

Feb. 24, 1959

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2,874,936

APPARATUS FOR EXCAVATING HOLES

Filed June 19, 1957

2 Sheets-Sheet 1

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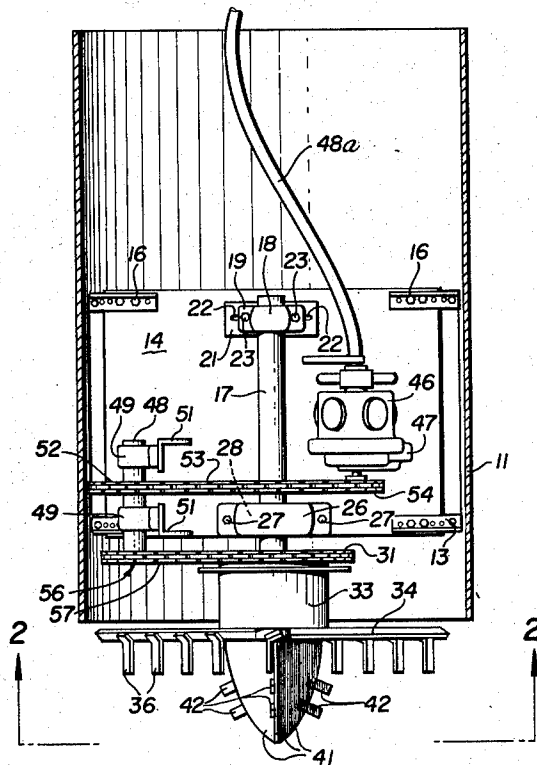
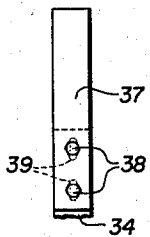
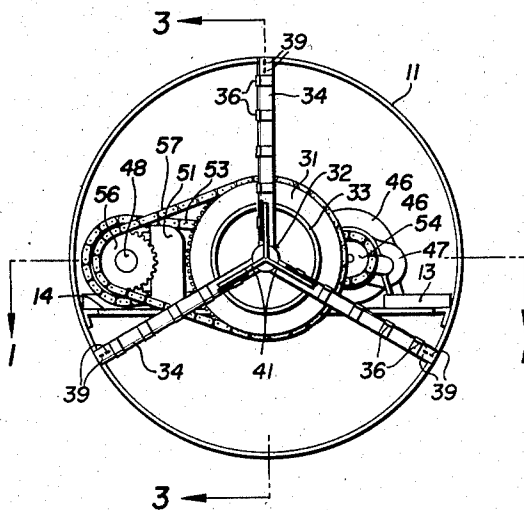


Fig. 7



F i g. 2



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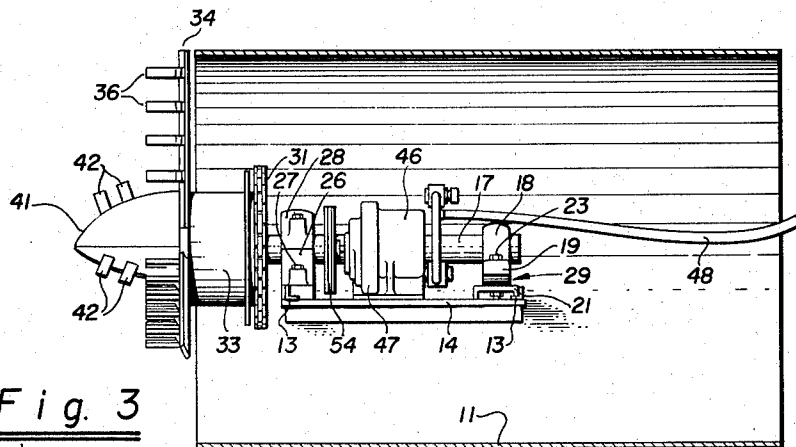


Fig. 3

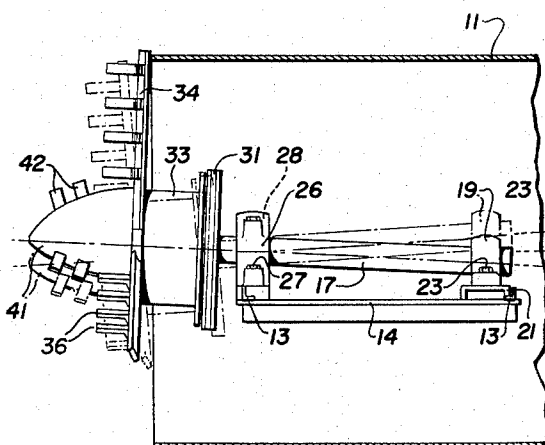


Fig. 4

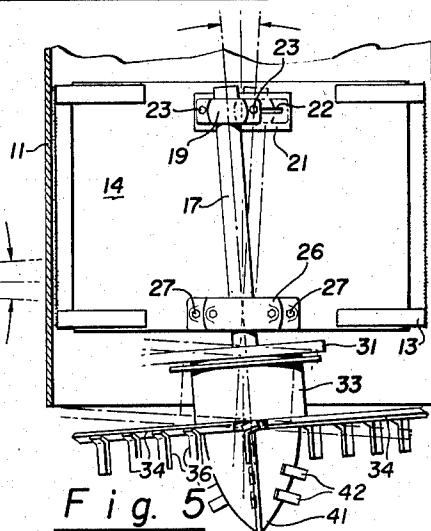


Fig. 5

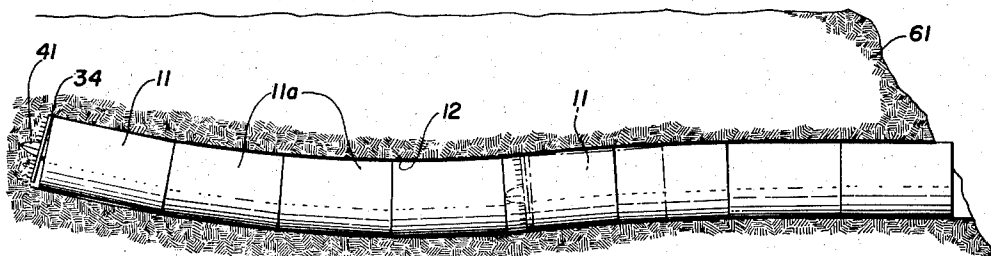


Fig. 6

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APPARATUS FOR EXCAVATING HOLES

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Application June 19, 1957, Serial No. 666,535

13 Claims. (Cl. 255—20)

This invention relates to a new and improved apparatus for excavating or boring holes in earth and is particularly useful in the boring of holes for culverts and pipe along precise lines of survey. The present invention permits the direction of the digging or boring apparatus to be adjustably varied up or down or to right or left in order to maintain the boring or digging very closely to the surveyed path or line of excavation.

One of the principal advantages of the present invention is the fact that means is provided to adjust the direction of the hole being cut relative to the direction of previous portions of the hole, and such adjustment can be made as frequently as necessary.

A further object and advantage of the invention is an arrangement whereby power is applied to the boring head in such manner that the shaft of the head is not likely to be sheared off and yet a relatively high torque may be applied.

A still further advantage of the invention is the fact that means is provided for digging holes of the above described nature which is inexpensive in construction and simple in operation.

Still another feature of the invention is the driving of the boring head by an air motor driven by air applied through a compressed air hose which may be extended into the hole being dug, regardless of the length of such hole.

Other objects of the present invention will become apparent upon reading the following specification and referring to the accompanying drawings in which similar characters of reference represent corresponding parts in each of the several views.

In the drawings:

Fig. 1 is a horizontal, longitudinal, sectional view of the device;

Fig. 2 is an end elevation as viewed substantially along the line 2—2 of Fig. 1;

Fig. 3 is a longitudinal, vertical, sectional view taken substantially along line 3—3 of Fig. 2;

Fig. 4 is a fragmentary side elevational view showing in dot-and-dash lines the vertical adjustability of the device;

Fig. 5 is a fragmentary plan view showing in dot-and-dash lines the horizontal adjustability of the device;

Fig. 6 is a schematic elevational view showing the device in operation at various steps in the excavation of a hole through an embankment; and

Fig. 7 is a fragmentary front elevation showing extensions attached to the radial arms.

The present apparatus is preferably contained in a large diameter, short cylindrical casing 11 which is approximately of the diameter of the hole 12 to be bored. Such casing may be one of several sections of large-diameter pipe to be laid or may be re-used, if desired. Casing 11 is provided with inwardly projecting brackets 13 to which base plate 14 is bolted by means of bolts 16 at such elevation that the axis of main shaft 17 is at the central

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axis of casing 11. Shaft 17 is mounted on plate 14 at its rearward end by means of self-aligning ball bearing 18 which is received in pillow block 19. An inverted channel 21 is welded to plate 14 adjacent the middle of its rearward edge and channel 21 is provided with a pair of laterally extending slots 22. Bolts 23 passing through slots 22 secure bearing 18 relative to base plate 14. At the middle of the forward edge of base plate 14 and bolted thereto by means of bolts 27 is a second pillow block 26 which contains a self-aligning thrust roller bearing 28. It is apparent from the foregoing that both the horizontal and vertical angles of the axis of shaft 17 relative to base plate 14 may be adjusted. Thus by moving rear pillow block 19 from side to side (as permitted by slots 22), the horizontal angle of shaft 17 may be altered. The vertical angle may be adjusted by increasing or decreasing the number of shims 29 interposed between the bottom of pillow block 19 and the top of inverted channel 21.

The forward end of shaft 17 carries a sprocket 31 and to sprocket 31 is welded a sleeve 32 which fits around the front end of shaft 17. Also welded to sprocket 31 is a large diameter pipe 33. Hence the torque applied by rotation of sprocket 31 (by means hereinafter described) is directly transmitted to pipe 33. Extending substantially radially from shaft 17 is a plurality of blade-holding arms 34 which are welded to sleeve 32 and also to pipe 33. Arms 34 are provided with staggered replaceable teeth 36 of standard commercial type used in earth-digging equipment. In order to provide for adjustment of the diameter of the hole 12 being excavated, when a larger or smaller diameter casing 11 is employed, arms 34 are provided with extensions 37 bolted thereto by means of bolts 38 passing through holes in extensions 37 and longitudinally elongated slots 39 in arms 34, the extensions 37 likewise carrying teeth 36. Forwardly of arms 34 are pilot blades 41 which comprise segments of heavy steel plate welded to inner sleeve 32 and to blade arms 34. Pilot blades 41 likewise carry replaceable teeth 42. Thus, as shaft 17 is revolved, as hereinafter described, the pilot blades 41 penetrate the earth formation and embed themselves in a manner to prevent misalignment of the main blade-holding arms 34. Blade-holding arms 34 are provided with a pitch of about 15° which assists in propelling the entire assembly through the earth.

The drive is supplied by a compressed air motor 46 equipped with a reduction gear 47 mounted on one side of base plate 14 and supplied with air by hose 48a. On the opposite side of base plate 14 is a jackshaft 48 received in pillow blocks 49 which are fixed to plate 14 by means of angle brackets 51. A sprocket 52 is mounted on shaft 48 and is driven by means of chain 53 from sprocket 54 on motor 46. Jackshaft 48 also carries on its forward end a sprocket 56 which is connected by means of chain 57 to sprocket 31. The ratio of the several sprockets is such that a considerable speed reduction is accomplished, with the result that whereas motor 46 revolves at 78 R. P. M., plate arms 34 revolve only at 14 R. P. M.

In operation, a hole 12 is started at one end of embankment 61 shown in Fig. 6 and casing 11 held in proper alignment with the direction of the hole to be dug. Motor 46 is started, causing pilot blades 41 to dig into the earth; and after pilot blades 41 have embedded themselves the proper distance, teeth 36 on arms 34 begin to cut a hole of the same diameter as casing 11. Casing 11 is pushed forwardly by any of several methods well understood in this art, such as by pushing with a truck or bulldozer, the use of a winch, or the like. As the casing moves forward, as assisted by the pitch

of arms 34, a continuous supply of newly cut earth entering the casing moves earth formerly cut progressively to the rear of the casing from whence it is ultimately expelled. When casing 11 is fully within hole 12, additional sections 11^a may be installed behind it until the hole is complete. At any time in the progress of the excavation, the angle of hole 12 may be adjusted. If the angle must be adjusted in a horizontal direction (see Fig. 5) bolts 23 mounting pillow block 19 to channel 21 are loosened and the pillow block moved sideways the required distance to accomplish the change in angle, whereupon bolts 23 are tightened. Because forward pillow block 26 contains a self-aligning bearing 28, no compensating adjustment must be made at the forward end. If vertical adjustment is required (see Fig. 4), bolts 23 are removed and shims 29 either inserted between pillow block 19 and channel 21 or removed, depending upon whether hole 12 must be depressed or elevated. Fig. 6 illustrates in exaggerated form how the direction of hole 12 may be frequently adjusted.

If it is necessary to dig holes of different diameters, different sized casings 11 may be employed and the same base plate 14 mounted interiorly thereof. Extensions 37 on the outer ends of arms 34 may be installed or removed, depending upon the lengths of arms 34 compared with the diameter of casing 11.

Although the foregoing invention has been described in some detail by way of illustration and example for purposes of clarity of understanding, it is understood that certain changes and modifications may be practiced within the spirit of the invention and scope of the appended claims.

I claim:

1. A device for excavating holes for pipe comprising a base plate, a section of pipe, means for mounting said plate in said section, a rotatable shaft, mounting means for mounting said shaft on said plate and normally coaxial with said pipe, said mounting means including means for adjustable movement to vary the direction of said shaft relative to said plate, means on said plate for rotating said shaft, and digging means on said shaft for boring a hole of a diameter at least as large as the diameter of said section in advance of said section, said digging means including a plurality of rotary, earth-engaging teeth.

2. A device for excavating holes for pipe comprising a base plate, a section of pipe, means for mounting said plate in said section, a rotatable shaft, a bearing receiving and mounting said shaft, normally coaxial with said section, mounting means for mounting said bearing on said plate, said mounting means comprising a first member attached to said bearing, a second member attached to said plate, one of said members being formed with an elongated slot, and fastening means passing through said slot joining said first and second members together for adjustable movement to vary the direction of said shaft relative to said plate, means on said plate for rotating said shaft, and digging means on said shaft for boring a hole of a diameter at least as large as the diameter of said section in advance of said section, said digging means including a plurality of rotary, earth-engaging teeth.

3. A device for excavating holes for pipe comprising a base plate, a section of pipe, means for mounting said plate in said section, a rotatable shaft, a bearing receiving and mounting said shaft, normally coaxial with said section, mounting means for mounting said bearing on said plate, said mounting means comprising a first member attached to said bearing, a second member attached to said plate, a plurality of removable shims between said first and second members, and fastening means joining said first and second members together to vary the direction of said shaft relative to said plate, means on said plate for rotating said shaft, and digging means on said shaft for boring a hole of a diameter at least as large as the diameter of said section in advance of said section,

said digging means including a plurality of rotary, earth-engaging teeth.

4. A device for excavating holes for pipe comprising a base plate, a section of pipe, means for mounting said plate in said section, a rotatable shaft, a self-aligning front bearing receiving and mounting said shaft normally coaxial with said section, said bearing being mounted on said plate adjacent said plate's forward edge, a rear bearing receiving and mounting said shaft, mounting means for said rear bearing adjacent the rearward edge of said plate, said mounting means including means adjustable laterally and in elevation to adjust the angle of said shaft relative to said plate, means on said plate for rotating said shaft, and digging means on said shaft for boring a hole of a diameter at least as large as the diameter of said section in advance of said section, said digging means including a plurality of rotary, earth-engaging teeth.

5. A device for excavating holes for pipe comprising a base plate, a section of pipe, means for mounting said plate in said section, a rotatable shaft, a self-aligning front bearing receiving and mounting said shaft normally coaxial with said section, said bearing being mounted on said plate adjacent said plate's forward edge, a rear bearing receiving and mounting said shaft, mounting means for said rear bearing adjacent the rearward edge of said plate, said mounting means including means adjustable laterally and in elevation to adjust the angle of said shaft relative to said plate, a pneumatic motor on said plate, drive means connecting said motor to said shaft adjacent said front bearing, and digging means on said shaft for boring a hole of a diameter at least as large as the diameter of said section in advance of said section, said digging means including a plurality of rotary, earth engaging teeth.

6. A device for excavating holes for pipe comprising a base plate, a section of pipe, means for mounting said plate in said section, a rotatable shaft, a self-aligning front bearing receiving and mounting said shaft normally coaxial with said section, said bearing being mounted on said plate adjacent said plate's forward edge, a rear bearing receiving and mounting said shaft, mounting means for said rear bearing adjacent the rearward edge of said plate, said mounting means including means adjustable laterally and in elevation to adjust the angle of said shaft relative to said plate, means on said plate for rotating said shaft, a plurality of radially extending arms at least as long as the radius of said section mounted for rotation with said shaft, and a plurality of teeth on said arms.

7. A device according to claim 6 in which said arms are disposed relative to said shaft with pitch.

8. A device according to claim 6 which further comprises a pilot blade in advance of said arms.

9. A device for excavating holes for pipe comprising a base plate, a section of pipe, means for mounting said plate in said section, a rotatable shaft, a self-aligning front bearing receiving and mounting said shaft normally coaxial with said section, said bearing being mounted on said plate adjacent said plate's forward edge, a rear bearing receiving and mounting said shaft, mounting means for said rear bearing adjacent the rearward edge of said plate, said mounting means being adjustable laterally and in elevation to adjust the angle of said shaft relative to said plate, drive means on said plate for rotating said shaft, a pipe within said section surrounding said shaft, said drive means being drivingly connected to said pipe, a plurality of radially extending arms mounted for rotation with said shaft and fixed to said pipe, and a plurality of teeth on said arms.

10. A device according to claim 9 which further comprises removable extensions on said arms and teeth on said extensions.

11. A device according to claim 9 which further comprises a pilot blade projecting from the forward end of said pipe.

12. A device according to claim 9 in which said drive

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means is drivingly connected to said pipe by a sprocket fixed to said pipe.

13. In a device for excavating holes, the combination including a section of pipe, a shaft, a self-aligning front bearing receiving and mounting a forward portion of said shaft, first means fixedly mounting said bearing substantially concentrically within said section, a rear bearing receiving and mounting a rearward portion of said shaft, second means mounting said rear bearing within said section, said second means being adjustable laterally and in elevation whereby said shaft is angularly displaceable to the axis of said section, a pipe of substantially greater diameter than said shaft mounted concentrically around

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the forward portion of said shaft within said section, a plurality of arms mounted radially of said pipe, drive means for rotating said pipe whereby torque is applied to said arms outwardly from said shaft, said rotating arms defining a circle having a diameter at least as great as said section, and a plurality of earth-engaging teeth carried by each said arm.

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