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Gremillion et al.

[11] **3,710,472**

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[54] **METHOD OF ATTACHING A WORKING IMPLEMENT TO A BACK HOE BUCKET**

[76] Inventors: **Gerard S. Gremillion,** 50 East 54th Street, Kansas City, Mo. 64112; **Bert M. McMillin,** 10120 Wenonga Lane, Leawood, Kans. 66206

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[21] Appl. No.: **139,704**

[52] **U.S. Cl.**.....**29/148.3,** 29/429

[51] **Int. Cl.**.....**B21k 19/00,** B23p 19/00

[58] **Field of Search**.....29/148.3, 400 R, 429, 526

[56] **References Cited**

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Primary Examiner—Thomas H. Eager

Attorney—Scofield, Kokjer, Scofield & Lowe

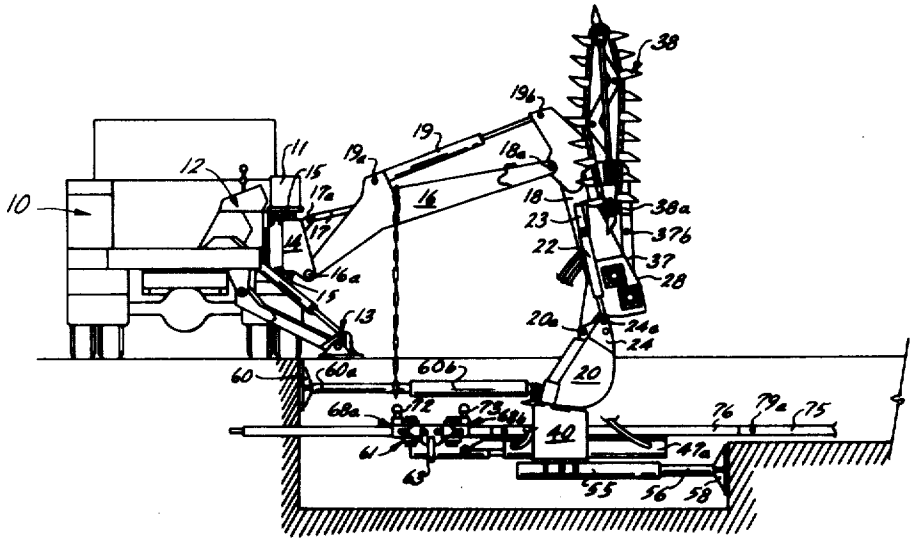
[57] **ABSTRACT**

A truck mounted hydraulically powered multiple purpose construction unit facilitates the activities of the underground contractor and the operation of municipal utilities requiring a single truck mounted unit to perform all functions relative to the construction and maintenance of various underground installations. The unit has a right rear corner boom turret mounting for maximum reach from the road shoulder. A dipper stick attaches to the boom and supports both a trencher and a back hoe bucket at the same time thereon. Each (back hoe bucket or trencher) may operate without necessitating a removal of the other from the dipper stick.

The back hoe bucket is constructed to cooperate with a number of tools or implements including a unique pipe-pusher by providing a method for quickly attaching the back hoe bucket to the corresponding implement. The implement then may be operatively positioned in the correct working environment by hydraulically positioning the boom and the dipper stick.

The selective mounting of the hydraulically movable boom and the location of the stowed position of the dipper stick, back hoe bucket, trencher and accessory tools and implements while on the truck occupy an optimum position with respect to movement of the boom about the substantially upright axis at the turrent mount and take advantage of the maximum articulated positions of the dipper stick, boom and the back hoe bucket.

1 Claim, 18 Drawing Figures



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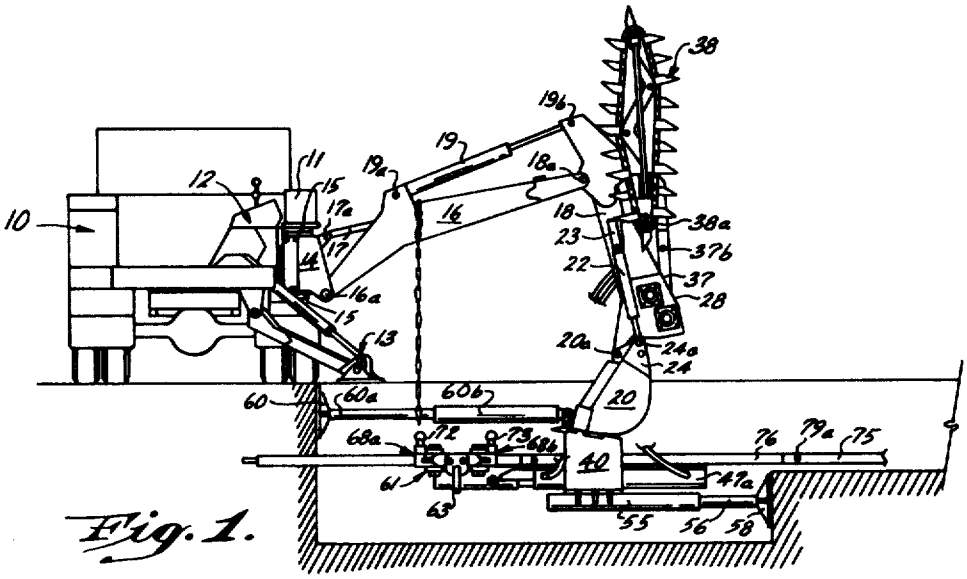
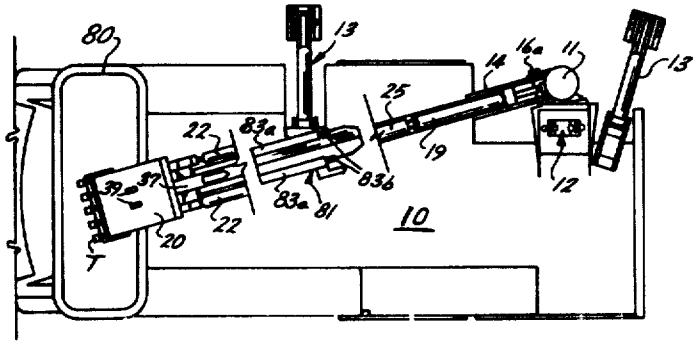


Fig. 1.



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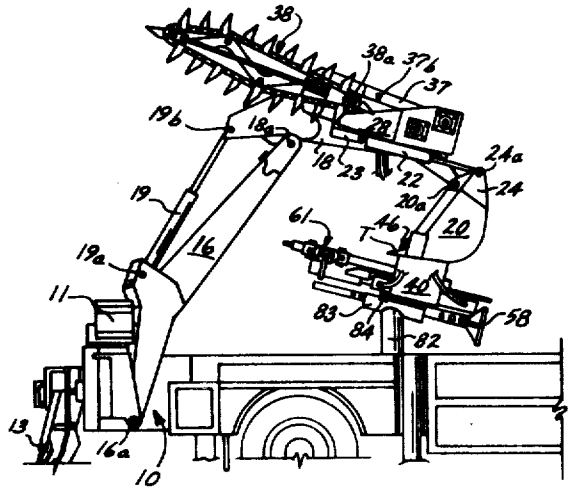
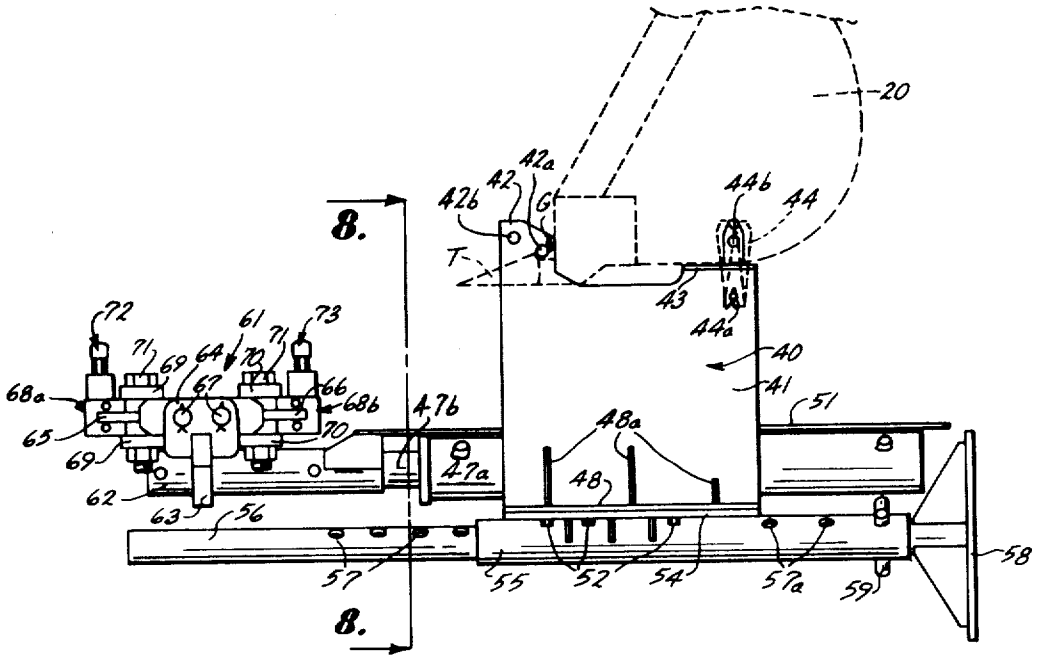


Fig. 3.

INVENTORS
Bert M. McMillin
Gerard S. Gremillion

BY Schield, Bzdyra, Schield & Lowe
ATTORNEYS



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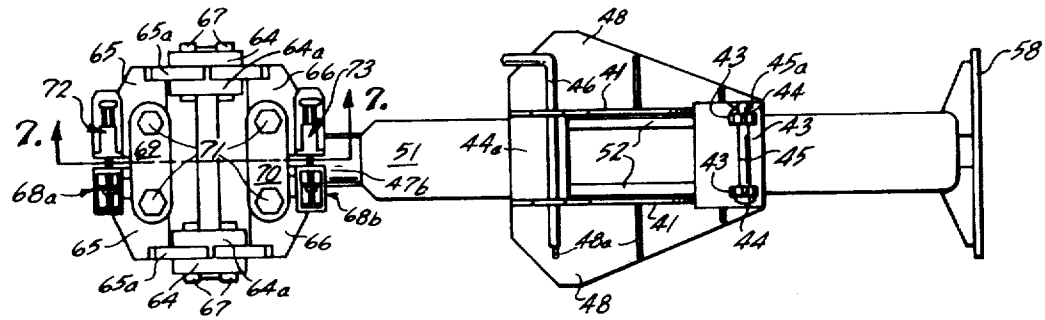

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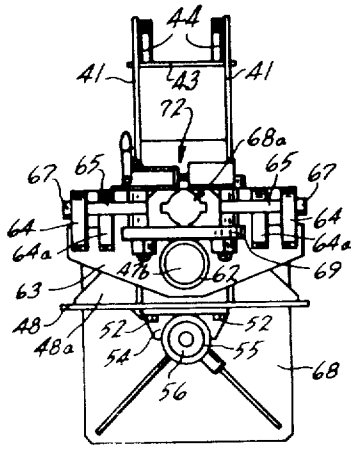
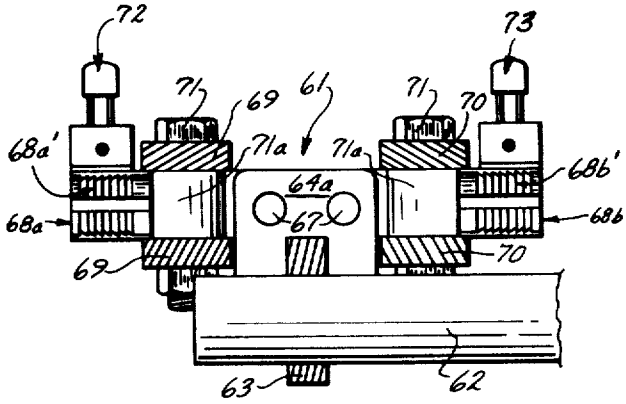


Fig. 6.

INVENTORS
Bert M. McMillin
Gerard S. Gremillion

BY Seofield, Forgue, Seofield & Lowe
ATTORNEYS



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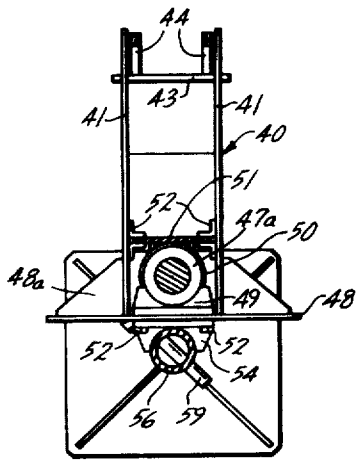

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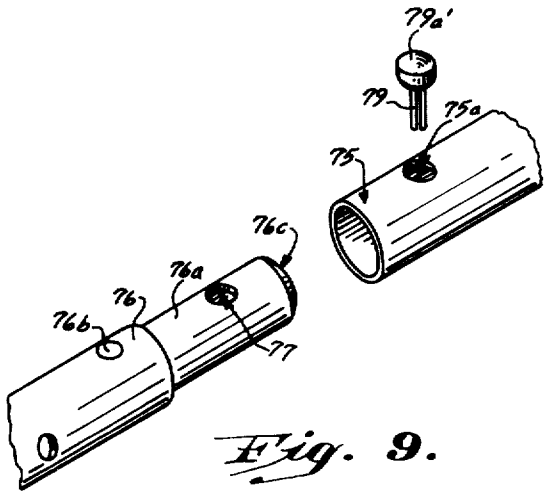

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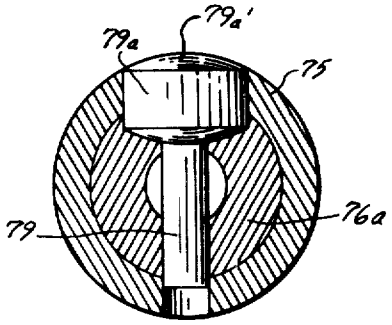


Fig. 11.

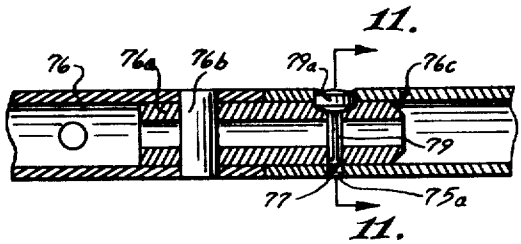
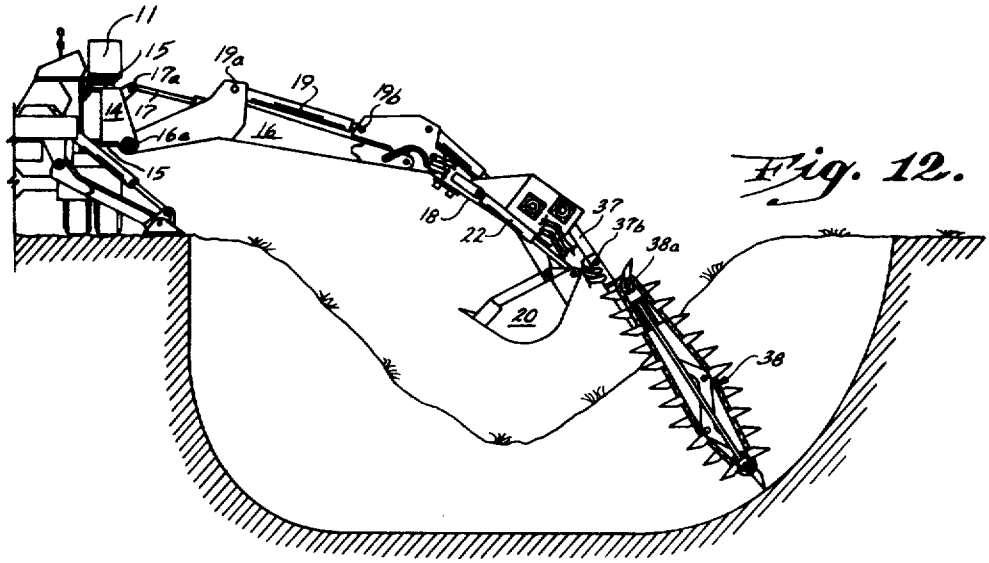


Fig. 10.

INVENTORS
Bert M. McMillin
Gerard S. Gremillion

BY Seyfarth, Hopkins, Seyfarth & Lowe
ATTORNEYS



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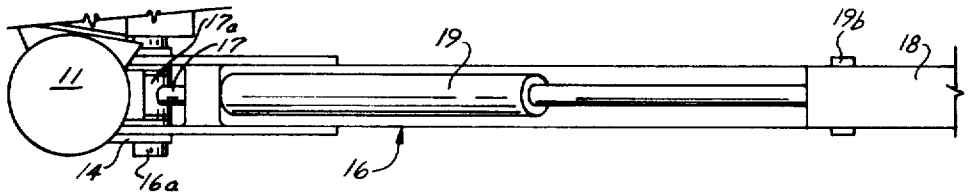

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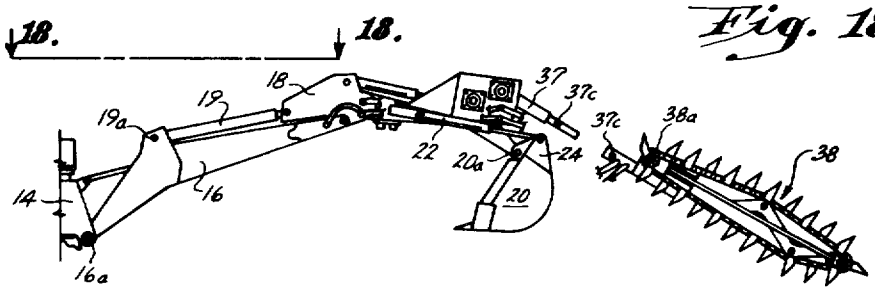

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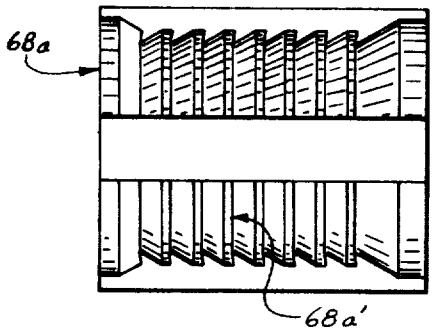
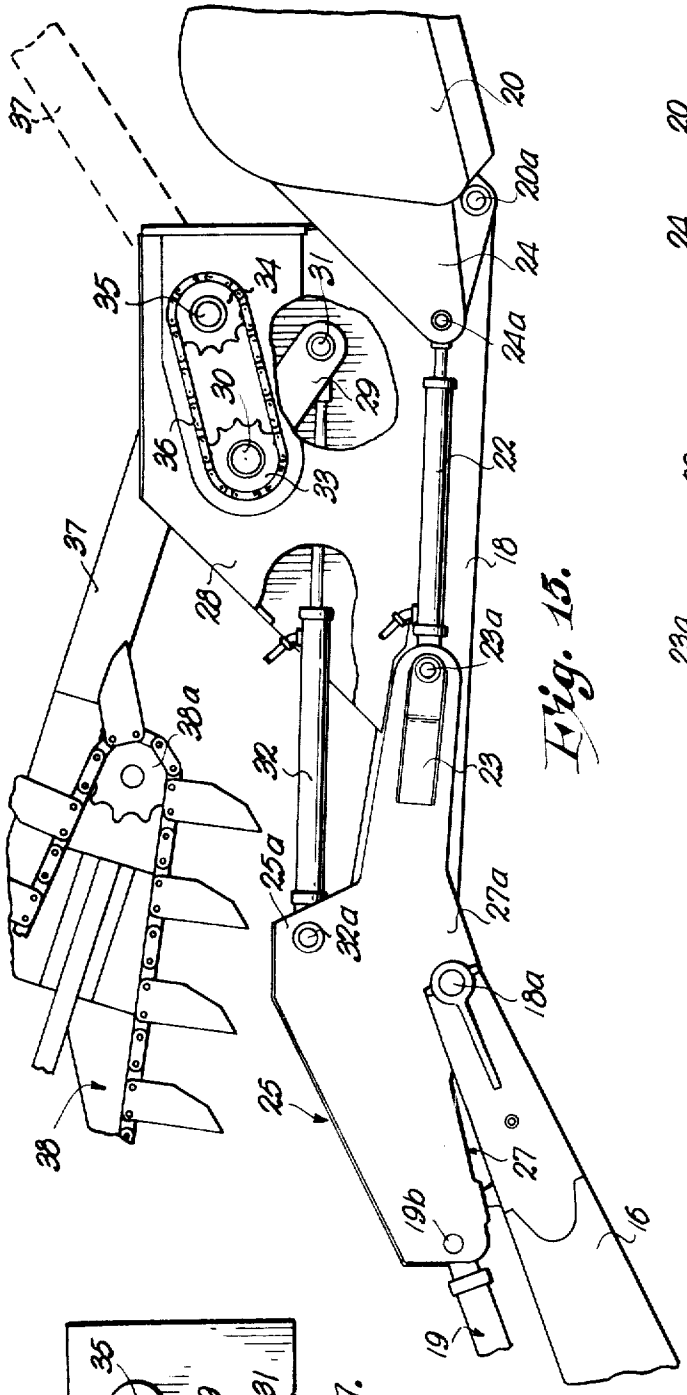


Fig. 14.

INVENTORS
Bert M. McMillin
Gerard S. Gremillion

BY Schofield, Fyfer, Schofield & Love
ATTORNEYS



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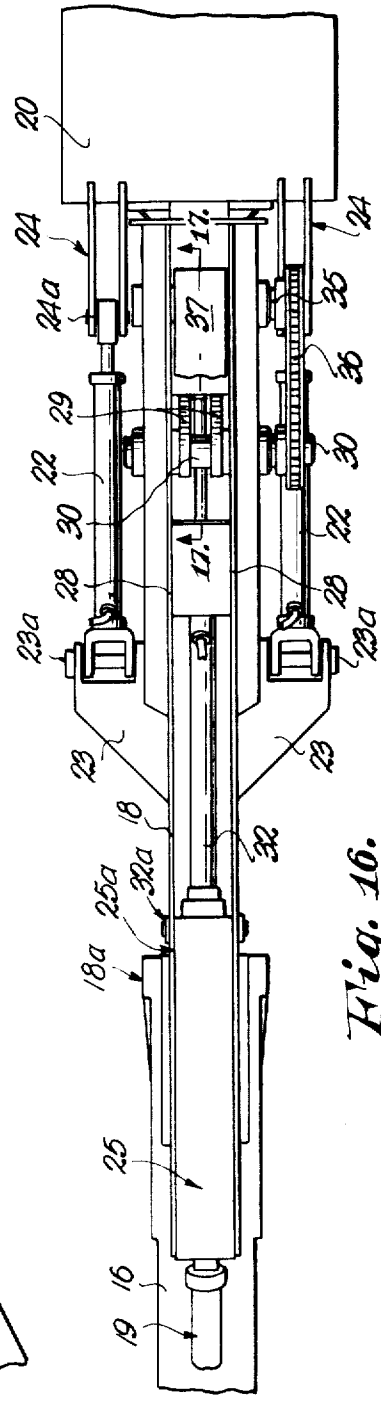

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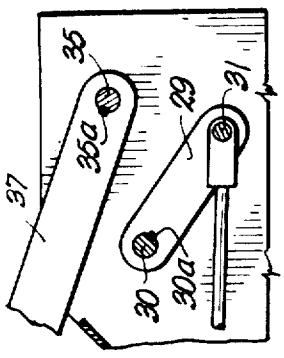

Fig. 17.

INVENTORS.
Bert M. McMillin
Gerard S. Gremillion

BY Scofield, Kokjer, Scofield & Lowe
ATTORNEYS.

METHOD OF ATTACHING A WORKING IMPLEMENT TO A BACK HOE BUCKET

BACKGROUND AND BRIEF DESCRIPTION OF THE INVENTION

The subject truck mounted hydraulically powered multiple purpose construction unit is specifically designed for use by underground contractors or to facilitate the installation of the various underground works required by municipal and public utilities. Prior art units included the separate and individual utilization of a back hoe generally supported by and operated with a conventional tractor chassis, a trencher which is often times substituted for the back hoe bucket and a hydraulic pipe-pusher for pushing bars or pipes through the soil generally beneath road beds. This type of equipment required several people to operate same and additionally called for at least a portion of the equipment to be trailered behind the principal prime mover or for a plurality of prime movers to assist and associate with each type of construction activity being performed. Further, the task of changing the back hoe bucket to a hydraulic trencher was a time consuming laborious job that required several workmen.

The present invention has successfully eliminated many of the above-mentioned shortcomings to underground construction activities and has done so, in part, by the unique construction of the truck mounted boom structure and related features. By mounting the boom turret at the right rear corner of the truck frame, maximum reach is provided outwardly from the road shoulder to perform the necessary construction tasks. The lower boom is hingedly connected to a swinging boom frame with the same being powered by a hydraulic rotary motor of conventional design. This lower boom is hydraulically movable both up and down and about a substantially upright axis. The outer end of the lower boom is pivotally connectable with the dipper stick. A hydraulic piston and cylinder assembly interconnect the lower boom with the dipper stick to give finger tip control over the articulated movement of the two booms. The dipper stick is uniquely constructed to simultaneously support the back hoe bucket and the hydraulically operated trencher thereon without necessitating the removal of either one for normal operation of the other. Finally, the positioning of the boom and the specifically designed maximum and minimum throws of the associated hydraulic pistons and of the rotary motor and swinging frame permit the entire boom assembly to be moved to various limit positions for both stowing and attachment with needed accessories.

One of the primary features of the invention includes the ability to quickly attach the back hoe bucket to an accessory such as the pipe-pusher. This quick attachment feature is facilitated in part by a pair of spaced apart holes in a portion of the bucket. The required implement (such as the pipe-pusher) is provided with a pair of outwardly extending loosely attached ears that are arranged in spaced apart relationship and alignable with the openings in the bucket so that when appropriately positioned the ears will extend through the bucket holes permitting same to be pin connected thereto. Spaced away from the upstanding ears mentioned above, the implement has an appropriately contoured shape with two spaced apart plate portions that are appropriately apertured to permit a second locking pin to be extended therethrough. This second locking pin abutts a back or rear groove in the bucket teeth to cooperate with the pin through the upstanding ears to fixedly attach the implement to the bucket. At this time, the implement may be appropriately moved by hydraulically initiating movement of the lower boom and the dipper stick to the needed location.

The pipe-pusher is a hydraulically powered mechanical device which operates to push continuous lengths of pipe or push bar sections to facilitate making road crossings through the heaviest of soil quickly and easily. The pusher assembly includes a pusher head mounted to a hydraulic cylinder. As suggested above, the hydraulic cylinder installs into a frame which attaches to the back hoe bucket thereby providing same with the maneuverability of the bucket itself. The uniquely constructed pusher head permits the push bars or the pipe to be fed into a guide on top of the hydraulic cylinder. The jaws of the head clamp onto the pipe as it is pushed forwardly and easily released as the cylinder retracts its piston. An operator need only continually attach sections of the pipe or push bars as the unit operates to extend same into the soil. Also, a cleat plate is provided at one or both end extremities of the pipe pusher for anchoring the unit into the soil during operations. These adjustable braces associated with the cleat plate isolate the dipper stick and the bucket from full pusher resultant forces and blocks out any movement from slack in the dipper stick, bucket and cylinder pivot points.

The push bars, designed to be utilized with the abovedescribed pusher unit, are constructed to maintain a constant outside diameter during the continuous operation of the unit and are interconnected in a unique fashion. The bars have a male and female end with suitable apertures being alignable in both to receive a roll pin having a thrust head weldedly attached thereto. Once the male end has been inserted into the female end with the holes in the aligned position, the roll pin with thrust head thereon is driven through the aligned hole so that the head of the pin extends from the outside diameter of the outer surface of the interconnected female rod end to a location near the inner surface of the male member. The pins are removed by hammering the end opposite the headed end out of the aligned apertures and are reusable.

One of the primary objects of the invention is to provide a uniquely constructed truck mounted construction unit that is simple to operate and inexpensive to manufacture while at the same time being extremely versatile in its utilitarian functions.

Another object of the invention is to provide a truck mounted construction unit of the character described which has extended the operational limits of a wide range of associated implements. It is a feature of the invention that the articulated boom structure is located relative to the truck frame so as to optimize the positioning of the working implement on the end thereof.

A further object of the invention is to provide a uniquely constructed boom or a truck mounted construction unit having both a back hoe bucket and a trencher mounted thereon. It is a feature of the invention that the back hoe bucket and the trencher are

mounted on the subject boom at the same time and individually controllable to thereby move same into an operative position without requiring the removal of one while the other implement (either the back hoe bucket or the trencher) is being utilized.

Another primary object of the invention is to provide a uniquely constructed labor saving device for use in the construction and utility industry. The usability of the device is enhanced by the unique connecting means that facilitates the attachment of the working implement to a back hoe bucket that is part of the device.

A still further object of the invention is to provide a unique method of attaching a working implement having a frame and structure to a back hoe bucket said method comprising the steps of

hydraulically moving said bucket to the proximity of said implement,

placing a portion of said implement frame structure interiorly of said bucket,

connecting said interiorly placed portion in said bucket with a pin, and

connecting said frame with a pin at a second bucket portion.

Another object of the invention is to provide a unique means for attaching a working implement to a hydraulically operated bucket similar to that used with conventional back hoes. This feature is both a labor and equipment saving device in that a hydraulic boom having the above-described bucket thereon maybe used to optimize the positioning of heavy working implements which heretofore required either a substantial manual effort or the use of individualized positioning equipment.

Another primary object of the invention is to provide a uniquely constructed pipe or rod pusher which operates to continuously push either pipe or push rods through surfaces such as road beds. An important feature of this invention resides in the ability to continuously push the pipe or the push rods with strokes of selectable lengths with a minimum of attendant personnel.

Another object of the invention is to provide a uniquely constructed push rod that permits the quick and easy attachment of the same or similar rods without increasing the outside diameter of the rod yet maintaining the needed strength at an associated joint.

A still further object of the invention is to provide a unique interconnecting means for the push rods mentioned above and includes a roll pin having a thrust head fixedly attached thereto and operable to be wedged between the inside and outside diameter of the interconnected push rods.

Other and further objects of the invention together with the features of novelty appurtenant thereto will appear in the course of the following description.

DETAILED DESCRIPTION OF THE INVENTION

In the accompanying drawings, which form a part of the specification and are to be read in conjunction therewith and in which like reference numerals are employed to indicate like parts in the various views:

FIG. 1 is a rear elevational view of the truck mounted construction unit with the pipe pusher shown attached to the back hoe bucket;

FIG. 2 is a top plan view of the truck mounted construction unit with the bucket and boom structure in the stow position and with a portion of the dipper stick broken away to show the cradle mount for the pipe-pusher;

FIG. 3 is a partial side elevational view of the truck mounted construction unit showing the articulated boom structure in position to remove the pipe-pusher from its cradle or to return same thereto and with the trencher mechanism thereattached;

FIG. 4 is a side elevational view of the pipe-pusher with the back hoe bucket shown in broken lines for illustrating the quick attach feature;

FIG. 5 is a top plan view of the pipe-pusher shown in FIG. 4;

FIG. 6 is an end view of the pipe-pusher shown in FIGS. 4 and 5;

FIG. 7 is a sectional view of the pipe-pusher head taken generally along the line 7—7 of FIG. 5 in the direction of the arrows;

FIG. 8 is a sectional view taken generally along the line 8—8 of FIG. 4 in the direction of the arrows;

FIG. 9 is a perspective view of the male and female ends of the push rods along with the connecting pin utilized therewith;

FIG. 10 is a sectional view of the push rods shown interconnected;

FIG. 11 is a sectional view taken along the line 11—11 of FIG. 10 in the direction of the arrows;

FIG. 12 is a partial schematic and elevational view of the construction unit utilizing the trencher mechanism;

FIG. 13 is an elevational view of the hydraulic boom structure and trencher mechanism showing the trencher mechanism removed from the trencher boom;

FIG. 14 is an enlarged elevational view of the forward or left-hand view of the pipe-pusher shown in FIG. 7;

FIG. 15 is a side elevational view of the dipper stick with portions of the trencher stow mechanism housing broken away to clearly illustrate interior portions thereof and with the broken lines indicating an alternative location of the trencher boom;

FIG. 16 is a top plan view of the dipper stick shown in FIG. 15 with the trencher and trencher boom broken away for clarity;

FIG. 17 is a sectional view of the trencher stow mechanism taken along the line 17—17 of FIG. 15 in the direction of the arrows; and

FIG. 18 is an enlarged top plan view of the lower boom and the hydraulic motor shown in FIG. 13 looking along the line 18—18 thereof.

Turning now more particularly to the drawings, reference numeral 10 generally indicates a truck having a specially designed chassis or frame for optimizing the utilization of the attendant structures mounted and supported thereon. A hydraulic actuator motor 11 is located at the right rear corner of the truck and is of known design such as that manufactured by the Cessna Aircraft Company of Wichita, Kans., under the name of "Rotary Actuator" and covered by U.S. Pat. Nos. 3,269,737 and 3,396,635. A control console 12 is located adjacent the actuator motor 11 and contains the necessary instruments to effect hydraulic control over the various attachments and the hydraulic booms that will be described, infra. The curb side of the truck

(attached to the right side of the subframe of the truck as it appears looking forwardly) has two hydraulically operated folding outriggers **13** attached thereto while the opposite side has a street side stabilizer jack (not shown) positioned to cooperatively stabilize and support the truck and boom attachments during the operation of the construction unit.

As suggested above, the hydraulic actuator motor **11** is pedestal mounted at the right rear corner of the truck and operates to rotate later described booms through a maximum arc of 200°. The motor **11** has a substantially vertical spline shaft (not shown) depending therefrom to fixedly engage a swinging frame **14**. The frame **14** is located between a pair of pivot castings **15** and is primarily comprised of a pair of spaced apart side wall lobes **14***a* with a back wall weldment interconnecting the two. Accordingly, the control console **12** may be selectively manipulated to cause motor **11** to swing the swing frame **14** from a stow position shown in FIG. **2** and from thence, over curb side of the unit through a 200° arc to a line 5° to the left of a line parallel to the unit longitudinal center line over the rear. A lower boom **16** is pin connected at **16***a* to the swing frame in the lower lobe region of the frame and permits to move up and down about a horizontal axis through pin **16***a*. This up and down movement is facilitated by means of a hydraulic piston-cylinder assembly **17** with the piston end pin connected at **17***a* to swing frame **14** and the cylinder end similarly connected (not shown) within the boxed weldment (same being rectangular in cross section) that comprises the lower boom design.

The dipper stick **18** is actually another boom that is pivotally connected to the lower boom **16** by pin **18***a* and is pivoted on same by the hydraulic piston-cylinder assembly generally shown by the numeral **19**. This dipper stick cylinder **19** is pin connected at **19***a* to the spaced apart raised box weldment of the lower boom **16** with the piston end being pin connected at **19***b* to the rearmost end portion of the dipper stick boom **18**. Accordingly, the hydraulic piston-cylinder assembly **19** is operable to articulate the dipper stick about pin **18***a* while the combined unit boom structures **16** and **18** are movable about pin **16***a* in accordance with the selective operation of the control console **12**.

As suggested above, the dipper stick **18** is constructed in a unique fashion to support two working implements simultaneously thereon while a single implement is positioned in the operating position. For instance, back hoe bucket **20** is connected with the outer end of the dipper stick by hinge pin **20***a*. A pair of hydraulic piston-cylinder assemblies **22** are located on either side of dipper stick **18** and operate to bucket **20** about the hinge pin **20***a* in accordance with the desired operation of same. To facilitate the mounting of the hydraulic cylinders, angled brackets **23** extend outwardly on either side of dipper stick **18** at the approximate thereof and support the pin interconnects **23***a* with the cylinder portion of the assemblies **22**. The piston end of the assemblies **22** interconnect with lobe brackets **24** which are weldedly attached to the rearward portion of bucket **20** and are spaced apart to permit the pin interconnects **24***a* to extend therethrough. It should be noted that the bucket **20** located in its retracted most position as shown in FIG. **5**, a plane from hinge pin **23***a* through cylinder piston assembly **22** and hinge pin **24***a* lies above the longitudinal plane through dipper stick **18** and bucket hinge pin **20***a* thereby assuring a mechanical advantage and in that the forward movement of the piston of assembly **22** will articulate bucket **20** about hinge pin **20***a*.

As suggested above, the dipper stick is constructed of boxed weldment having a rectangular cross section and includes support structure for a later described trencher boom and trencher stow mechanism. The rear or inner end of dipper stick **18** that pin connects to the hydraulic piston cylinder assembly **19** extends upwardly at an angle (FIG. **15**). That portion of the dipper stick surface as seen from above as in FIG. **16** and identified by the numeral **25** terminates in a spaced apart bracket area identified by the numeral **25***a* for the purpose of interconnecting the cylinder portion of a hydraulic piston and cylinder assembly **32** in the proper position to operate the trencher stow mechanism as will be described. The under portion of the dipper stick opposite the inclined weldment **25** and hereinafter identified by the numeral **27** is likewise inclined upwardly (as shown in FIG. **15**) and eventually forms the spaced apart lobes **27***a* that facilitate the interconnection of the outer end of lower booms **16** with the dipper stick thereat by the hinge pin **18***a*. As viewed in FIG. **15**, the dipper stick then extends in a substantially horizontal plane along the lower end thereof eventually terminating in the hinged interconnect with bucket **20**. The upper surface of dipper stick **18** past the bracket support area **25***a* is tapered somewhat to maintain uniform stress levels and then supports the upstanding weldment spaced apart plates identified by the numeral **28** which form a supporting structure for the trencher stow mechanism.

The trencher stow mechanism mentioned above is comprised of a pair of legs **29** that are fixedly connected to shaft **30** by **30***a*. The shaft **30** extends through suitable bearinged apertures in plates **28** with its axis being substantially horizontal. The lower portions of the legs **29** support push bar **31** therebetween. The piston end of the hydraulic piston cylinder assembly **32** is journalled thereon with a sufficiently loose fit to permit the push bar **30** to rotatively turn therein as the piston is moved either fore or aft with respect to the dipper stick. The cylinder end of assembly **32** is pin connected at **32***a* so as to permit the cylinder to swing thereon in a limited arc as will be described.

The rotatable shaft **30** of the trencher stow mechanism extends outwardly beyond the vertical plane of one of the plates **28** as shown in FIGS. **15** and **16** in order to accommodate a sprocket **33** that is fixedly attached thereto. Another sprocket **34** is located upwardly and to the right (as seen in FIG. **15**) of sprocket **33** and is fixedly attached to a shaft **35**, same being located between the two plates **28** with the apertures therein having suitable bearings to facilitate necessary rotative movement of the shaft **35**. The bicycle or roller type chain **36** interconnects sprocket **33** and sprocket **34** to impart a rotary motion to shaft **35** due to the movement of legs **29** by the piston of assembly **32**. The trencher boom **37**, however, is fixedly attached to shaft **35** by key **35***a* so that any rotary motion thereof likewise results in the rotation of the trencher boom **37**. In actual practice, the trencher boom will rotate slightly less than 180° from a stow

position shown in FIG. 1 to an operating position shown in FIG. 12.

It should be pointed out that the trencher boom is substantially rectangular in cross section and reduced in size at outer end thereof (the reduced end portion being identified by the numeral 37*a* in FIG. 13) to facilitate the telescoping interconnect with various working implements such as the trencher which will be described in more detail. However, other implements such as a posthole digger or auger could be attached in place of the trencher and pin connected by placing a latch pin 37*b* through alignable holes 37*c*.

The trencher itself is generally represented by the numeral 38 and is of a conventional design, same being operated by a hydraulic motor (not shown) and chain drive sprocket 38*a* which mounts directly to the hydraulic motor shaft output. The motor provides a sufficient output torque and chain speed for efficient digging. It is, of course, possible to extend or vary the digging operation and to lengthen the boom for a deeper cut if desired by having a plurality of positions along the telescoping boom for attachment thereto. The conventional hydraulic lines may be of the quick connect variety and attached to the trencher hydraulic motor whenever appropriate so that the console operator has full control over the operations of the trencher and the hydraulic means described above for positioning same.

BACK HOE ATTACHMENT TO WORKING IMPLEMENTS

A very significant feature of construction unit lies in its ability to quickly attach the back hoe bucket to various types of working implements and to utilize the boom structure for the positioning of the particular implement. To accomplish the quick attachment mentioned above, the bucket 20 is provided with a pair of holes 39 (see FIG. 2) which are selectively sized and spaced as well as being located in the relatively flat forward surface of the bucket. Each implement will have a frame, similar to that shown in FIG. 4 and designated by the numeral 40, attached thereto. This frame includes spaced apart side walls 41 as shown in FIGS. 4 and 5 with the upper left-hand portion 42 of each of the spaced apart side walls 41 including being apertured at 42*a*. The right-hand upper portion of the frame 40 has a plate 43 spanning the walls 41 with a pair of rectangularly shaped (as seen from above) holes 43*a* therein. Each one of the holes 43*a* has an upright ear member 44 which is fixedly mounted to shaft 44*a* located below plate 43 and spanning the distance between the side walls 41. Each ear is permitted to swing loosely on the shaft 44*a* within its corresponding oversized rectangular hole 43*a* but is limited in the movement therein by the dimensions of the hole.

From the above, it can be seen that the frame 40, supportingly connected to a working implement such as the pipe-pusher which will be described later, is quickly and easily attached to the back hoe bucket 20 having the necessary and properly spaced holes 39 therein. For example, the bucket 20 is first positioned hydraulically by movement of the above-described hydraulically controlled boom to the upper surface of the frame 40. Since both the holes 43*a* in the frame plate 43 and the bucket holes 39 are oversized with respect to both the ear members 44, the position of the bucket with respect to the upstanding ear members may be somewhat variable and exact alignment is not critical. Therefore, the bucket is dropped downwardly to a position shown in FIG. 4 with the ear members protruding through the holes 39 in bucket 20. At this time, a latch pin 45 may be inserted through aligned holes 44*b* in the ear members 44. A spring clip 45*a* may be utilized with the smaller end of a locking pin member 45 to insure that the locking pin member 45 does not inadvertently slip out. At the same time that bucket 20 aligns itself with the upright ear members, the bucket teeth (identified by the letter T) comes to rest with the flat surface thereof on a front plate 44*a* which spans the upright walls 41 at the upper left-hand portion 42 below the aperture 42*a*. The structure of the teeth T is such that a groove portion G is formed in between the forwardmost lip of the bucket itself and the end of the teeth angulation. Groove G permits an L-shaped latch pin 46 to be inserted through the aligned apertures or holes 42*a* to thereby fixedly locate the forward portion of the bucket with respect to the working implement. Of course, when the bucket is hydraulically raised and the two described latch pins seat against the respective frame portions and bucket areas and the working implement is fastly held so that same may take on all the hydraulic position-ability of the bucket itself.

PIPE PUSHER

Turning now more particularly to the pipe pusher itself, FIGS. 4 through 8 illustrate the unique features embodied within same. One of the principal portions of the pipe-pusher is the hydraulic cylinder and piston assembly represented by the numerals 47*a* and 47*b*, respectively. The frame 40 has a lower plate 48 weldedly attached to the lower end portions of side walls 41 with stiffening gussets 48*a* included therebetween. The cylinder 47*a* is fixedly attached to the upper surface of plate 48 between walls 41 by a mounting pad 49. A similar pad 54 is attached to the underside of plate 48 for holding a stiff leg or bracing sleeve discussed later. Both pads are bolted to plate 48 by bolts 53. Finally, a horizontal guide or surface plate 51 is provided for the pipe or push rod at a proper elevation above the cylinder and is supported relative to the inner surfaces of the side walls 41 by angled brackets generally represented by the numeral 52.

As suggested above, the bolts 53 extend through a mounting pad 54 as well as through mounting pad 49. The pad 54 fixedly and rigidly attaches a stiff leg weldment telescoping collar to the lower portion of the frame 40. An extendible rod or stiff leg 56, being selectively apertured at 57 along the length thereof, slidably fits within collar 55 with the alignable holes 57*a* on the rear or righthand (as seen in FIG. 4) end portion thereof. A cleat plate 58 is located on the end of the extendible rod 56 to facilitate the anchoring of the pipe-pusher unit into the soil. Latch pin 59 permits the extendible rod 56 and cleat plate to be quickly and easily set in place by removing the pin and then replacing same through the appropriate alignable apertures in the collar (57*a*) and in the extendible rod (57). Finally, shown in FIG. 1, an additional cleat plate 60 and combination rod 60*a* and collar 60*b* may extend forwardly from the pipe-pusher frame for additional support by

pin connecting same through the frame holes **42***b*. However, it should be noted that the pipe-pusher unit is still supported from the back hoe bucket **20** by the above-described quick attach feature and generally the use of a single rearwardly extending cleat plate and telescoping rod is sufficient for most pushing operations.

The pipe-pusher head is generally indicated by the numeral **61** and is shown in detail in FIGS. **4** through **7** with FIG. **14** being an enlarged view of one side portion of the jaws used therein. As mentioned above, the pipe-pusher head **61** is mounted onto the outer end of the piston **47***b*. This mounting is accomplished by weldedly attaching a sleeve **62** on the outer portion of the piston. The yoke member **63** extends transversely to the center line of the piston and the sleeve combination and provides a supporting surface for the upper portion of the pusher head. Further, the outer end portions of yoke **63** have lugs **64** either cast of weldedly attached thereto with bracketing lugs **64***a* being of a similar size and shape but spaced inwardly therefrom. A pair of forward pivot arms **65** and a pair of rear pivot arms **66** are attached to the lugs **64**. For example, the two forward pivot arms each have a lug attachment **65***a* locateable between the forward portions of the lug combination **64** and **64***a* while the two rear pivot arms have lug attachments **66***a* locatable between the rearward half portions of the lug combination **64** and **64***a*. Further, the cooperating lugs **64**, **64***a* and **65***a*, **66***a* are either pin connected at **67** or bolted thereto. In any event, the selected spacings between the upright lug brackets **64** and **64***a* are suitable to permit some degree of movement of the pivot arms **65** and **66** as will be described so that when one of the jaws engages the rods of pipe being pushed, the harder to push the more tightly that you grasp the pipe or rod.

The four pivot arms, which are weldedly attached at their outer edge portions to a corresponding vertically oriented intermediate lug **65***a* or **66***a* operatively occupy a substantially horizontal plane as shown in FIG. **6** and have the pipe or push bar engaging jaws **68** welded to the inner end portions thereof. For purposes of identification, the two separable jaw units forming the forward jaw is identified by the numeral **68***a* while the two separable jaw units forming the rearward jaw is identified by numeral **68***b*. It is, therefore, seen that each pair of pivot arms has a jaw **68***a* or **68***b* which was properly oriented, cooperate to selectively engage the pipe or the push rods at either the outer or inner end of the pusher head depending on how the later described clamps are set.

Each pair of pivot arms **65** and **66** is interconnected by pivot links **69** and **70**, respectively. Each set of pivot links (there being an upper and a lower link for each set of pivot arms) has a nut and bolt combination **71** extending through an annular spacer collar **71***a* in each corresponding pivot arm to not only connect the inner end portions of the pivot arm by the link structure but also to space the pivot links a preselected vertical (as seen in FIG. **7**) distance apart. The outer end portions of each jaw unit is connected by a push-pull clamp with the forward jaw **68***a* having push-pull clamp generally shown at **72** being located thereon while the rearward jaw **68***b* has push-pull clamp **73** attached to the upper surface thereof. These push-pull clamps are manufactured by the Lapeer Manufacturing Company of Detroit, under the trademark "KNU-VISE" and are further designated as a push-pull clamp-P&P800.

As stated above, the jaws **68***a* and **68***b* operate in pairs to selectively engage the pipe or push rod being utilized by the subject pusher. As shown more clearly in FIG. **7** and **14**, the teeth of the forward jaws **68***a* are oriented in an opposite direction with respect to the jaw teeth shown as comprising the rearward jaw **68***b*. Stated another way, the teeth in the forward jaw **68***a* have a squared off edge **68***a'* facing the push rods as same would move forwardly with sloping sides which taper off at approximately 30° from the edge. The teeth in jaw **68***b* have to be squared off edge **68***b'* facing the push rods' movement when same would be pulled out of the soil. For example, when the pipe or push rods are being hydraulically pushed forward or through the soil (as contrasted to pulling the pipe or push rods out of the soil), the forward push-pull clamp **72** will be opened thereby causing the jaw **68** to be substantially disengaged from grabbing the pipe or push rods moving therethrough. The rearward clamp **72**, however, is closed causing the teeth of jaw **68***b* to engage and contact the pipe at this location.

It should be pointed out that the pusher head **61**, including the pivot arms **65** and **66** are not rigidly connected so that lateral movement of the jaws with respect to the push rod axis is both permitted and desired. Accordingly with either clamp set, the corresponding jaw will be sufficiently skewed to bind, engage or otherwise contact the push rod so that the jaws will grip to the rod tighter as the push becomes harder.

With the teeth in the rear jaw **68***b* being oriented at a substantially right angle to the axis of the pipe or push rod and with the jaw units, as seen from the end, being semicircular, the teeth, therefore, contact the cylindrical pipe or rods along arcuate segmented portions of the outer surface of same. Therefore, when the hydraulic cylinder **47***a* is actuated to extend piston **47***b*, the jaw **68***b* engages that portion of the pipe or rods therein and drives or pushes the pipe or rods a distance determined by the piston's (**47***b*) movement. After the pipe or push rods have been pushed the preselected distance (determined either by the operator or by the piston stroke), the jaw teeth are so angled that rearward movement of the pusher head may be accomplished without pulling the pipe or push rods back out of the soil. (Note that the frictional contact with the soil is sufficient to retain the pipe or rod at its prior pushed position.) Assuming that the piston had been retracted a preselected distance or a stroke, the rear clamp being already set needs no further attention as the jaw teeth at jaw **68***b* once again contact and engage the pipe or rods during the forward movement of the piston **47***b* thereby facilitating the continuous pushing of the rods. Of course, additional rod lengths are easily added when necessary as will be described in conjunction with the push rod description.

After a sufficient length of pipe or rods have been pushed through the road bed and it is desired to retrieve same, the reverse process may be performed. In other words, the forward clamp **72** may be set to engage the pipe and the rear clamp loosened. In this manner, the teeth of the forward jaw **68***a* are also oriented transverse to the longitudinal direction of the

pipe or push rods' desired movement. As the forward jaw **68***a* skews to contact the pipe, retraction of piston **47***b* pulls same from the soil. Once in a retracted position, the piston allowed to extend without movement of the pipe or rods due to the angle or slope of the teeth (see FIG. **14**) until the piston is extended its preselected distance. At this time, the jaw **68***a* again contacts the push rods to remove same from the soil a full distance stroke length or any intermediate distance determined by the operator thereof. It should be pointed out that if the jaws would for any reason malfunction, the pipe or rods may be inserted within the outer or forward end of sleeve **62**, the pusher raised by the above-described hydraulic boom and the pushing continued by actuation of cylinder **47***a*.

PUSH RODS

Turning now more particularly to the uniquely constructed push rod used with the pusher described above and the method of interconnecting same, FIGS. **9–11** clearly illustrate this concept. The push rod is conveniently sized in that the diameter, weight, and length are selected so that a single workman is able to handle same. Further, with the unique method and apparatus for attaching the sections of pipe, the use of the construction unit described above is substantially enhanced in that the pipe sections are easily placed into compartments within the truck chassis and withdrawn therefrom when needed.

The push bars, as shown in the above-mentioned figures, are designed to slip fit and to be pinned together thereby eliminating problems with cross threading or worn-out threads. Each length of push rod has a female end designated by the numeral **75** and which is suitably apertured through its diameter in communicating relationship therewith and extending from the outside through the inside diameter of the rod at **75***a* with a larger opening **75***b*. The male end of the rod length is comprised of two different diameter tubular end portions, **76** and **76***a*, with **76** indicating the larger diameter portion and with **76***a* being smaller with the smaller portion. The portions are pin connected at **76***b* together. The forwardmost end of the male rod portion is chamferred at **76***c* to facilitate the easy fit within the female end **75**.

The male end further has a tapered hole **77** extending through the diameter of same that will be in communicating relationship with the similarly oriented hole **75***a* in the female end portion when the male end portion is fully inserted therein. Therefore, when the male end is slipped into the corresponding female end, tapered hole **75***a* align with the tapered hole **77** and a combination roll pin and thrust head (**79** and **79***a*, respectively) lock the two portions together.

It is significant to note that the unique roll pin **79** and thrust head **79***a* are integrally formed and driven into place through communicating holes so that the thrust head is wedged in the tapered holes between both the outer diameter tubular portion of the female end and the reduced diameter male end as shown in FIGS. **10** and **11**. Also, the thrust head has a crown **79***a'* of the same diameter as the rod itself thereby insuring that the jaw teeth do not inadvertently crimp the sides of what otherwise would be a recess in same were it not for the crown. Finally, the pin and head is easily removed by hammering on a tool at the end opposite the thrust head through aligned holes **75***a* and **77** and may be readily reused.

As suggested above, the construction unit including the location of the rotary motor **11** and the selected boom lengths coordinate with the over-all unit to optimize the use thereof. The location of bucket **20** in FIG. **2** is the stow position that the boom structure occupies for road travel etc. In this position, the bucket **20** rests on a frame **80** which is located over the truck cab. Coincidentally, dipper stick **18** is moved to its upper limit position, the boom **16** is raised clear the cab frame **20** and swung to the left limit position (as viewed by looking forwardly), and thence lowered upon frame **80**. By utilizing this procedure, the operator need not observe either the bucket or the boom but may operate the control console "blind" and accomplish stowing.

An added feature of the invention is the location of the pipe-pusher cradle hereinafter identified by the numeral **81** and shown in FIGS. **2** and **3**. The cradle is basically comprised of a substantially upright mounting post **82** which is welded to the deck of truck **10** at a location that is in line with bucket **20** in its stow position (as seen in FIG. **2**) and the motor **11**. An open ended V-shaped trough (as seen from the end or in section) is attached to the mounting post **82** and is identified by the numeral **83**. This elongated V-shaped trough has the flanged upper supporting areas **83***a* on each edge portion thereof which cooperate with the edge portions of the lower plate **48** of the pipe pusher to supporting the weight of same. Flanges **83***a* are located forwardly of a pair of opposed upstanding ears **83***b*, each of which has a suitable aperture therein to permit a latch pin to be inserted therethrough. The depth of the V-shaped trough is such that most if not all of the weight of the pipe-pusher is carried on the flanges **83** *a* from the lower plate **48** of the frame **40**. This enables the stiff leg collar **55** to be positioned within the cradle without putting any excess weight on same. At the same time, the latch pin **84** will extend through the apertured ears **83***b*, through a locking sleeve (not shown) located between hydraulic cylinder **47***a* and extendible stiff leg **56** to thereby fixedly locate the pipe-pusher within the cradle once same is stowed.

With the pipe-pusher cradle being in line with the back hoe bucket, dipper stick and lower boom when same are stowed in the road position as shown in FIG. **2**, a pipe pusher may be located in the cradle as shown in FIG. **3** by utilizing the hydraulic equipment described above. First, a back hoe removed from the road position by raising the lower boom **16** up to its maximum position. The bucket is then curled to its limit position. At this point, the boom is also already at its leftmost position when looking towards the front of the unit. The dipper stick boom **18** may then be lowered by appropriately actuating hydraulic cylinder **19** until the bucket makes contact with the upper portion of the pipe pusher frame. This contact will automatically cause the ear members **44** to protrude through the spaced apart holes **39** in bucket **20**. The latch plate pin **45** and clip **45***a* are then attached inside the bucket and the bucket may be tipped slightly forward. The front latch pin **46** may then be inserted through holes **42***a* to occupy its locking position within groove G. The cradle latch pin **84** is then removed and

the bucket curled back to its original position. Retracting the piston of cylinder-piston combination **19**, moves dipper stick boom **18** upwardly and the pusher will come out of the pusher cradle. When the pusher clears the cradle, rotary motor **11** may be actuated to swing the pipe-pusher over the side and set on the ground. A lead bar and possibly one additional bar may be inserted into the pipe-pusher as described above. The hydraulic hoses may then be appropriately connected and the pusher ready to operate.

To stow the pipe-pusher, it is necessary to raise the pusher out of the ground until the lower boom **16** is all the way up. Bucket **20** is then curled to its limit and hydraulic motor **11** energized to swing a boom and dipper stick to the left in a gentle fashion until it stops. The dipper stick hydraulic cylinder and piston assembly **19** is then actuated until the pusher is seated in the cradle and the latch pin is inserted. The bucket is then uncurled slightly to facilitate the removal of the bucket latch pin located in groove G and the inside latch pin **45**. The back hoe may then be raised away from the pusher with the bucket uncurled and lowered to occupy the stow or road position.

It may be seen from the above discussion that the subject construction unit is capable of being operated almost completely by "feel" and accordingly has resulted in the elimination of many mistake producing features. This is accomplished, in part, by the location of the various movable portions of a construction unit and by optimizing the length of the piston stroke in the boom piston, dipper stick piston and the bucket pistons.

It is contemplated that a safety latch pin (not shown) may be installed in the trencher boom to keep same from pivoting except when the trencher is needed. This pin must be removed prior to the operation of the trencher or related implement. With the boom **16** raised, the hydraulic motor **11** is energized to swing boom **16** clear of the truck and bucket **20** is curled to its limit position. Energization of the piston assembly **32** retracts the associated piston thereby pivoting the arms **29** to the left (as shown in FIG. **15**) and moving the trencher boom **37** in a clockwise direction (FIG. **15**) or to the operative position as shown in FIG. **12**. The trencher is then unfolded to the digging position and the trencher hydraulic motor may be accordingly energized. If for any reason an undue load is put on the trencher, it has been designed to stall being protected by a hydraulic release valve. Merely raising upon boom **16** and reduce the speed of the trencher motor will eliminate this problem. When the trenching job is completed and the trenching motor is turned off, it may be returned to its original position by reversing the above-described process and the safety latch pin inserted prior to movement of the unit.

From the foregoing, it will be seen that this invention is one well adapted to attain all of the ends and objects hereinabove set forth, together with other advantages which are obvious and which are inherent to the invention.

It will be understood that certain features and subcombinations are of utility and may be employed without reference to other features and subcombinations. This is contemplated by and is within the scope of the claims.

As many possible embodiments may be made of the invention without departing from the scope thereof, it is to be understood that all matter herein set forth or shown in the accompanying drawings is to be interpreted as illustrative and not in a limiting sense.

Having thus described our invention, we claim:

1. Method of attaching a working implement having a frame or similar structure to a back hoe bucket, said method comprising the steps of

hydraulically moving said bucket to the proximity of said implement,

placing a portion of said implement frame structure interiorly of said bucket,

connecting said interiorly placed portion in said bucket with a pin, and

connecting said frame with a pin at a second bucket position.

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