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Colson

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[54] **MEANS FOR ELIMINATING ROLL OF TUNNELING SHIELD**

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[52] **U.S. Cl.** **61/85**

[51] **Int. Cl.** **E01g 5/14**

[58] **Field of Search** 61/85, 43, 42, 44, 61/45, 84

[56] **References Cited**

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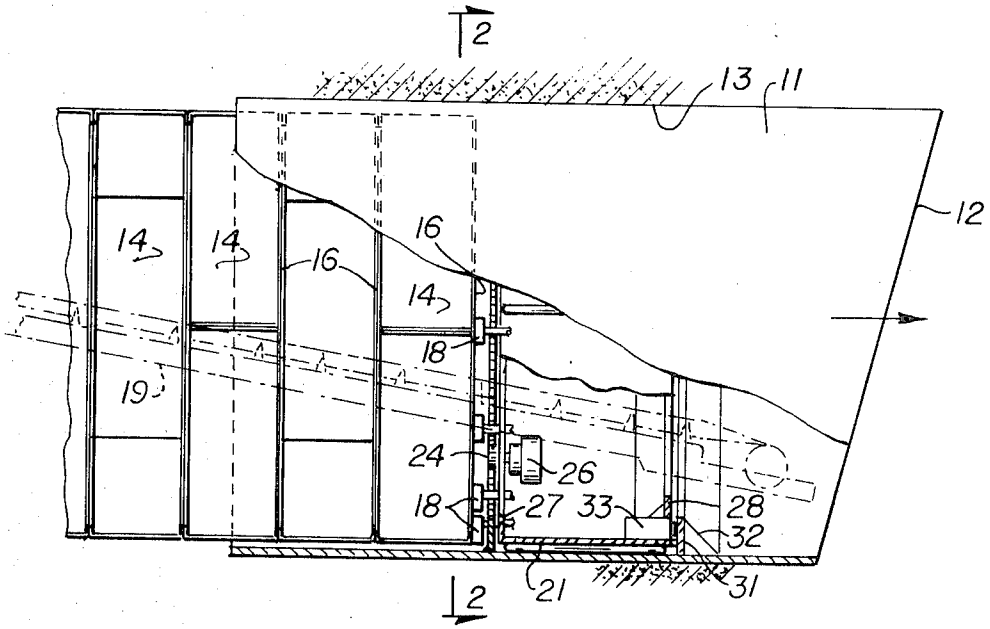
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[57] **ABSTRACT**

A tunnel shield is pushed through the ground by hydraulic rams, but has a tendency to rotate and, unless corrected, the forward support for the spoil conveyor and other equipment gets out of proper alignment and there are other undesirable results. To restore alignment an interior shell is rotatably mounted inside the shield and provides the forward support for the aforementioned equipment. Means is provided to rotate the interior shell relative to the shield so as to restore the interior shell to level position whenever the shield has rotated.

3 Claims, 3 Drawing Figures



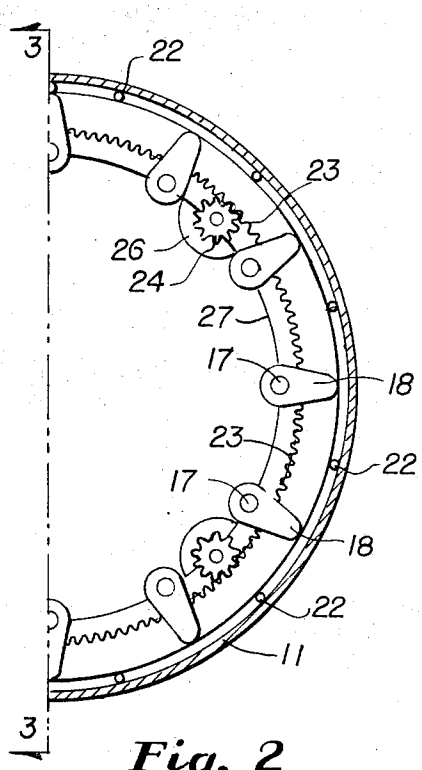


Fig. 2

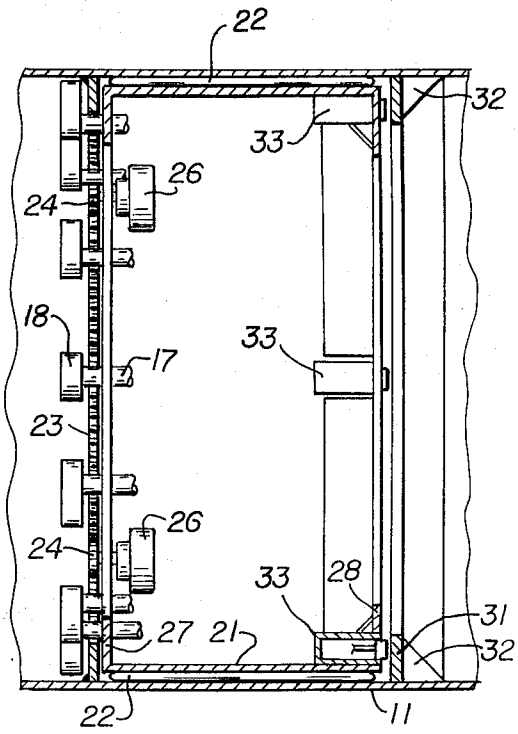


Fig. 3

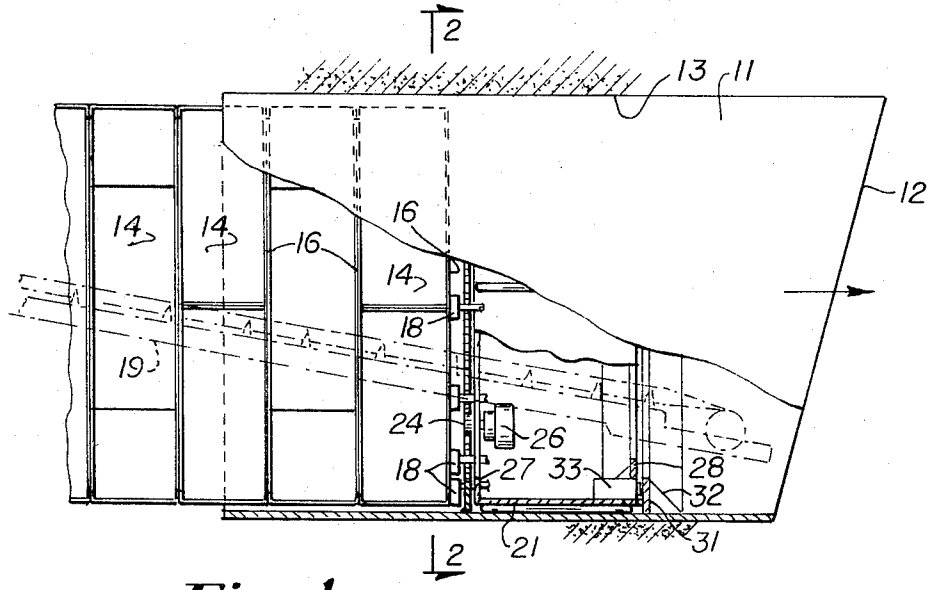


Fig. 1

MEANS FOR ELIMINATING ROLL OF TUNNELING SHIELD

This invention relates to a new and improved means for eliminating roll of tunneling shields. More particularly, the invention relates to a means for restoring to vertical the forward support of conveyors and other equipment which are installed in the interior of tunnel shields which are driven through earth by hydraulic rams.

A principal object of the present invention is to provide means to support or anchor the forward end of equipment used in tunnel construction in such manner that a permanently horizontal support is provided regardless of rotation of the tunnel shield. It will be understood that spoil conveyors, shield driving control equipment and the like is located in the tunnel shield, and for proper alignment and operation it is very desirable that the support be kept permanently horizontal. In practice, however, it has been found that shields tend to rotate as a reaction to the driving forces, and this rotation causes misalignment and other failures of the conveyor and other equipment. The present invention has for its principal purpose the avoidance of such misalignment.

Heretofore, surveying of the tunnel shield has been necessary to reveal rotation. In previous practice, elaborate means were required to correct rotation and such means are avoided in accordance with the present invention. Further, correcting the rotation of the shield has required suspension of normal tunneling activities which in some instances seriously delays completion of the tunneling. Such costly delays are likewise eliminated by this invention.

In order to detect rotation of the tunnel shield, it is necessary to survey; and because of the fact that equipment which is installed inside tunnels interferes with surveying, such surveying has been extremely difficult. Offset methods of surveying have been utilized. The present invention makes such surveying largely unnecessary. A simple spirit bubble, properly located in the interior shell, is all that is required to detect rotation and to determine when the rotation has been corrected. In one method used to correct alignment of the tunnel shield throughout its tunneling operations, a set of targets is placed and a laser beam is used in conjunction with these targets to keep the tunnel shield in its correct alignment both horizontally and vertically throughout its passage through the earth. When the shield rotates, it destroys the relative position of the targets in relation to the one.

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 schematic side elevational view of a tunnel shield broken away to reveal interior construction.

FIG. 2 is a vertical sectional view taken substantially along the line 2—2 of FIG. 1.

FIG. 3 is an enlarged sectional view taken substantially along the line 3—3 of FIG. 2.

A conventional tunnel shield 11 is a cylindrical member having a beveled forward end 12 which is pushed through relatively soft earth to define the tunnel bore 13. Conventionally, liners 14 are installed at the rear of the shield 11, said liners comprising pluralities of arcuate sections which are bolted together and eventually form the interior of the tunnel. Since the shield 11 is of larger diameter than the exterior of the liners 14, a slight gap is created between the exterior of the liners 14 and the bore 13, and this is ordinarily filled with grout, gravel or some other material.

The liners 14 ordinarily have radial flanges 16 by which the various sections are bolted or otherwise connected together edge to edge. The flanges 16 are used as a means for thrusting the shield 11 forwardly as the digging of the tunnel progresses. Thus, a plurality of hydraulic rams 15 is located pivotted to brackets 20 with the shield 11, and the rearward extending rods 17 of these rams provided with feet 18 which engage the flanges 16. Hydraulic force applied to the rams causes the shield 11 to be pushed forward, the liners 14 providing the anchor or support against which the shield 11 is pushed. It has been found in actual practice that this means of propelling the shield 11 is satisfactory except for the fact that the reaction forces tend to cause the shield 11 to rotate at times, and the extent and frequency of such rotation is unpredictable. A great amount of equipment is installed inside the shell 11, and the operator of the hydraulic controls is also located there. Among the equipment are conveyors 19 which convey the spoil from the floor of the bore 13 to the rear where it is deposited onto cars or is otherwise conveyed away. It is quite important that all this equipment be maintained level; but if the shield 11 is not maintained against rotation, then very expensive time consuming realignment procedures have been required. These procedures are unnecessary in accordance with the present invention.

An interior shell 21 is mounted approximately midway of the length of shield 11 and this interior shell has a lesser length than the shield. Pluralities of rollers 22 or other bearing means are interposed between the shield 11 and the interior shell 21 to permit relative rotation thereof. A ring gear 23, or segments thereof, are mounted fixed relative to shield 11. A plurality of pinions 24 turned by hydraulic or electric motors 26 are supported so that they are fixed relative to interior shell 21. By energizing motors 26 in either direction, the interior shell 21 may be turned relative to shield 11. The rams (not shown) which move rods 17 are located fixed to shell 21. Hence, the forward thrust of these rams is transmitted by means of annular front support ring 28 on the forward end of shell 21 against a matching annular push ring 31 which is fixed to shield 11 and strengthened by gussets 32. When the rams push forward, ring 28 pushes against the ring 31 and forces the shield 11 forwardly, the thrust being absorbed by flanges 16 or one of the liners 14 and transmitted by that liner rearwardly to the other liners. To prevent the friction of rings 28 and 31 from preventing reverse rotation of the shell 21, back-off rams 23, or springs or other means are fixed to shell 21 and project through apertures in forward support ring 28 to bear against push ring 31. Thus, after the main driving rams have been deenergized, it is possible by means of the back-off rams 33 to push the shell 21 rearward away from push ring 31 to permit the motors 26 to turn shell 21 to restore the original horizontal position thereof regardless of the position in shield 11.

It is apparent that if there is a tendency for shield 11 to rotate, the interior shell 21 will rotate and the shield itself will be pushed forward in its proper vertical posi-

tion. In some cases, however, the friction between the rings **28** and **31** will cause the shield **11** as well as the shell **21** to rotate. Rather than it being necessary to restore the shield **11** to its proper position relative to the vertical, it can be left in its misaligned position without further difficulty, and the interior shell **21** restored to its proper relationship to the vertical, thereby preserving the alignment of the equipment which is all anchored to the interior shell.

What is claimed is:

1. In a tunneling machine a shield, a shell rotatably supported within said shield, rotation means cooperable between said shield and said shell for rotating said shell relative to said shield comprising a ring gear on said shield, a pinion rotatably mounted on said shell meshing with said ring gear, a motor for revolving said pinion, and drive means for driving said shield and shell together in the same direction as the axis of their relative rotation comprising a plurality of rams fixed to said shell and having rods extending rearwardly of both said shell and shield and having means at their ends opposite said rams for anchoring said rods to the wall of a tunnel.

2. In a machine according to claim **1** a first annular ring on the forward end of said shell and a second annular ring fixed to said shield immediately forward of said first ring to transmit thrust of said shell to said shield.

3. A machine according to claim **2** which further comprises back-off means for forcing said rings apart after completion of forward thrust of said shield.

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