United States Patent [19]

Rees et al.

[11] **3,716,997**

[45] **Feb. 20, 1973**

[54] TUNNEL BORING EQUIPMENT

[75] Inventors: **Donald Frank Rees**, Wentworth; **Michael Alexander Richardson**, Hindhead, both of England

[73] Assignee: **William F. Rees Limited**, Surrey, England

[22] Filed: **May 19, 1971**

[21] Appl. No.: **144,858**

[52] **U.S. Cl.** **61/85**, 61/42

[51] **Int. Cl.** **E21d 19/04**

[58] **Field of Search** 61/85, 84, 42–45, 61/63; 299/31, 33

[56] **References Cited**

UNITED STATES PATENTS

1,766,568	6/1930	Updegraff	61/84
3,075,591	1/1963	Pirrie et al.	61/85 X
3,247,675	4/1966	Winberg	61/84
3,411,826	11/1968	Wallers et al.	61/85 X
3,556,599	1/1971	Fikse	299/33 X
3,613,379	10/1971	Jacobs	61/84 X

FOREIGN PATENTS OR APPLICATIONS

325,396	1/1903	France	61/85

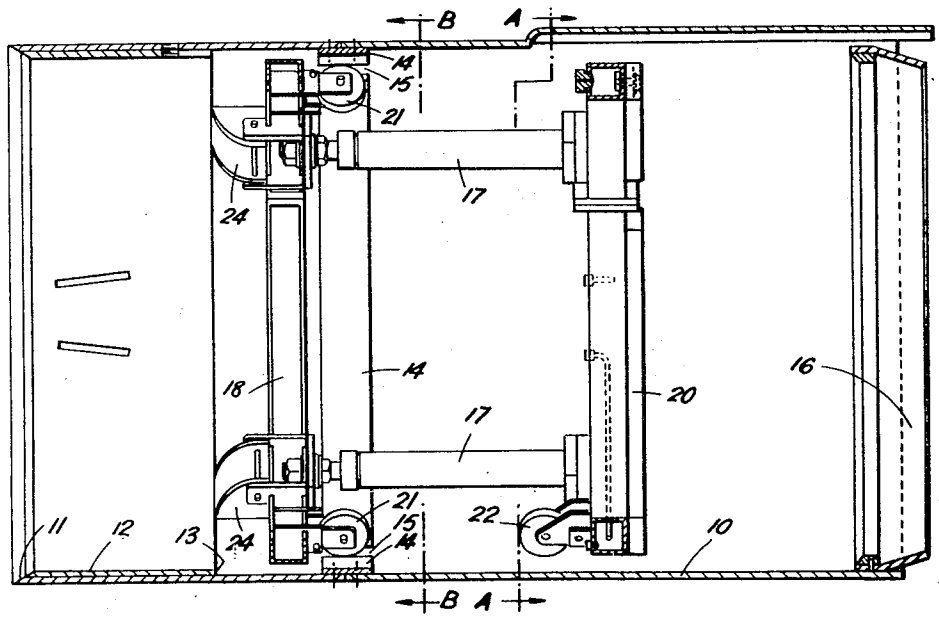
Primary Examiner—Dennis L. Taylor

Attorney—Cushman, Darby & Cushman

[57] **ABSTRACT**

The specification discloses tunnel boring equipment comprising a tubular shield having reaction points therein, and a plurality of rams mounted on a carriage which is movable along the shield and has pawls 24 which can be engaged with the reaction points to transmit thrust from the rams to the shield to advance the shield along the tunnel.

5 Claims, 10 Drawing Figures



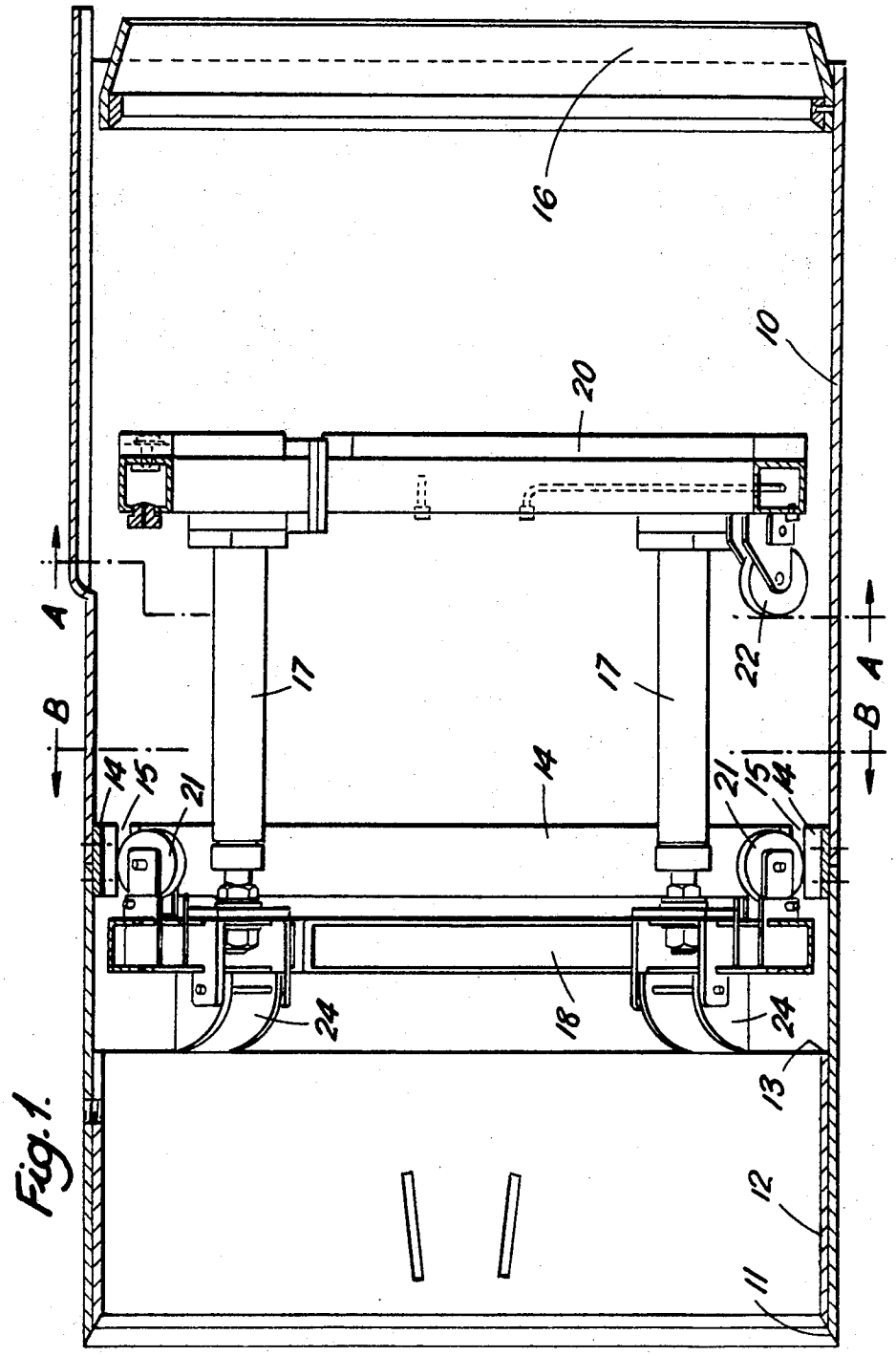


Fig. 1.

Fig. 2.

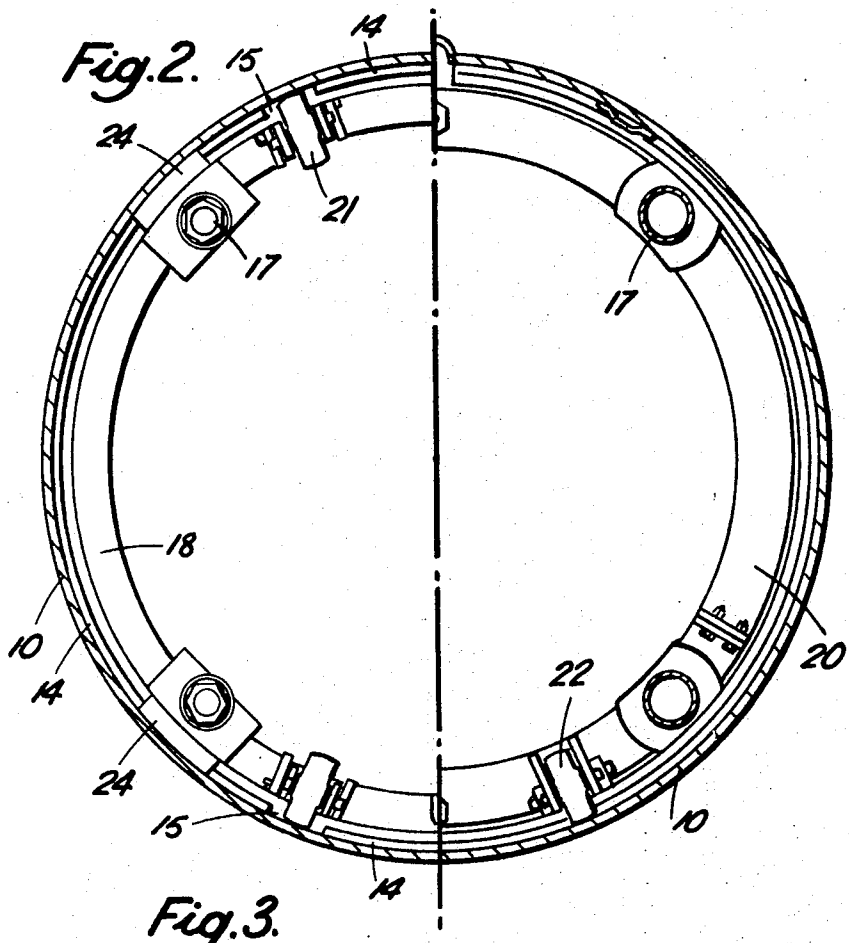


Fig. 3.

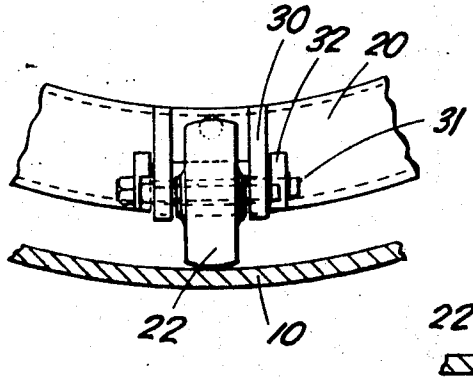


Fig. 4.

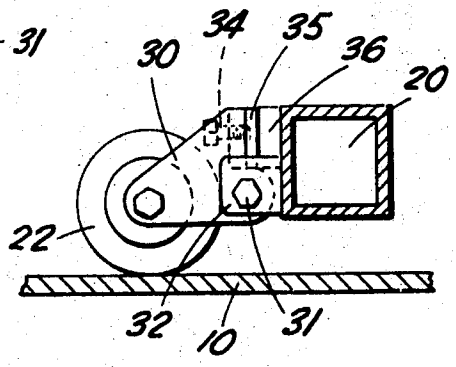


Fig. 5.

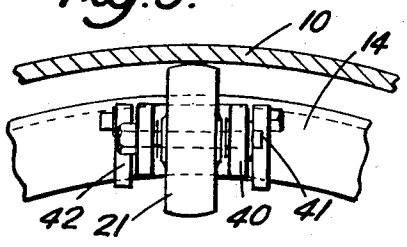


Fig. 6.

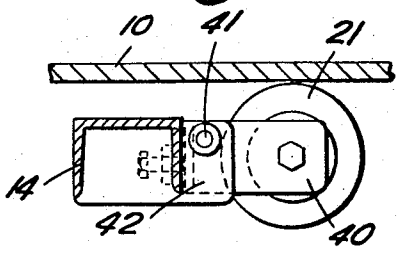


Fig. 7.

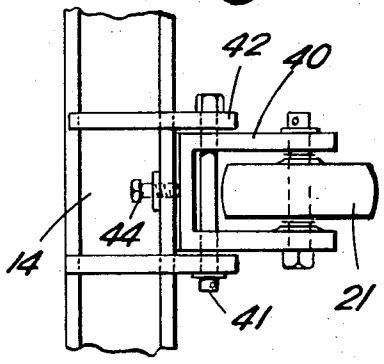


Fig. 8.

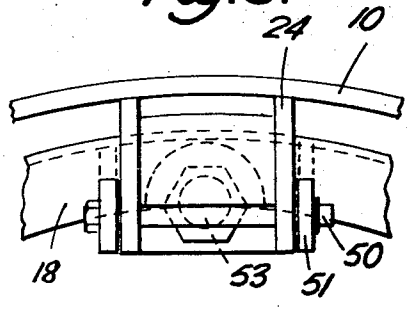


Fig. 9.

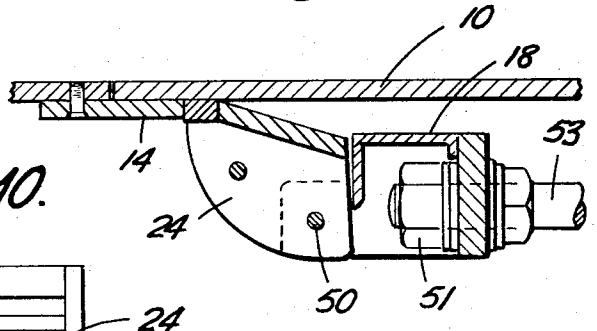
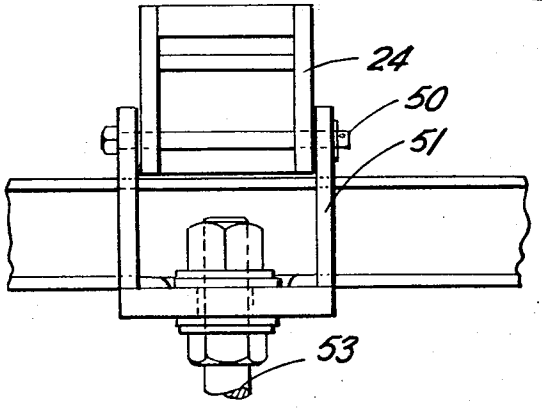


Fig. 10.



TUNNEL BORING EQUIPMENT

The invention relates to tunnel boring equipment of the kind in which a tubular shield, which may or may not incorporate mechanical ground cutting tools, is progressively advanced along a tunnel as boring proceeds, the advance being effected by means of rams acting between anchor or reaction points on the shield and a tunnel lining which is inserted, section by section, behind or within the rear portion of the shield as the boring proceeds. Such tunnel boring equipment will hereinafter be referred to as "tunnel boring equipment of the kind described."

The invention provides tunnel boring equipment of the kind described in which the rams are mounted on a carriage which is movable, with the rams, along the shield, there being means by which, in at least one position of the carriage, the thrust of the rams may be transmitted to the shield.

Preferably the carriage and shield have cooperating means by which the thrust from the rams may be transmitted to the shield at two or more positions of the carriage along the shield.

The carriage may comprise two rings concentric with the shield, means for mounting each ring for movement along the shield, a plurality of rams connected to move said rings towards and away from each other, one ring being capable of engaging the tunnel lining inserted behind or within the rear portion of the shield and the other ring having means for engaging said anchor or reaction points.

Said means for engaging said anchor or reaction points may comprise a plurality of releasable pawls mounted on said other ring.

Said anchor or reaction points may comprise abutments around the internal surface of the shield, which abutments face towards the rear end of the shield.

The invention has the advantage that the rams may be moved forwardly along the shield to provide room at the rear for manipulation of lining sections and may be moved rearwardly to facilitate access to the tunnel face during excavation. Furthermore in the case where the thrust can be transmitted at two or more positions, the length of the rams may be reduced, the shield being advanced by two or more operations of the rams with movement of the carriage between successive operations, for each section of lining inserted. It may also be possible to reduce the length of the shield with the advantage of easier steering of the shield.

A specific embodiment of equipment according to the invention will now be described, by way of example, with reference to the accompanying drawings, in which:

FIG. 1 is a longitudinal section through the equipment,

FIG. 2 shows cross-sections through the equipment, the right hand side being a section on the line A—A in FIG. 1 and the left hand side being a section on the line B—B in FIG. 1,

FIGS. 3 and 4 are end and side elevations of one of the roller units for supporting a thrust ring,

FIGS. 5, 6 and 7 are end and side elevations and plan of one of the roller units for guiding a reaction ring, and

FIGS. 8, 9 and 10 are end and side elevations and plan of one of the reaction anchor units.

The equipment forming the subject of this example is intended for use in boring tunnels of somewhat small diameter (e.g. about 900–1,300 mm.) and may be used in conjunction with the lining system described in Specification No. 24383/69 or that described in Specification No. 35088/69.

There is a tubular shield **10** with a cutting edge **11** at the leading end. Within the leading end of the shield there is a fixed sleeve **12** ending in a step **13** and spaced behind the step there is fixed a ring **14** which is cut away to provide gaps at four locations **15**. There is a flexible sealing ring **16** at the rear end of the shield.

Within the shield there is a carriage for four hydraulic rams **17**. The carriage comprises a reaction ring **18** and a thrust ring **20** to which the pistons and cylinders of the rams are secured, respectively. The reaction ring has four equally spaced rollers **21** which run on the internal surface of the shield and the thrust ring has two rollers **22** which run on the lower part of the shield. Accordingly the carriage comprising the two rings and the rams is movable, as a unit, lengthwise of the shield and the two rings are movable towards and away from one another by operation of the rams. The rollers **21** can pass through the gaps at **15**.

At each of the attachment points of the four rams to the reaction ring there is a pawl **24** which is engageable behind the step **13** or behind the ring **14** thereby to absorb thrust from the rams.

In the operation of the equipment, the carriage is first moved as far as possible to the rear of the shield thereby to provide maximum space at the front of the shield for excavation of the tunnel face. The pawls are then engaged behind step **13** and the rams energized to engage the ring **20** with the lining section (not shown) last erected and to push the shield forward a distance about equal to the stroke of the rams which is a little more than half the length of a lining section. The rams are then retracted and the carriage moved rearwardly until the pawls may be engaged behind the ring **14**. The rams are again extended to complete the forward movement of the shield. The rams are again retracted and the carriage may then be moved into the front of the shield to provide maximum space at the rear for erection of the next lining section.

FIGS. 3 and 4 show details of the two roller support units for the thrust ring **20**. Each of these units comprises a fork **30** in which the roller **22** is journalled, the fork being pivotally supported at **31** in a bracket **32** secured to the ring **20**. The fork has an adjustable thrust screw **34** which engages a plate **35** bonded to a rubber pad **36**.

FIGS. 5 to 7 show details of one of the four roller support units for the reaction ring **18**. Each roller **21** is supported for rotation in a fork **40** pivoted at **41** to a bracket **42** secured to the ring **18**. A screw **44** engages the base of the fork **40** to adjust the position of the roller radially of the shield.

FIGS. 8 to 10 show details of one of the four pawls **24**. The pawl is of channel section and is pivoted at **50** to a bracket **51** which is secured to the reaction ring **18**. The piston **53** of one of the rams is also secured to the bracket **51**.

The invention is not, of course, restricted to the constructional details of the above example. For instance the tubular shield is not necessarily of circular cross

section. It may, for example, be of rectangular cross section and used for boring pedestrian subways about 2,300 mm. by 2,100 mm. Again, the flexible sealing ring **16** may be omitted if desired.

We claim:

1. In tunnel boring equipment in which a tubular shield is progressively advanced along a tunnel as excavation proceeds at one end of the shield,

a. a carriage located within the shield,

b. means to mount the carriage in the shield for movement along the shield,

c. a plurality of thrust rams mounted on the carriage, to act against the erected tunnel lining,

d. releasable means on the carriage to act against fixed reaction means on the shield to prevent movement of the carriage along the shield towards said one end, and

e. fixed reaction means on the shield for engagement by said releasable means.

2. Tunnel boring equipment according to claim **1** wherein two fixed reaction means for engagement by said releasable means, which reaction means are spaced apart along the shield.

3. Tunnel boring equipment according to claim **1** wherein said releasable means on the carriage comprises a plurality of releasable pawls.

4. In tunnel boring equipment in which a tubular shield is progressively advanced along a tunnel as boring proceeds, the advance being effected by means of rams acting between anchor or reaction points on the shield and a tunnel lining which is inserted, section by section, behind or within the rear portion of the shield as the boring proceeds, the rams being mounted on a carriage which is movable, with the rams, along the shield, and there are means by which, in at least one position of the carriage, the thrust of the rams may be transmitted to the shield, the improvement wherein the carriage comprises two rings concentric with the shield, means for mounting each ring for movement along the shield, a plurality of rams connected to move said rings towards and away from each other, one ring being capable of engaging the tunnel lining inserted behind or within the rear portion of the shield and the other ring having means for engaging said anchor or reaction points.

5. Tunnel boring equipment according to claim **4** wherein said means for engaging said anchor or reaction points comprises a plurality of releasable pawls mounted on said other ring.

* * * * *