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(54) **CONDUIT PULLING APPARATUS AND  
METHOD FOR USE IN HORIZONTAL  
DRILLING**

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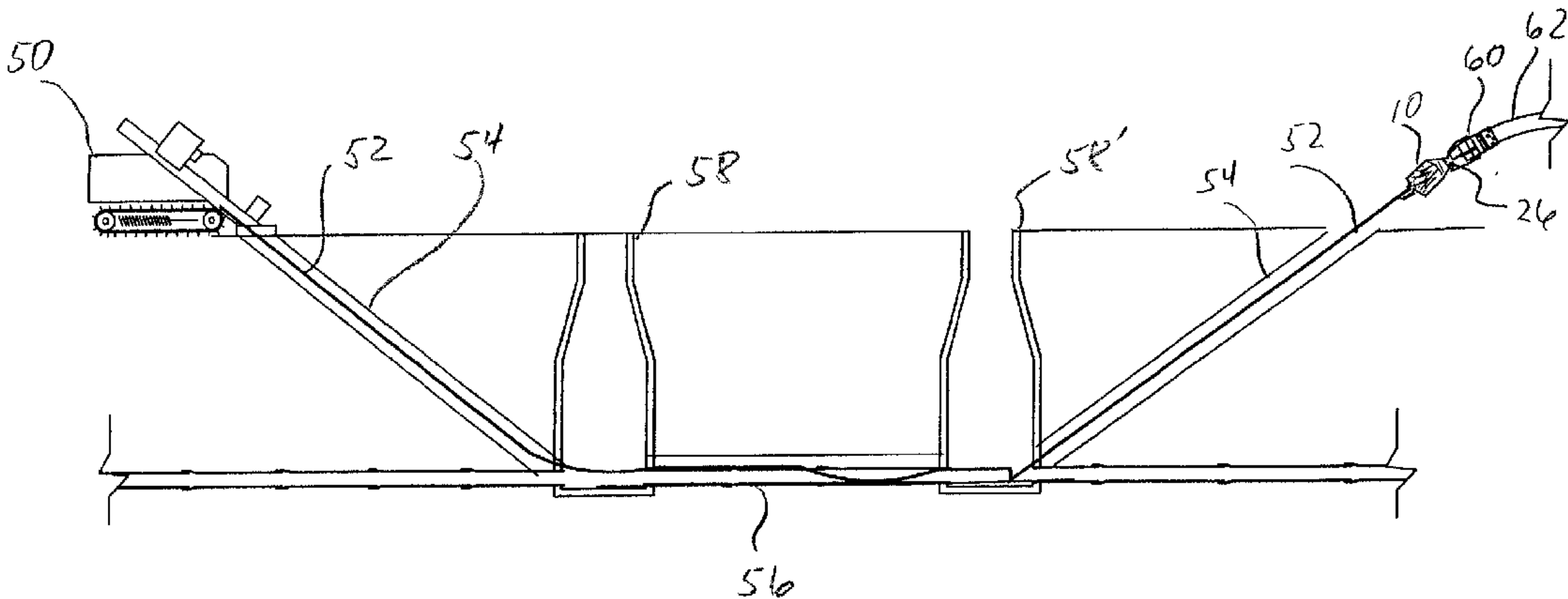
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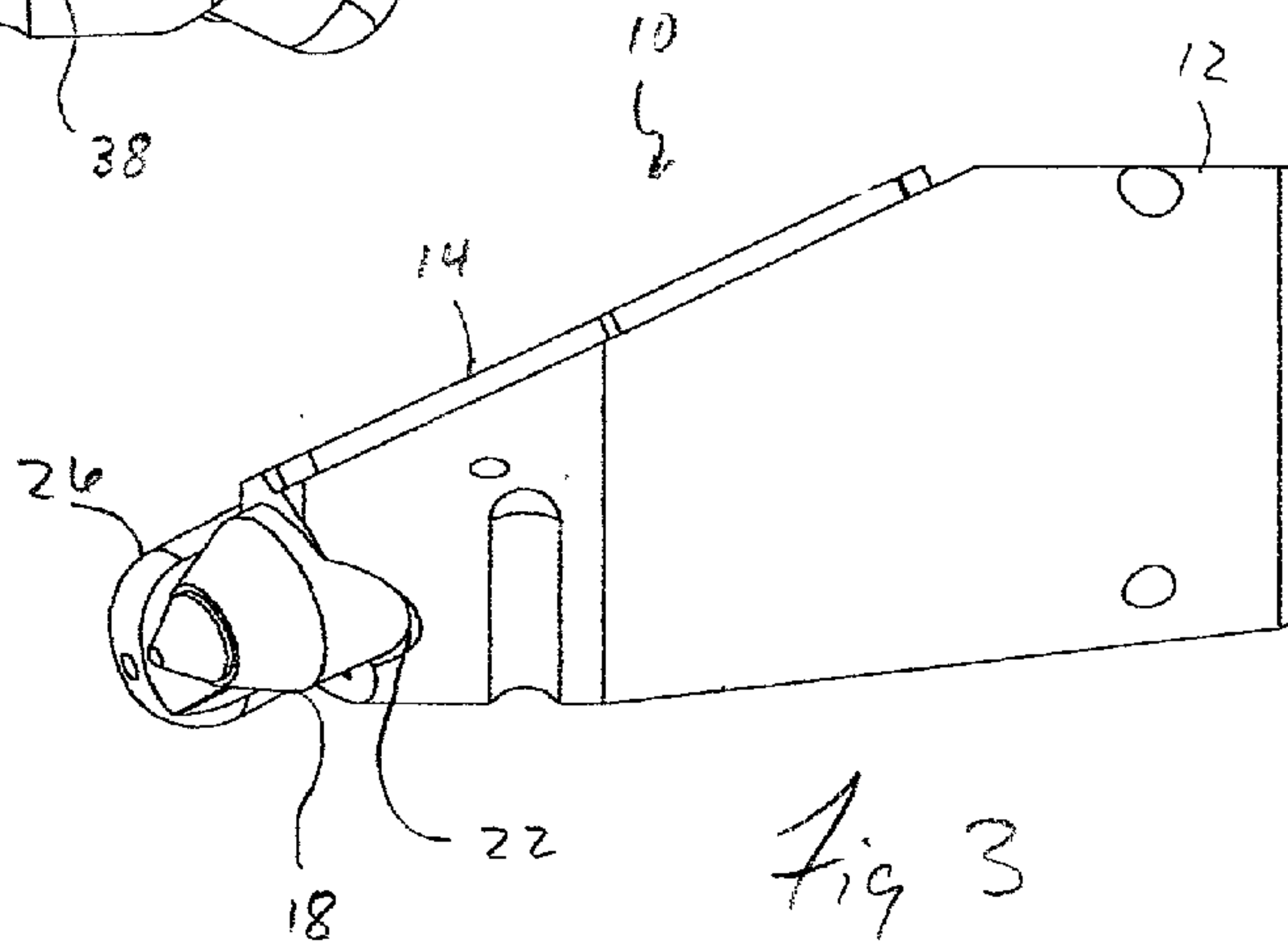
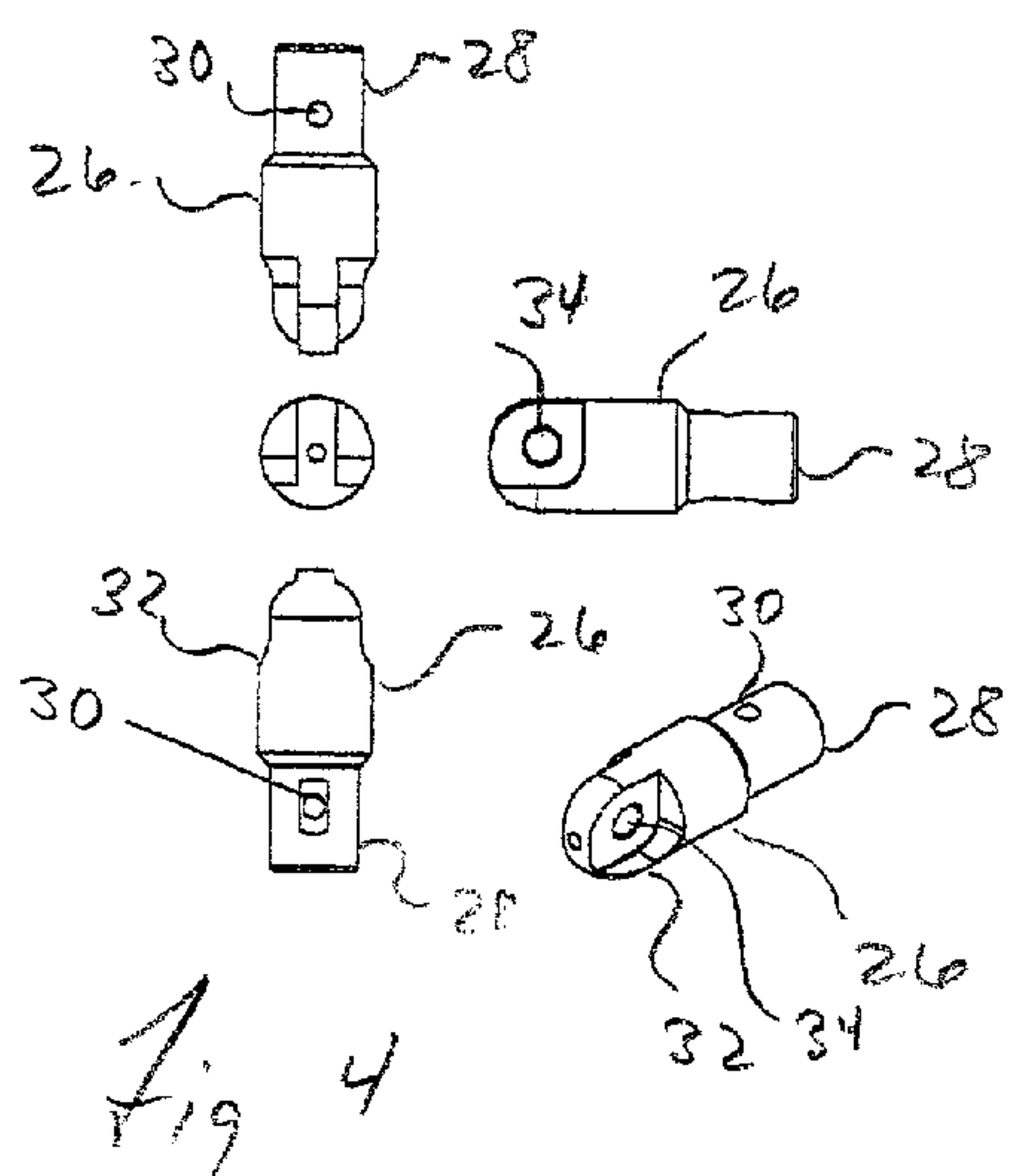
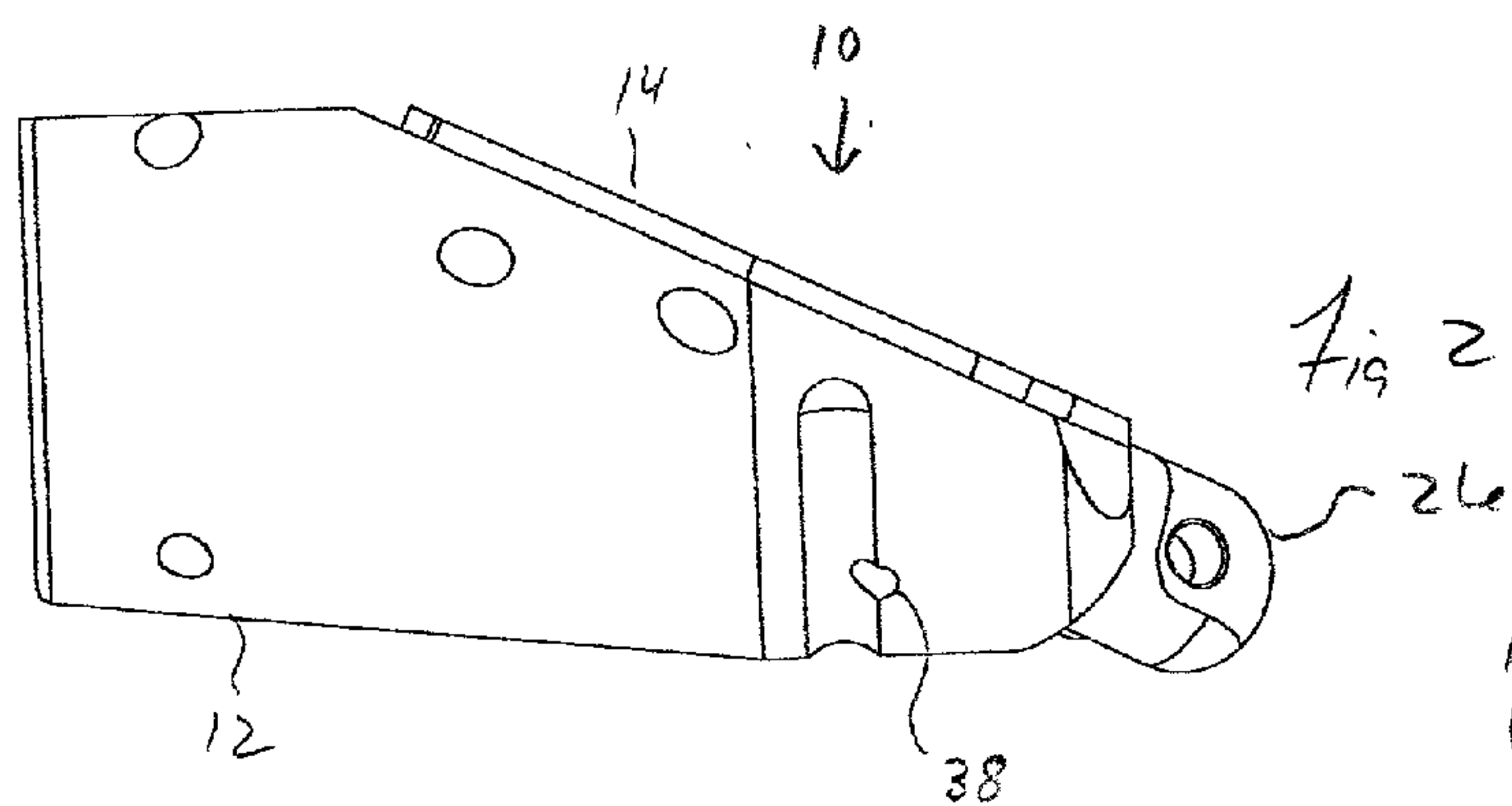
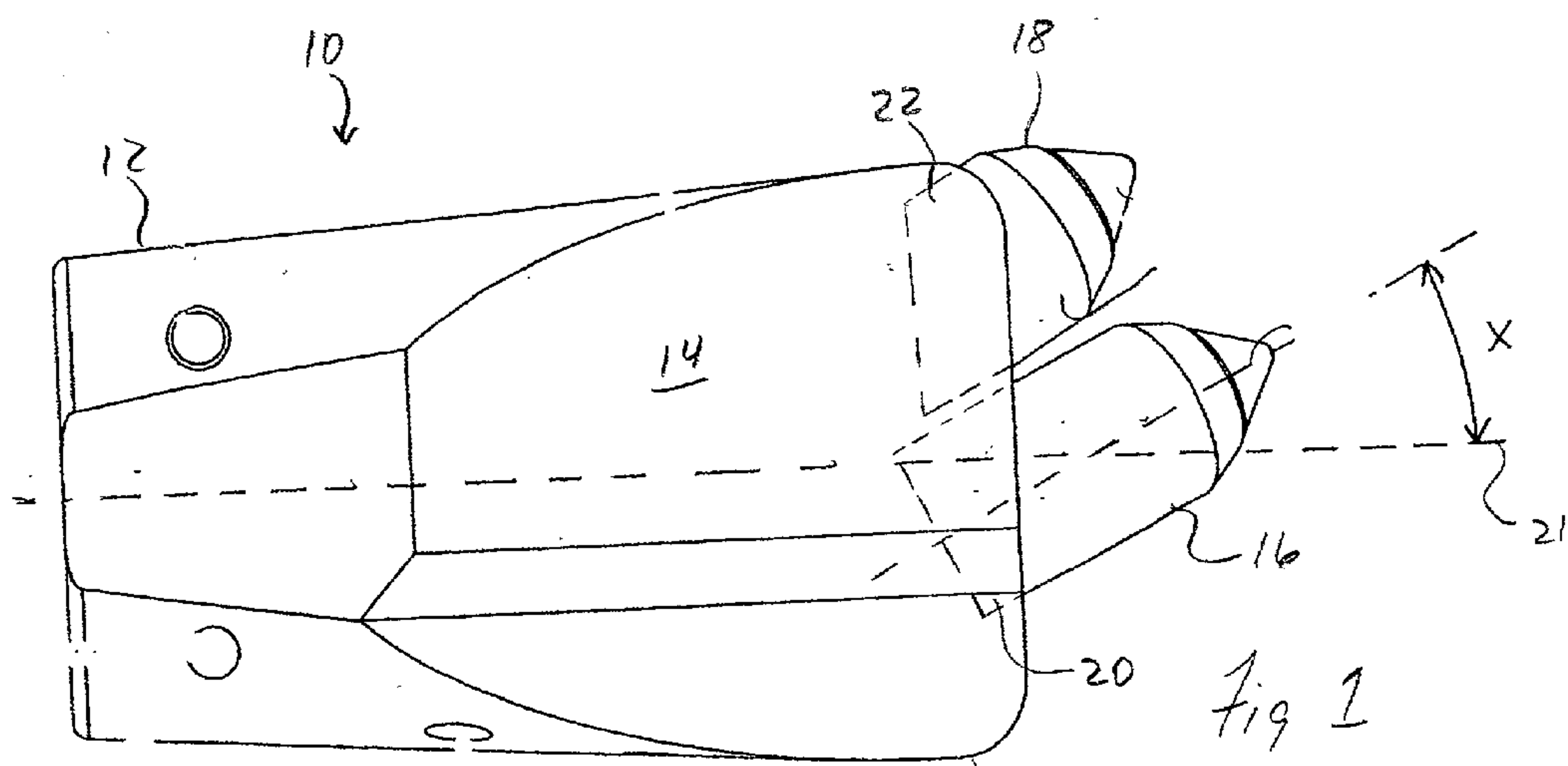
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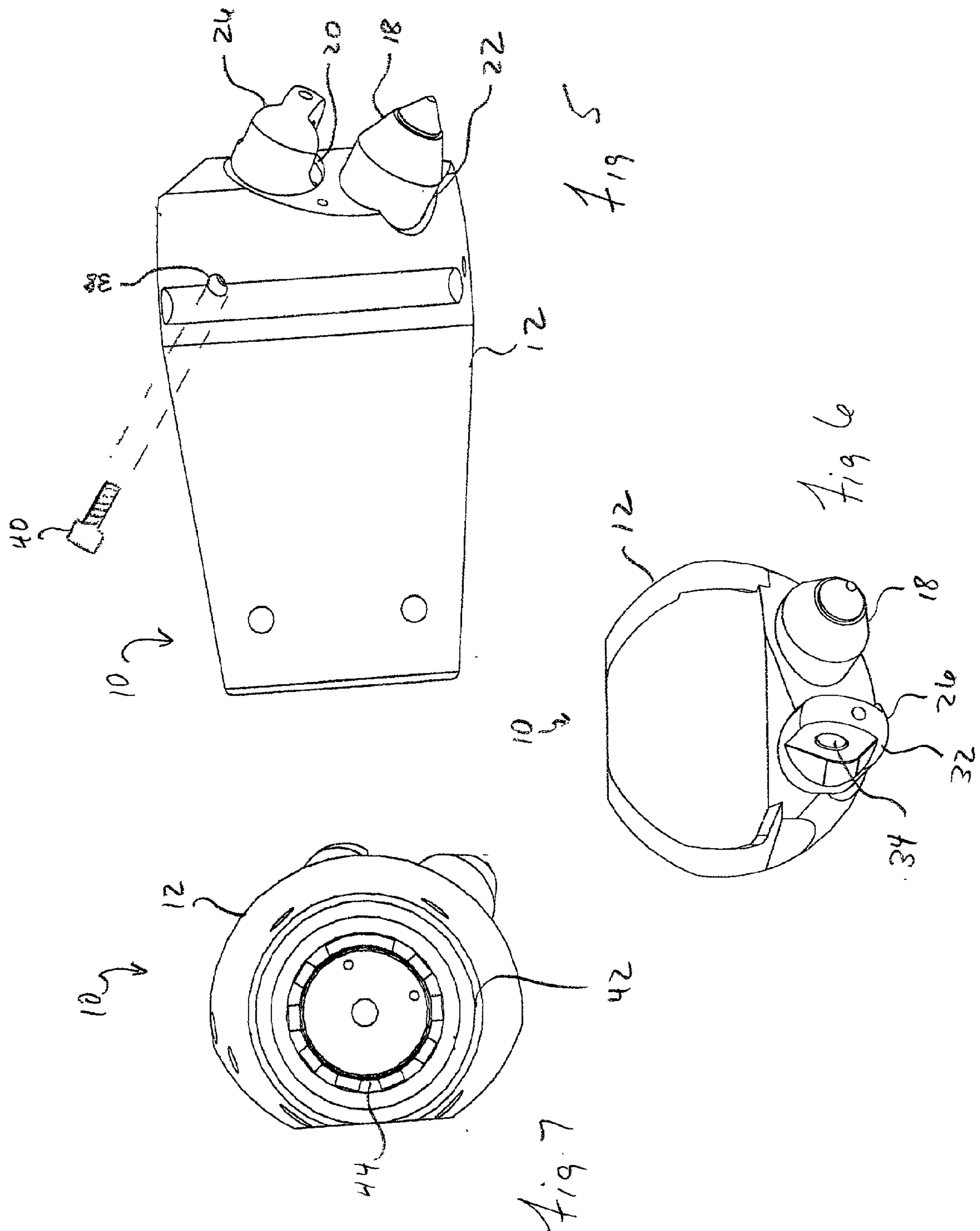
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(57) **ABSTRACT**

An apparatus for pulling a conduit through a horizontal bore includes a drill head having a forward most end including a pocket configured to receive an elongated body; coupler, a coupling member including an elongate body configured to fit in the pocket and a connecting end extending outside of the drill head beyond the pocket configured for coupling the coupling member and drill head to a conduit pulling means, a hole in the drill head intersecting the pocket alignable with a retainer aperture in the elongate body and a retainer adapted to pass through the aperture and hole to secure the coupling member to the drill head. In one variation, a clevis and or bearing swivel passed through an eyelet in the connecting end is used with a rope, chain or cable to connect the drill head to a pipe puller for pulling a pipe or conduit through an underground horizontal bore.







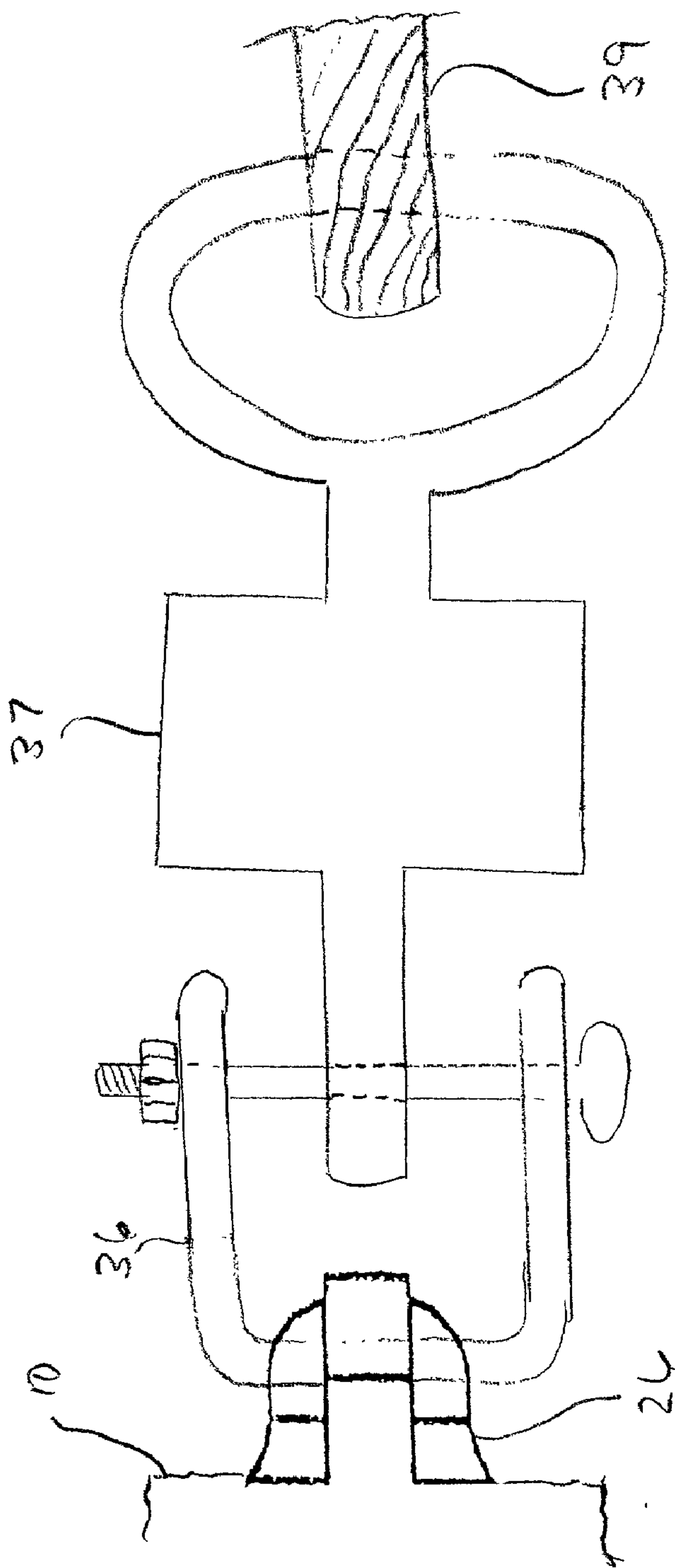


Fig 8





## CONDUIT PULLING APPARATUS AND METHOD FOR USE IN HORIZONTAL DRILLING

[0001] This application claims priority of U.S. Provisional Patent Application Serial No.: 60/263,172, filed Jan. 22, 2001.

### TECHNICAL FIELD

[0002] The invention relates to directional boring and, in particular to an improved apparatus and method for pulling pipes, conduits and cables through a bore formed with a horizontal drilling apparatus.

### BACKGROUND OF THE INVENTION

[0003] Directional boring apparatus for making holes through soil are well known. The directional borer generally includes a series of drill rods joined end to end to form a drill string. The drill string is pushed or pulled through the soil by means of a powerful hydraulic device such as a hydraulic cylinder. See Malzahn, U.S. Pat. Nos. 4,945,999 and 5,070,848, and Cherrington, U.S. Pat. No. 4,697,775 (RE 33,793). The drill string may be pushed and rotated at the same time as described in Dunn, U.S. Pat. No. 4,953,633 and Deken, et al., U.S. Pat. No. 5,242,026. A spade, bit or head configured for boring is disposed at the end of the drill string and may include an ejection nozzle for water to assist in boring.

[0004] After a bore is formed it is desirable in many circumstances to utilize the horizontal drilling apparatus to pull a conduit such as a pipe or other utility such as an electric or telephone cable back through the bore as the drill string is retracted. The invention provides a unique tool and means to utilize the drill bit and drill string of a horizontal drilling apparatus to accomplish this task.

### SUMMARY OF THE INVENTION

[0005] An apparatus for pulling a conduit through a horizontal bore in accordance with the invention includes a drill bit having a generally cylindrical body with a plurality of spaced apart pockets disposed in a forward most end of the drill bit. A coupling member adapted for use with the drill bit includes an elongate body configured to fit into a centrally positioned one of the pockets and a connecting end extending outside of the pocket. The elongate body includes a retainer aperture that is alignable with a hole in the drill bit that intersects the pocket allowing a retainer to be inserted through the retainer hole and retainer aperture to secure the coupling member to the drill bit.

[0006] In one aspect each of the pockets is adapted to receive a cutting tooth for use in drilling operations and the bit may be of the steerable type, including a face or plane adapted for steering the bit during drilling operations.

[0007] In another aspect, a method of pulling a conduit through an underground bore in accordance with the invention includes positioning a drill string in a substantially horizontal underground bore with a drill bit coupled to the drill string being positioned in a location outside the bore. A cutting tooth is removed from a pocket at the forward most end of the drill bit and a coupling member is inserted in the pocket. A retainer is inserted through a hole in the bit and a retainer aperture in an elongate body of the coupling member, locking or securing the elongate body in the drill bit. A flexible pulling means which may include a clevis, bearing

swivel, rope, cable or chain is used to connect the coupling member to a pipe or conduit puller. The drill string is retracted or pulled from the underground bore, simultaneously pulling the drill bit and conduit through the bore.

### BRIEF DESCRIPTION OF THE DRAWINGS

[0008] FIG. 1 is bottom view of a drill bit suitable for use in connection with the invention;

[0009] FIG. 2 is a first side view of an apparatus according to the invention including the drill bit of FIG. 1 with a coupling member installed;

[0010] FIG. 3 is a second side view of the apparatus of FIG. 2;

[0011] FIG. 4 includes top, bottom, front, side and perspective views of a coupling member of the invention;

[0012] FIG. 5 is a third side view of the apparatus of FIG. 2 illustrating a retainer for retaining the coupling member of FIG. 4;

[0013] FIG. 6 is a front view of the apparatus of FIG. 2;

[0014] FIG. 7 is a rear view of the apparatus of FIG. 2;

[0015] FIG. 8 is a perspective view of the coupling member of FIG. 4 with a clevis and bearing swivel attached; and

[0016] FIG. 9 is a schematic representation of the apparatus of FIG. 2 in use in a method of the invention.

### DESCRIPTION

[0017] While the making and using of various embodiments of the present invention are discussed in detail below, it should be appreciated that the present invention provides many applicable inventive concepts which can be embodied in a wide variety of specific contexts. The specific embodiments discussed herein are merely illustrative of specific ways to make and use the invention and are not to delimit the scope of the invention.

[0018] Turning now to FIGS. 1-8 there is shown a bit 10 generally of the type disclosed and claimed in copending U.S. patent application Ser. No. 09/657,353 filed Sep. 7, 2000, assigned to Earth Tool Company L.L.C., Oconomowoc Wis., the entire contents of which is incorporated herein by reference for all purposes. The bit includes a bit body 12 including a sloped face or steering plane 14 effective for steering the bit in dirt. During drilling operations a first cutting tooth 18 and second cutting tooth 16 are set in tooth pockets 20 and 22 in the forward end 24 of the bit body. As illustrated, second cutting tooth 16 is positioned proximate central axis 21 of bit body 12. Bit body 12 further comprises a hole 38 extending through the bit body into the tooth pocket 22.

[0019] As best shown in FIG. 7, a rear connection 42 is provided to allow the bit 10 to be mounted at the lead end of a drill string. Connection 42 includes a grooved socket 27 designed to receive a splined projection at the front of an adjoining sonde housing component as described in U.S. patent application Ser. No. 09/373,395, filed Aug. 12, 1999 and PCT publication No. 11/11303, published Mar. 2, 2000,



assigned to Earth Tool Company L.L.C., Oconomowoc Wis., the entire contents of which are incorporated herein for all purposes.

[0020] After the drilling operation is completed, second cutting tooth 16 is removed from tooth pocket 22 in bit body 12. After removal of cutting tooth 12 a pullback tooth 26 is inserted into tooth pocket 22. Pullback tooth 26 comprises an elongate, generally cylindrical body including a cylindrical shank portion 28 and a semi-flattened end portion 32 with eyelet or eye 34. Shank portion 28 is configured to be received in tooth pocket 22 of bit body 12 with aperture 30 aligned with hole 38 in bit body 12 and end portion 32 extending outward beyond pocket 22. In the illustrated embodiment, aperture 30 is treaded to receive a threaded retainer therein.

[0021] When pullback tooth 26 is inserted into tooth pocket 22, shank portion 28 is positioned so as to align aperture 30 with hole 38 in bit body 12. After alignment, a retainer 40, for example a threaded cap screw, is inserted through hole 38 in bit body 12 and into aperture 30, securing pullback tooth 26 in position in pocket 22. After pullback tooth 26 is so secured, an appropriate coupler, such as clevis 36 and/or bearing swivel 37 is attached to pullback tooth 26 by means of eye 34. A cable rope or chain 39 may also be used with clevis 36 and/or bearing swivel 37. Pullback tooth thus allows a pipe or conduit to be connected to bit 10 and pulled through the bore as the bit is withdrawn.

[0022] Referring now to FIG. 9, in order to replace a pipe section 56 located between manholes 58 and 58', a horizontal drilling machine 50 with a drill string 52 and bit 10 is used to drill a bore 54 from ground level to manhole 58 and from manhole 58' back to ground level. After bore 54 is complete, a cutting tooth such as tooth 16 of FIG. 1 is removed from bit 10 and replaced with pulling tooth 26. Retainer 40 is installed to secure pulling tooth 26 and clevis 36 and/or bearing swivel 37 (FIG. 8) is connected through eyelet 34. Clevis 36 with or without bearing swivel 37 is connected directly or with a flexible rope, cable or chain to a pipe puller 60 which is fastened to the end of replacement pipe or conduit 62. Drilling machine 50 is then used to retract drill string 52 pulling replacement pipe 62 through bore 54 and into position in old pipe section 56 between manholes 58 and 58'. After replacement pipe 62 is in position, pipe puller 60 is positioned in manhole 58 and disconnected from bit 10.

[0023] As will be appreciated, the use of pullback tooth 26 in pocket 22 to draw a pipe or conduit through a bore places the pulling load near the axial centerline (corresponding to axis 21 of FIG. 1) of bit 10. This arrangement coupled with the use of a bearing swivel 37 attached to pullback tooth 26 or clevis 36 allows the operator to rotate the drill string while the string is being retracted through the bore while simultaneously drawing a pipe or conduit. Rotating the drill string in this manner facilitates removal of the drill string from the bore while simultaneous pulling or drawing a conduit through the bore.

[0024] It will be appreciated the invention is not limited to the specific bit geometry illustrated in the Figures. For example, it is contemplated that the invention may be used in connection with other conventional drill bits utilized in horizontal drilling including "duck bill" flat bladed angled drill bits, rock bits and others. In connection with "duck bill"

type bits, the use of the invention will entail drilling a hole in the leading end of the bit to receive the pullback tooth.

[0025] While certain embodiments of the invention have been illustrated for the purposes of this disclosure, numerous changes in the invention presented herein may be made by those skilled in the art, such changes being embodied within the scope and spirit of the present invention as defined in the appended claims.

1. An apparatus for pulling a conduit through a horizontal bore comprising:

a drill head having a forward most end including a pocket configured to receive an elongated body; coupler

a coupling member including an elongate body configured to fit in the pocket and a connecting end extending outside of the drill head beyond the pocket, the connecting end configured for coupling the coupling member and drill head to a conduit pulling means.

2. The apparatus of claim 1 wherein the drill head further comprises a hole intersecting the pocket and adapted to receive a retainer for retaining the elongate body in the pocket.

3. The apparatus of claim 2 wherein the elongate body further comprises a retainer aperture, the retainer aperture being alignable with the hole in the drill head and configured to receive a retainer for retaining the elongate member in the pocket.

4. The apparatus of claim 3 wherein the pocket is outwardly angled with respect to a central axis of the drill head.

5. The apparatus of claim 4 wherein the hole is substantially perpendicular to the pocket.

6. The apparatus of claim 1 wherein the connecting end includes a hole configured to receive coupler for coupling the drill head to a conduit pulling means.

7. The apparatus of claim 1 wherein the connecting end comprises an eyelet.

8. The apparatus of claim 1 wherein the pocket is adapted to receive a cutting tooth for use in drilling operations.

9. The apparatus of claim 1 wherein the drill head includes a steering face for steering the drill during drilling operations.

10. The apparatus of claim 9 wherein the drill head includes a plurality of spaced apart pockets adapted to receive a plurality of cutting teeth.

11. An apparatus for pulling a conduit through a horizontal bore comprising:

a drill bit comprising a generally cylindrical body having a forward most end, the drill bit including a plurality of spaced apart pockets disposed in the forward most end including a central pocket configured to receive an elongate body;

a coupling member including an elongate body adapted to fit in the central pocket and a connecting end extending beyond the forward most end, the connecting end configured for coupling the coupling member and drill head to a conduit puller.

12. The apparatus of claim 11 wherein the drill bit further comprises a hole intersecting the central pocket and wherein the elongate body further comprises a retainer aperture, the hole and the aperture being alignable to receive a retainer for retaining the coupling member in the central pocket.

**13.** The apparatus of claim 11 wherein each of the pockets is adapted to receive a cutting tooth for use in drilling operations.

**14.** The apparatus of claim 11 wherein the drill head includes a steering face for steering the drill during drilling operations.

**15.** A method of pulling a conduit through a horizontal bore comprising:

positioning a drill string in a substantially horizontal underground bore with a drill bit coupled to the drill string being positioned in a location outside the bore;

inserting a coupling member in a pocket in the drill bit, the coupling member including an elongate body configured to fit in the pocket and a connecting end extending outside of the pocket;

coupling the connecting end to a conduit; and

pulling the drill string and the conduit through the bore.

**16.** The method of claim 16 further comprising installing a retainer in alignable holes in the drill bit and coupling member to retain the coupling member in the pocket.

**17.** The method of claim 15 further comprising the step of attaching a flexible pulling means to the connecting end of the coupling member and the conduit puller means.

**18.** The method of claim 17 wherein the flexible pulling means is one of a rope, cable and chain.

**19.** The method of **17** wherein the connecting end includes an eyelet and the flexible pulling means comprises a clevis.

**20.** The method of claim 17 wherein the flexible pulling means further comprises a bearing swivel.

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