Oct. 3, 1967 L. O. KELLEY ET AL 3,344,866

PORTABLE ROCK BREAKING DEVICE

Filed May 14, 1965 4 Sheets-Sheet 1

Fig. 1

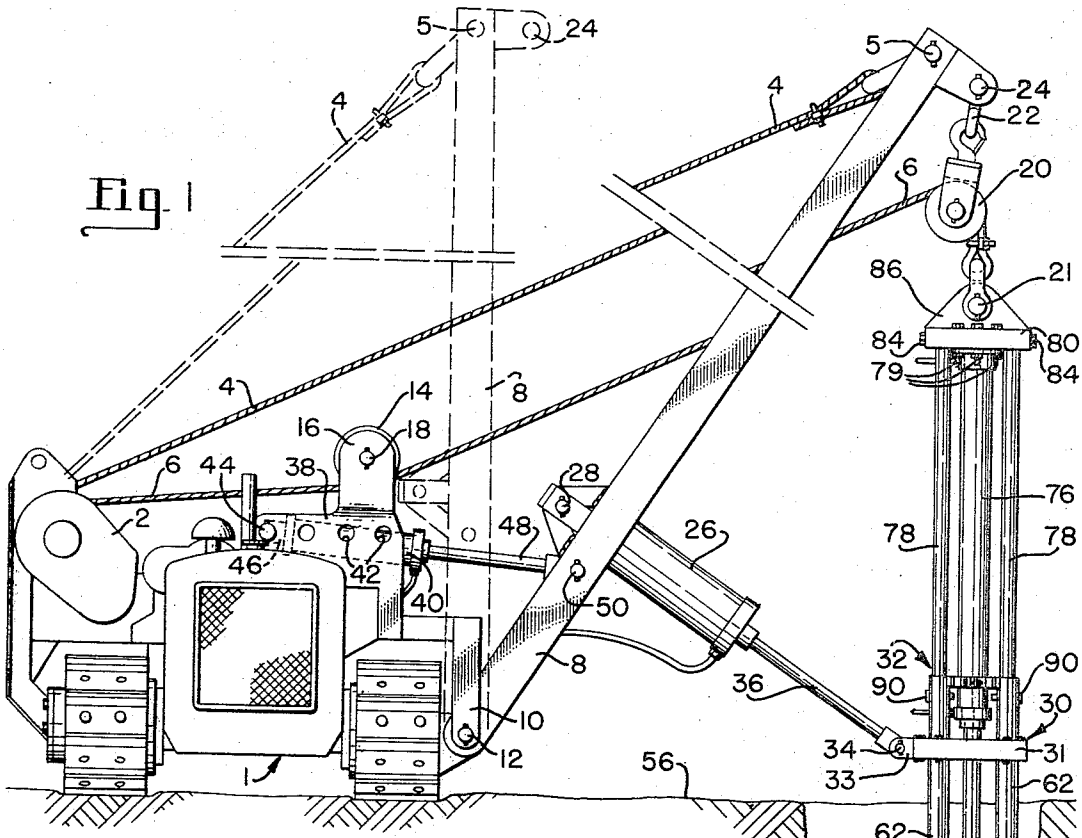


Fig. 4

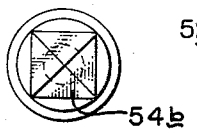


Fig. 2

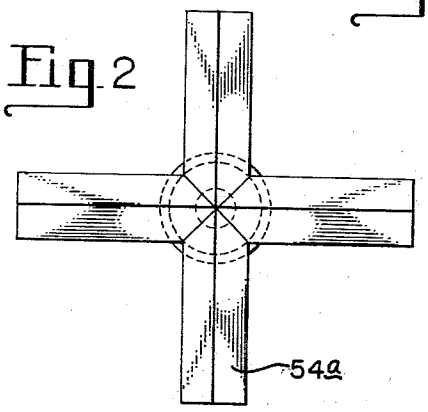
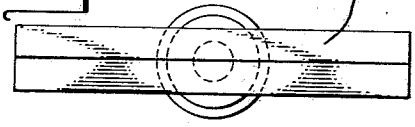
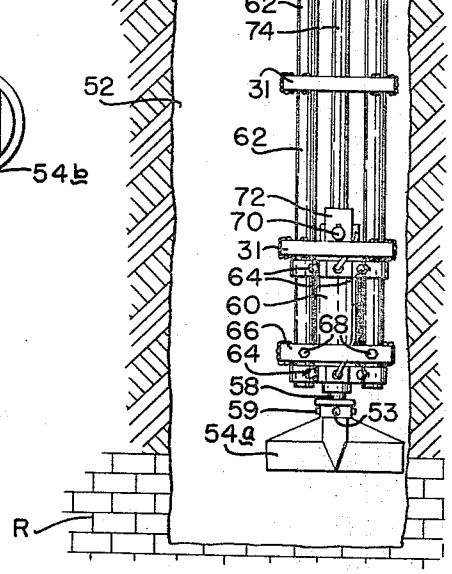


Fig. 3





INVENTORS
LEON O. KELLEY
CRAIG E. HATCHER

BY

Wayland D. Keith
THEIR AGENT

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Fig. 5

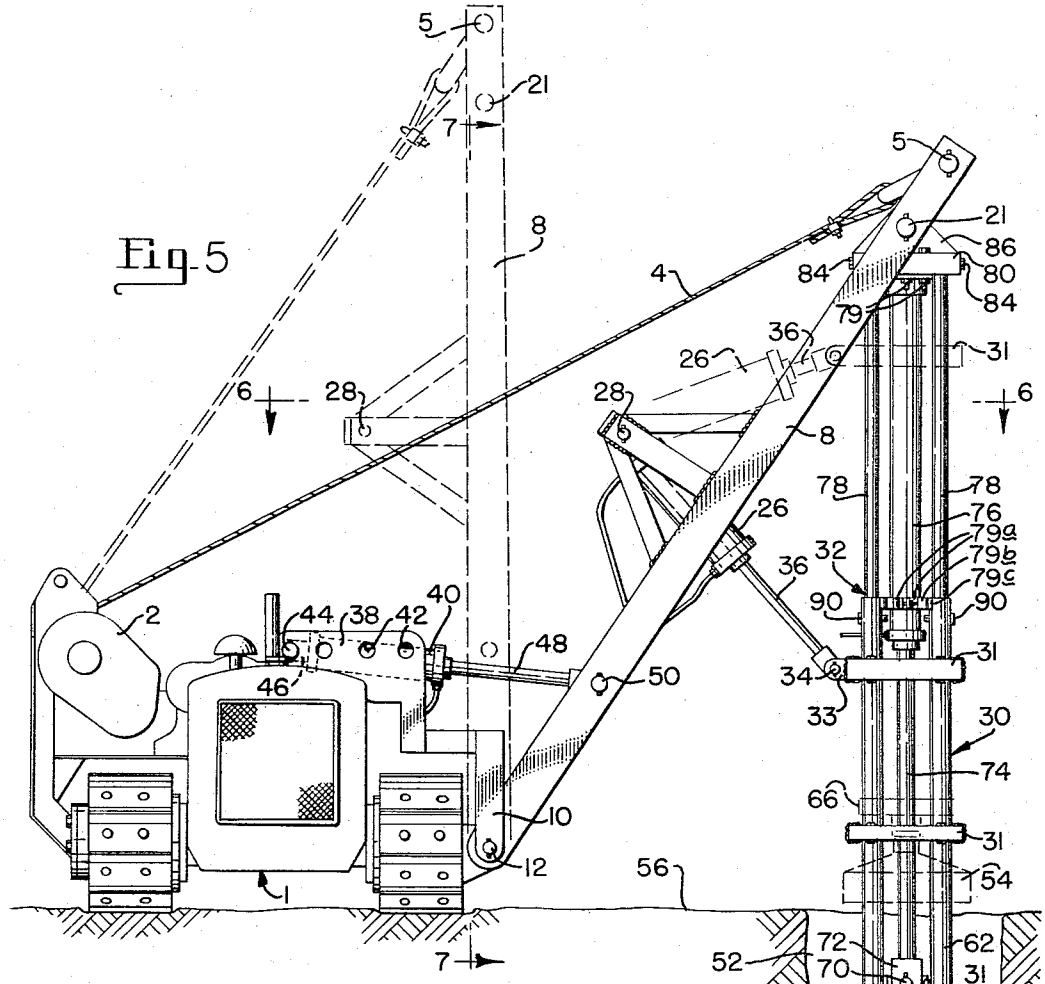
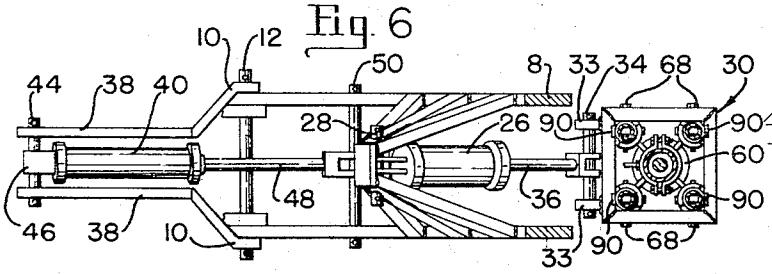


Fig. 6



LEON O. KELLEY
CRAIG E. HATCHER
INVENTORS

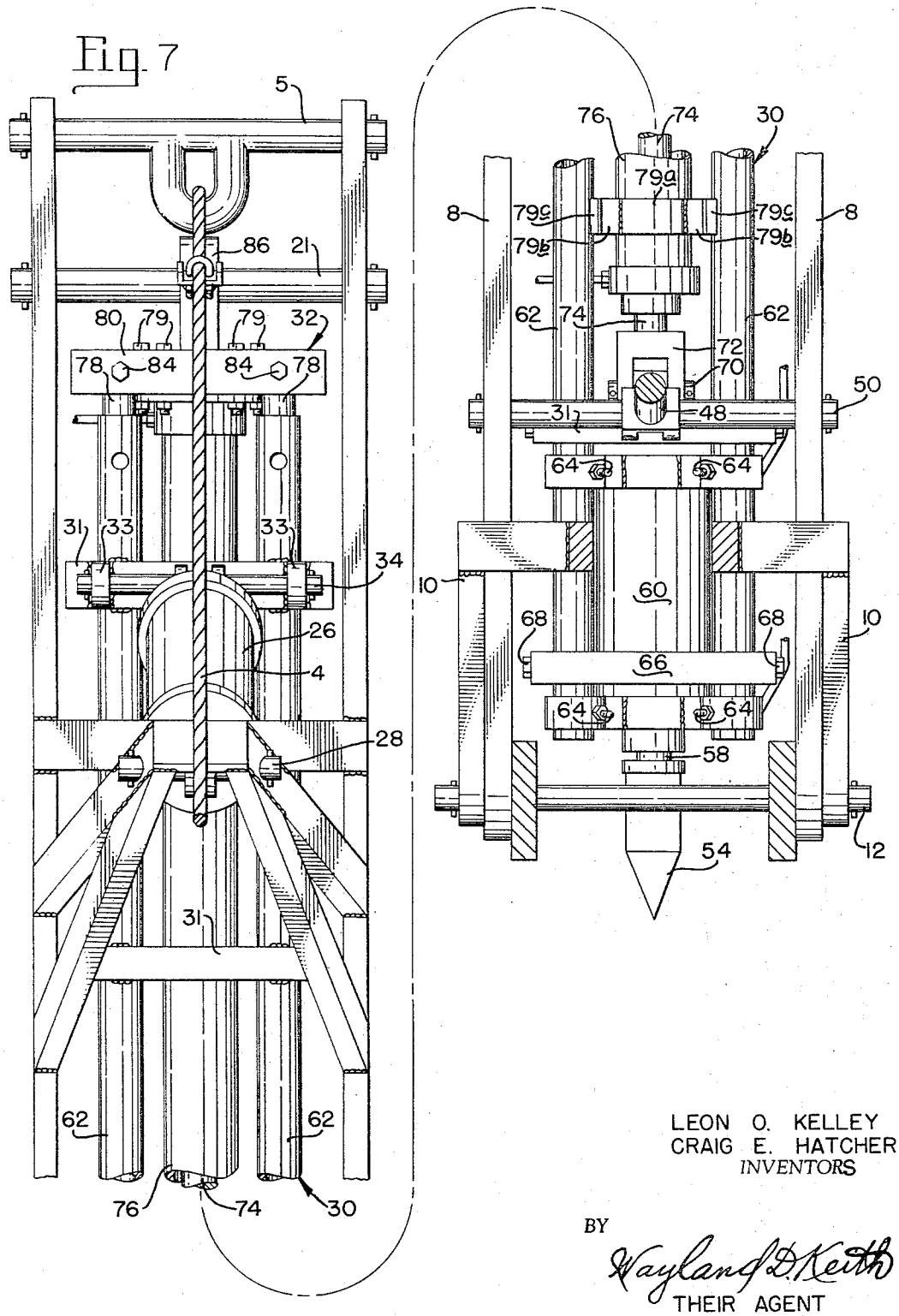
BY
Wayland D. Keith
THEIR AGENT

Oct. 3, 1967 L. O. KELLEY ET AL 3,344,866

PORTABLE ROCK BREAKING DEVICE

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Fig. 7



LEON O. KELLEY
CRAIG E. HATCHER
INVENTORS

BY

Wayland D. Keith

THEIR AGENT

Oct. 3, 1967 L. O. KELLEY ET AL 3,344,866

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Fig. 8

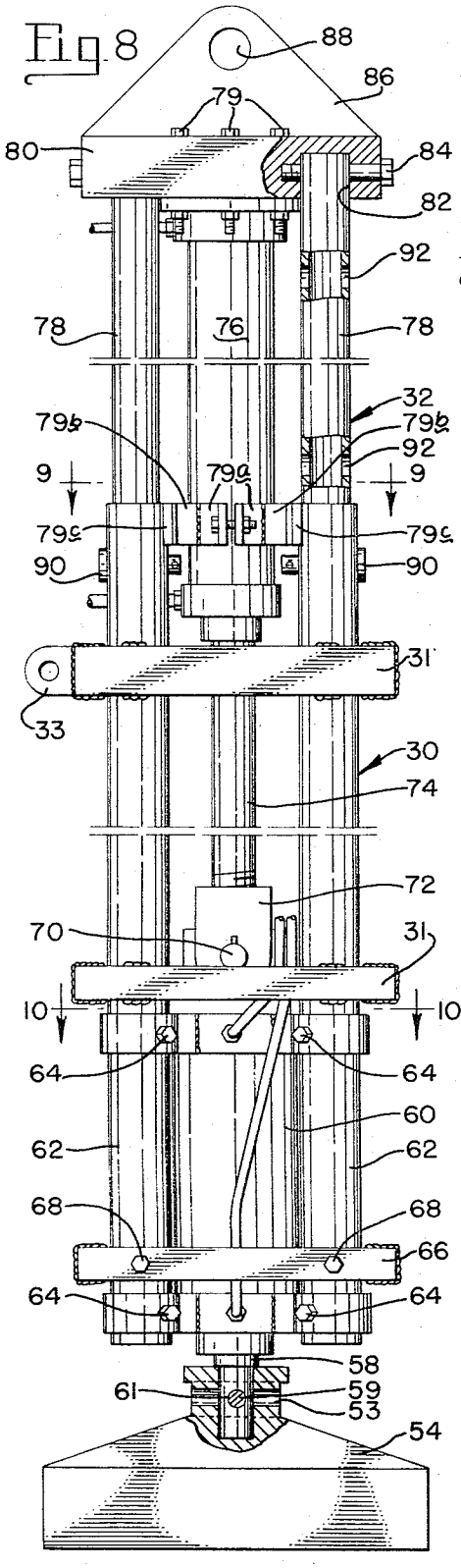


Fig. 9

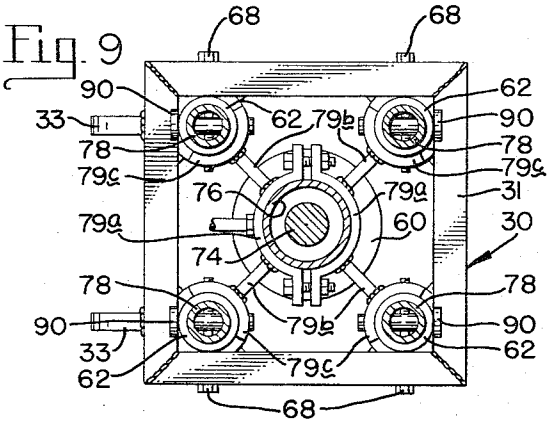
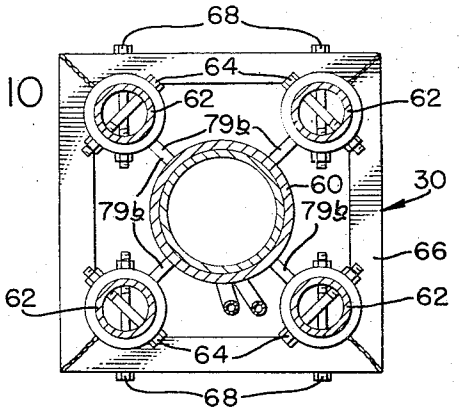


Fig. 10



LEON O. KELLEY
CRAIG E. HATCHER
INVENTORS

BY Wayland D. Keith
THEIR AGENT

United States Patent Office

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PORTABLE ROCK BREAKING DEVICE

Leon O. Kelley, P.O. Box 488, Stamford, Tex. 79553, and Craig E. Hatcher, 57 Carolane Trail, Houston, Tex. 77024

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4 Claims. (Cl. 173—43)

ABSTRACT OF THE DISCLOSURE

A tractor mounted, fluid actuated rock breaking hammer for use in ditches or trenches, to form same with substantially smooth sides and bottom, with relative safety to workers and to the populace of the area. Which hammer is remotely controlled for moving from side to side, and is freely suspended from a boom by means of a cable. The frame of the hammer is extensible.

This invention relates to improvements in rock breaking equipment and more particularly to rock breaking equipment for breaking rock in ditches, such as ditches in which a pipeline, cable, and the like are buried.

In the digging of ditches for laying pipe, telephone cable and the like, rock is often encountered, which makes the work slow and time consuming. The usual practice under these conditions, in sparsely populated areas, is to blast the rock from the ditch, which leaves a ditch with ragged sides and an uneven bottom. In populated areas it is usually necessary to remove the rock by manual methods or by the use of a hand operated impact hammer. It is desirable to have a ditch with smooth side walls and a relatively smooth bottom. The earth burden can be readily removed with a combination back-hoe; however, when solid rock is encountered, a back-hoe is of little value in deepening the ditch.

The present device is so constructed that it may be brought into use when a solid rock formation is encountered, whereby the rock may be loosened by the use of bits of various types, to the desired depth in the ditch, while maintaining the side walls thereof relatively uniform. The device is so constructed that it may be used from the ground surface down to such depth as is normally dug for placing pipe, telephone cable, or the like therein.

The present device is used in combination with a "side boom" winching mechanism which is mounted on a tractor, which tractor is preferably of the crawler type.

Various rock breaking hammers or drills have been proposed heretofore, both hand operated or air operated, however, these for the most part, lacked the versatility of being maneuverable from a remote point of control, in order to expedite the handling of the equipment for the most advantageous breaking of the rock in the ditches, some of which are too narrow in which to work with comfort, and some of which are too dangerous for workers to enter.

An object of this invention is to provide a tractor mounted, fluid actuated rock breaking hammer to break rock in a ditch or trench.

Another object of the invention is to provide a boom mounted rock breaking hammer, which may be moved from side to side of a ditch and lowered thereinto, by remote control, to break the rock therein.

Still another object of the invention is to provide a tractor mounted, rock hammer mechanism which is suspended from a boom, which boom has a hydraulic ram for "bucking up" and an air hammer for disintegrating the rock and the like.

Still another object of the invention is to provide a rock breaking hammer mechanism which is suspended by a boom on a tractor, thereby enabling the rock breaking

mechanism to be moved along a ditch to break rock therein, by an operator actuating the rock breaking hammer by remote control.

Still a further object of the invention is to provide a rock breaking hammer which has a sliding extensible frame to enable the air actuated portion thereof to be maintained the correct distace from the surface receiving the impact.

And still another object of the invention is to provide a rock breaking hammer, wherein the bits used therewith may be readily removed and replaced.

And still another object is to provide a rock breaking hammer which has a frame assembled in such manner that it may be readily disassembled and reassembled in a minimum of time.

A further object of the invention is to provide a rock breaking hammer, the frame of which may be extended to various positions, and whereby pins may be inserted thereinto to maintain the frame in selected positions.

And still another object of the invention is to provide a rock breaking hammer which may be raised and lowered by a fluid cylinder and which may be moved from side to side by a fluid cylinder.

And still another object of the invention is to provide a rock breaking hammer which may be raised and lowered by means of a cable and which may be moved from side to side with respect to the ditch by a winch operated boom line.

Still another object of the invention is to provide a rock breaking hammer which is simple in construction, easy to operate and low in the cost of manufacture.

With these objects in view and others which will become apparent as the description proceeds, reference is to be had to the accompanying drawings in which like reference characters designate like parts in the several views thereof, in which:

FIG. 1 is a front elevational view of a tractor, showing a side boom attached thereto, showing the winch and boom line thereon for controlling the angularity of the side boom, and further showing a winch line by which a rock breaking hammer is suspended in a ditch, which is shown in section, and shownig a fluid cylinder for moving the side boom laterally and showing a further fluid actuated cylinder for moving the frame of the rock breaking hammer laterally;

FIG. 2 shows an enlarged bottom plan view of one form of "star" bit for breaking rock, which view is an enlargement of the bit shown in FIG. 1;

FIG. 3 is an enlarged bottom plan view of a wedge-shaped bit;

FIG. 4 is an enlarged bottom plan view of a pointed or pick-type bit;

FIG. 5 is a modified form of the rock breaking hammer, showing the frame thereof attached to a side boom which side boom is mounted on a crawler-type tractor;

FIG. 6 is a sectional view taken on line 6—6 of FIG. 5, looking in the direction indicated by the arrows;

FIG. 7 is an enlarged rear elevational view of the side boom mechanism as shown in FIG. 5 and showing the rock breaking hammer attached thereo, with parts broken away and shown in section to bring out the details of construction;

FIG. 8 is an enlarged side elevational view, with parts broken away and shortened, and parts shown in section, to bring out the details of construction of the rock breaking hammer and the associated mechanism;

FIG. 9 is a sectional view taken on line 9—9 of FIG. 8, looking in the direction indicated by the arrows;

FIG. 10 is a sectional view taken on line 10—10 of FIG. 8, looking in the direction indicated by the arrows.

With more detailed reference to the drawings, the numeral 1 designates generally a tractor, which, in the pres-

ent instance, is of the crawler type. A conventional winching mechanism **2** is mounted on the side thereof, which winching mechanism usually has two winding drums thereon for spooling cables **4** and **6** thereonto, as will best be seen in FIG. 1. These winches are individually controlled from the operator's position, as is well known in the art of side booms and winches. A side boom **8** is pivotally mounted on frame **10** by a pin **12** to permit the side boom to hinge thereabout and may be moved from the positions indicated in the full and dashed outline FIGS. 1 and 5 to any position, including horizontal, by the manipulation of the winch in winching mechanism **2** that controls cable **4** which is connected in associated relation to side boom **8** by pin **5**.

The second cable **6** extends outward and beneath a sheave **14** mounted on an upstanding bracket **16** so that the sheave will rotate about the axle **18** which guides the line outward between side boom members **8** and on to a block or pulley **20**, which pulley is suspended on an eye member **22** pivotally mounted on pin **24**. In this manner the block **20** is free to seek its pull position at any position of the boom **8**. A fluid actuated cylinder **26** is pivotally mounted on boom **8** by a pivot pin **28** and is connected to the frame **30** of the rock breaking hammer mechanism generally designated by the numeral **32** by a pivot pin **34**, which connects the plunger **36** of cylinder **26** in such manner that the frame **30** may be swung laterally from side to side of the ditch by remote control from the operator's position by opening and closing valves to supply fluid under pressure thereto.

The frame **10** is secured to the tractor **1** in a manner that is in general practice in mounting side boom mechanisms on tractors; however the present frame **10** has a horizontal frame **38** across the top thereof, which comprises spaced apart bars to receive a fluid cylinder **40** therebetween in a manner as will best be seen in FIGS. 1 and 6. The bars of frame **38** have holes **42** therein which are in alignment to receive a pin **44** therethrough. The pin may be adjustably positioned through selected holes **42** and through the perforate lug **46** on fluid cylinder **40**, thereby giving a greater range of movement to the boom **8**. The cylinder **40** has a plunger **48** extending outward therefrom and is pivotally connected to the boom **8** by a pivot pin **50**, which may be readily removed and replaced when desired.

Although a winch line **4** is provided for overall wide angle movements of boom **8**, the fluid cylinder **40** may be used for relatively short range, lateral movements of the boom **8** to control the movements of the rock breaking hammer **32** when it is desired to keep the frame positioned vertically. However, when it is desired to swing the frame laterally at an angle, the fluid actuated cylinder **26** may be used.

By combining the movements of boom **8** and plunger **36** in cylinder **26**, the rock breaking hammer frame **32** may be correctly positioned within ditch **52**. The rock breaking hammer **32** is shown as having a pin **21** through hole **88** in lug **86** in FIGS. 1 and 8 as being suspended from a cable **6** on boom **8** and having a further cable **4** to vary the angularity of boom **8**. The frame **30** of the rock breaking hammer mechanism **32** may be moved from the position indicated in the full outline in FIG. 5 to the position indicated in the dashed outline therein, so that a bit **54** is moved above the terrain **56** in which the ditch **52** is being dug; then by moving the boom **8** fom the full outline position to the dashed outline position as shown in FIGS. 1 and 5, the tractor **1** may be readily transported over the terrain with a minimum of width to be reckoned with.

Various types of bits, such as **54**, **54***a* and **54***b* may be readily removed from or inserted on to plunger **58** of the fluid actuated cylinder **60**. It is preferable to have the fluid actuated cylinder **60** air actuated and is so constructed as to deliver short vibratory strokes or relatively long reaching, high inertia strokes as the bit **54** or **54***a* may be made of a relatively heavy mass of material or the bits may be relatively light with a sharp or pick point, as indicated in FIG. 4, for use with a fast acting vibratory type of plunger **58**.

The length of the stroke of air cylinder **60** may be controlled by conventional methods of controlling air hammers and air cylinders, and no claim is being made for the air cylinder per se, as the use of the cylinder will be modified to suit the individual needs and requirements of the particular job on which it is being used. The cylinder **60** is mounted on the lower end of frame members **62**, which frame members are preferably tubular, by bolts **64** so by removing the bolts **64** and the lower frame retaining braces **66** which secure the frame braces to the upright frame members **62** by bolts **68**, which will enable the air cylinder **60** to be removed upon the removal of support pin **70** which passes through the lug on the upper end of cylinder **60** and through a clevis **72** on the lower end of fluid cylinder plunger **74** that is operatively associated with fluid cylinder **76**. The upright tubular frame members **62** preferably telescope over smaller tubular members or bars **78** in sliding relation, so that the tubular members **60** may be moved from the position shown in full outline in FIG. 5 to the position shown in dashed outline therein. A head **80** is provided, which has spaced apart holes **82** therein to receive the upper ends of tubular members **78**, which tubular members **78** are held in fixed relation with respect to head **80** by bolts **84** passing therethrough and threadably engaging the head **80**.

The head **80** has a lug **86** on the upper side thereof in which is formed a hole **88** through which pin **21** is positioned, by which pin the rock breaking mechanism **32** is supported on cable **6** in the form of invention as shown in FIG. 1, and by boom **8** as shown in FIG. 5.

The cylinder **76** is secured to the lower face of head **80** by bolts **79**. The lower end of the cylinder **76** has a clamp member **79***a* mounted on and secured thereto, which has outwardly extending arms **79***b* on which is positioned arcuate guide members **79***c* that move in sliding, guided relation on the inner faces of upright tubular members **62**, as will best be seen in FIGS. 8 and 9. In this manner the cylinder **76** is stabilized both at the top and bottom with respect to head **80**.

The members **60** may be secured against longitudinal movement at any desired point between the position indicated in full outline in FIG. 5 and the position indicated in dashed outline therein by inserting pins **90** therethrough and through spaced apart holes **92** in tubular members **78**. In this manner fluid pressure does not have to be maintained on cylinder **76** at all times; however it is optional with the operator to maintain the tubular members **62** and **78** in fixed relation with pins **90** or by removing the pins **90** and moving the plunger **74** of the fluid cylinder **76** to the desired position and closing the valves, which may be done if desired.

FIG. 1 shows one manner of suspending the rock breaking hammer **32** by the cable **6**, which is attached thereto by pin **21**, which will enable the rock breaker frame to be lowered to the lowermost position and, if desired, the plunger **36** may be disconnected by removing pin **34** for ditches of excessive depth. However, the usual practice is to utilize plunger **36** connected by pin **34** to frame **32**.

The form of the invention as shown in FIG. 5 utilizes the same rock breaking mechanism as heretofore set out; however the hammer mechanism **32** is pivotally supported on a pin **21** which passes through the side boom members **8**, as will best be seen in FIGS. 5 and 7. This form of the invention utilizes a single winch line **4** to raise and lower the boom **8** and the cylinder **26** is utilized to move the plunger **36** in and out, by air pressure, to maintain the hammer mechanism **32** in the desired position within ditch **52**.

The operation of both forms of the hammer mech-

anism 32 is identical and is controlled from the operator position by hydraulic valves (not shown) to move the frame 30 up and down with respect to support head 80, and conventional air valves (not shown) are utilized to control the flow of air, under pressure, to pneumatic cylinder 60, as is well known in the art of pneumatics.

The air hammer mechanism 32 preferably has the frame 30 banded with a series of surrounding frame members 31, one of which has an apertured lug 33 to receive the pivot pin 34 therethrough. It is preferable to have the frame members 31 welded or otherwise secured to the upright tubular members 62 so as to maintain the tubular members 62 in spaced apart, parallel relation to enable these to be freely slidable on upright tubular member 78.

It is preferable to have the plunger 58 transversely apertured near the lower end thereof, as indicated at 59, to receive a transverse pin 61 therethrough so a bit 54, 54*a* or 54*b* may be readily attached thereto by passing a pin 61 through a transverse hole 53 in the shank of the bit or hammer, which transverse holes 53 are preferably arranged at right angles in the respective bit shanks so a bit or hammer may be correctly positioned thereon with respect to the work to be accomplished.

The hydraulic cylinders 26, 40, and 76 are preferably double acting hydraulic cylinders, and while the air cylinder 60 is shown to be a double acting cylinder, it is to be understood that this is representative of an air cylinder and that a conventional single acting spring return plunger may be readily used and still be within the purview and scope of the present invention, as it is the arrangement of the cylinders and the manner of manipulation thereof which is considered new and novel and not the construction of the cylinders per se.

Operation

With the boom 8 in upright position, as indicated in dashed outline in FIGS. 1 and 5, the tractor 1 may be moved over the terrain, whereupon, by lowering the boom as indicated in full outline in FIGS. 1 and 5, the hammer mechanism 32 may be lowered to a position of use to break rocks or the like, whether in the starting position in the ditch, as indicated by the dashed outline of the hammer in FIG. 5 or whether it is at a point within the depth of the ditch, as indicated in full outline in FIGS. 1 and 5. With the boom 8 lowered, to the position as shown in full outline in FIGS. 1 and 5, the hydraulic cylinder 76 is utilized to lower the mechanism so the bit 54*a* or 54 will be in the position as shown in full outline in FIGS. 1 and 5, respectively. With the bits or hammers in this position, pins 90 may be inserted through upright tubular members 62 and through holes 92 in tubular member 78. This will relieve strain from the hydraulic system and support the hammer either on the cable 6, as shown in FIG. 1, or directly on the boom 8, as shown in FIG. 5. With the bit 54*a* or 54 in the respective forms as shown in FIGS. 1 and 5 in this position, a conventional air hammer control valve (not shown), which is positioned at the operator's position, directs air to the air cylinder 60 to sequentially reciprocate plunger 58 to actuate hammer or bit 54*a* or 54, respectively, in a manner well understood in the art of pneumatic hammers, an example of such reciprocating hammer is disclosed in the patent to Reaney, No. 1,731,984, issued Oct. 15, 1929. However, various valve systems to sequentially reciprocate fluid motors, such as an air hammer, are well known in the art, and not valving mechanism per se is shown in the present device. As the rock, generally designated by the letter R, is loosened and broken from the bottom of ditch 52, the winching mechanism 2 may unwind cable 6 to lower the entire hammer mechanism 32 downward until the hammer or bit 54*a* has penetrated to the correct depth in the rock R. When it is desired to retract the air cylinder 60 and upright tubular members 62 out of ditch 52, the plunger 74 is retracted to release the weight from pins 90, whereupon pins 90 are removed from apertured holes therein and the frame, generally designated by the numeral 30, is moved to the uppermost position, whereupon the pins 90 may be replaced through holes in upright tubular member 62 and upright tubular member 78; then by disconnecting plunger 36 from lug 33 by removing pin 34, the cylinder 26 may be swung out of the way, then, by tightening cable 4, the boom 8 may be moved to the position indicated in dashed outline in FIGS. 1 and 5 and the hammer mechanism 32 may either be suspended by the boom 8 or it may be readily removed, either by removing pin 21 in FIG. 1 or FIG. 5, and the hammer mechanism be removed and transported independently.

While the mechanism has been described somewhat in particular for breaking rock in ditches, it is to be understood that it may be used for breaking rock or concrete, such as pavement or the like, or for any use for which a mobile, high impact hammer is applicable, as the present device is readily adjustable to different elevations.

Having thus fully shown and described the invention, what is claimed as new and desired to be secured by Letters Patent is:

1. A portable rock breaking device for use with a mobile prime mover, which device comprises;
   - (a) an outwardly extending frame pivotally mounted on and extending upwardly from a side of the prime mover,
     - (1) said outwardly extending frame having a sheave pulley mounted therein near the upper end thereof,
   - (b) hoisting means mounted on the prime mover and being connected to said outwardly extending frame to move said outwardly extending frame relative to the prime mover,
   - (c) a second hoisting means,
   - (d) a cable mounted on said second hoisting means and extending over said sheave pulley,
   - (e) a hammer frame, which comprises an upper section and a lower section, which frame is suspended, by the upper end thereof, from the cable, to vary the elevation thereof,
     - (1) a fluid cylinder mounted on the lower end of said hammer frame,
     - (2) a fluid actuated plunger mounted in said fluid cylinder for sequential reciprocation therein,
     - (3) a fluid supply means,
     - (4) a fluid conduit connected between an end of said fluid cylinder and said fluid supply means to supply fluid, under pressure, to said fluid cylinder to reciprocate said plunger in said fluid cylinder,
   - (f) a second fluid cylinder pivotally mounted on said outwardly extending frame, the plunger of which extends outward therefrom and is connected to the lower-most of said hammer frame sections, to vary the angularity thereof with respect to the vertical.

2. A portable rock breaking device for use with a mobile prime mover, as defined in claim 1; wherein
   - (a) the upper and lower sections of said hammer frame being telescoped together, and
     - (1) means to selectively maintain one section of said hammer frame in selected, secured relation with respect to said other section thereof.

3. A portable rock breaking device for use with a mobile prime mover as defined in claim 2; wherein
   - (a) said means to hold one of said hammer frame sections in selected relation with respect to the other of said hammer frame sections is a second fluid actuated cylinder having a plunger therein,
     - (1) one end of said second cylinders being connected to one hammer frame section, and
     - (2) the distal end of said plunger of said second cylinder being connected to the other of said hammer frame sections.

4. A portable rock breaking device for use with a mobile prime mover, as defined in claim 2; wherein

(a) said hammer frame sections are tubular,

(1) the tubular members of one frame section being the portions which telescope into complementary tubular members of said other frame section,

(b) said means to selectively maintain one section of said hammer frame in selected, secured relation with respect to said other section thereof is a hydraulic cylinder, having a plunger therein, being connected to one of said hammer frame sections,

(1) the plunger of said hydraulic cylinder being connected to the other of said frame sections,

(c) a fluid conduit connected to each end of said hydraulic cylinder to supply fluid under pressure to move said plunger within said cylinder,

(1) said conduits being connected to said source of hydraulic pressure to selectively move said plunger in said cylinder on said hammer frame

section longitudinally with respect to the other said hammer frame section.

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HALL C. COE, *Primary Examiner.*