March 7, 1939. C. H. HUNSAKER 2,149,345

EARTH BORING APPARATUS

Filed April 25, 1938

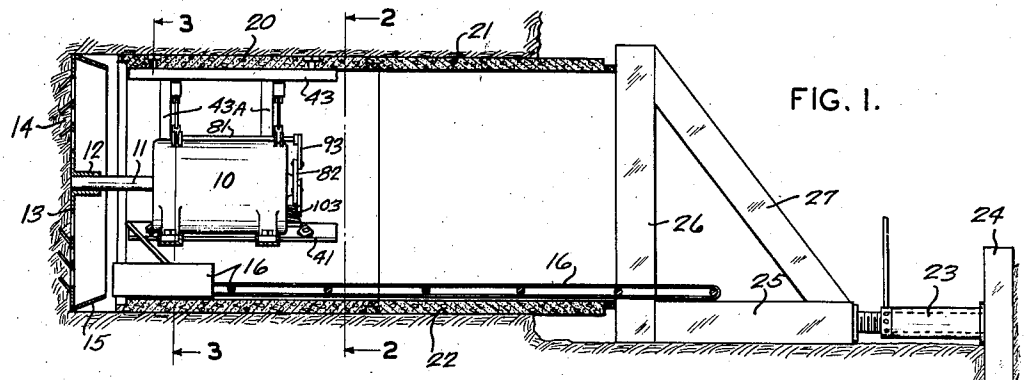


FIG. 1.

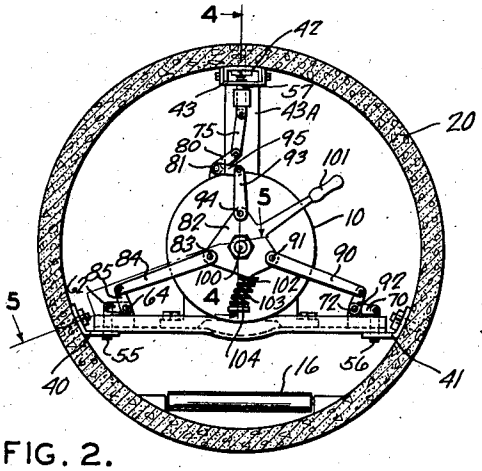


FIG. 2.

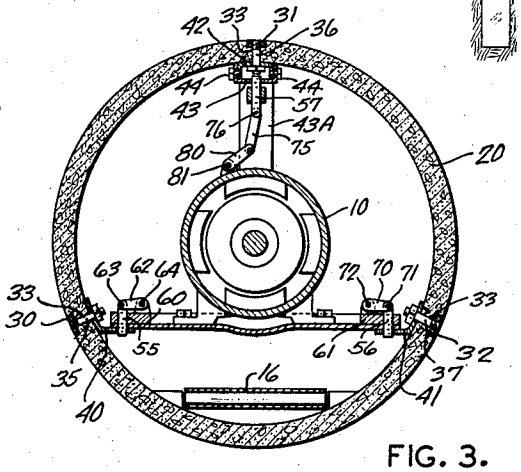


FIG. 3.

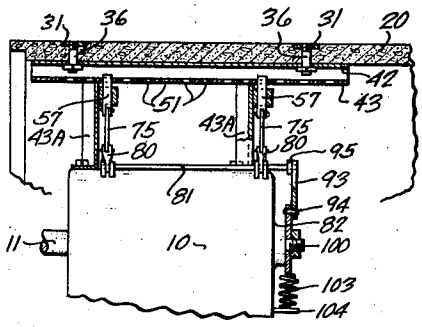
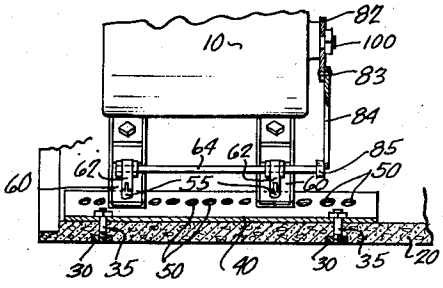


FIG. 4.

FIG. 5.



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Patented Mar. 7, 1939

2,149,345

UNITED STATES PATENT OFFICE

2,149,345

EARTH BORING APPARATUS

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Application April 25, 1938, Serial No. 204,041

7 Claims. (Cl. 262—7)

This invention relates to improvements in earth boring apparatus, and more particularly to improved mounting and control expedients for the drilling assembly utilized in certain types of tunnelling and other subterranean excavation work.

In certain types of subterranean work, it has proven advantageous, as in the installation and placement of preformed conduit sections, of concrete for example, to locate the drill unit in a forward section of the casing or conduit in a horizontal tunnel. In such case, the earth is removed just ahead of the leading conduit section of a string thereof, is conveyed as by a flight or screw conveyer from the working face, rearwardly through the string to a zone of deposit or haulage. As the earth, soil or rock, sometimes known as the spoil, is removed, the one or more sections of conduit, for example concrete pipe, are forced forwardly into the bore as by hydraulic or mechanical jacks. In this procedure it is desirable substantially to coordinate the rate at which the string of conduit sections is advanced, and the rate of spoil removal by the drill assembly. It is toward the attainment of a distinctly improved result in these operations, that the present invention is directed, and for attainment of which result it has its principal objective.

More particularly expressed, as to structure for attainment of the foregoing object, it is a purpose of the present invention to provide means enabling a quick and easy advance of the drill assembly forwardly of the bore and with respect to the leading tube or conduit section, within the bore and similarly to provide for ease and readiness of retraction of the drilling unit away from the working face and substantially inwardly of the leading pipe or tube section.

It is a further object of the invention to provide a readily detachable, yet structurally secure arrangement for operatively positioning the drill assembly in adjustable relation to the conduit section in which it is located.

A still further object of the invention is attained in an improved latch-type connection through which the drill assembly may be variably positioned axially of the conduit section, and yet which permits and provides for an almost instantaneous readjustment of position of the drill, for example, to care for emergencies due to caving earth, quicksand and the like, as well as to provide for ready compensation for temporary disparities in rates of advance of the drill and of the one or more conduit sections of the string within the tunnel.

The foregoing and numerous other objects will more clearly appear from the following detailed description of a presently preferred embodiment of the invention, considered in connection with the accompanying drawing, in which:

Fig. 1 is a longitudinal section, in a vertical plane, of a drilling assembly located in operative relation in a string of concrete pipe sections, and illustrating one manner of advancing such sections into and ultimately through the tunnel bore, certain of the elements being shown in elevation for clearness; Fig. 2 is a transverse sectional elevation as taken along line 2—2 of Fig. 1; Fig. 3 is a staggered transverse section of the device as viewed along line 3—3 of Fig. 1; Fig. 4 is a fragmentary longitudinal section of the device as viewed along the line 4—4 of Fig. 2, and Fig. 5 is a fragmentary sectional elevation along line 5—5 of Fig. 2.

Referring now by characters of reference to the drawing, there is shown by way of exemplifying an application of the invention, a combined electric motor and reduction-gear unit, designated as 10. Carried by a projecting shaft 11 of the unit 10, is a hub portion 12 of a rotary cutter or drill 13 of such design as to serve, when rotated by the shaft 11, to remove the earth or other spoil from the working face 14, whence the spoil falls into a transfer device 15 for delivery to a conveyor, indicated generally at 16. The conveyor is shown as being of belt type, although a screw, flight, or other type of conveyor may be utilized.

There has been selected for illustrative description, a tunnel casing consisting of preformed concrete pipe sections, a leading one of which, shown at 20, serves through means hereinafter described to support the rotary drill unit 10. For simplicity of illustration and brevity of description only one additional pipe section 21 is shown in the drawing. As the earth or other spoil is removed from the working face 14 to form the bore 22 later occupied by the pipe sections, the latter are advanced by means of jacks, one of which is shown at 23 in engagement with a suitable abutment post or the like 24. Jacking displacement of the sections 20—21 is translated thereto as by an A frame formed of elements illustrated at 25, 26 and 27.

Referring now to the apparatus more particularly characterizing the present improvements, it is a preference to provide the leading pipe section, with a plurality of rows of holding members such as nuts, the rows of which are located by reference to Fig. 3, and indicated therein at 30, 31 and 32. In forming the pipe section, it is also

preferred to core a suitable opening such as 33 inwardly from each of the nuts in the several rows, so as to facilitate the insertion and threading up of bolts 35, 36 and 37 in a number and location corresponding to those of the nuts 30, 31 and 32.

Each of the bolts in the rows 35 and 37 engages an angle bracket, there being one for each of the corresponding rows of bolts and nuts, the brackets being indicated at 40 and 41 and extending as rails or track elements interiorly along the sides and longitudinally of the forward pipe section. At the top of this section is provided a securing structure somewhat differently formed, and consisting of paired, relatively inverted channel elements, one thereof nested within the other as shown at 42 and 43 (Figs. 2 and 3) the channels 42 and 43 being secured together as by bolts or screws 44.

For a purpose hereinafter more clearly appearing, each of the brackets or rails 40 and 41 is provided with a series of aligned openings 50 (Fig. 5), the channel member 43 at the top of the conduit or pipe section being similarly apertured as shown at 51 (Fig. 4). These apertures 50 and 51 are of substantial diameter, and serve to receive coordinately actuated plungers of the locking or latching mechanism by which the drilling assembly is detachably secured to the rails or brackets 40, 41 and 43. For this reason the corresponding openings 50 and 51 in the different brackets or rails are located with their centers in common transverse planes of the pipe section by which the operating or drilling assembly is carried.

It will have appeared from the drawing that the brackets or rails 40 and 41 serve, through the base of the drill unit, as the primary supports for the motor gear and drill assembly 10—12, and that the channel 43 and its associated elements is especially constructed in coaction with an arm 43—A on the drill assembly, to resist torque effects set up by cutting resistance to rotation of the drill or cutter 13, these stresses obviously occurring in an angular direction opposite to that of rotation of the shaft 11.

For interlocking securement of the drill unit to the rail 40, there are provided a plurality, preferably a pair, of plungers 55, and similarly in cooperation with rail 41, a plurality of plungers 56, a corresponding set of plungers 57 serving to engage the openings 51 in the channel member 43. Each of the plungers 55 operates through an aperture therefor in the base element of the drill unit, indicated at 60, and the plungers 56 in corresponding manner through a base element 61. Actuation of the plungers 55 is provided for by a plurality of arms 62, each pivotally connected as at 63 to the associated plunger 55. The arms 62 are angularly and axially secured to an associated rock shaft 64. The same arrangement prevails, except for a relatively opposite disposition, in arm 70 pivoted at 71 to plungers 56, and secured to rock shaft 72.

The plungers 57 are each pivotally connected to a link 75, as at 76, the link 75 being in turn pivotally connected to links 80, secured to and actuated by a rock shaft 81.

To provide for quick and conjoint actuating of plungers 55, 56 and 57, there is provided a manually actuated, rockably mounted plate 82 to which is pivotally connected, as at 83, a link 84, in turn pivotally connected to an arm 85 secured to rock shaft 64. A similar link 90 is pivoted at 91 to the plate 82, and its opposite end pivotally engages an arm 92 secured to rock shaft 72. A somewhat similar connection is effected from the rockable plate 82 to the shaft 81, as through a link 93 pivoted to the plate as at 94, and at its opposite end to an arm 95 secured to the rock shaft 81. The plate 82 is journalled for reciprocal movement in an arcuate path on a center stud or pivot 100, carried as by a boss on the end of the frame or housing of the motor-gear unit 10. For convenience of actuation of the grouped control elements, there is provided a handled arm or lever 101, fixed to the plate 82.

In the arrangement described, an angular displacement of the control lever 101 within a range, say of 30°, is sufficient to actuate the several sets of latching or locking plungers between fully engaged and fully disengaged positions. For the purpose of providing a quick in-and-out actuation of the plunger groups, the plate 82 is provided with a projection 102, extending into the end of a coiled compression spring 103, the opposite end of which is anchored to and abuts a stationary supporting plate 104.

It will have appeared from the foregoing description of parts and their relation that, with the handle 101 positioned as shown (Fig. 2) the several plungers 55, 56 and 57 are seated in the openings or recesses providing seats therefor, and indicated at 50 and 51, whereby the drilling assembly is positively positioned against displacement longitudinally of the leading pipe sections as well as against displacement angularly within the pipe section. It will appear as obvious from the foregoing description, that when the lever 101 is actuated to the left or counterclockwise (Fig. 2), rock shaft 81 will be rotated clockwise as will rock shaft 64, while rock shaft 72 will be rotated counterclockwise, but each with the effect, through the arm and linkage arrangement described, of withdrawing the plungers. Under these conditions the unit 10 and related elements may be quickly and easily moved forwardly or rearwardly along the trackage, and when the desired position of the drill or cutter is attained, merely a snap action of lever 101 in a clockwise direction (Fig. 2) will serve to restore the plungers to a different set of seats, and again operate to lock the unit 10 in its readjusted position.

It will have appeared that with the lever 101 in either extreme position, the spring 103 will be at a relatively reduced loading, but is subjected to a maximum loading when the control lever is in an intermediate position. Thus the spring 103 provides, with the plate 82 and projection 102, a toggle arrangement tending either to latch, or to unlatch the plungers unless the control lever is occupying one of its end positions.

The advantages of a quick-detachable connecting expedient for a drilling unit used in the manner above described, will be apparent when it is considered that, due to differences in nature of the earth or rock encountered in boring or drilling, it is often possible, for a short period at least, to advance the drill unit at a rate exceeding that of forward propulsion of the pipe sections by the jacks. This provision is also of advantage during the intervals required for re-location of the jack abutments such as 24. Even more importantly, however, is the ability, for personal safety and to reduce the yardage of earth handled, as well as to minimize disturbance of circumjacent earth, to provide for a quick withdrawal or retraction of the drill unit into the leading pipe section, or failing this, to approach

this condition as closely as possible. Such an emergency arises, for example, when the horizontal bore encounters loose sand or gravel, or perhaps quicksand. Due to the present facility for quickly unlatching and retracting the drill unit, the leading pipe section may be quickly advanced, through forward jacking of the string, so that its leading edge again encounters firm, undisturbed earth.

The foregoing are only a few examples of the many instances in which it has been found by experience that a quick-acting releasable mount for a drilling unit, such as herein detailed, effects many savings in time, reduced personal hazards and drilling costs.

It will have appeared that the arrangements and assembly characterizing the present invention serve fully to attain each of the objects hereinabove expressly stated, as well as the other implied improved results and advantages suggested by the foregoing detailed description.

Although the invention has been described by making specific reference to a presently preferred, exemplary embodiment, it will be understood that numerous changes may be made in the parts and their relation, as well as in the specific mode of usage outlined, all without departure from the spirit and full intended scope of the invention as defined by the claims hereunto appended.

I claim as my invention:

1. The combination in earth tunnelling apparatus, of a casing extending within the bore, a powered tunnelling unit within the casing, longitudinal supports for the unit extended within and along the walls of the casing, and a plurality of interfitting elements carried by the supports and the unit, and so related in assembly as to prevent unintended rotational and longitudinal displacement of the unit within the casing, and a single operating member in controlling relation to the several said interfitting elements.

2. In combination with a powered tunnelling unit and a conduit section in which the unit is operatively disposed, means for detachably and adjustably positioning the unit longitudinally of the conduit, said means including at least a pair of brackets or rails mounted internally of opposite sides of the conduit section, at least one of the rails being provided with a series of spaced recesses, a plurality of plungers carried by the tunnelling unit and adapted to interfit the recesses, a rock shaft for actuating the plungers and connections from the shaft to the plungers.

3. A quick-detachable and adjustable supporting device for mounting a tunnelling unit internally of a tunnel conduit section, and including spaced trackage elements on which the unit is slidably supported, at least one of the trackage elements being provided with a plurality of longitudinally spaced recesses, and at least a pair of plungers carried by the tunnelling unit in positions selectively to engage different recesses of said trackage element, and means for concurrently actuating the plungers into and out of interfitting relation with said recesses.

4. Means providing an adjustable mounting for a powered tunnelling unit in a tunnel casing section, said means including a pair of oppositely disposed parallel angle elements carried internally of the opposite walls of the tunnel casing section, a pair of plungers on each side of the unit, a series of spaced apertures in each of the angle elements, and a manual control member connected in extending and retracting relation to the several plungers.

5. Means providing an adjustable mounting for a powered tunnelling unit in a tunnel casing section, said means including a pair of oppositely disposed parallel angle elements carried internally of the opposite walls of the tunnel casing section, a pair of plungers on each side of the unit, a series of spaced apertures in each of the angle elements, a manual control member connected in extending and retracting relation to the several plungers, and additional means constituted by cooperating, adjustably related elements carried respectively by the tunnelling unit and by the tunnel casing section, said elements being in interfitting relation to prevent torsional displacement of the unit within the tunnel casing section.

6. Means providing an adjustable mounting for a powered tunnelling unit in a tunnel casing section, said means including a pair of oppositely disposed parallel angle elements carried internally of the opposite walls of the tunnel casing section, a pair of plungers on each side of the unit, a series of spaced apertures in each of the angle elements, a manual control member connected in extending and retracting relation to the several plungers, and spring means associated with the plungers, and tending to bias the plungers from an intermediate position either to positions of engagement or disengagement.

7. The combination in tunnelling apparatus, of a tunnel conduit or casing extending into the bore, a powered tunnelling unit in the conduit, a pair of elongate elements of angle section extended along the opposite sides and internally of the casing, a channel element along the inside top portion of the casing, the angles and channels each being provided with a row of apertures, a pair of plungers at each of the opposite sides of the tunnelling unit, a pair of plungers at the top thereof, the plungers of each pair being appreciably spaced from each other in a direction longitudinally of the casing, and adapted to operate between relatively extended and relatively retracted positions for selective interengagement with the apertures in the angle and channel elements, a rock shaft extending longitudinally of the tunnelling unit for each of said pairs of plungers, articulated connections between the shafts and plungers, a rockably mounted element operatively connected to all of the rock shafts, a manual control member connected to said element, and a spring associated with the rockably mounted element, and tending to bias said element from a position corresponding to intermediate plunger positions, to either of two positions, in one of which the plungers are engaged with said apertures, and in another of which the plungers are freed of said apertures.

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