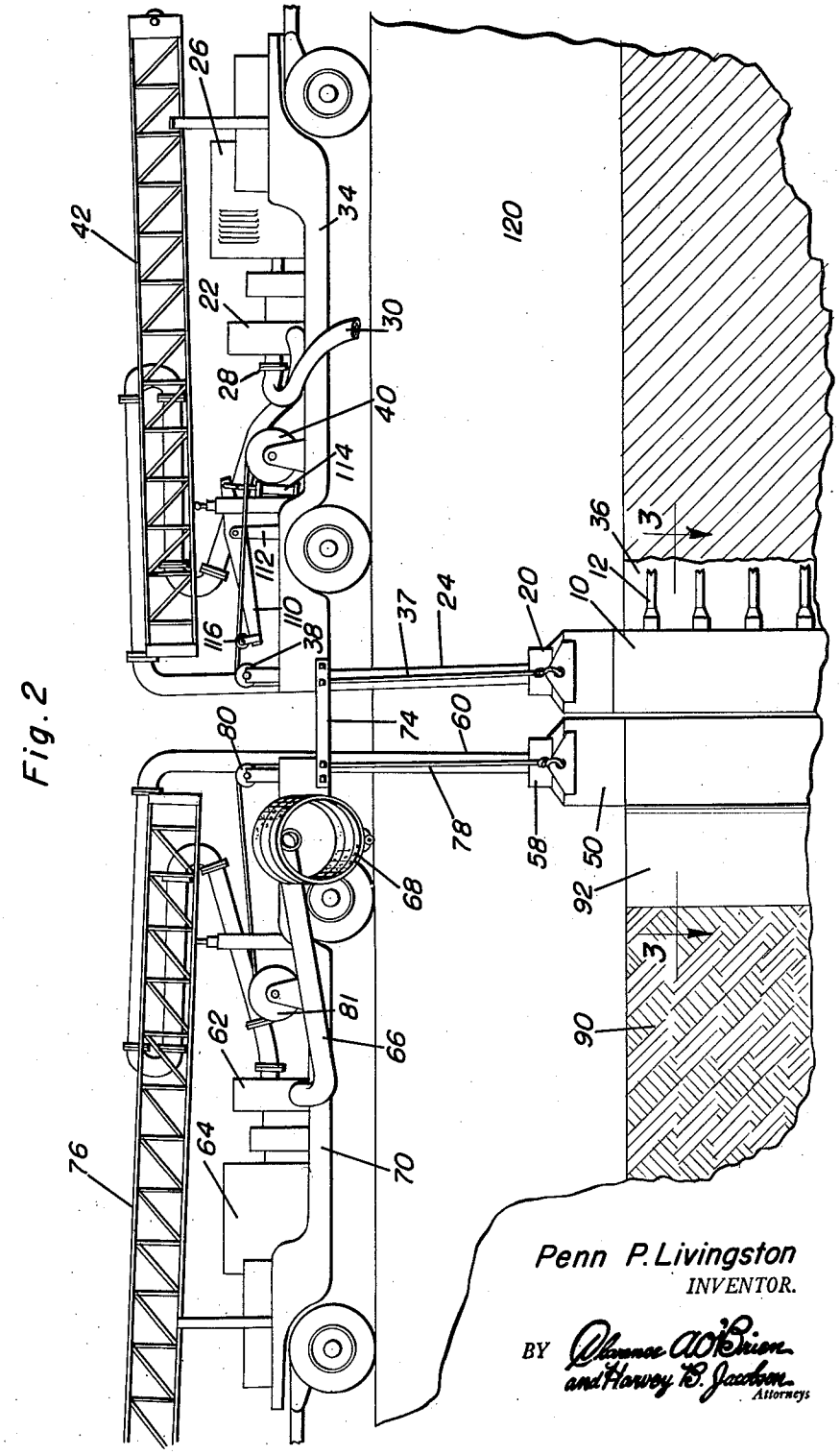


Fig. 2

Penn P. Livingston
INVENTOR.

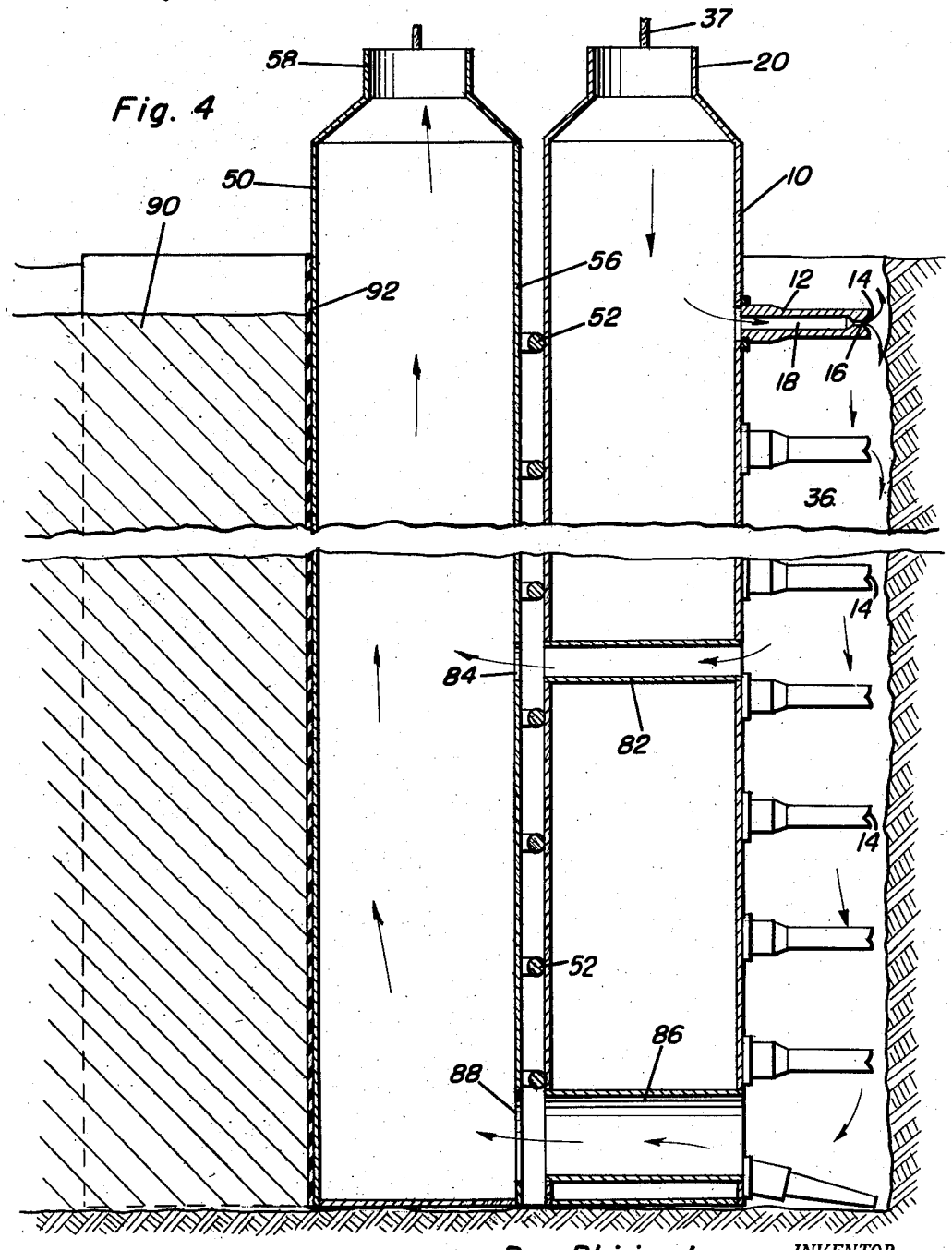
BY Clarence A. O'Brien and Harvey B. Jacobson
Attorneys

July 2, 1957 P. P. LIVINGSTON 2,797,503

TRENCH CUTTING TOOL

Filed July 31, 1953 3 Sheets-Sheet 3

Fig. 4



Penn P. Livingston INVENTOR.

BY Thomas A. O'Brien and Harvey B. Jacobson Attorneys

United States Patent Office 2,797,503 Patented July 2, 1957

2,797,503

TRENCH CUTTING TOOL

Penn P. Livingston, Austin, Tex.

Application July 31, 1953, Serial No. 371,482

7 Claims. (Cl. 37—80)

This invention relates to a cutting tool and particularly to a cutting tool to be used to provide a deep trench in non-consolidated soil.

In non-consolidated earth it is frequently found that the earth is substantially pervious either because of gravel beds, sand bars or the like extending laterally through the formation or because the entire formation is of such unpacked nature that water readily seeps therethrough. Such grounds are usually found in river valleys, seashores or the like and considerable difficulty has heretofore been experienced because of the ground water seeping away through such formations. When dams are built on such formations the water sought to be retained will frequently seep under the dam so that the ground becomes waterlogged and the water in the retaining basin will be to a considerable extent lost. Also, in relatively arid lands the water deposited on higher lands will frequently seep through the pervious layers to lower lands so that the water will be lost from the higher lands which becomes substantially arid or unusable. Also, at the mouth of rivers or the like it is frequently found that the fresh water which is flowing on a layer of salt water will be pushed back by the salt water when the fresh water is pumped out.

It has heretofore been proposed to provide relatively narrow trenches across this formation and to supply substantially impervious dams therein. These dams may be constructed of clay, bituminous material, asphaltic material, or cementitious mixtures. The heretofore available equipment has been capable of making such trenches only when the formation is of relatively shallow depth such as formations of up to one hundred feet. However, such formations may be several hundred feet in depth and heretofore it has been impossible to provide suitable trenching equipment to provide the trenches into which the impervious walls may be built.

The cutting equipment according to the present invention provides a device which may be extended to considerable depth such as several hundred feet and which may be readily pressed forward to cut non-consolidated earth such as sand, gravel and silt or even hard clay and to remove the material so that an impervious wall may be built in the trench.

The construction according to the invention comprises a pressure chamber adapted to extend downwardly to the depth the trench is desired to reach and having cutting bits arranged on the forward face thereof and means for introducing cutting mud under pressure into the pressure chamber and ejecting it through the cutting bits to dislodge and remove the pervious material. A suction chamber is applied behind the pressure chamber and arrangement is made for the discharge of the fluid from the cutting bits through the pressure chamber into the suction chamber where it will be drawn out and delivered to a sorting machine which will remove the boulders and other materials therefrom. A flexible dam is applied to the rear end of the suction chamber and a slurry will be supplied in the ditch not only to prevent caving of the

sides of the trench but also to push the cutting tool forward against the cutting face so that the tool may be advanced.

It is accordingly an object of the invention to provide an improved trench cutting device.

It is a further object of the invention to provide an improved cutting tool for a trench cutting device.

Other objects and many of the attendant advantages of the present invention will be apparent from the following detailed description taken in conjunction with the accompanying drawings in which:

Figure 1 is a top plan view of a cutting system utilizing the cutting tool according to the invention;

Figure 2 is a side elevation of the system showing the cutting tool in section substantially on the plane indicated by the section line 2—2 of Figure 1;

Figure 3 is a cross section through the cutting tool taken substantially on the plane indicated by the section line 3—3 of Figure 2; and,

Figure 4 is an enlarged vertical elevation of the cutting tool taken substantially on the plane indicated by the section line 4—4 of Figure 3.

In the exemplification according to the invention a casing or housing enclosing a pressure chamber 10 is provided as an elongated casing preferably constructed of metal plates welded into rectangular formation and having a width equal to the width of a trench to be cut and of any suitable depth as may be desired. A plurality of cutting tools such as fish-tail bits 12 are rigidly mounted on the front of the pressure chamber 10 and each of the bits 12 is provided with a cutting face 14 having a jet opening 16 therein and a passage 18 communicating with the interior of the pressure chamber 10. A collar 20 is connected to the upper end of the chamber 10 and communicates with a suitable source of fluid under pressure such as the pressure pump 22 by means of a substantially flexible hose 24. The pressure pump 22 may be driven by any suitable prime mover such as the motor 26 and the intake end 28 is connected by means of a flexible conduit 30 to any suitable source of fluid such as the supply canal 32.

The motor 26 and the pressure pump 22 will preferably be mounted on a suitable vehicle 34 so that the equipment may be progressively moved along as the trench 36 is cut. The vehicle 34 will preferably also be used to support the pressure chamber 10 by means of a cable 37 passing over a sheave 38 and onto a drum 40. A lifting tower 42 may be pivotally mounted on the vehicle 34 as herein shown in lowered position but may be raised into elevated position to provide a derrick over which the cable 37 may be extended to lift out the cutting tool which is preferably constructed in relatively short sections and riveted or bolted together as may be desired to provide a chamber of the desired length to provide a trench of the necessary depth. A second casing or housing enclosing a suction chamber 50 is arranged in proximity to the rear of the pressure chamber 10 and is provided with a plurality of rollers 52 mounted on ears 54 on its forward end 56. The top end of the suction chamber 50 is provided with a collar 58 to which is connected a suction line 60 which extends through a coupling pipe to a suction pump 62 driven by a suitable prime mover 64 which is capable of providing a substantial vacuum in the suction line to evacuate the cuttings and fluid from the suction chamber 50. A discharge conduit 66 from the suction pump 62 discharges the cutting fluid and the cuttings carried thereby into a rotary screen 68 which substantially separates the cutting fluid from the cuttings and separates the cuttings into various sizes so that the boulders delivered in the suction chamber 50 may be separated into various sizes for various uses as may be later desired. The suction pump 62 and the attendant devices are also

preferably mounted on a suitable vehicle such as the vehicle 70 which may be rigidly connected in end to end relation to the vehicle 34 by any suitable means such as the connecting plates 72 and 74. A derrick 76 is likewise mounted on the vehicle 70 for elevation into vertical position to lift the sections of the suction chamber 50 as may be desired and for this purpose a cable 78 is connected to the suction chamber 50 and entrained over a sheave 80 and wound on a drum 81. For simplicity of illustration the derricks 42 and 76 are eliminated from Figure 1 to more readily show the disposition of the various component parts of the structure.

Horizontal passages 82 are provided in the pressure chamber 10 and extend from the trench 36 to the rear of the pressure chamber 10 and the suction chamber 50 is provided with suitable apertures 84 for receiving any cuttings or fluid which may pass through the passage 82. A particularly enlarged passage 86 is provided adjacent the bottom of the pressure chamber 10 and is of substantially the full width of the chamber 10 so that relatively large boulders may pass through the passage through an aperture 88 into the section chamber 50. For simplicity of nomenclature the chamber 50 has been designated a suction chamber although it is quite evident that the pressure may also be applied in the chamber 50 by connecting line 60 to the pressure side of pump 62 instead of the suction side thereof. Then, the flow will be outwardly through the passages 82 and 86 so that the cutting fluid and the cuttings carried thereby will move upwardly in the space ahead of the chamber 10 in trench 36 and be discharged at the top thereof.

In order to provide a forward pressure to move the bits 12 against the cutting face at the end of the trench a slurry 90 is applied in the trench behind the suction chamber 50 and a flexible dam 92 is applied to the rear face of the chamber 50 and is preferably constructed of relatively resilient flexible material such as rubber belting or the like and extends rearwardly a material distance behind the chamber 50 so that the slurry 90 will be retained and prevented from passing along the sides of the chamber 50. The weight of the slurry 90 will apply pressure to the chamber 50 which because of the rollers 52 will apply pressure to the chamber 10 and force the bits 12 against the cutting face.

The slurry 90 may be delivered into the trench by means of a suitable conduit 96 fed by a pressure pump 98 receiving fluid through a conduit 100 from the canal 32 and mixing it with suitable material in the slurry tanks 102. The tanks 102 and the pump 98 together with an engine 104 for driving the pump 98 may well be mounted on a vehicle 106 so that the entire structure may move with the cutting tool.

A walking beam 110 is mounted on a standard 112 on the vehicle 34 and is actuated by means of a suitable fluid cylinder 114 and has a sheave 116 adapted to engage the line 37 so that by actuation of the walking beam 110 the pressure chamber 10 may be reciprocated with respect to the suction chamber 50 so that the bits 12 may have mechanical motion to tear away parts of the formation which the jet action does not move.

In the operation of the cutting device according to the invention a guide ditch 120 will be provided by any suitable means such as the bucket and chain ditchers now in use. The canal 32 will be arranged in spaced relation to the guide ditch 120 so that suitable fluids such as water may be available for making the slurries or drilling mud as may be desired. An initial bore may be provided by any suitable means and the pressure chamber 10 and the suction chamber 50 may be lowered thereinto after which a weight of slurry 90 will be positioned behind the pressure chamber and the suction chamber 50 to cause the drill bits 12 to be projected against the cutting face. Fluid under pressure will then be delivered into the pressure chamber 10 and will escape through the bits 12 to dislodge the formation which will be washed out by the cutting fluid and delivered into the suction chamber 50 and removed from the tool by means of the suction pump 62. The weight of the slurry 90 will be sufficient to push the tool forward and also to prevent the side of the trench from caving and as the device moves along, the trench may be filled with the slurry that has had added to it any suitable nonporous material such as clay, bitiminous mixture, asphaltic mixture, or cementitious mixture as may be desired. The addition of this cementitious or other impervious material will advance the slurry 90 so that it will be constantly pressed against the flexible dam 92 to provide a substantially impervious dam as the cutting tool moves forward. The rocks and other similar material removed from the cuttings by means of the screen 68 may be suitably admixed into the material filling the ditch as may be desired.

Instead of utilizing the ditching device to provide a dam to prevent the flow of water in certain localities where the water is located in very thin layers it may be desirable to use the ditching machine to provide a plurality of radial ditches and to provide a porous layer such as gravel at the water level so that the water may flow from a large area into a central sump and from there be pumped out for irrigation or other purposes.

The ditching device may be utilized to construct wells in regions adjacent to streams or other sources of water by providing a connector hole at a distance from the stream, lake or other body of water and then constructing laterals substantially parallel to the body of water. Perforated pipe may then be laid in the laterals and embedded in porous material such as gravel and the trench filled with any suitable fill. A liquefying material such as "Calgon" may be added to the slurry in the trench so that it may readily be pumped out through the perforated pipe to provide a water collecting area. The well may be cased as is desired and the pipes introduced through the casing. The collector pipes may be valved if desired.

It will thus be apparent that the present invention has provided a cutting tool for providing relatively deep trenches in non-consolidated material for controlling the water flow therein.

For purpose of exemplification a particular embodiment of the invention has been shown, and described according to the best present understanding thereof. However, it will be apparent to those skilled in the art that various changes and modifications may be made in the construction and arrangement of the parts thereof without departing from the true spirit and scope of the invention.

What is claimed as new is as follows:

1. For use in a trench cutting apparatus having means for supplying working mud under pressure and suction means for withdrawing spent fluid and cuttings, a cutting tool comprising a first vertically disposed housing defining a pressure chamber, a second vertically disposed housing defining a suction chamber, a mud receiving connection on said first housing adjacent the top of the pressure chamber and adapted to receive fluid under pressure, cutting bits fixed on the forward side of said pressure chamber, said bits having jet passages communicating with the interior of said chamber, means including bearings holding said housings spaced from and movable with respect to each other, said first housing having passages extending through said pressure chamber and communicating said suction chamber with the area in front of said pressure chamber, a collar on said second housing adjacent the top of said suction chamber and adapted to be connected to a suction device, and a flexible dam secured to the rear of said suction chamber and extending rearwardly thereof.

2. A trench cutting tool comprising a first elongated casing defining a pressure chamber, a second elongated casing defining a suction chamber, bearing means opera-

tively connected between said casings to facilitate relative movement between said casings, an inlet connection on said first casing adjacent the top thereof, said inlet connection being adapted to admit mud under pressure into said pressure chamber, a plurality of cutting bits rigidly mounted on the front of said first casing, said cutting bits having mud passages therein communicating with the pressure chamber, a plurality of conduits mounted in said first casing and extending through the pressure chamber from front to rear, said second casing having apertures communicating said conduits with said suction chamber, an outlet collar on said second casing adjacent the top thereof, and a flexible dam mounted on the rear of said second casing.

3. A trench cutting tool comprising a first elongated casing defining a pressure chamber, a second elongated casing defining a suction chamber, bearing means retaining said casings spaced from each other and facilitating relative movement therebetween, an inlet connection on said first casing adjacent the top thereof, said inlet connection being adapted to admit mud under pressure into said pressure chamber, a plurality of cutting bits rigidly mounted on the front of said first casing, said cutting bits having mud passages therein communicating with the pressure chamber, a plurality of conduits mounted in said first casing and extending through the pressure chamber from front to rear, said second casing having apertures communicating said conduits with said suction chamber, an outlet collar on said second casing adjacent the top thereof, and a flexible dam mounted on the rear of said second casing, said first casing being adapted for up and down movement on said bearing.

4. A cutting tool comprising a first elongated vertically disposed housing constituting a pressure chamber, a connection in said housing adjacent the top of the pressure chamber adapted to receive fluid under pressure, a plurality of jet type cutting bits rigidly secured on one vertical face of said housing, a second elongated housing positioned adjacent the side of the first mentioned housing opposite to the side carrying the cutting bits, means including a plurality of rollers mounting said first housing on said second housing to facilitate relative movement between said housings, fluid conduits extending horizontally through said first housing, said second housing having apertures corresponding to said conduits, said first mentioned housing being adapted for up and down movement with respect to said second housing.

5. A trench cutting device comprising a first vertically extending housing constituting a pressure chamber, a plurality of cutting bits mounted on the forward face of said first housing, said bits having jet passages communicating with the pressure chamber, said pressure chamber being adapted to receive cutting fluid under pressure, a second housing constituting a suction chamber, said pressure chamber being movably mounted with respect to said second housing, bearing means interposed between said second housing and said first housing to facilitate relative movement between said housings, conduits forming passages extending from the front to the rear of said first housing and extending through said pressure chamber, said second housing having openings communicating said suction chamber with said passages, and a flexible dam secured to the rear of said second housing and adapted to seal said housing to the sides of a trench, said dam cooperating with a fluid in the trench to apply forward pressure on said chambers.

6. A trench cutting device comprising a first vertically extending housing constituting a pressure chamber, a plurality of cutting bits on the forward face of said housing, said bits having jet passages communicating with the pressure chamber, said pressure chamber being adapted to receive cutting mud under pressure, a second housing constituting a suction chamber positioned adjacent the rear of said pressure chamber, bearing means operatively connected between said housings to facilitate relative movement between said housings, conduits in said first housing forming passages extending from the area in front to the rear of said pressure chamber, said suction chamber having openings communicating with said passages, and a vertically flexible dam secured to the rear of said second housing and adapted to seal said second housing to the sides of a trench, said dam reacting with a fluid in the trench to apply forward pressure on said device, said first housing being reciprocably movable with respect to said second housing.

7. A trench cutting device comprising a first vertically extending housing constituting a pressure chamber, a plurality of cutting bits on the forward face of said first housing, said bits having jet passages communicating with the pressure chamber, means for supplying cutting fluid under pressure into said pressure chamber, a second housing constituting a suction chamber positioned adjacent the rear of said pressure chamber, bearing means connected between said housings in order to facilitate relative movement between said housings, conduits mounted in said first housing forming passages extending from the front to the rear of said pressure chamber, said suction chamber having openings communicating with said passages, and a vertically extending flexible dam secured to the rear of said second housing and adapted to seal said chamber to the sides of a trench, said dam reacting with a fluid in the trench to apply forward pressure on said device.

References Cited in the file of this patent

UNITED STATES PATENTS

543,637	Bates	July 30, 1895
671,429	Bacon	Apr. 9, 1901
1,758,047	Jensen	May 13, 1930
2,518,591	Aston et al.	Aug. 15, 1950