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Lynch

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[54] **UNDERWATER PIPELINE TRENCHING APPARATUS**

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[52] **U.S. Cl.** **61/72.4,** 37/65, 254/105

[51] **Int. Cl.** **E02f 5/02,** E02f 1/00

[58] **Field of Search**......................61/72.4, 72.1, 72.3; 254/105, 106, 107, 108; 37/64, 65

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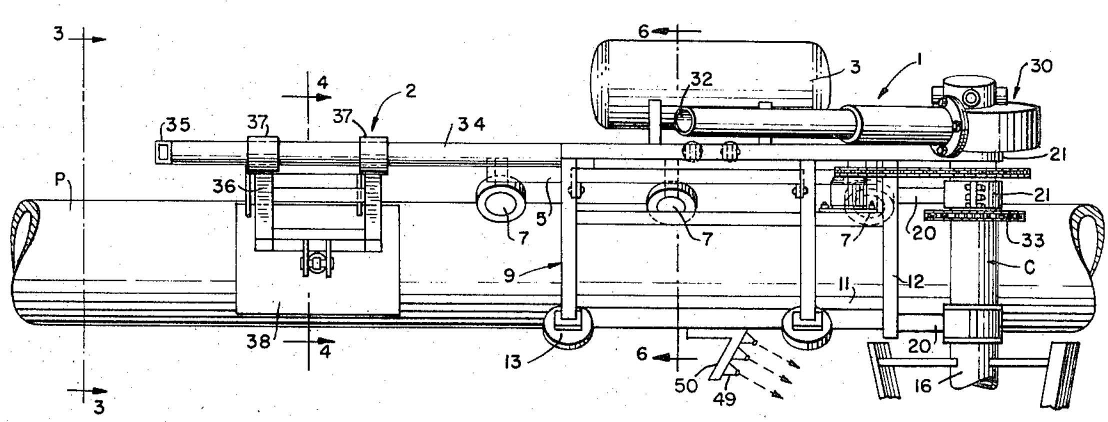
[57] **ABSTRACT**

A pipeline trenching apparatus includes a carriage adapted to travel along the periphery of the pipeline. Rotary cutter drums advance with the carriage and are mounted upon frame elements pivotally attached to the carriage. Advancement of the apparatus is achieved by a reciprocating propulsion section connected to the carriage and provided with clamping elements alternately engaging and releasing the pipeline as the propulsion section is extended and retracted.

11 Claims, 12 Drawing Figures



PATENTED MAY 15 1973 3,732,701

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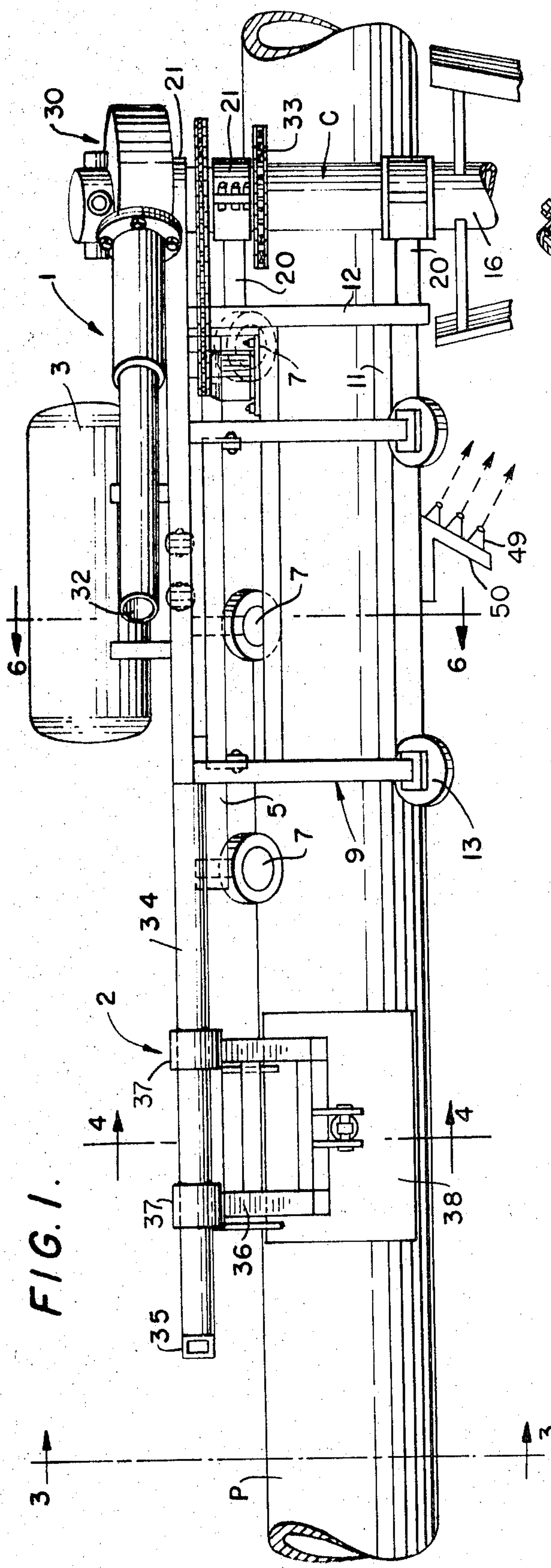

FIG. 1.

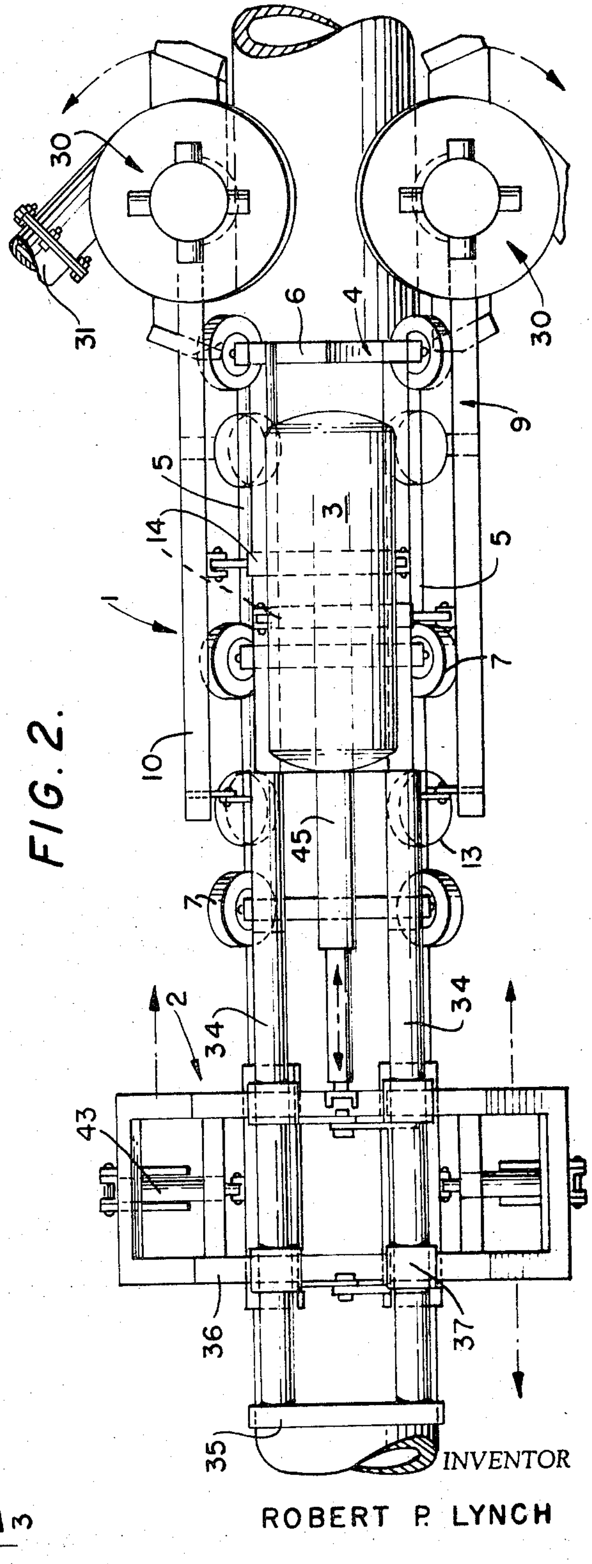

FIG. 2.

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FIG. 3.

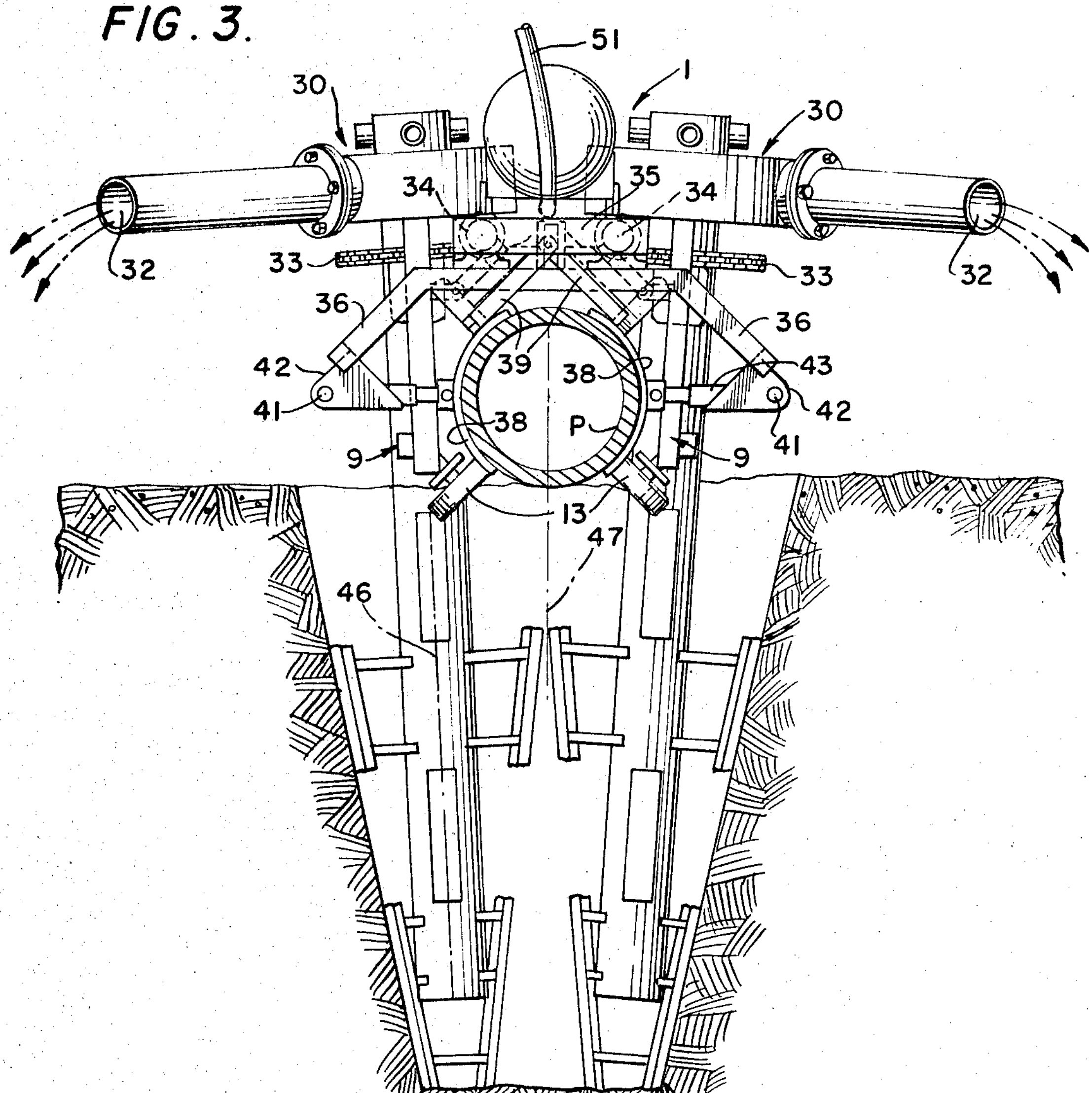

FIG. 4.

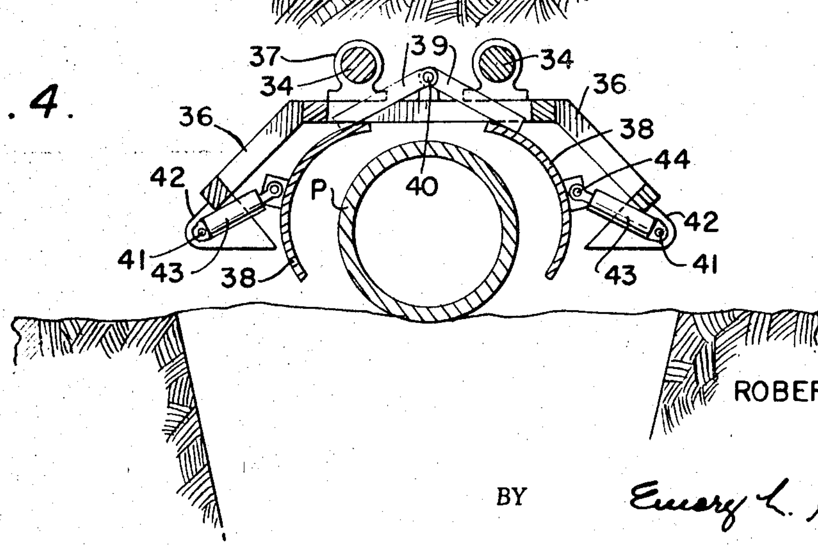

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FIG. 5.

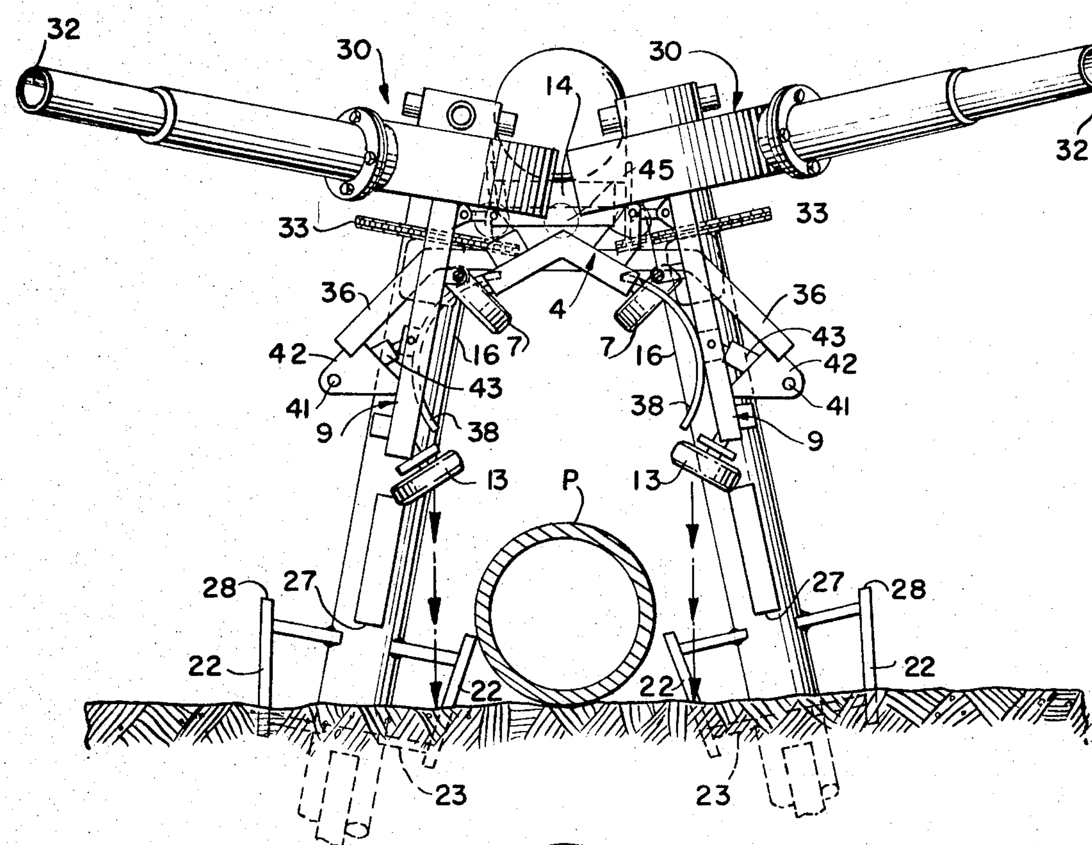

FIG. 6.

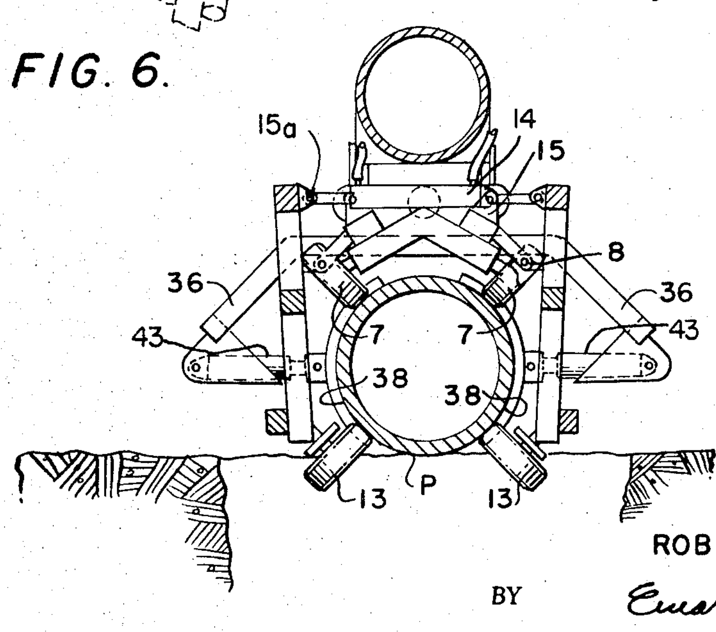

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FIG. 7.

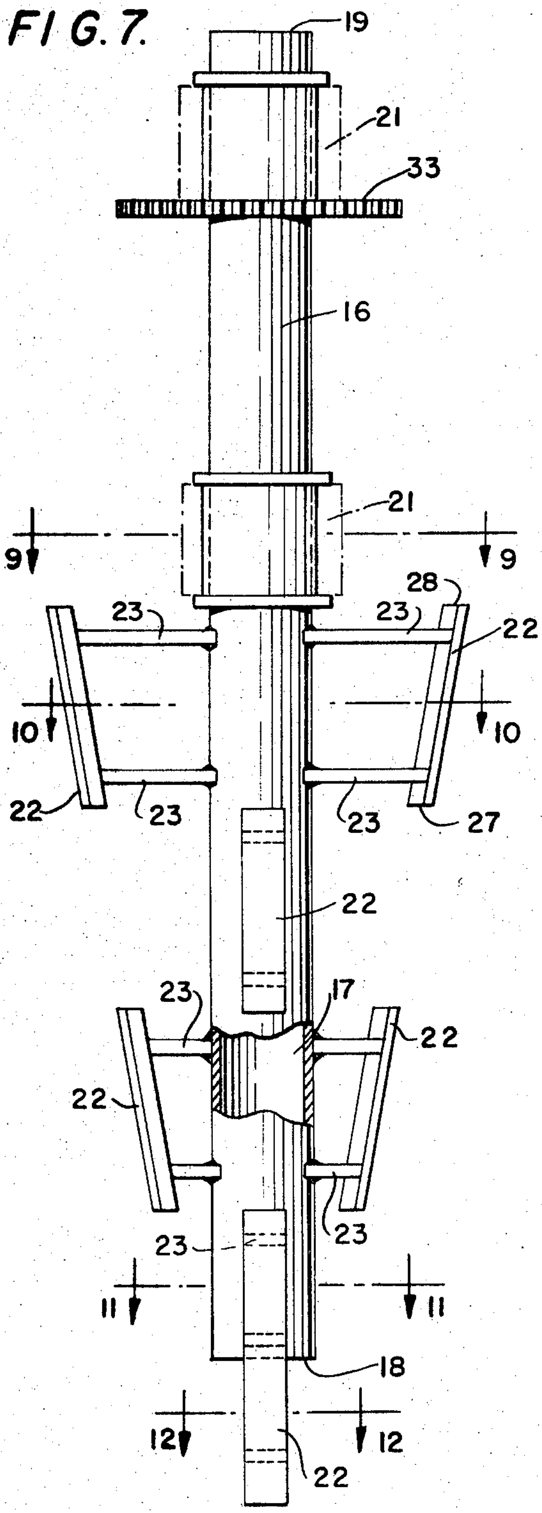

FIG. 8.

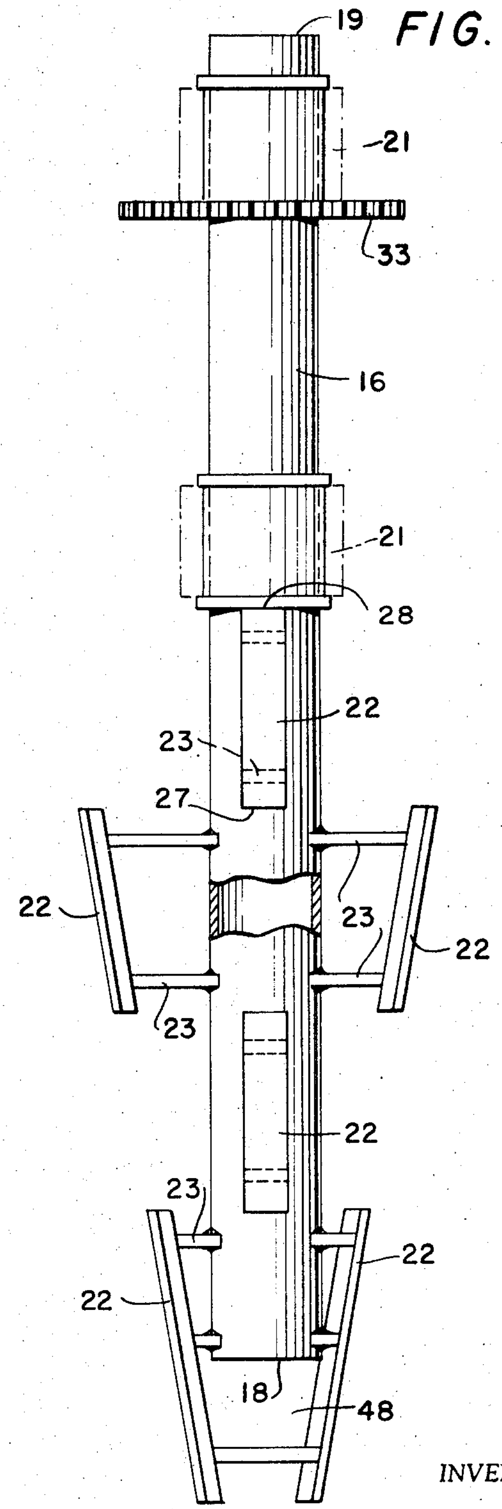

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FIG. 9.

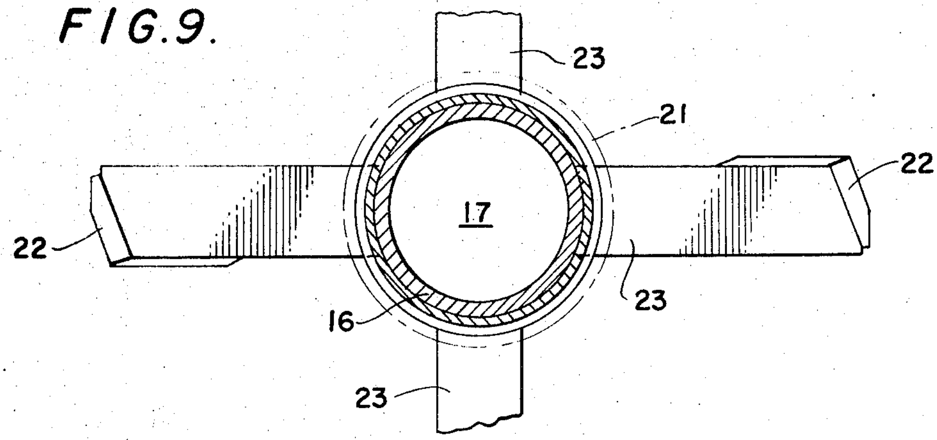


FIG. 10.

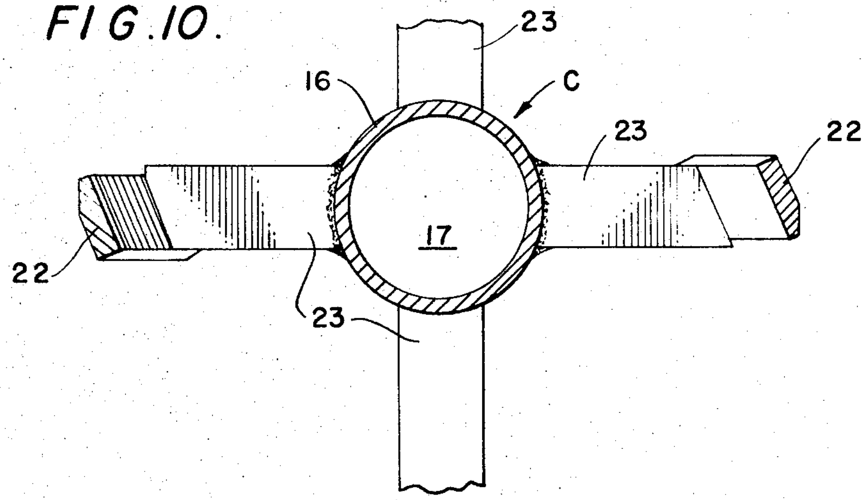


FIG. 11.

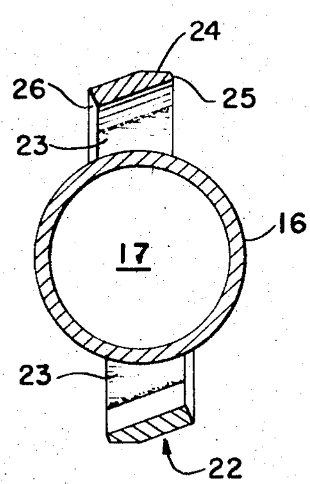
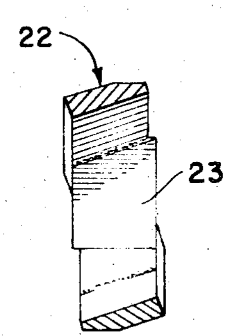


FIG. 12.



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UNDERWATER PIPELINE TRENCHING APPARATUS

This invention relates generally to pipeline machines, and more particularly, to an apparatus for the placement of underwater pipelines in trenches.

Steel pipelines as utilized to transport oil or from offshore locations to an onshore processing and distribution station are usually buried in the ocean floor to prevent damage from bottom currents, anchors, fishing gear, and other potential hazards. The most common technique utilized for burying offshore pipelines involves the use of an apparatus such as a jet barge in combination with a submersible jet sled. The barge serves as a floating base and contains extensive apparatus including high pressure water pumping machines and suction dredge pumps, all of which lead by means of often cumbersome lines to the jet sled, which comprises a frame adapted to straddle a pipeline previously deposited upon the ocean floor.

Many types of jet sleds are well known in the art, yet all of these utilize a basic principle wherein high pressure water generated upon the barge is transmitted to a plurality of nozzles on the sled so arranged as to excavate a trench immediately below the pipeline. The disrupted soil often is subsequently removed by means of a plurality of suction pipes behind the jet nozzles which communicate with the barge-mounted dredge pumps.

Many disadvantages are inherent in the above-described system, none of the least of which is the inefficiency of an arrangement wherein both the water jet and suction forces are generated on the surface of the water and must be transmitted through significant distances to the sled device located on the ocean floor. It will be appreciated that a strong surface current and/or rough seas impose potential dangers to the connecting lines between the barge and sled. Additionally, a problem often arises in the means commonly used to advance the jet sled along the pipeline. This is usually effected by means of a cable system between the barge and sled and wherein the barge pulls itself by means of an anchor winch, which operation is extremely hazardous and difficult to control at any time when the surface of the water is not perfectly calm.

The present invention seeks to provide an improved arrangement for the placement of underwater pipelines in trenches and includes a unitary assembly comprising a pipe-riding carriage and a reciprocating propulsion section which is adapted to be initially placed over a previously deposited pipeline on the ocean floor and which contains a pair of mechanical cutter drums for digging a trench beneath the pipeline. The reciprocating propulsion section is automatically and sequentially clamped to the periphery of the pipeline while a fluid cylinder is actuated to advance the pipe-riding carriage as the cutter drums are rotated to remove the soil beneath the pipeline. Self-contained suction dredge pumps associated with the cutter drums remove the dislodged soil and direct it laterally of the moving apparatus. Additional means for facilitating the soil removal may be included in the form of water jet nozzles when the apparatus is employed in an environment comprising clays of high cohesion such as the soil referred to as gumbo and which will be found in the Gulf of Mexico, among other areas.

Accordingly, one of the objects of the present invention is to provide an improved underwater pipeline trenching apparatus including a pipe-riding carriage having a pair of cutter drums located at the forward end thereof and which are adapted to be lowered over a previously deposited pipeline and subsequently pivoted inwardly with their lowermost portions positioned beneath the center of the pipeline.

Another object of the present invention is to provide a pipeline trenching apparatus including cutter drums carried by a pipe-riding carriage which is sequentially advanced along the length of the pipeline as the cutter drums rotate, by means of a reciprocating propulsion section connected to the carriage and including pipe clamping shoes.

A further object of the present invention is to provide a pipeline apparatus having a pipe-riding inner frame provided with a pair of outer frame sections pivotally attached thereto and each supporting a rotary cutter drum.

Still another object of the present invention is to provide a pipeline trenching apparatus having a pipe-riding carriage with cutter means thereon and including self-contained advancing means comprising a reciprocating pipe clamping section connected to the pipe-riding carriage.

With these and other objects in view which will more readily appear as the nature of the invention is better understood, the invention consists in the novel construction, combination, and arrangement of parts hereinafter more fully described, illustrated, and claimed.

A preferred and practical embodiment of the present invention appears in the accompanying drawings, in which:

FIG. 1 is a side elevation of the pipeline trenching apparatus of the present invention;

FIG. 2 is a top plan view of the apparatus shown in FIG. 1;

FIG. 3 is a rear end elevation taken along the line 3—3 of FIG. 1;

FIG. 4 is a transverse sectional view taken along the line 4—4 of FIG. 1;

FIG. 5 is a front end elevation of the apparatus of FIG. 1 with the cutter drums removed for purposes of clarity;

FIG. 6 is a transverse sectional view taken along the line 6—6 of FIG. 1;

FIG. 7 is an elevational view of one of the cutter drums with portions broken away to show the hollow interior of the cutter tube;

FIG. 8 is a view similar to FIG. 7 of the tube as it appears when rotated ninety degrees with respect to FIG. 7;

FIG. 9 is a horizontal sectional view taken along the line 9—9 of FIG. 7;

FIG. 10 is a horizontal sectional view taken along the line 10—10 of FIG. 7;

FIG. 11 is a horizontal sdctional view taken along the line 11—11 of FIG. 7; and

FIG. 12 is a horizontal sectional view taken along the line 12—12 of FIG. 7.

Similar reference characters designate corresponding parts throughout the several figures of the drawings.

Referring now to the drawings, particularly FIGS. 1 and 2, the trenching apparatus of the present invention will be seen to comprise a unitary assembly including two joined principal components, namely, a forwardmost pipe-riding carriage generally designated 1, and rearmost reciprocating propulsion section 2. The apparatus is illustrated in these figures as it appears when disposed in its working position wherein the weight of the machine as counterbalanced by means of a suitable ballast tank **3**, is borne by means of a plurality of rollers engaging the periphery of the previously deposited pipeline P resting upon the ocean floor.

It will be appreciated that conventional means may be employed to deliver the apparatus from a surface craft to its use position. Suitable means may include a pair of guide wires leading from a surface barge to the pipeline. After divers have connected the lower ends of the guide wires to the pipeline and the wires are tensioned, the trenching apparatus may be lowered from the barge to the pipeline by fairleading the guide wires through appropriate guide shackles (not shown) on the apparatus.

The pipe-riding carriage **1** is constructed so as to permit ready placement of the apparatus upon a previously deposited pipeline P. The carriage includes an inner frame **4** which is of generally rectangular configuration and which includes longitudinally extending side rails **5—5** fixedly joined together by means of transverse end rails **6—6.** Depending from each side rail **5** are a plurality of inclined fixed support rollers **7.** By referring to these rollers as "fixed", it is not meant to convey the idea that the angular position of their axes is stationary since it is intended that suitable well-known means may be provided to permit selective adjustment of each roller axle according to the diameter of the particular pipeline being operated upon. As will be seen most clearly in FIG. **6** of the drawings, the rollers **7** are preferably adjusted so that an extension of the plane of rotation of these rollers will pass through the center axis of the particular pipeline being served. Notwithstanding the adjustable feature desirable with the fixed support rollers **7**, it will be understood that during the normal operation of the apparatus, the mounting axles of these rollers are maintained in a fixed position with respect to the supporting inner frame **4.**

Pivotally attached to each inner frame side rail **5**, as at the pivot points **8**, is an outer frame section **9** each comprising a generally rectangular framework including a top rail **10**, bottom rail **11**, and vertical connecting rails **12—12.** While the lateral extent of the inner frame **4** is substantially equal to the diameter of the pipeline P, it will be noted that the overall vertical extent of the outer frame sections **9—9** is significantly greater than the pipeline diameter. Depending downwardly and inwardly from the lower portion of each outer frame section **9** are a plurality of pivotal clamp rollers **13** providing guide means for the outer frame section. These are referred to as pivotal rollers in view of their radial or arcuate displacement during attachment and removal of the apparatus from a pipeline, as illustrated in the alternate positions as shown in FIGS. **5** and **6** and which will be described hereinafter. The axles of the pivotal clamp rollers **13**, like the axles of the fixed support rollers **7**, may be connected to their supporting framework by any conventional means which will permit angular adjustment thereof so that when in the clamping position as shown in FIG. **6** an extension of the plane of rotation of these rollers will likewise pass through the center axis of the pipeline P.

Means are provided on the pipe-riding carriage **1** to displace the outer frame sections **9—9** between the alternate positions of FIGS. **5** and **6.** Preferably, this means comprises a pivot-clamping cylinder **14** such as a pneumatic or hydraulic cylinder for the arcuate displacement of each outer frame section with respect to the inner frame **4** and thus, the pipeline itself. As shown in FIGS. **2** and **6**, the stationary end of each cylinder **14** is pivotally attached to an anchor block **15** forming a part of the inner frame **4** while the free or operating end of the cylinder is pivotally attached as at **15***a* to the top rail **10** of one of the outer frame sections **9.** With the foregoing arrangement in mind, it will be appreciated that, since the outer frame sections **9** are pivotally attached to and supported by the inner frame **4** as pivot points **8** located below the top rails **10** of each outer frame section **9**, upon actuation of the two pivot-clamping cylinders **14**, the pair of outer frame sections will be arcuately displaced either towards or away from one another about their respective pivot points **8—8.** During the initial placement of the apparatus upon the pipeline P, the two cylinders **14** are actuated in order to collapse or retract their operating piston rods in order to move the two outer frame section top rails **10—10** towards one another as in the condition shown in FIG. **5** whereupon the lower portions of the outer frame sections and their attached pivotal clamp rollers **13** will be parted from one another so that the apparatus may be lowered upon the pipeline until the fixed support rollers **7** are resting thereupon, after which the fluid cylinders **14** are actuated in order to extend their operating rods to move the outer frame sections **9—9** to the working position of FIG. **6** as will be covered more in detail hereinafter.

In the present arrangement, the trench cutting action is achieved by means of a pair of cutter drums, generally designated C, one of which is provided at the forwardmost extension of each other frame section **9.** The details of a preferred cutter drum are illustrated in FIGS. **7-12** of the drawings, wherein it will be seen that each cutter drum C includes a tube **16** comprising a hollow pipe member providing a continuous internal passageway **17** extending from the bottom opening **18** of the tube through the top opening **19** thereof.

A cutter drum tube **16** is mounted adjacent the forward portion of each outer frame section **9** by means of a pair of support arms **20—20** connected to each vertical connecting rail **12** on the one hand and provided at the opposite end with a support collar **21**, which collar surrounds the upper portion of the cutter tube **16.** The actual cutting elements of each cutter drum C comprise a plurality of angled cutter bars **22** attached to the periphery of the cutter tube **16** in the cantilevered manner by means of radially extending cutter bar brackets **23** as shown most clearly in FIGS. **7** and **8** of the drawings. The cross-sectional configuration of each cutter bar itself will be most readily apparent from FIG. **11** wherein it will be seen that the leading edge of each cutter bar **22** is provided with a bevel **24** on its outermost surface. Each cutter bar is attached, by means of its pair of brackets **23**, in an angular relationship with respect to the cutter drum tube when viewed both in vertical as well as horizontal plan. As shown in FIG. **11** each cutter bar is mounted with its leading edge **25** disposed a greater radial distance from the center axis of the cutter drum than the trailing edge **26** thereof. Additionally, the lower portion **27** of each cutter bar is positioned at a closer radial distance to the cutter tube than the upper portion **28** thereof. As shown in FIGS. **7** and **8**, each cutter bar **22** is paired with an oppositely disposed cutter bar mounted at the same angle and same distance from the cutter tube, while the next lowest pair of cutter bars are disposed 90° with respect to the first-mentioned pair of cutter bars. This relationship continues with the next succeeding lowermost pairs of cutter bars such that an alternate arrangement will be seen to exist. Other than the above-referenced offset or staggered relationship one other important feature should be recotnized with regard to the various cutter bars and that is that each succeeding lowermost pairs of cutter bars **22** are attached to the cutter drum tube **16** by means of brackets **23** of a decreasing radius which radii are selected to provide a cutting path when the drum is rotated which will describe a plurality of arcs all of which will conform to the configuration of an inverted cone. Noting that the lower portion **27** of one bar is located in the same horizontal plane as the upper portion **28** of the next lowest cutter bar, it will thus follow that, upon rotation of the cutter drum as it is lowered into an ocean bed, a conically shaped cavity will be produced therein.

In the present apparatus a pair of the above-described cutter drums are employed, one of which is carried by each of the outer frame sections **9** such that actuation of the pivot-clamping cylinders **14** produces a concurrent tilting or lateral pivoting of the two cutter drums C—C. The disposition of the lowermost pair of opposed cutter bars **22—22** will be of particular concern when considering the operation of the apparatus now being described. As will be seen the lower portion **27** of these lowermost cutter bars extends well below the bottom opening **18** of the cutter drum tube **16** so that at all times during operation of the apparatus these bottom cutter bars will insure that the bottom opening of the tube **18** will be spaced from the side and bottom walls of the trench T.

The mechanism associated with the operation of the described cutter drums will now be covered. As previously set forth, a complete cutter drum assembly is mounted forward of the vertical connecting rail **12** of each one of the outer frame sections **9** and supported in this position by means of the bearings or support collars **21—21**. These collars **21** provide the entire supporting means for the cutter drum and its various rotating components. The uppermost extremity of the cutter drum tube **16** is journaled within the pump collar **29** (FIG. **1**) which is fixedly attached to the forwardmost limit of the top rail **10** of its respective outer frame section **9**. Carried by each pump collar **29** is a suction dredge pump **30** which may be of any suitable well-known construction but which is preferably driven by an appropriate hydraulic motor. The negative suction of the pump **30** will be understood to communicate with the top opening **19** of the cutter drum tube **16** while the outlet or discharge of the pump is directed through the discharge tube **31** having its exit portion **32** extending in a direction away from the center line of the pipeline P and preferably rearwardly of the cutter drum C. With the foregoing structure in mind it will be appreciated that, upon actuation of the suction dredge pumps **30**, a negative pressure will be created in the area of the bottom opening **18** of each cutter drum tube **16** such that a suspension of any dislodged soil and rocks in the area of the lower portion of each cutter drum will be drawn upwardly through the internal passageway **17** by the pump and thence directed outwardly through the exit portion **32** thereof.

Any suitable means may be provided to impart a simple rotary motion to the cutter drum C—C. Preferably, another hydraulic motor (not shown) is provided on each outer frame section **9** including a gear-drive which may mesh either directly or by means of a chain with the cutter drum drive gear **33** fixedly attached to each cutter drum tube **16** in the area adjacent the uppermost support collar **21**.

The operation of the structure described up to this point may now be related. As the trenching apparatus is lowered from the surface barge to the previously deposited pipeline P it is guided so that the opened outer frame sections **9** and their respective cutter drums will straddle the pipeline. It will be apparent that initially the apparatus must assume a three-point position of rest, that is, the rearmost portion of the apparatus will be disposed upon the pipeline while the lowermost portion of the two spread-apart cutter drums engage the ocean floor. Before the apparatus can assume the position as shown in FIGS. **1** and **2**, the operator initiates rotation of the two cutter drums and the operation of their respective dredge pumps **30**, whereupon the apparatus in actuality digs its own way into the normal horizontal position until the fixed support rollers **7** engage the upper portion of the pipeline periphery. During this digging-in procedure and when the uppermost pairs of cutter bars **22** have been lowered to a point below the midline of the pipeline, the operator actuates the fluid cylinders **14—14** to progressively close the outer frame sections **9—9** whereby, when the apparatus is fully supported on the pipeline by means of the rollers **7**, the outer frame sections **9—9** will be clamped to the pipeline by means of the rollers **13** and the components will appear as in FIGS. **3** and **6**.

A unique arrangement is included to provide the self-contained advancing mechanism. Extending from the rear of the inner frame **4** are a pair of parallel longitudinal guide members **34—34** having their forward portions rigidly attached to the rear end rail **6** and their distal portions connected by means of the cross bar **35**. Associated with the pair of longitudinal guide members **34—34** is the reciprocating propulsion section **2** having a rigid shoe frame **36** attached to the guide members **34** by means of a plurality of slide blocks **37** journalled about each of the guide members **34**. The shoe frame **36** will thus be seen to be capable only of longitudinal reciprocating motion within the limits of the extent of the guide members **34** and is provided to serve as a movable support for a pair of movable pipe clamping shoes **38—38**. Each shoe **38** comprises an arcuate plate having a radius of curvature substantially similar to the radius of pipeline P being operated upon and is adapted to engage a significant portion of the periphery of the pipeline on opposite sides of its vertical center line. The supporting and operating structure associated with the pipe clamping shoes is shown most clearly in FIGS. **2** and **4** wherein it will be seen that an upper portion of each shoe is rigidly connected to a shoe link **39**, the upper extremities of which are pivotally connected as at **40** to the top center portion of the shoe frame **36**. Pivotally anchored at **41** to the side bar **42** of the shoe frame **36** is a shoe actuating cylinder **43** which has the distal portion of its movable piston rod pivotally connected to the outer periphery of each shoe **38** as at **44**. It will thus be apparent that, upon actuation of the two shoe actuating cylinders **43—43**, the respective pipe clamping shoes **38—38** may be selectively manipulated between the clamping position of FIG. **3** and the open position of FIG. **4** of the drawings. With the cylinders

43 extended and with a positive pressure forcing the two clamping shoes tightly against the periphery of the pipeline, as in FIG. 3, it will be appreciated that the entire shoe frame assembly 36 is rigidly anchored to the pipeline P. With the apparatus in this condition, as shown in FIGS. 1 and 2, and with the cutter drums C rotating, the entire pipe-riding carriage 1 may be advanced longitudinally of the pipeline by the actuation of a propulsion fluid cylinder 45, one end of which is rigidly secured to the inner frame 4 of the carriage 1, while its other end is attached to the propulsion section 2. Thus, self-contained means are provided to advance the cutter bar-equipped pipe-riding carriage 1 within the limits of the longitudinal extent of the two guide members 34—34. With the propulsion cylinder 45 fully extended and the rear portion of the shoe frame 36 juxtaposed the cross bar 35, the two shoe-actuating cylinders 43—43 are collapsed a sufficient amount to release the clamping pressure of the shoes upon the pipeline, whereupon the propulsion cylinder 45 may be retracted to move the shoe frame 36 to its forwardmost limits as defined by the collapsed position of the cylinder 45, after which the shoe actuating cylinders 43 are again actuated to clamp the shoes 38 to the pipeline and the previously described procedure is repeated.

When the cutter drums are revolving in a contrarotary manner it will be understood that the longitudinal axes of the two drums will be slightly inclined towards one another, from the carriage 1 to the bottom of the trench T, as indicated by the cutter drum axis lines 46—46 illustrated in FIG. 3. WIth this arrangement the cutter bars 22 which are closest to the vertical central axis 47 of the pipeline on one cutter drum will be parallel to and closely spaced from the cutter bars of the other cutter drum, such that a minimum space is presented between the two inclined cutter drums. With the disclosed structure of cutter bars it will be appreciated that only two cutter bars on each cutter drum will be shaving the trench bank at any one time, thereby insuring a maximum cutting torque being concentrated and distributed to the single pair of cutter bars engaging the trench wall. The described spaced-apart and staggered arrangement of the cutter bars also encourages the unimpeded descent of the dislodged soil and rocks to the bottom of the trench T during operation of the apparatus. As the machine progresses along the pipeline with the cutter drums revolving, the dislodged soil and rocks are continuously falling by gravity to the bottom of the trench and into the suction zone 48 located below the bottom opening 18 of the cutter drum torque tube 16. Maintenance of the suction zone 48 is insured by means of the arrangement of the lowermost cutter bars 22 on each cutter drum, since the lower portion 27 of these last-mentioned cutter bars is spaced well below the bottom opening 18 of the tube 16 so that the dislodged material may be readily drawn upwardly through the opening 18 as a result of the suction action generated by the dredge pumps 30.

When the apparatus is being operated in an environment comprising clays of high cohesion, such as gumbo, there is a possibility that, as the cutter bars 22 shave away portions of the trench wall during advancement of the machine, large chunks of the clay may become lodged within the areas between the cutter bars 22, their supporting brackets 23, and the periphery of the torque tube 16. For this reason it is proposed to provide one or more water jet nozzles 49 with their exit portions directed to the cutter drums. As shown in FIG. 1, these nozzles 49 are preferably attached to the lower portion of each outer frame section 9 by means of a suitable bracket 50, and it will be understood that water under sufficient pressure is supplied to these nozzles from the surface barge communicating with the apparatus. Thus, as the drums revolve, it will be seen that high speed water jets will impinge upon the cutter drums to knock off any lodged material therein, causing this material to break up and subsequently fall by gravity into the influence of the suction zone 48. By mounting the water jet nozzles 49 on the lower portion of the outer frame sections 9 it will follow that the force of the jetted water will at all times impinge upon the cutter drums regardless of the inclination of the cutter drums, since these drums are likewise attached to the outer frame sections.

All of the hydraulic and other forces required to operate the various mechanisms included in the present apparatus may be supplied thereto from a suitable surface barge by means of a surface line or umbilical cord 51, as shown in FIG. 3. Additionally, it is desirable to include suitable manual switches or valves (not shown) on the apparatus itself to enable a diver to actuate the various components of the device. When a pipeline P has been buried and it is desired to remove the apparatus therefrom, the procedure involved is exactly the reverse of that utilized in attaching the machine. With the cutter drums revolving, the forward portion of the machine is lifted by suitable cable means while the pivot/-clamping cylinders 14 are actuated to spread apart the outer frame sections and their attached cutter drums. When the pipe-riding carriage 1 is thus clear of the pipeline, the outer frame sections 9 may be reclosed as the apparatus is being raised to the surface of the water.

I claim:

1. An underwater pipeline trenching apparatus comprising, a carriage unit adapted for support upon a pipeline disposed on the floor of a body of water, said carriage including an inner frame section and a pair of outer frame sections, a plurality of support rollers on said inner frame section engageable with the periphery of the pipeline when said carriage unit is in its normal working position, said outer frame sections pivotally attached to said inner frame section for movement between an open position and a clamping position with respect to said pipeline, guide means on said outer frame sections engageable with said pipeline when said outer frame sections are in the clamping position, a rotary cutter drum attached to each outer frame section, a propulsion section disposed adjacent one end of said carriage unit, reciprocating drive means connected to said propulsion section for alternately moving said propulsion section towards and away from said carriage unit, guide members attached to said carriage unit and longitudinally extending from one end thereof, slide means on said propulsion section engaging said guide members, and clamping means on said propulsion section selectively engageable with the pipeline to lock said propulsion section thereto whereby, said drive means may be actuated to propel said carriage unit along said pipeline.

2. An underwater apparatus according to claim 1 wherein, said cutter drums are attached to the forward end of said outer frame sections and said propulsion section is joined to the rear of said carriage unit.

3. An underwater apparatus according to claim 1 including, a fluid-actuated cylinder connected between each said outer frame section and said inner frame section for selectively displacing said outer frame sections between the open and clamping positions.

4. An underwater apparatus according to claim 1 wherein, said inner frame section is normally disposed above the top of said pipeline and said support rollers engage the upper portion of the pipeline periphery, and said outer frame section guide means is disposed on the lower portion of said outer frame sections and engages the lower portion of the pipeline periphery when in the clamping position.

5. An underwater apparatus according to claim 1 wherein, each said cutter drum includes a central tube having an internal passageway extending from its bottom opening to its top opening, and a plurality of cutter bars adjacent the exterior of said tube and connected thereto by means of outwardly extending brackets.

6. An underwater apparatus according to claim 5 including, pairs of diametrically opposed cutter bars projecting from said tube, and successive pairs of said bars are angularly offset with respect to one another.

7. An underwater apparatus according to claim 6 including, pairs of said cutter bars successively angularly offset from one another from the uppermost to the lowermost of said pairs.

8. An underwater apparatus according to claim 6 including, a pair of said cutter bars extending substantially below said bottom opening.

9. An underwater apparatus according to claim 1 including, water jet nozzles supported upon said carriage and directed towards each said cutter drum.

10. An underwater pipeline trenching apparatus comprising, a carriage unit adapted for support upon a pipeline disposed on the floor of a body of water, said carriage including an inner frame section and a pair of outer frame sections, a plurality of support rollers on said inner frame section engageable with the periphery of the pipeline when said carriage unit is in its normal working position, said outer frame sections pivotally attached to said inner frame section for movement between an open position and clamping position with respect to said pipeline, guide means on said outer frame sections engageable with said pipeline when said outer frame sections are in the clamping position, a rotary cutter drum attached to each outer frame section, a propulsion section disposed adjacent one end of said carriage unit, reciprocating drive means connected to said propulsion section for alternately moving said propulsion section towards and away from said carriage unit, and clamping means on said propulsion section selectively engageable with the pipeline to lock said propulsion section thereto, said propulsion section clamping means including a pair of arcuate shoes pivotally mounted on said propulsion section, a fluid-actuated cylinder connected to each said shoe for displacing same between its locking and released positions whereby, said drive means may be actuated to propel said carriage unit along said pipeline.

11. An underwater pipeline trenching apparatus comprising, a carriage unit adapted for support upon a pipeline disposed on the floor of a body of water, said carriage including an inner frame section and a pair of outer frame sections, a plurality of support rollers on said inner frame section engageable with the periphery of the pipeline when said carriage unit is in its normal working position, said outer frame sections pivotally attached to said inner frame section for movement between an open position and a clamping position with respect to said pipeline, guide means on said outer frame sections engageable with said pipeline when said outer frame sections are in the clamping position, a rotary cutter drum attached to each outer frame section, each said cutter drum includes a central tube having an internal passageway extending from its bottom opening to its top opening, and a plurality of cutter bars adjacent the exterior of said tube and connected thereto by means of outwardly extending brackets, a suction dredge pump mounted adjacent the upper portion of said tube and communicating with said top opening, propulsion section disposed adjacent one end of said carriage unit, reciprocating drive means connected to said propulsion section for alternately moving said propulsion section towards and away from said carriage unit, and clamping means on said propulsion section selectively engageable with the pipeline to lock said propulsion section thereto whereby, said drive means may be actuated to propel said carriage unit along said pipeline.

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