United States Patent [19]

Poundstone

[11] **3,905,430**

[45] **Sept. 16, 1975**

[54] **APPARATUS FOR RAISE DRILLING**

[75] Inventor: **William N. Poundstone**, Pittsburgh, Pa.

[73] Assignee: **Consolidation Coal Company**, Pittsburgh, Pa.

[22] Filed: **Aug. 29, 1973**

[21] Appl. No.: **392,602**

[52] **U.S. Cl.** **175/53**; 175/67; 299/2; 299/17; 299/18; 299/19

[51] **Int. Cl.**[2] **E21C 23/00**

[58] **Field of Search** 175/67, 53, 393, 422, 285; 299/17; 61/.5

[56] **References Cited**

UNITED STATES PATENTS

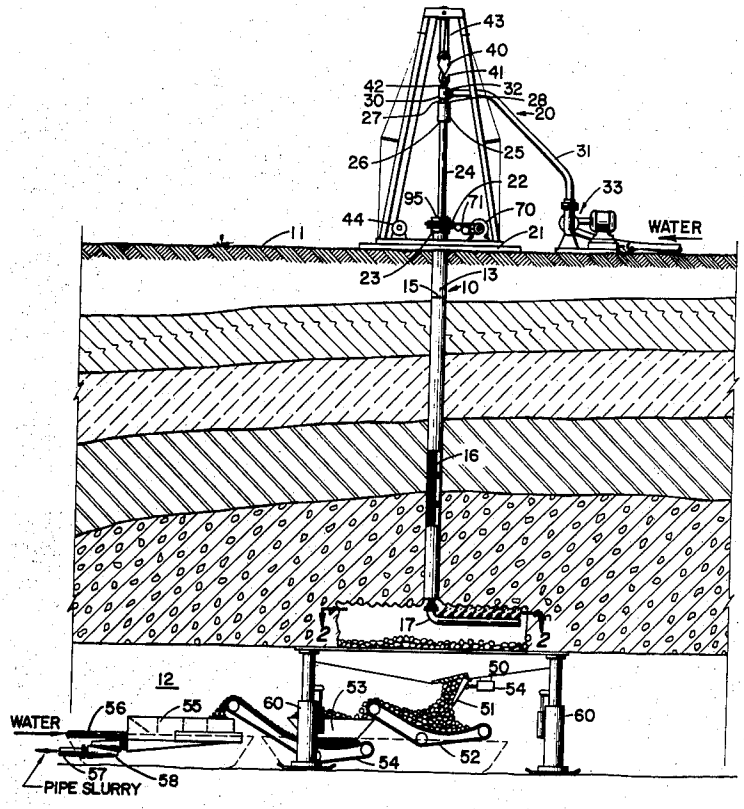
950,363	2/1910	Blake	299/17 X
2,290,502	7/1942	Squires	175/406 X
2,684,834	7/1954	Miller et al.	175/53
2,758,653	8/1956	Desbrow	175/50
2,785,875	3/1957	Hayes	175/67 X
2,847,189	8/1958	Shook	175/285 X
3,231,029	1/1966	Winberg	175/53
3,470,952	10/1969	Blount	175/422 X
3,675,729	7/1972	Neilson	175/53

Primary Examiner—Frank L. Abbott
Assistant Examiner—Richard E. Favreau
Attorney, Agent, or Firm—William J. Miller

[57] **ABSTRACT**

An apparatus for forming large diameter shafts between the roof of a mine tunnel and the surface of the earth. A pilot hole is drilled between the surface of the earth and the roof of the mine. A pipe is inserted through a pilot hole to the roof of the mine, and an arm is connected to the lower end of the pipe. The arm has a plurality of jets mounted facing toward the roof and in fluid communication with the inside of the pipe. The upper end of the pipe is connected to a high pressure pump which in turn is connected to a source of fluid, such as water. Apparatus is provided for rotating the upper end of the pipe and for pulling the pipe toward the surface of the earth as the roof is eroded by fluids from the jets impinging on the roof of the mine.

1 Claim, 3 Drawing Figures



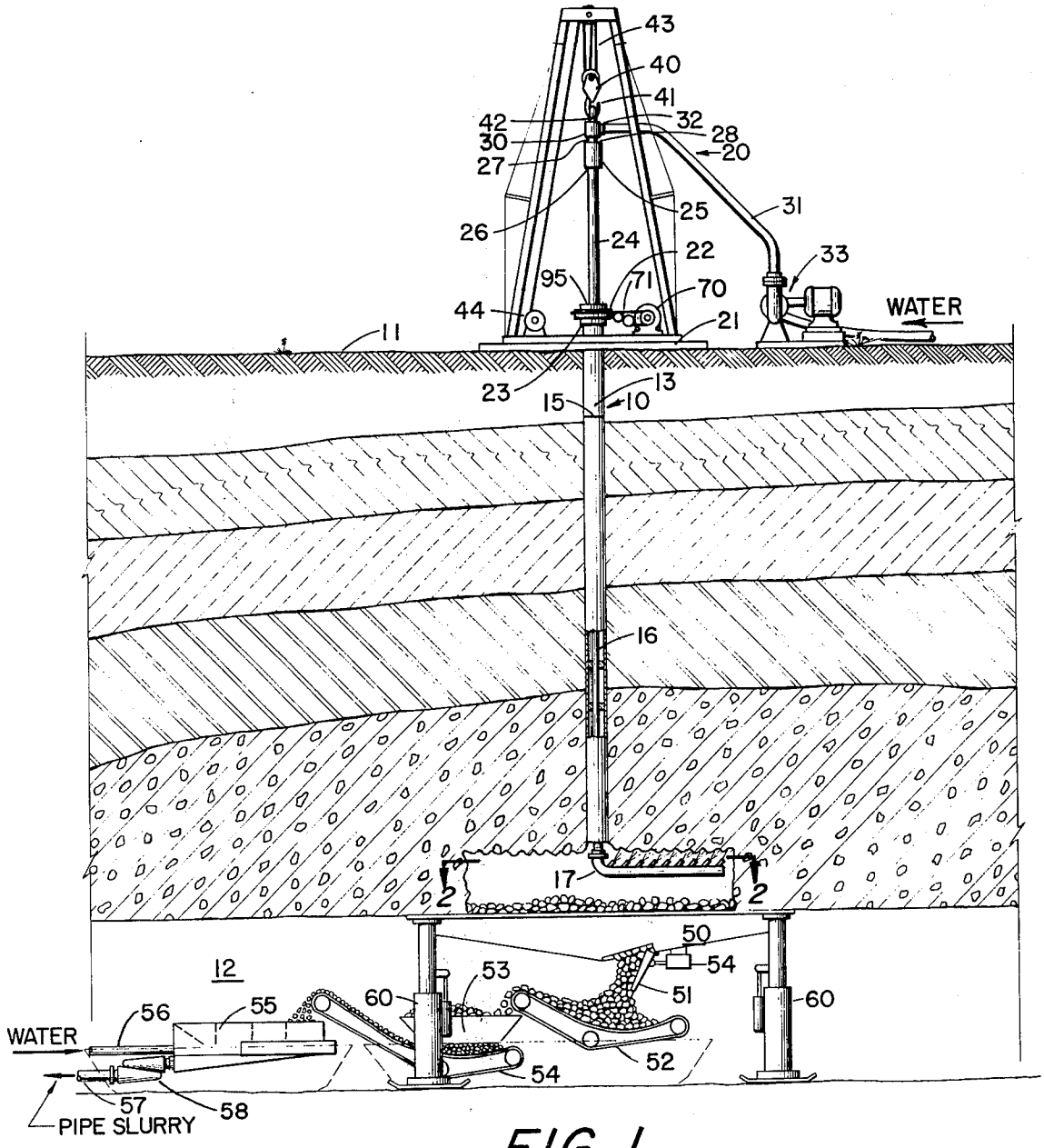


FIG. 1

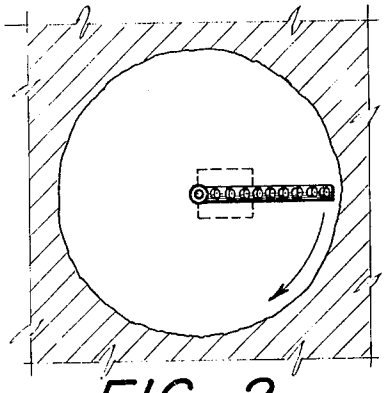


FIG. 2

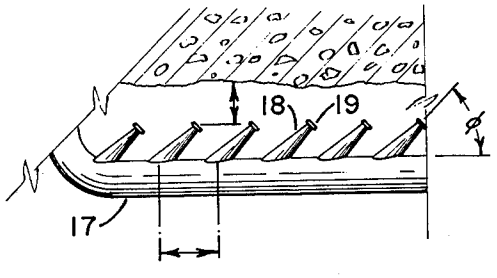


FIG. 3

APPARATUS FOR RAISE DRILLING

BRIEF DESCRIPTION OF THE PRIOR ART

Raise drilling has been used for many years for forming shafts in mines and for mining operations.

U.S. Pat. No. 3,486,572 is illustrative of the apparatuses used for raise drilling. This patent discloses the forming of a bore hole from one level in a mine to a lower level in a mine and running a cable down the hole which is attached to a drill. The cable is pulled up while the drill is rotated. Means are provided below the drill for catching the material dislodged.

U.S. Pat. Nos. 3,231,029 and 3,460,867 are also illustrative of this type of mining.

Some reaming has been employed using jets. The patent to Schweitzer et al., U.S. Pat. No. 2,018,284, shows the use of jets to slightly widen the bottom of a well bore, and the patent to Shook, U.S. Pat. No. 2,847,189, illustrates jets used in combination with a scraper for removing material during raise drilling. It should be noted that the jets are not used for the purpose of dislodging the coal.

BRIEF DESCRIPTION OF THE INVENTION

One of the extremely costly processes during any mining operation underground is the forming of shafts for either moving men and materials into and out of the mine or for air vents for either moving air into or out of the mine. These shafts will be several hundred feet deep and over 6 feet in diameter. The normal method of forming the shafts is to either bore a hole from the surface or to raise drill from the mine roof to the surface. In either case the equipment to perform the operation is extremely expensive, usually several million dollars, and requires many personnel over a period of time.

This invention describes a means for forming a large diameter shaft which can be performed by one or two people without an expensive drilling rig. The invention basically consists of drilling a bore hole of small diameter from the surface of the earth to the mine roof. Pipe is inserted into the bore hole to the mine roof where a second pipe, mounted at right angles to the aforementioned pipe, is attached. The right angle pipe has a length equal to the desired radius of the shaft to be formed. The right angle pipe has mounted thereon a plurality of jets having an extremely small orifice and attached at an angle to the pipe. A high pressure pump is rigidly attached to the top of the pipe with its inlet connected to a rotatably sealed pipe. A source of water is connected to this pipe. Water will flow to the pump where it is compressed to an extremely high pressure, for example, 20,000 pounds, and forced down the pipe and into the jets. The bore hole pipe is rotated, causing the jets to cut the roof of the mine as the pipe is being rotated. The angle of the jets prevents cutting uniform ridges in the roof of the mine.

The invention above-described will form large diameter shafts with a very minimum of horsepower and equipment and few people to operate the apparatus.

DESCRIPTION OF THE FIGURES

FIG. 1 shows the cross-section of earth from the surface to a mine tunnel and details the pilot drill and the right angle jet cutting pipe;

FIG. 2 is a view taken through lines 2—2 of FIG. 1; and

FIG. 3 is a detailed drawing of the right angle pipe and jets illustrated in FIG. 1.

Referring to all of the drawings but in particular to FIG. 1, a bore hole **10** is drilled from the surface **11** to a mine tunnel **12**. A casing **13** is used to line the bore hole to a particular depth. The casing in FIG. 1 is illustrated as lining the bore hole from the surface **11** to tunnel **12**; however, the casing could stop far short of this depth, for example, at depth **15**. The remainder of the bore hole could be left uncased.

Inside the casing is inserted a communicating means such as a vertical support pipe **16** being attached to right angles to a jet mounting pipe **17**. A plurality of jets **18** is attached to mounting pipe **17** so that the jets are in fluid communication with the interior of pipe **17**. Jets **18** have an orifice **19** at their terminus having a diameter which depends upon the amount of horsepower available. Details of a preferred embodiment will be disclosed in the discussion of FIG. **3**.

At the surface of the earth a drill rig **20** is placed over well bore **10**. Casing **13** extends through a base **21** of drill rig **20** and has a rotatable means **22** mounted thereto. Rotatable means **22** is mechanically connected to vertical support pipe **16** and rotatably mounted on casing **13** by means of bearing **23**. A pipe **24** is connected to vertical support pipe **16** by any usual means, such as threads, at one end and is connected to pump **25** at its outlet **26**. An inlet pipe **27** has one end connected to the inlet **28** of pump **25** and has the other end connected to rotatable joint **30**. Pipe **31** is connected to the inlet **32** of rotatable seal **30**. Pipe **31** may be connected to any source of water, or to a pump generally referred to as **33** which would have its inlet connected to a source of water. The use of a pump is only necessary if the inlet water pressure is insufficient to provide ample water to pump **25**.

A pulley block **40** has one end connected through a hook **41** to an eye **42** attached to the top of rotatable seal **30**. The other end of pulley block **40** is connected through a plurality of lines **43** to a winch **44**.

The material being dislodged by jets **18** may be collected in a hopper **50** having an outlet **51** which can drop into a conveyer **52** to a crusher **53**, a second conveyer **54**, and into a slurry hopper system **55**. Water will be supplied through a pipe **56** to slurry hopper **55** and the mixture removed from hopper **55** through a pump **58** and slurry pipe **57** to the disposal area for the mined material.

Hopper **50** may be supported against the roof by any usual means, such as hydraulic supports **60**. Supports **60** may also be mechanical. If hopper **50** and the subsequent conveyer system and slurry system are not desired, the material can be collected in any ordinary manner, such as permitting it to drop to the mine floor and removing it by conveyers to shuttle cars or high loaders to any form of mine transportation.

Referring to FIG. 3, a detail of the jets is illustrated. The angle θ is sufficient to prevent the jet from creating channels in the coal which would happen if the jets were vertical. The orifice size, as previously mentioned, for the preferred embodiment is 0.008 inch in diameter and can handle 6 to 10 horsepower per nozzle. Jets should be mounted apart by a distance of 3 to 4 inches. The distance from the top of the mounting pipe **17** to the roof of the mine will be approximately 4 to 5 inches. Assuming 6 to 10 horsepower per nozzle, it is estimated that no more than 4,000 to 5,000 horse-

power will be required to bore a hole. Little energy is required to rotate the vertical support pipe **16** and the jet mounting pipe **17**; therefore, a small motor **70** is connected through a belt drive **71** to rotatable means **22.**

OPERATION

The apparatus described in FIGS. **1** through **3** operates in the following manner:

Motor **70** through belt drive **71** rotates rotatable means **22** which is mechanically secured to vertical support pipe **16** causing same to rotate. Since jet mounting pipe **17** is likewise rigidly connected to vertical support pipe **16,** jet mounting pipe **17** will rotate through 360° about the axis of pipe **16.**

Fluids entering pipe **31** either directly or through pump **33** will pass through rotatable seal **30** and to the inlet **28** of pump **25** where the water is compressed to 20,000 to 30,000 pounds per square inch. The highly compressed water is then pumped through pipe **24** to vertical support pipe **16** and into jet mounting pipe **17.** The high pressure fluid or water will then enter jets **18** and out of orifice **19** against the roof of mine **12.**

The high velocity jets will dislodge the material above them, causing it to drop to the hopper. Hopper outlet **51** can be opened and closed by a mechanical arm control **59.** Once the coal passes through outlet **51,** it will drop onto conveyer **52** and be conveyed to crusher **53** where, once crushed, it will drop onto conveyer **54** and into slurry hopper **55.** As previously mentioned the slurry system does not need to be incorporated. The material can fall to the floor of the mine where it can be removed by any suitable means, or it can fall into the hopper as shown in FIG. **1** and the coal dropped from outlet **51** to any suitable hauling means.

Approximately 30 gallons of water a minute will be jetted against the roof of the mine. The amount of water being released by the jets can therefore be easily absorbed by the material being mined and hauled away; therefore, nno accumulation of water to any appreciable extent will form on the mine floor.

Pump **25** has its outlet directly connected to pipe **24.** No rotatable seal is used because the high pressure involved would cause extreme technical difficulties. The low pressure side, however, would not pose a problem for a rotatable seal. The pump **25** is powered by slip rings mounted around the rotational axis of the pump and connected electrically to the pump. Brushes biased against the slip rings are connected electrically to a source of power all in a manner well known in the art.

As the surface is eroded by the high velocity jets, winch **44** will apply tension to lines **43** which will lift pulley block **40.** Hook **41** through eye **42** will raise rotatable seal **30,** pump **25,** and vertical support pipe **16.** Once a new joint of pipe in vertical support pipe **16** moves above rotatable means **22,** any suitable clamping arrangement can be utilized to hold pipe **16** until a section is removed and pump **25** is reconnected. A split clamp, such as **95,** mounted on top of rotatable means **22** can be used to retain pipe **16.**

It is obvious that changes and modifications can be made in the apparatus disclosed in this specification and claims. These modifications and changes are fully within the scope of this invention.

I claim:

1. An apparatus for forming large diameter shafts between the roof of a mine tunnel and the surface of the earth having rock and material therebetween comprising:

a. means for forming a pilot hole between said surface and said roof;

b. means communicating through said pilot hole for conveying fluids under pressure, said communication means having an upper end and a lower end;

c. pump means having an inlet and an outlet, means for securing said pump means rigidly to said communicating means, swivel joint means having an inlet and an outlet, means for connecting the outlet of said swivel joint means to the inlet of said pump means, and means for connecting the inlet of said swivel joint means to a source of fluid;

d. a jet mounting pipe attached to the lower end of said communication means, said jet mounting pipe having fluid communication with said communication means;

e. a plurality of jets attached to said jet mounting pipe, said plurality of jets adapted to direct said fluid under high pressure against the exposed surface of said rock and material above said mine roof, thereby dislodging same;

f. means for rotating said communication means and said jet mounting pipe; and

g. means for raising said communication means, pump means, and said jet mounting pipe as said rock and material are dislodged by said jets.

* * * * *