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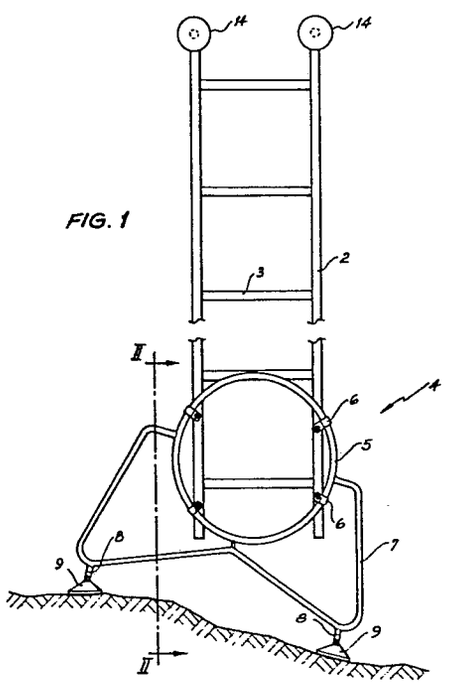
(54) Ladder levelling arrangements.

(57) A ladder leveller (4) comprises an arcuate member (5) which is preferably a circular ring, at least two and preferably three or four mounting elements (6) in the form of saddles to be connected to the ladder and through which the arcuate member may slide, and a support frame (7) connected to the arcuate member (5) and arranged to support the ladder on sloping ground and preferably also on other surfaces such as steps, whereby the ladder is pivotally mounted on the ladder leveller about an axis through the centre of the circle along which the arcuate member (5) extends. The ladder leveller may with advantage include swivelling feet (9) and an overcentre clamping lock (15) for added security if desired.

FIG. 1



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LADDER LEVELLING ARRANGEMENTS

The present invention relates to ladder levelling arrangements for the purpose of permitting a ladder to be easily positioned and safely supported on a variety of surfaces with the ladder remaining essentially upright (when the ladder is viewed from the front).

When a ladder is to be placed against a structure such as a building, the ladder can be safe and stable providing the supporting ground is hard and substantially horizontal. However, particularly when long extension ladders are used, it is a common practice for a second person to stand on the bottom of the ladder so as to provide stability resisting any tendency for the feet of the ladder to slip or the ladder itself to tip sideways.

A ladder is subjected to considerable vibration and some degree of shock loading when a heavy man climbs to the top of the ladder and it is very important that the ladder does not move or slip during movement of the man. A major problem arises where the ground beneath the ladder is sloping sideways since a conventional ladder can only be used in such circumstances if suitable packing is inserted under one leg so as to keep the ladder upright. There is an acute danger that unsuitable packing may be employed, or that the packing may not be accurately and safely positioned, or alternatively that the packing may be not of quite the right dimension so

that the ladder has a slight degree of lean which may not be noticed but prove to be unsafe when a man has climbed the ladder and is doing a job such as painting.

Accordingly, there has been a longstanding requirement to provide a suitable device which can be safe and easily compensates for uneven or sloping ground beneath a ladder.

For aluminium ladders it has been proposed to incorporate, in at least one of the feet of the ladder, an adjustable foot which can be moved up or down and clamped in a desired position. One form of such a levelling device comprises a foot which is mounted by screw-threaded engagement so that rotation of the foot permits adjustment of its height. However, this form of adjustment is tedious and slow; these factors raise a substantial risk that a workman may not give sufficient attention to ensuring that the ladder is accurately positioned before commencing to climb the ladder. Furthermore, the workman must bend down to make the adjustment and this is a tiring task which may induce dizziness when the workman stands up straight. This dizziness may cause misjudgement as to whether the ladder is truely upright.

It is considered that the proposals hitherto made have failed to provide a simple, cheaply constructable but reliable and very safe arrangement to permit rapid and accurate positioning of a ladder on sloping or uneven ground (including steps) and the present invention is concerned with dealing with these objectives.

According to the present invention, there is provided in one aspect, a ladder levelling device comprising

(a) an arcuate member,

(b) at least two mounting elements slidably engageable with the arcuate member and arranged to be

connected to the ladder at respective spaced locations,

(c) support means connected to the arcuate member for supporting the arcuate member in a stable manner on the ground,

(d) the arcuate member having a portion thereof shaped to follow the arc of a circle, and

(e) the arrangement being such that when the mounting elements are fixed to the ladder and the bottom of the ladder is supported off the ground and the support means extend to either side of the ladder, then the arcuate member and the associated support means can move rotatably relative to the ladder and the mounting elements about the centre of said circular arc through a range of relative positions.

Preferably, the mounting elements are in the form of saddle-like elements arranged to extend around the arcuate member and to be fixed to the ladder. Other forms of mounting element could be used, for example eye bolts, but saddles are the preferred form of mounting element and are preferably of spring steel.

The present invention may be provided in various embodiments and in one convenient embodiment the device can be prepared with instructions and if desired a template to facilitate fitting of the device to an existing conventional ladder. Alternatively, the device could be embodied in a ladder as original equipment in which case the mounting elements could be integral with the ladder structure itself.

Although certain embodiments of the invention could be operative with only two or three mounting elements, preferably four are used. Most preferably, the four spaced mounting elements are arranged in a square array with two vertically spaced fixing points

on each rail of the ladder, the lower and upper fixing points being at the same height on the respective rails.

Especially when more than two mounting elements are used, it is best to form the arcuate member as a substantially circular hoop of rigid construction and most preferably in the interests of a lightweight stable structure the support means is best formed from a metal framework fixed to the arcuate member at suitable locations between the mounting elements.

Since the arcuate member slides relative to the mounting elements and the mounting elements are engaged over the arcuate member so that, at least normally, the arcuate member cannot be removed from disengagement with the mounting elements, the surface of the arcuate member should be smooth for best performance and corresponding surfaces of the mounting elements should be similarly smooth.

In a preferred embodiment of the invention, the degree of relative movement in both directions of the arcuate member is limited by virtue of at least one of the connection points between the support means and the arcuate member being such that when this point is moved adjacent one of the mounting elements, the connection acts as a limit stop.

Most conveniently, the mounting elements are in the form of saddles having an essentially closed loop surrounding the arcuate member, which preferably is of circular cross-section, each of the saddles being adapted to be bolted to a rail of the ladder.

For the purpose of providing a neat, simple, cheaply constructed and very effective embodiment of the invention, it is preferable that the arcuate member is a closed circular ring and that the support means is

in essence of a generally W-shaped form which (considering the central position of the ring for horizontal ground) is welded to the ring at diametrically opposite sides halfway up the ring and the centre leg of the W is welded at the middle, bottom portion of the ring. In a preferred embodiment, four mounting elements are used and thus when the ladder is on horizontal ground the attachment points of the support means to the ring are located approximately mid-way between adjacent mounting elements.

Various materials may be used but in the interests of cheapness of construction, the support means and arcuate member can readily be made from mild steel with spring steel being used for the saddles.

The ground engaging portion of the support means may be provided with suitable feet which preferably are of sufficient surface area to spread the load of the ladder. The feet are preferably pivotal relatively to the main part of the support means to permit the ladder to be supported at different angles to the vertical direction. This is best achieved by fitting a leg with a fixed ball-shaped tip located at each side of the support means, and snap fitting a moulded foot with a part-spherical cavity onto the tip.

Surprisingly it has been found that without high tolerance engineering, embodiments of the invention can work very effectively and easily. The user simply places the support means of the ladder levelling device on the ground at the desired location and swings the ladder pivotally. Indeed the user does not even have to support the effective weight of the ladder to do this. When the ladder leans against a structure, the weight of the ladder is sufficient to provide enough frictional force so that the ladder will not normally move any further and as soon as a person climbs on the ladder, the extra weight substantially increases the

jamming tendency between the mounting elements and the arcuate member. Since the general plane of the arcuate member tends to move to be at a slight angle to the general plane of the ladder when a person steps on the ladder, movement of the ladder is prevented.

Furthermore, it has been found that even if sinking of the support means at one side of the ladder occurs, even with a man on the ladder it is possible for the ladder to remain upright and adjust relative to the ladder levelling device.

In the interest of even greater safety, a clamping device could be incorporated to secure more positively the arcuate member relative to the ladder. The most preferred form of this device is an over-centre clamping lock operable on an engagement member which has a sliding fit over the arcuate member such that when the lock is operated the arcuate member is pulled upwardly adjacent to one of the mounting elements, thereby positively taking up clearance between the arcuate member and the mounting element and, by virtue of frictional forces imposed by the locking element, tending to clamp the arcuate member against any movement.

Further security for the ladder user can be provided by incorporating a suitable high friction engagement pad at the top end of the ladder; this pad may be formed from resiliently compressible deformable rubber which has a high co-efficient of friction with other surfaces.

For illustrative purposes only, an embodiment of the invention will now be described with reference to the accompanying drawings, of which:

Figure 1 is an illustration from the rear of a ladder when fitted with an embodiment of the invention and looking in the direction of arrow A in Figure 2,

the ladder being supported on sloping ground;

Figure 2 is a cross-sectional side elevation taken along the line II-II of Figure 1 illustrating the bottom portion of the ladder and the levelling device;

Figure 3 is a cross-sectional view on an enlarged scale through a pivotal foot of the ladder leveller;

Figure 4 is a view corresponding to Figure 1 on an enlarged scale and schematically illustrating an optional locking device for the ladder leveller of Figures 1 to 3; and

Figure 5 is a side elevation taken in the direction of arrow B in Figure 4 and showing the locking device with the adjacent saddle omitted for clarity.

Referring first to Figure 1, a ladder comprises side rails 2 and rungs 3 and although in the drawing only a short ladder is illustrated, the invention is equally applicable to extension ladders which may be made of various materials including aluminium and wood.

A levelling device 4 is connected to the bottom portion of the ladder and comprises a rigid circular ring 5, four saddles 6 and a rigid W-shaped support frame 7 which is fixed to the ring, conveniently by welding, at the mid-point of each side of the ring and at the bottom of the ring when the device is viewed on horizontal ground.

As illustrated in Figure 2, the bottom portion of the W-shaped frame is bent to form a pair of legs 8. The legs 8 terminate in feet 9, one of which is shown in detail in Figure 3, and comprise a steel ball 10 screw-theadably secured on the associated leg 8 and snap-fitted into a moulded plastic foot pad 11 having a high friction facing 12. Thus, a firm and secure support for the ladder can be provided on a wide variety of ground surfaces including relatively steep slopes

and steps. Furthermore, the foot 9 swivels to accommodate the desired degree of lean of the ladder towards a building.

The saddles 6 which are secured by screws 13 to the ladder rails, and the ring 5 have smooth surfaces so that the ring can slide smoothly through the saddles. As can be clearly seen in Figure 1, the positioning of the saddles in a square array permits a wide range of movement of the ladder relative to the ring. The spacing of the saddles 6 and the shape and size of the support frame 7 are chosen such that the following operational requirements can be achieved:

1. The levelling device does not interfere with the person climbing the ladder since when a foot is placed on any rung it may project to the rear of the ladder without coming into interference with any portion of the levelling device.
2. The ends of the legs of the W-shaped frame 7 are welded to the ring and thus provide limiting stops which limit the extent to which the levelling device can be rotated relative to the ladder thereby preventing use of the ladder (without packing) on a dangerously steep slope.
3. The legs 8 of the frame 7 are widely spaced and provide a stable working base for the ladder and even when the ladder is used on a steep slope, a perpendicular line projected downwardly from the downhill ladder rail 2 falling inboard of the corresponding foot 9 so that a stable construction is provided. It will be appreciated that the feet could be altered to provide a wider spacing if this is desired but in the illustrated embodiment the ring cannot be rotated past a position corresponding to a moderately steep slope.

Advantageously at the top of the ladder, as shown in Figure 1, pivotal abutment pads 14 (of the same form

as that shown in Figure 3 for the bottom feet 9) are utilised at each side of the ladder whereby firm non-slipping engagement of the top of the ladder with a structure such as a building can be provided. The facing of this foot can be of a non-marking rubber such as white rubber.

Tests have indicated that providing the ladder is positioned substantially upright (relative to the sideways direction) and is inclined to a structure at a safe working angle typically of about 20^{o}, then the ladder leveller is very safe and a jamming effect occurs between the ring and the saddles particularly when the saddles are of a spring steel and there is no practical possibility of the ladder slipping when weighted by a man. However, should an additional positive locking feature be required then an additional clamp can readily be installed. Figures 4 and 5 illustrates such an optional clamp which is fixed to one of the rails 2 of the ladder.

As shown in Figures 4 and 5, the clamp comprises an over-centre lock 15 having a pivotal lever 16, a mounting bracket 17 secured to the rail 2 by a bolt 18, and a pivotal linkage 19 having a closed eye 20 at one end through which the ring 5 passes and an attachment leg 21 pivotably mounted on the lever 16 to engage the clamp, the lever 16 is displaced essentially upwardly and retained in the displaced position when it moves "over-centre". During this displacement, the ring 5 is pulled upwardly so that hard engagement is established (a) between the ring 5 and the upper portion of the saddle 6 and (b) between the ring 5 and the lower portion of the closed eye on the linkage 18.

In using a ladder fitted with a levelling device embodying the present invention, a fast and very simple operation is achieved. The user simply places the feet of the levelling device on the ground and swings the

ladder so as to be upright and rests it against the structure. The user can climb the ladder immediately although if the optional clamping device of Figures 4 and 5 is included the user can snap this to the closed position to provide extra safety.

Levelling devices embodying the invention thus permit essentially automatic levelling of the ladder in a speedy and reliable manner, the construction being simple and therefore resistant to defects and failures after a period of service and/or abuse. Furthermore, the device can be made without exacting manufacturing requirements by simple techniques such as welding of very cheap materials such as mild steel tube. Essentially there are no wearing parts and since a relatively loose fit only is required between the saddles and the ring, no trouble should be experienced even if the levelling device is used in dirty conditions which may include spilt paint, mortar or other contaminants.

CLAIMS:

1. A ladder levelling device comprising

an arcuate member (5) having a portion thereof shaped to follow the arc of a circle

support means (7, 8, 9) connected to the arcuate member for supporting the arcuate member in a stable manner on the ground, and

at least two mounting elements (6) slidably engageable with the arcuate member (5) and arranged to be connected to the ladder at respective spaced locations such that when the mounting elements (6) are fixed to the ladder and the bottom of the ladder is supported off the ground and the support means extend to either side of the ladder, then the arcuate member (5) and the associated support means (7, 8, 9) can move rotatably relative to the ladder and the mounting elements (6) about the centre of said circular arc through a range of relative positions.

2. A ladder levelling device as claimed in claim 1, wherein said mounting elements comprise saddles (6) or eye-bolts, the arcuate member being of substantially circular cross-section.

3. A ladder levelling device as claimed in claim 2, wherein the saddles (6) are of spring steel.

4. A ladder levelling device as claimed in any one of claims 1 - 3, wherein four mounting elements are provided.

5. A ladder levelling device as claimed in any one of claims 1 - 4, wherein the arcuate member is a circular ring (5).

6. A ladder levelling device as claimed in any one of claims 1 - 5, wherein the support means comprises a metal framework (7) attached to the arcuate member (5) at each side thereof at locations which, when the ladder is disposed on horizontal ground, are spaced from the nearest mounting element by a distance corresponding

to the desired limit of rotation of the ladder relative to the arcuate member.

7. A ladder leveller device as claimed in claim 6, wherein the metal framework (7) is generally W-shaped, the centre of the W being fixed to a bottom portion of the arcuate member (5), and the arcuate member being a circular ring.

8. A ladder levelling device as claimed in any one of claims 1 - 7, and further comprising a security clamp (15) comprising an over-centre lock operable on an engagement element (20) which fits over the arcuate member (5) but which on operation of the lock pulls the arcuate member (5) upwardly relative to an adjacent mounting element (6) to clamp the arcuate member against the mounting element, the over-centre lock being adapted to be fitted to a rail (2) of the ladder adjacent a mounting element.

9. A ladder levelling device as claimed in any one of claims 1 - 8 and wherein the arcuate member is of tubular steel.

10. A ladder levelling device as claimed in any one of 1 - 9 and wherein the support means have legs (8) terminating in feet (9) which are universally jointed onto the legs for motion through a range of positions.

11. A ladder levelling device as claimed in any one of claims 1 - 10 wherein the support means (7, 8, 9) have ground engaging surfaces (9) spaced apart such that for the normal range of positions of the ladder the respective longitudinal axes of the rails (2) of the ladder intersect the ground between said ground engaging surfaces.

12. A ladder including a ladder levelling device as claimed in any one of claims 1 - 12 and wherein either the mounting elements are securely fixed to the rail of the ladder or are integrally formed therewith.

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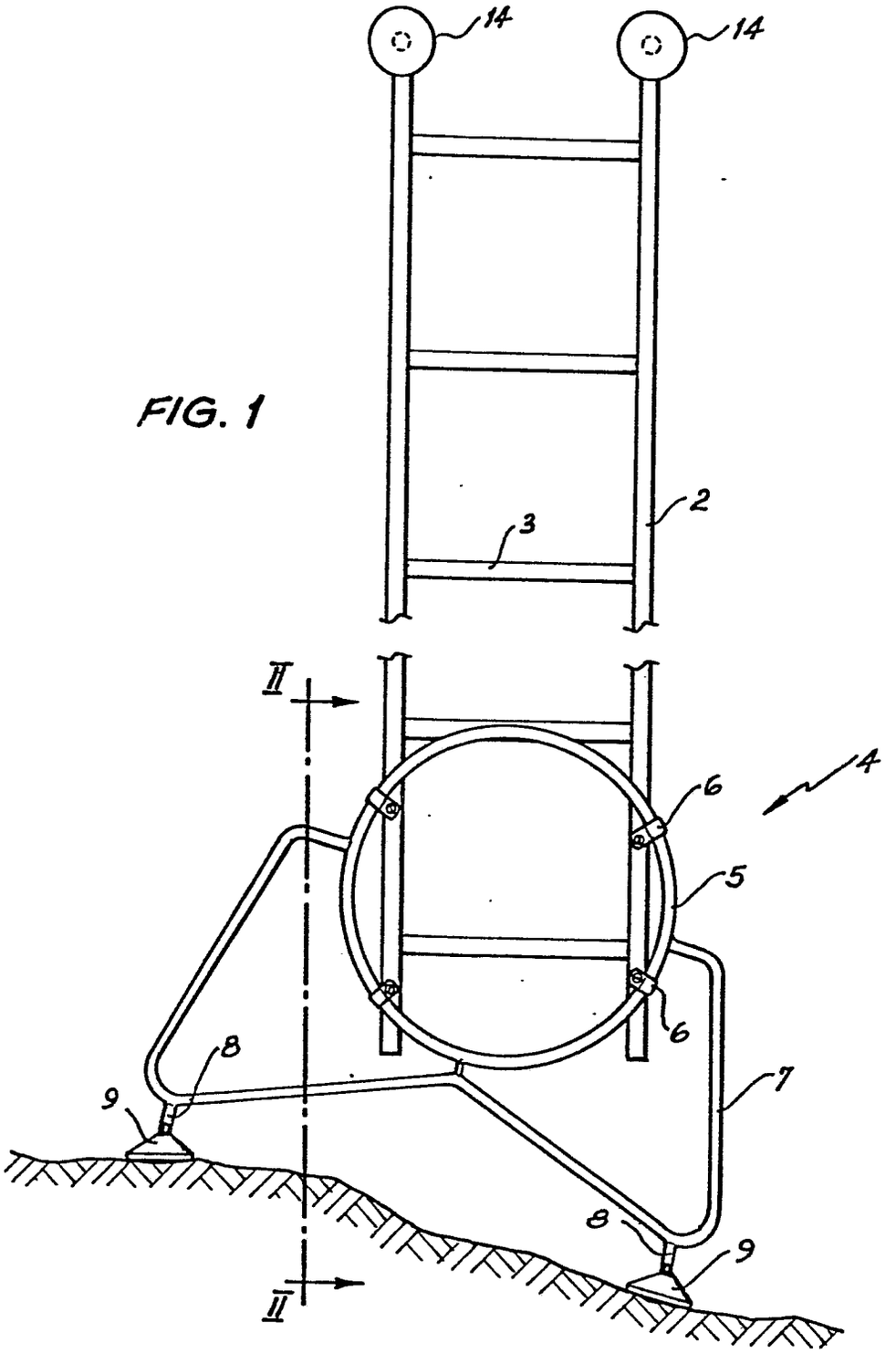
FIG. 1



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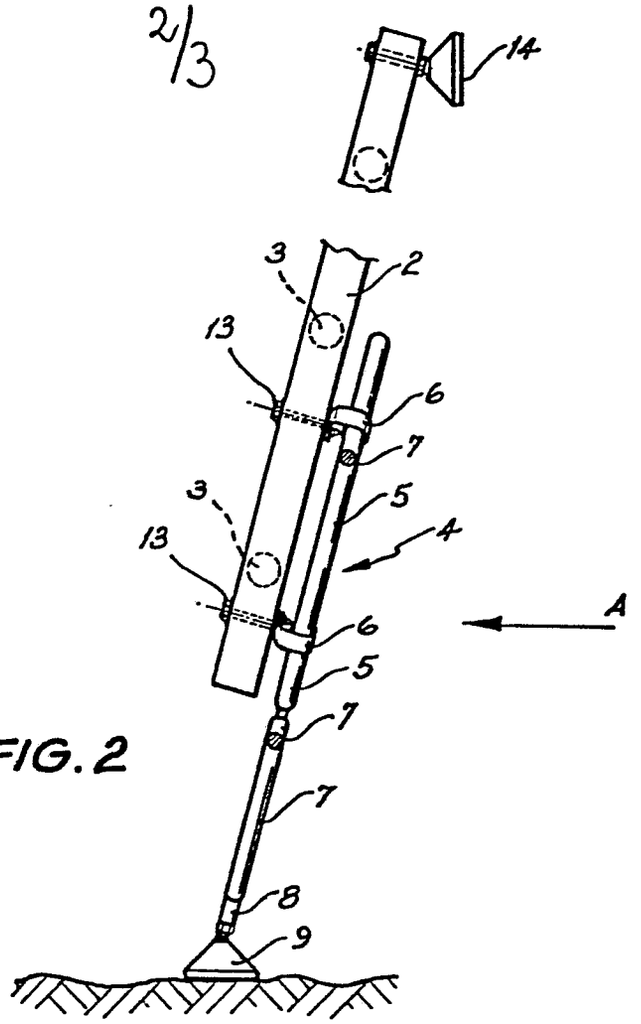

FIG. 2

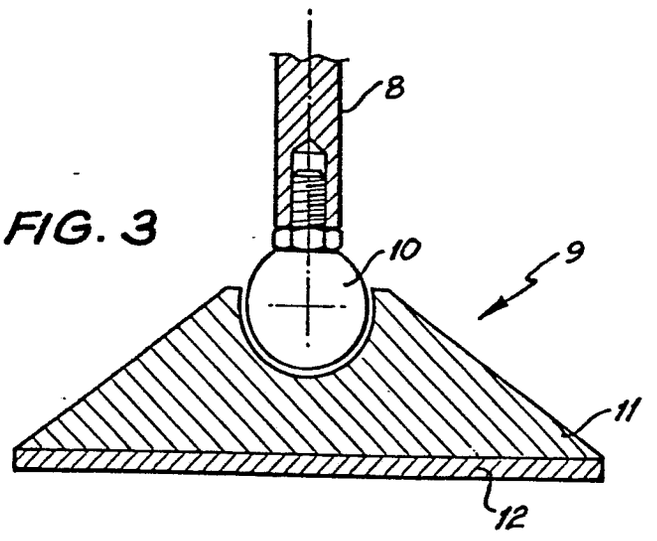

FIG. 3

FIG. 4

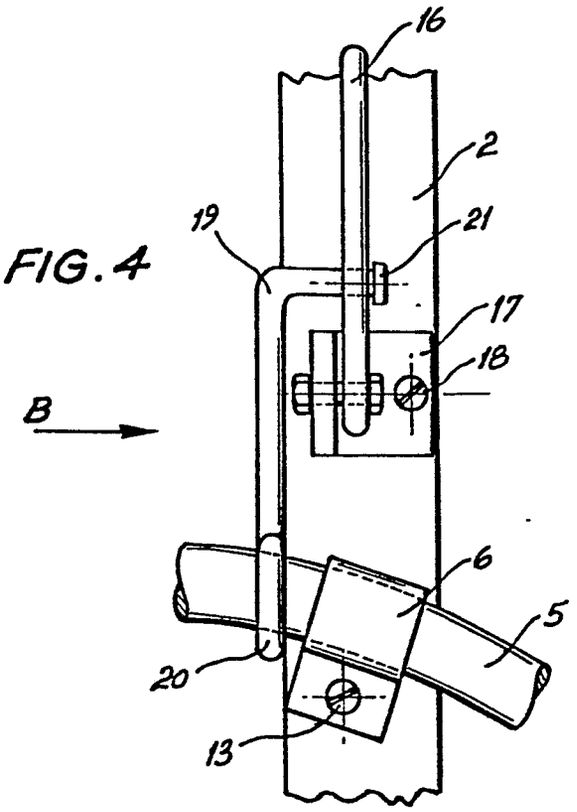

FIG. 5