United States Patent

Forbes

[15] **3,706,441**

[45] **Dec. 19, 1972**

[54] **JACKING DEVICES**

[72] Inventor: **Dudley Norman Forbes**, 268 Pastuer Road, Blackheath Ext. 1, Johannesburg, Republic of South Africa

[22] Filed: **May 24, 1971**

[21] Appl. No.: **146,104**

[30] **Foreign Application Priority Data**

May 22, 1970 Republic of South Africa.....70/3468

[52] **U.S. Cl.**.....**254/98**, 254/104

[51] **Int. Cl.**.....**B66f 3/08**

[58] **Field of Search**.....254/104, 100, 98

[56] **References Cited**

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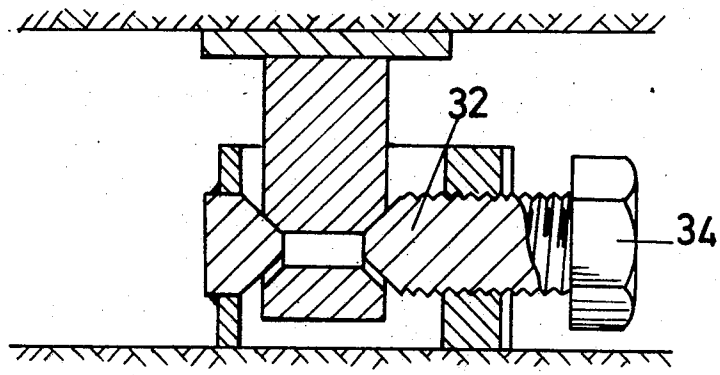
Primary Examiner—Othell M. Simpson

Attorney—Young & Thompson

[57] **ABSTRACT**

This invention deals with a jack which can be incorporated in the length of a pit prop, can be used as a flat jack or can be used as a pulling jack. Essentially the jack is composed of a plunger held in a stirrup by a conical anvil and a pointed screw engaging in opposed conical recesses in the plunger. By turning the screw the stirrup is caused to move transversely to the plunger axis and at the same time the plunger moves up and down in the stirrup. If used as part of a pit prop, the plunger forms telescopic extension of the prop and the stirrup rests on an end of the prop. Acting as a jack the top of the plunger acts on one surface and the stirrup on another. For pulling purposes the plunger is attached to the element to be pulled. The device of the invention generates large forces, but is only suitable for small displacements.

11 Claims, 10 Drawing Figures



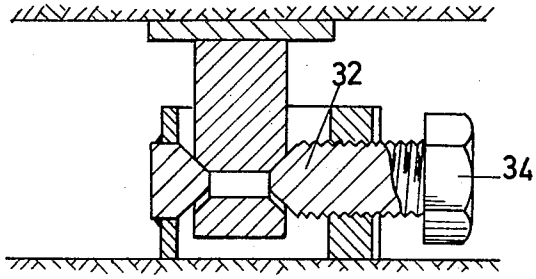


Fig. 1

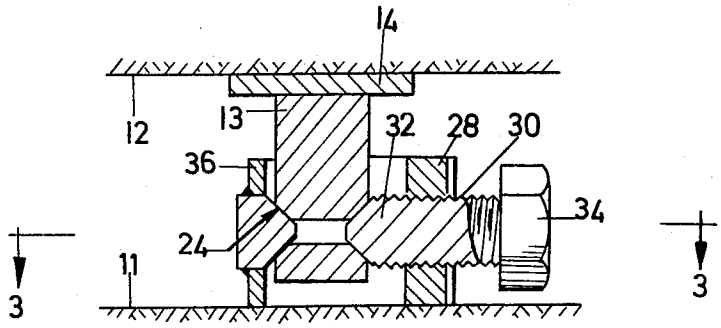


Fig. 2

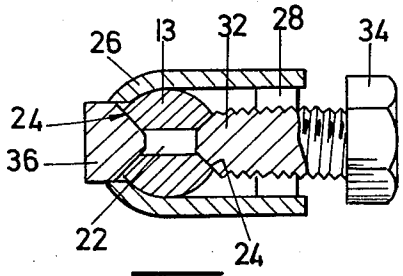


Fig. 3

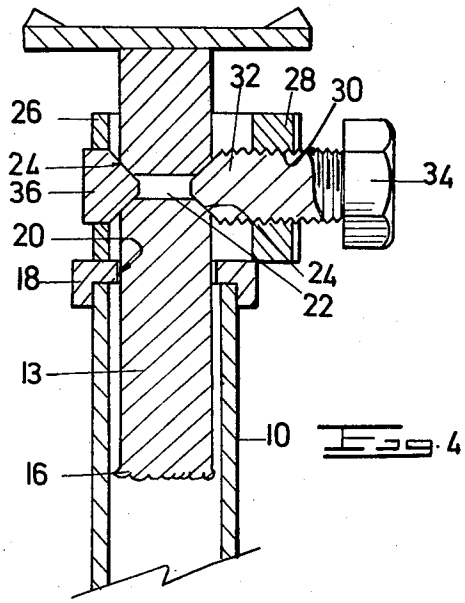


Fig. 4

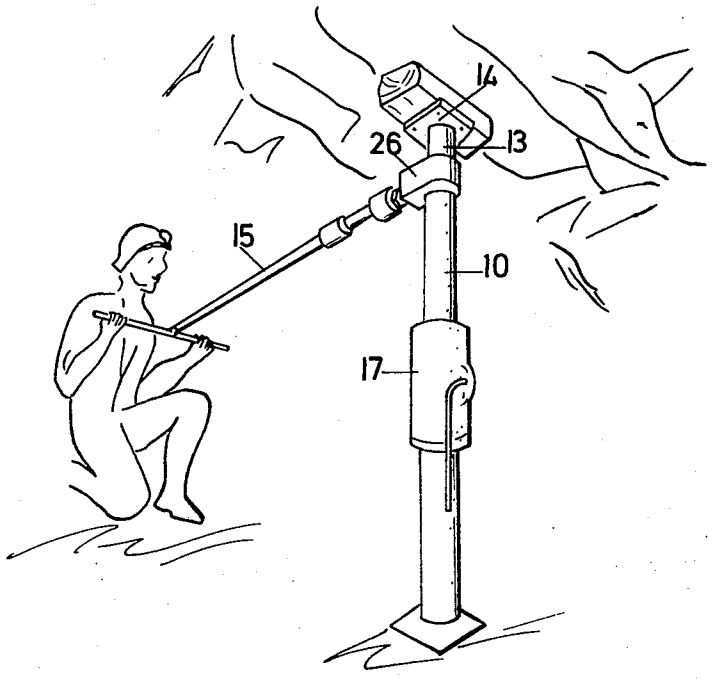


Fig. 5

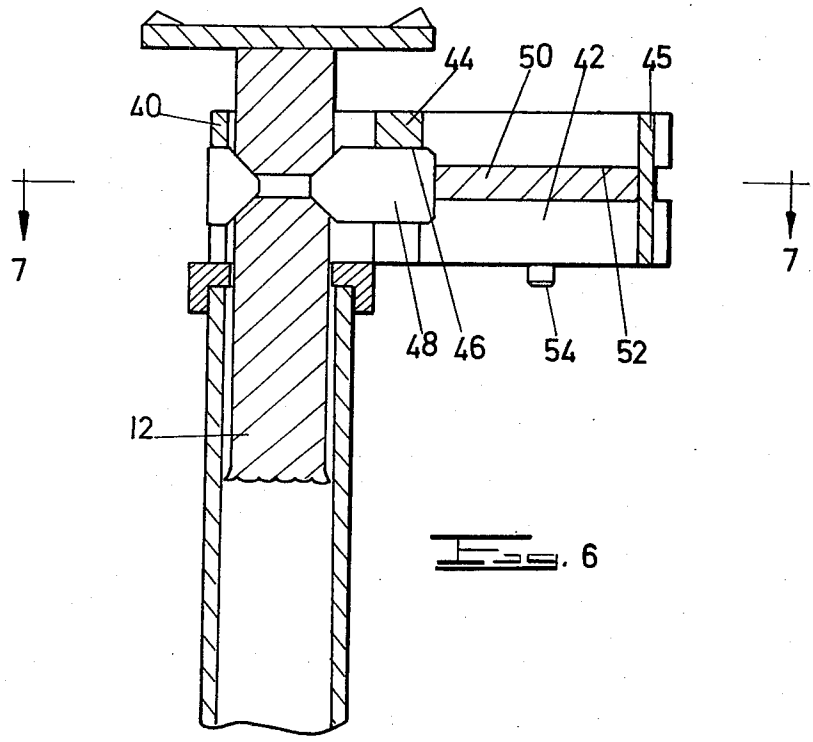

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Fig. 6

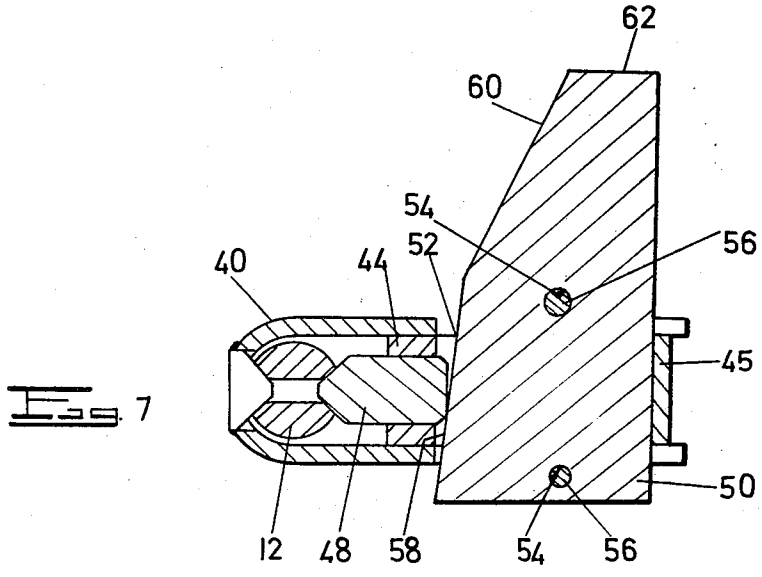
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Fig. 7

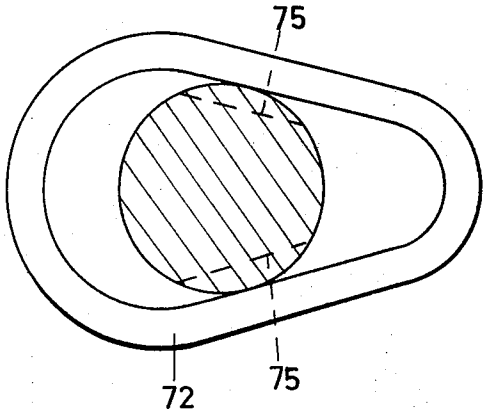

Fig. 9

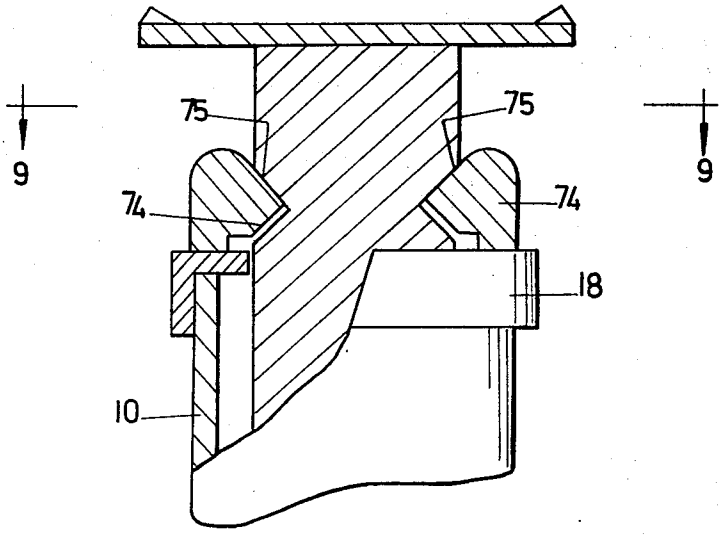

Fig. 8

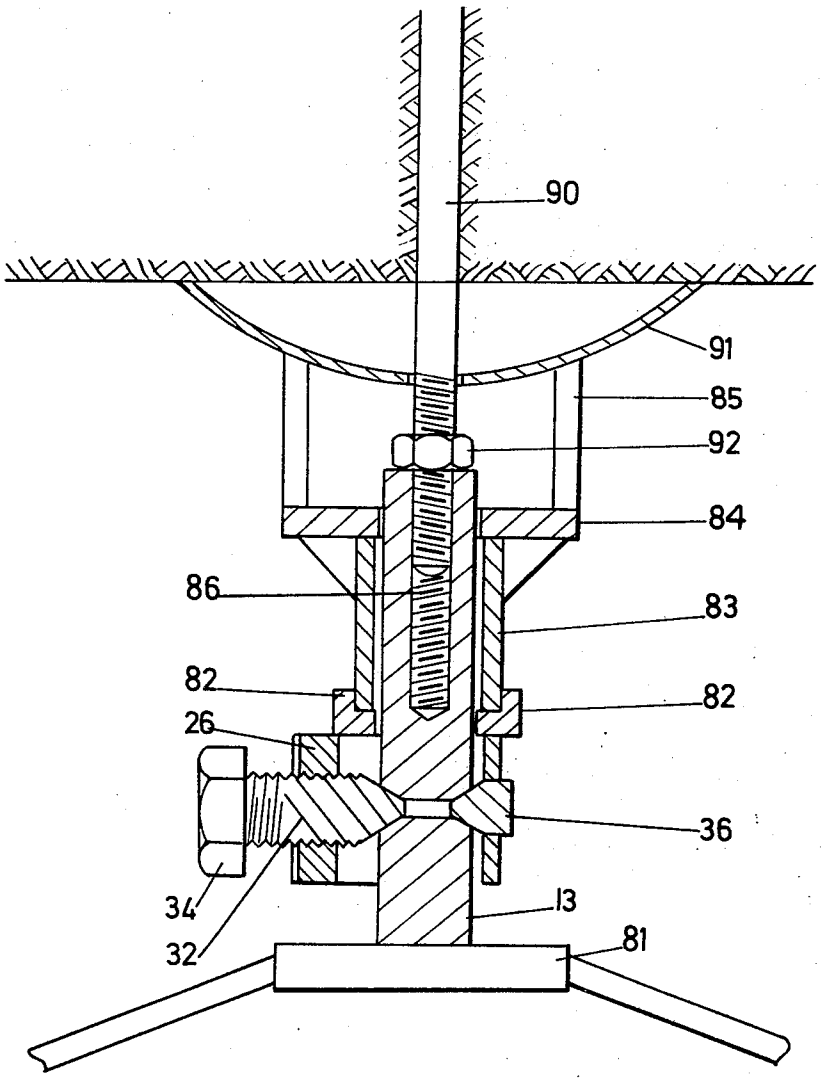

Fig. 10

JACKING DEVICES

In the mining industry various types of roof props are used. These are secured in position in a variety of ways. In order to re-use these props it is necessary to be able to strike them. Ideally striking should take place from a place of safety some distance away. As far as the applicant is aware, this is only possible with hydraulically operated props. In mechanical props it is necessary to remove a wedge from a distance — a most difficult operation — or to operate a screw turning axially about the prop and thus carrying the full load acting on the prop — almost impossible from a distance.

In both cases it is not easy to reset the prop to the original load should dangerous conditions develop. Again this is readily possible with hydraulics.

One object of the invention is to provide a jack which can be incorporated in a prop and which can be struck from a distance. In the preferred form of the invention an object of the invention is to provide a jack which can be reset in a way similar to hydraulic jacks incorporated in hydraulic pit props.

In general an object of the invention is to provide a mechanical jack in which the force required to move the jack plunger is geared down. The use of the jack is not restricted to pit props, but the jack can be put to a variety of uses where a short travel and a large force is required.

A mechanical jack according to the invention comprises:

a plunger,

two tapered recesses on opposite sides of the plunger transverse to the direction of movement of the plunger and tapering towards the axis of the plunger,

a casing in which the plunger can move up and down, and

a pair of opposed wedges carried by the casing, tapered complementally to the recesses and so positioned that on movement of the casing relatively to the plunger the wedges move in the same sense in the recesses.

Thus as the casing moves the wedges move in to pinch the plunger between them or move out to allow the plunger to sink between them.

The angles of taper are chosen with a view to the multiplication of force required. This is dealt with more fully below.

Further according to the invention, one wedge is fixed on the casing and the other wedge is movable relatively to the casing, means being provided to hold the movable wedge against displacement relatively to the casing by forces acting on the plunger.

In this case the recesses and wedges are preferably conical. If they are, the movable wedge may be held by screw threads on the casing.

The movable wedge may also be held by a third wedge driven between the head of the movable wedge and an abutment on the casing.

It is also possible that the wedges be fixed on the casing in which case the recesses are tapered slots converging to one side of the plunger and the casing has convergent sides complemental to the convergence of the slots, movement of the casing taking place along the lengths of the slots.

The invention is further discussed with reference to the accompanying drawings, in which

FIG. 1 is a section through a mechanical jack according to the invention at the start of its operation,

FIG. 2 is the same view showing the jack fully operative,

FIG. 3 is a section on the line 3—3 in FIG. 2,

FIG. 4 shows the jack of FIG. 1 on a pit prop,

FIG. 5 is a perspective view illustrating a pit prop in use,

FIG. 6 is a view similar to FIG. 4 of a different embodiment,

FIG. 7 is a section on the line 7—7 in FIG. 6,

FIG. 8 is a view similar to FIG. 4 of a further embodiment,

FIG. 9 is a section on the line 9—9 in FIG. 8, and

FIG. 10 is a sectional view showing a jack in use for stressing roof bolts.

FIGS. 1, 2 and 3 show the preferred embodiment of the invention in its simplest form as a jack acting between two surfaces 11 and 12. The jack is composed of a plunger 13 carrying a plate 14. Towards its lower end the plunger is formed with opposed conical recesses 24 formed at the ends of a pilot bore 22.

The plunger 13 is surrounded by a stirrup 26 having a cross-member 28 which has a central threaded bore 30. Passing through the bore 30 is a bolt 32 having its axis at right angles to the axis of the plunger 13. The bolt 32 has a head 34 and a conical point complemental to a recess 24. Opposite the bolt 32 the stirrup 26 there is fixed a conical anvil 36. The anvil 36 and the bolt 32 serve as wedges engaging in the recesses 24.

In use the jack is inserted between the surfaces 11 and 12 (FIG. 1) with the wedges 36 and 32 partially engaged in the recesses 24. To jack the surfaces apart the head 34 is turned to screw in the wedge 32. As a result the stirrup 26 moves over to the right and slides on the surface 11. At the same time the plunger 13 moves up.

If the cone angles are 45°, the plunger 13 will move half the distance that the stirrup 26 moves. At the same time the force exerted by the screw 32 transversely to the plunger 13 will be multiplied by two in the axial direction of the plunger 13 minus any frictional losses. A small turning force exerted on the head 34 is thus multiplied many times. In fact it has been found that the normal person sitting on the surface 12, with the surface 11 as the floor, can jack himself up and down at will simply by turning the head 34 by hand. The turning effort required is very small. Note, however, that the distance moved is very small even though it is perceptible to the sitter.

The jack thus far described may be used as a flat jack between surfaces which are wide enough apart to receive the jack. In a suitable case the stirrup 26 would rest on the surface 11 through a suitable slide plate.

A major application of the jack of the invention is shown in FIG. 4. In this case the plunger 13 has been extended to form an extension to the upper tubular portion 10 of a pit prop.

At its upper end the extension 13 is provided with a roof-engaging plate 14. The lower end of the extension is peened over at 16. The extension 13 is of smaller diameter than the interior of the pit-prop 10 and is guided by a collar 18 which is secured to the upper end of the pit-prop.

The bore 20 through the collar 18 is such that the extension 13 is a sliding fit therein but is such that the

peened over end 16 of the extension cannot pass through the collar 18. Thus the extension 13 is held captive with limited relative movement in the pit-prop 10.

In use, the parts are assembled as shown in FIG. 4. Thus in relation to forces acting on the plate 14, a solid connection is formed between that plate 14 and the pit-prop 10 via the wedges 32 and 36 and the stirrup 26.

When the prop has to be struck, the bolt 32 is undone by a long spanner of any suitable kind. The force, if any, acting on the plate 14, causes the plate 14 to move down as the inclined sides of the conical depressions 24 slide down as the point of the conical member 36 and the conical point of the bolt 32 move apart.

Note that, if friction is ignored, the force acting along the bolt 32 and hence binding its threads is halved in relation to force acting along the length of the prop.

The striking of a prop is illustrated in FIG. 5. As shown the operator is handling a long spanner 15 acting on the screw 32. The tubular portion 10 is the upper part of a prop of any suitable design. The jack of the invention has been used very successfully as the upper part of a prop of the kind described in South African Pat. No. 67/1411 and which is of the screw type.

A prop of patent No. 67/1411 fitted with a jack of the invention as illustrated in FIG. 4 was submitted for testing to the National Mechanical Engineering Institute at Johannesburg. The prop was fitted between the upper and lower plattents of a 100 ton Amsler Universal testing machine. Load was then applied hydraulically to provide a compressive load of 9,000 kg. No trouble was experienced in releasing the jack head 34 by means of a 0.3 meter long spanner. In another test a 0.45 meter long spanner was used to release the load to enable the load sustained to be reduced to 4,500 kg. Subsequently the spanner was used to restore the original value of 9,000 kg.

It is also proposed to use the jack in conjunction with a friction type prop. In this case the portion marked 17 is any yielding mechanism of the friction type. In use the prop is installed with the wedges of the jack in the FIG. 1 position. The prop is extended to act between roof and hanging in a way conventional with friction type props. Thereafter stressing of the prop proceeds with the jack of the invention. The screw 32 is turned until the required prestress is obtained. One way of ensuring this is to turn the screw 32 until the friction mechanism starts yielding. Another way would be to use a torque spanner suitably calibrated.

Once installed the prop acts in the normal way and yields when conditions so require.

On striking the prop the operator does what is illustrated in FIG. 5. He slowly unscrews the screw 32. If he notices any movement of the hanging, he can immediately reverse his action and turn the screw 32 back to the fully stressed position.

Provided that the spanner 15 is long enough, the operator can always work from a safe place.

The embodiment shown in FIGS. 6 and 7 is generally similar to that described above. However here the stirrup 40 has longer arms 42 and two cross-pieces 44 and 45. The inner cross-piece 44 of the stirrup 42 has a round, untapped, bore 46 through which passes a wedge in the form of a rod 48 having its inner end matching the conical depression in the insert 12. A horizontal wedge member 50 is received between the two cross-pieces 44 and 45 and passes through slots 52 in the arms of the stirrup 42. The wedge member 50 has slots 54 which can receive pins 56 to hold the member 50 in position in the arms 52. These pins 56 have to be removed before the pit-prop is struck.

The wedge member 50 has two wedge surfaces 58 and 60 of which surface 60 is at a more acute angle than surface 58 and tapers towards the narrower end 62 of the wedge member 50. The wedge surface 58 acts on the outer end of the rod 48 to hold the latter in position.

In this case the prop is struck by striking the end 62 of the wedge member 50 with a long hammer or even with a remotely controlled power-operated striking tool.

The latter embodiment is not as suitable as that of FIGS. 4 and 5. The use of long hammers is not much liked. Note, however, that if during hammering, bad conditions develop, the wedge 50 can be knocked back to restore the original conditions.

Another less efficient way of obtaining some of the advantages of the invention is illustrated in FIGS. 8 and 9. In this case the stirrup 26 and the parts that it carries are replaced by a simple stirrup 72. The stirrup is ovoid in shape and as can be seen from FIG. 8 it provides two wedge shaped edges 74. The edges converge to the right. The extension 13 in this case is formed with two wedge-shaped slots 75 which similarly converge. The prop of FIGS. 8 and 9 is set by knocking the stirrup 72 to the left and is struck by knocking it to the right in FIG. 9. The area over which frictional forces have to be overcome is relatively large and in any case this embodiment suffers from the disadvantage that long hammers have to be used.

In FIG. 10 the jack of FIG. 1 is adapted to perform a pulling function rather than a lifting function. Here the plunger 13 is provided with a threaded bore 86 and a handled head 81. The stirrup 26 and the parts that it carries are the same as in FIGS. 1 and 2, except that the cone angle is 30° in order to give a bigger mechanical advantage. The stirrup 26 rests against a collar 82 which is mounted by a thrust bearing (not shown) on a tube 83. The tube 83 terminates on a plate 84 having support legs 85.

In use the jack is screwed to the free end of a roof bolt 90 installed with the conventional domed washer 91 and a nut 92. The jack is in the FIG. 1 position. The handles of the head 81 are first turned as far as they can go to ensure that the roof bolt 90 is tightly in position.

Now the head 34 is turned to stress the roof bolt. Preferably a torque spanner is used. When the required prestress has been reached, the nut 92 is screwed home by means of a spanner inserted through a gap in the legs 85. The jack may now be removed by unscrewing it from the free end of the roof bolt.

Note that with suitable stops on the screw 32 to regulate the extent of withdrawal from the recess 24 and to regulate the extent to which it can be screwed it, a torque wrench may become redundant. Uniformly positioned stops will ensure that all roof bolts are stressed to the same extent. After all equal stress is more important than the absolute value of the stress.

The jack of FIG. 10 is suitable for all pulling functions where a small elongation at great force is required.

I claim:

1. A mechanical jack comprising:

a plunger,

two tapered recesses on opposite sides of the plunger transverse to the direction of movement of the plunger and tapering towards the axis of the plunger,

a casing in which the plunger can move up and down, and a pair of opposed wedges carried by the casing, tapered complementally to the recesses and so positioned that on movement of the casing relatively to the plunger the wedges move in the same sense in the recesses.

2. A jack as claimed in claim 1 in which the recesses are tapered slots converging to one side of the plunger and the casing has convergent sides complemental to the convergence of the slots, movement of the casing taking place along the lengths of the slots.

3. A jack as claimed in claim 1 including a threaded bore at one end of the plunger, a handle to rotate the plunger at the other end, and at the threaded bore end an abutment on which the casing can slide and adapted to space the casing from a surface to which the plunger is screwed.

4. A jack as claimed in claim 1 in which one wedge is fixed on the casing and the other wedge is movable relatively to the casing, means being provided to hold the movable wedge against displacement relatively to the casing by forces acting on the plunger.

5. A jack as claimed in claim 4 in which the recesses and wedges are conical.

6. The jack claimed in claim 5 in which the movable wedge is held by screw threads on the casing.

7. A jack as claimed in claim 5 in which the movable wedge is held by a third wedge driven between the head of the movable wedge and an abutment on the casing.

8. A jack as claimed in claim 6 including a head plate at one end of the plunger, an extension at the other end of the plunger, and surrounding the extension a tubular end of an elongated support.

9. A jack as claimed in claim 6 in which the support is of the screw type.

10. A jack as claimed in claim 8 in which the support is of a yielding type.

11. A jack claimed in claim 10 in which the support is of the friction type.

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