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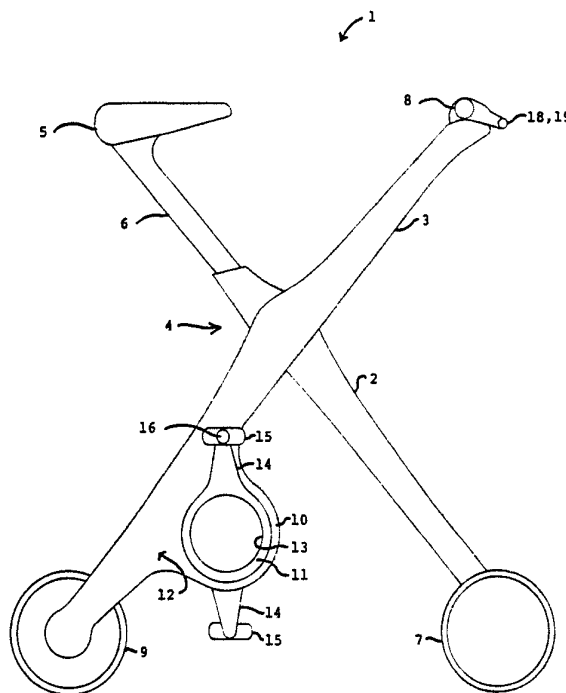
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(54) Title: A COLLAPSIBLE BICYCLE



(57) Abstract

A collapsible bicycle (1) comprises two elongate frame members (2, 3) for pivoting about a point along their length by a pivot mechanism (4). The first frame member (2) has a seat (5) and a first wheel (6). The second frame member has a steering actuator (7) and the second wheel (8). The pivot mechanism (4) is selectively lockable in one or more positions.

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A COLLAPSIBLE BICYCLE

The present invention relates to a bicycle which is capable of being collapsed into a more convenient configuration for storing and transporting.

Several designs for collapsible bicycles are known, but few have been successful because, amongst other things, the mechanism for folding and unfolding and deploying the bicycle is unwieldy and complicated, requiring several operations, and the collapsed bicycle is often not very compact. Collapsing such prior art bicycles often requires removal of several locking pins and the handlebars, for example. The mechanism for achieving the folding is often heavy, and the bicycles themselves are often heavy as a result, which is clearly undesirable.

There is a desire therefore for a collapsible bicycle which is compact, but which is easy to collapse and deploy and requires minimal steps to collapse or deploy it.

According to one aspect of the present invention, a collapsible bicycle comprises two elongate frame members connected for pivoting about a point along their length by a pivot mechanism, the first frame member having a seat and a first wheel, the second frame member having a steering actuator and the second wheel, the pivot mechanism being selectively lockable in one or more positions.

Thus there is provided a substantially X-shaped collapsible bicycle. The collapsible bicycle is light in weight and is capable of being folded and unfolded very readily and simply.

The pivot mechanism may be skewed by a few degrees to the plane of the bicycle. This causes the handlebars, seat and wheels to move transversely during folding, which allows the bicycle to be folded to a more compact shape since these parts will not interfere with each other.

The pivot preferably comprises a joint which is capable of being locked to fix the frame in the deployed configuration by the use of a single pin or catch

mechanism. This provides a simple, one-step operation for folding the bicycle whilst allowing secure and rigid locking of the frame in its open position.

One or both wheels may be mounted on single-sided
5 arms, which may be integral with the frame members, and which allow the frame members to be brought more closely together when the bicycle frame is collapsed.

A preferred feature of the invention disclosed in this specification is the use of indirect steering on the
10 bicycle, the steering mechanism preferably using cables or rods running from the steering actuator, which preferably comprises a simple handlebar, to a hub on which the front wheel is mounted. This obviates the use of conventional forks, also allowing the bicycle to be collapsed more
15 easily and compactly.

An example of the present invention, with modifications of various components, will now be described with reference to the accompanying drawings, in which:-

Fig. 1 is a side elevation of the bicycle;

20 Fig. 2 is a front elevation of the bicycle;

Fig. 3 is a cross-sectional view of a first example of a frame member;

Fig. 4 is a cross-sectional view of a second example of a frame member;

25 Fig. 5 is a cross-sectional view from the front of a first example of the pivot mechanism;

Figs. 6 and 7 are side views of the pivot mechanism in the folded and deployed configurations respectively, with the body of one frame member removed for clarity;

30 Fig. 8 is a cross-sectional view of the rear wheel and hub;

Fig. 9 is a cross-sectional view of the front wheel and hub showing a hub centre steering mechanism;

Fig. 10 is a cross-sectional view of the hub of Figure
35 9;

Fig. 11 is an elevation of the hub of Figure 10;

Fig. 12 is a plan view of the hub of Figure 10;

Fig. 13 is a cross-sectional view of the handlebar and the end of the second frame member;

Fig. 14 is a detailed cross-sectional view of the rear wheel and drive assembly;

5 Fig. 15 is a detailed view of an idler mounting;

Fig. 16 is an end view of a first half of a second example of a pivot mechanism;

Fig. 17 is an end view of a second half of the pivot of figure 16;

10 Fig. 18 is a view of the connected first and second halves of the pivot of figures 16 and 17, shown in the unfolded, deployed configuration of the frame;

Fig. 19 is a cross-sectional view along X-X of Figure 18;

15 Fig. 20 is a front view of a bicycle having a helical pivot mechanism;

Fig. 21 is a front view of the bicycle of figure 20 in its folded configuration; and,

20 Fig. 22 is an exploded view of the bicycle, showing the components used.

In Figure 1, a bicycle 1 has two elongate main frame members 2,3 which are mounted for pivoting about a pivot mechanism 4 which is, roughly speaking, located at the middle of the frame member 3. The precise positioning of the pivot mechanism 4 along the frame members 2,3 can vary, however, from design to design according to the final requirements of the user. However, as can be clearly seen, the frame is generally X-shaped in its deployed configuration.

30 A seat 5 is mounted on a saddle tube 6 which is slidable within the first frame member 2. The tube 6 is lockable by means of a locking ring which fits in a recess in the tube 6 so as to be adjustable for height. The seat 5 may be composed of an elastomeric material, such as polyurethane foam, and the saddle tube 6 may be carbon- or glass-reinforced nylon or polypropylene, for example. At

the other end of the frame member 2 is mounted the front wheel 7.

Mounted on the second frame member 3, at one end, is a handlebar 8 and, at the other end, the rear wheel 9.
5 Whilst a handlebar 8 is described in this specification, it is to be understood that other steering actuators, such as a steering wheel for example, may be used.

Mounted on, or preferably integral with, the second frame member 3 is a casing 10 on or in which is mounted for
10 rotation an annular front cog 11. The casing 10 curves outwardly so as to increase the length of the region 12 where the casing 10 joins the second frame member 3, thereby reducing the stress on the join 12, and is formed in two halves, one on either side of the front cog 11. The
15 casing 10 is therefore able to enclose the front cog 11, the cog 11 being mounted on bearings provided within the casing 10 on an internally-moulded circular flange 13. Enclosing the front cog 11 in this way assists in keeping the cyclist's clothing clean.

20 A pair of crank arms 14 is attached to or integral with the front cog 11, the crank arms 14 being triangular, again so as to reduce the stress applied to the region where the crank arms 14 join the cog 11. Pedals 15 are mounted for rotation on the free ends of the crank arms 14.
25 Ball bearings may be used to support the pedals 15, although if a low friction-type material is used, the pedals 15 may bear directly on hollow integral posts 16 formed on the free ends of the crank arms 14.

Front and rear brake levers 18,19 are fixed to the
30 handlebar 8 for actuating in the conventional manner.

As shown in Figure 3, each of the frame members 2,3 may be formed in two halves 20,21 having the same broadly U-shaped profile. On assembly of the two halves 20,21, a first flange 22 of one half 21 fits into a recess 23 formed
35 between a first flange 24 and a short projecting web 25 formed close to the first flange 23 of the other half 20. Similarly, the second flange 26 of the other half 20 fits

into a recess 27 formed between the second flange 28 and a projecting web 29 on the first half 21. Spaces 30,31 formed between the respective pairs of flanges 22,24,26,28 of the frame member half 20,21 may be filled with uni-directional fibre or a uni-directional fibre/polymer composite reinforcement to increase further the rigidity of the frame members 2,3, continuous carbon or glass fibres being suitable materials for the reinforcing materials. In this case, each half 20,21 may be a short fibre composite or a polymer, and may additionally include continuous glass or carbon fibres. Alternatively, the two halves 20,21 may be joined together, for example by heating, without leaving any space between the adjacent pairs of legs 22,24,26,28. Other suitable materials for the frame members 2,3 include aluminium or magnesium alloys.

An alternative method of construction of the frame members 2,3 is shown in figure 4. Each frame member 2,3 is formed in two halves 20,21 as in the first example by a *CINPRES* (trade mark) process in which nitrogen is used in injection moulding to form hollow runners 31,32 on either side of the half 20,21. The two halves 20,21 are then welded together using friction or hot plate welding, for example. Much of the strength of this construction derives from the hollow runners 31,32.

A first example of a pivot mechanism 4 is shown in Figures 5 to 7, the pivot mechanism 4 being skewed by a few degrees, for example 7.5° , so that the wheels 7,9 and handlebar 8 and seat 5 do not interfere with one another on folding of the bicycle. The first frame member 2 has a generally frustoconical projection 40 which is received by a corresponding socket 41 in the second frame member 3. A circular ridge 42 on the second frame member 3 surrounds the socket 41 and locates in a corresponding circular groove 43 in the first frame member 2. As well as locating the frame members 2,3 with respect to one another, this arrangement also serves to seal the pivot mechanism 4. The projection 40 is retained within the socket 41 by means of

integrally moulded bayonet fixings 45,46 provided at the leading edge of the projection 40 and innermost edges of the socket 41 respectively and made non-returnable by a pair of C-clips 44 which are snapped over the fixings 45,46. Access to the C-clips 44 is through a circular opening 47 in the second frame member 3, the opening 47 being sealed by a sealing plug 48 which also bears against the C-clips 44 to help keep them in position.

In a variation of this form of the pivot mechanism, which is not shown in the drawings, each of the projection 40 and socket 41 may have a broadly W-shaped cross-section. Through-holes are provided in the centre of the projection 40 and the socket 41 for receiving a steel pin about which the frame members 2,3 can pivot. The two frame members 2,3 can be fixed together by means of a nut fixed to a screw thread on the end of this steel pin. The innermost opposed surfaces of the projection 40 and socket 41 slide over each other during pivoting of the frame members 2,3 in this example.

As shown most clearly in Figures 6 and 7, between the outer surface 50 of the annular projection 40 and the facing surface 51 of the annular socket 41 is an annular space 52. Four wedge-shaped abutments 53 project from the outer surface 50 of the annular projection 40. The abutments 53 are integral with the annular projection 40 and are equally spaced about its circumference. Four corresponding integral wedge-shaped abutments 54 are provided on the opposed surface 51 of the annular socket 41. As shown in figure 6 which is a detailed view of the pivot mechanism 4 when the bicycle is in its folded configuration, the sloping surfaces of corresponding pairs of abutments 53,54 meet when the bicycle is folded.

When the bicycle is unfolded to its deployed configuration as shown in Figure 7, the annular projection 40 and socket 41 rotate with respect to one another, which brings the radial surfaces of corresponding pairs of

abutments 53,54 into abutment when the bicycle is in its fully deployed configuration.

The frame members 2,3 are retained in the folded and deployed configurations by a sliding lock 60 which passes
5 through a slot 61 in the outermost wall defining the socket 41 and into one of two correspondingly shaped triangular recesses 62,63 provided in the outer wall of the annular projection 40 according to whether the bicycle is to be
10 locked in its folded or deployed configuration. The slider 60, which slides in a direction generally parallel to the frame member 3, is provided with reinforcing ridges 64 and is biased by a coil spring 65 into engagement with the recesses 62,63. The slider 60 is connected by a rod or
15 cable 66 which runs parallel and close to the frame member 3 to a trigger release provided in the vicinity of the handlebar 8 and which is described in more detail below. The user is able to pull this trigger, thus causing the slider 60 to withdraw from the recess 62 and allowing the
20 bicycle to be folded or unfolded. A stop 67 is provided internally of the frame member 3 to prevent withdrawal of the slider 60 so far that it comes out of engagement with the slot 61 in the annular socket 41.

Referring to Figure 8, the rear wheel 9 is rigidly fixed to a hardened steel stub axle 70 which is mounted for
25 rotation in a pair of conventional deep groove steel ball bearings 71. A toothed drive belt 17 is drivingly connected to the stub axle 70, the teeth of the belt 16 engaging a drive cog 73. The drive belt 17 may comprise helically wound fibre glass tension members in a neoprene
30 body, the teeth being faced with nylon fabric.

The drive cog 73 is drivingly connected to the stub axle 70 through a free wheel mechanism 72, which may be of the type disclosed in GB-A-2174464. The belt 17 is prevented from jumping off the drive cog 73 by a snubber
35 wheel 74 mounted for rotation on an axle stub 75. Whilst the bearings 71 may be of the conventional ball bearing type, the stub axle 70 may alternatively bear directly onto

the plain surfaces of bearings made of a low friction material such as a low friction plastics.

The tyre 76 shown is non-pneumatic and is made of thermoplastic polyurethane by injection moulding or extrusion. The tyre 76 is seated between four annular ridges 77 on the wheel rim 79 which are paired, each pair receiving an extension 78 of a respective side wall of the tyre 76. Further details of the tyre are disclosed in our copending British patent application no. (90/4181/01). As an alternative to non-pneumatic tyres, the wheel rim 79 may have a conventional pneumatic tyre or the wheel 9 may be tyreless and made of a solid rubber compound or polyurethane, or foamed rubber or polyurethane, or the like. A cover plate 80 seals the rear wheel drive components.

Referring to Figures 9 to 12, the front wheel 7 is provided with a pair of bearings 90. The front wheel 7 may again have a non-pneumatic tyre as with the rear wheel 9 or may be of the conventional rubber tyre type or may be made of solid or hollow polyurethane or the like. The wheel 7 is retained for rotation in a hub 91 by a screw 92 and washer 93 and bears on the bearings 90, which may be conventional deep groove steel ball bearings. Alternatively, a suitable low friction plastics may be used for the bearings.

The hub 91 has a bore 94 passing through its centre (see Fig. 10), the longitudinal axis of the bore 94 being perpendicular to the longitudinal axis of a flared portion 95 of the hub 91 which receives the front wheel 7. The hub 91 is mounted for rotation on the frame member 2 about the longitudinal axis of the bore 94 by sleeves 96,97 passing through lower and upper arms 98,98' provided at the C-shaped end of the frame member 2 and which are secured in the bore 94 by a bolt 99.

Further possible ways of mounting the front wheel 7 include using a stub axle screwed into the wheel 7 and which is preferably fixed in place with a nut. The stub

axle bears directly on a pair of bearings which are provided in a large circular recess within the hub. The hub is again mounted for rotation about an axis perpendicular to the axis of the recess in the arms 98,98' of the C-shaped end of the frame member 2. Conventional ball bearings or plastics bearings may be used. In addition, as an alternative to the sleeves 95,96, a bolt may pass through and project out of both ends of the bore 94 of the hub 91; bearings are provided for mounting the bolt in the arms 98,98' of the frame member 2.

The hub 91 has a further sleeve 100 which is located in the bore 94 under the sleeve 95 in such a manner that they cannot rotate with respect to one another and which has cable guide grooves 101,102 provided in an integral plate 103, the normal to the plate 103 being parallel to the longitudinal axis of the bore 94. Two sheathed ball-end steering cables 104,105 are fixed at one end to the hub 91, the cables running along the cable guide grooves 101,102 over guides within or on the frame members 2,3 to the handlebar 8. Other means of fixing the cable ends can be employed.

The steering cables 104,105 are preferably retained within the frame members 2,3 over substantially the whole of their length, passing over suitable guides 106,107 provided within the frame members 2,3 and through the centre of the pivot mechanism 4 (see Figure 5) so that their length is unchanged during folding.

As can be seen in Fig. 13, the handlebar 8 is moulded in two parts, an upper and a lower part, and is mounted for rotation on the second frame member 3. A steering pulley 110 is pivotally mounted in the second frame member 3 by means of a stepped bayonet-type fitting 111; a snap fit may alternatively be used. A sleeve 112, which is part of the handlebar lower moulding, is mounted in a recess 113 in the end of the frame member 3 and is a snap fit on the steering pulley 110. A brake and steering cables guide 114 is also a snap fit against the steering pulley 110 and bears

against the sleeve 112 to maintain the sleeve 112 in position. The brake and steering cables guide 114 has a bore 115 which is co-axial with the pivot axis of the handlebar 8. The brake cables 132 pass up through the bore 115 and over guides 116 which are respectively angled to the left and right to guide the brake cables 132 to the front and rear brake levers 18,19. Passing the brake cables through the centre of the steering pulley 110 prevents the brakes being actuated when the handlebar 8 is turned. The steering pulley 110 and other handlebar components are covered and sealed by a cover plate 117 which is the upper handlebar moulding.

An automatic tensioner including a spring 118 is provided to take up any slack in the steering cables 104,105 that may develop with wear, the steering cables 104,105 wrapping around the steering pulley 110 and being fixed to either end of the spring 118. Manual adjusters may also be provided at a position close to the handlebar 8 for convenience.

Rotation of the handlebar 8 rotates the steering pulley 110 which pulls one of the cables 104,105 so as to cause the front wheel hub 91 to rotate about the longitudinal axis of the bore 94, thereby causing the front wheel 7 to turn and allowing the bicycle to be steered.

The steering cables 104,105 may be a high density polyethylene fibre such as *DYNEEMA* (trade mark).

Rather than using cables to steer the front wheel 7, a system of rods, at least some of which would be in torsion, may be used for steering. The rods could be encased within the frame members 2,3 and suitably connected to the hub 91. In addition, rather than using a hub 91, small forks may be mounted for rotation on the end of the frame member 2, the handlebar turning the forks indirectly by suitably connected or rods as described above.

Also shown in Figure 14 is a sliding trigger 119 which is attached to the cable 66 connected to the pivot mechanism release slider 60. The remote trigger 119 is

located under the head at the end of the frame member 3 and can be gripped and pulled by the cyclist so as to withdraw the slider 60 from the recesses 62,63. A front light mounting bracket 120 is pivotally connected to the handlebar mouldings 112,117.

Referring again to Figure 9, a brake arm 130 is mounted on a pivot 131. A cable 132 is attached at one end to the brake arm 130 and runs up the frame member 2, over the pivot mechanism 4 to the front brake lever 18 on or near the handlebar 8. When the front brake cable 130 is pulled by operation of the lever 18, the other end 133 of the brake arm 130 bears directly on the wheel 7, so achieving braking. The brake arm 130 is shown with a plurality of cooling fins 134 and may be composed of an alloy of aluminium and silicon carbide, for example, which has sufficient durability whilst providing enough friction to bring about efficient braking. The brake cable 130 and substantially all of the brake arm 130 may be retained within the frame member 2, which would therefore be flared at its lower end.

As shown in Figure 14, the drive from the front cog 11 to the rear wheel 9 is via the toothed belt 17 which passes through over an idler 140 situated on the second frame member 3. The use of the idler 140 causes the belt 17 to run very close to the frame member 3, which is useful in keeping the belt 17 clear of any obstructions on the road or other surfaces on which the bicycle is used and clear of the cyclist's clothing, and in keeping the belt 17 clean. In the example shown, the belt 17 is actually enclosed within the end of the frame member 3. The position of the idler 140 in this example is adjustable by virtue of its eccentric mounting, as shown most clearly in Figure 15, in the second frame member, so that the tension in the belt 17 can be adjusted. Alternatively, the idler 140 may be slidably mounted so that it can be locked in a position which gives optimum tension in the belt 17. The adjustment

of the idler 140 may additionally or alternatively be carried out automatically.

An alternative front cog mechanism may consist of a front cog which drives an intermediate double-cog via a small drive belt or chain, the main drive belt running off the second of the cogs on the double-cog. In this way, by the use of appropriate gear ratios, a saving in weight may be achieved without sacrificing the mechanical advantage of the drive. Finally, a conventional drive system could also be used.

As shown in Figure 22, a rear brake arm 135 is pivotally mounted on the second frame member 3 and is operated by a brake cable 136 which runs up to the rear brake lever (not shown) on or near the handlebar 8. When the brake cable 136 is pulled, the rear brake arm 135 pivots so as to apply a rear brake directly to the rear wheel 9 in a similar fashion to the front brake arm 130.

A further example of the pivot mechanism 4 is shown in figures 16 to 19, the second example being a skew pivot and figures 16 to 18 being on the skew plane of each half of the pivot. The pivot 4 consists of a first half 150 rigidly attached to or integral with the first frame member 2 and a second half 151 rigidly attached to or integral with the second frame member 3. Each of the pivot halves 150,151 has a tubular portion 152,153, the axis of which is collinear with or parallel to the axis of the respective frame member 2,3. The first pivot half 150 has a plain bearing surface 154, the normal to which is skewed to the longitudinal axis of the tubular portion 152. The bearing surface 154 is sector-shaped, having an angle of about 75°, which defines the degree of opening of the frame members 2,3 as will be described more fully below. The second pivot half 151 has a similar plain bearing surface 155, the normal to which is again skewed to the longitudinal axis of the tubular portion 153. The skew angle α between the two halves 150,151 of the pivot mechanism is approximately 7.5°.

The bearing surface 154 has three cylindrical holes passing through it, the centre of the first hole 156 forming the pivot point of the frame members 2,3 and being positioned towards the centre of the circle of which the bearing surface 154 is a sector. The other two holes 157,158 are positioned equidistant from the first hole 156 and separated by the angle of the sector, that is 75°. The bearing surface 155 of the second pivot half 151 is provided with first and second holes 159,160 which correspond to the first hole 156 and the two radial holes 157,158 of the first pivot half 150 respectively.

The two pivot halves 150,151 are pivotally connected by a hardened steel pin 161 which passes through the first holes 156,159 in the first and second pivot halves 150,151. The pin 161 is screw threaded into the first hole 156 of the first pivot half 150 and is a sliding fit in the hole 159 in the second pivot half 151. A button head 162 may be used to finish the end of the pin 161.

A locking pin 163 passes through the second hole 160 in the second pivot half 151 and through one radial hole 158 of the first pivot half 150 when the bicycle is in the deployed configuration, and through the other radial hole 157 when the bicycle is in its collapsed configuration. A tapered bush 164 is provided within each of the radial holes 157,158 of the first pivot half 150. The locking pin 163 is urged towards the first pivot half 150 and into one of the radial holes 157,158 by a spring 165, one end of the spring 165 passing into a recess 166 provided within the locking pin 163, the other end of the spring 165 bearing against a cover plate 167. The cover plate 167 is fixed to the second half 151 by two screws 168.

A further pin 169 passes through an elongate aperture 170 provided in the second pivot half 151, the longitudinal axis of the aperture 170 being parallel to the longitudinal axes of the holes 159,160. The locking pin 163 may be released from engagement with the first pivot half 150 by sliding the pin 169 along the aperture 170 so as to

compress the spring 165, thereby withdrawing the locking pin 163 from the hole 157,158. By this simple release mechanism, the locking pin 163 can be withdrawn, allowing the bicycle to be collapsed or deployed, the spring 165 forcing the locking pin 163 back into one of the holes 157,158 on release of the pin 169. As shown in figure 19, a cable 171 having a ball end 172 may pass through a small bore in the pin 169 and round an idler 173 up to a lever (not shown) on or near the handlebar 8. Pulling the cable 171 pulls the pin 169 along the aperture 170, withdrawing the locking pin 163 as before, thereby providing a remote release mechanism. A remote release mechanism using rods and levers in tension and/or torsion, for example, may alternatively be used.

15 The two pivot halves 150,151 may be provided with corresponding faces which abut when the bicycle is in its deployed configuration.

20 A yet further example of the joint is shown in figures 20 and 21 and comprises a helical thread 170 on which the two pivot halves 171,172 run, each of the pivot halves 171,172 having corresponding internal screw threads. When the bicycle is deployed, the pivot halves 171,172 each run up the thread 170 towards the other and meet when the bicycle is in its fully deployed configuration.

CLAIMS

1. A collapsible bicycle (1) comprising two elongate frame members (2,3) for pivoting about a point along their length by a pivot mechanism (4), the first frame member (2) having a seat (5) and a first wheel (6), the second frame member having a steering actuator (7) and the second wheel (8), the pivot mechanism (4) being selectively lockable in one or more positions.
2. A bicycle according to claim 1, wherein the pivot mechanism (4) is skewed to the plane of the bicycle (1).
3. A bicycle according to claim 1 or claim 2, wherein the pivot mechanism (4) is a hub mechanism, the first half of the hub mechanism being rigidly attached to or integral with the first frame member (2) and the second half of the hub mechanism being rigidly attached to or integral with the second frame member (3).
4. A bicycle according to claim 1 or claim 2, wherein the pivot mechanism (4) is formed by a projection (40) on one frame member (2) which is received in a corresponding socket (41) in the other frame member (3) so that the frame members (2,3) can pivot with respect to one another by virtue of the projection (40) pivoting within the socket (41).
5. A bicycle according to claim 4, wherein the annular projection (40) and the socket (41) each have a plurality of corresponding stops (53,54), each stop (53) on the annular projection (40) engaging a corresponding stop (54) on the socket (41) when the bicycle is in its deployed configuration.
6. A bicycle according to claim 4 or claim 5, wherein the pivot mechanism (4) is lockable with the bicycle in at

least one of its deployed and folded configurations by a slider (60) which passes through an aperture (61) in the wall of the pivot socket (41) and into a recess (62,63) in the projection (40).

5

7. A bicycle according to claim 1 or claim 2, wherein the pivot mechanism (4) comprises two pivot halves, the first pivot half (150) being rigidly attached to or integral with the first frame member (2), the second pivot half (151) being rigidly attached to or integral with the second frame member (3), the pivot halves (150,151) being pivotally connected by a pivot pin (161).

8. A bicycle according to any of claims 1 to 7, wherein the pivot mechanism (4) is capable of being locked by a single pin (60,169).

9. A bicycle according to claim 8, wherein the pin (60,169) is connected by a rod or cable (66,171) to a remote trigger (116).

10. A bicycle according to claim 1 or claim 2, wherein the pivot mechanism (4) comprises a helical thread (170) on which each of two pivot halves (171,172) run, each pivot half (171,172) having a corresponding internal screw thread.

11. A bicycle according to any of claims 1 to 10, wherein each wheel (7,9) is mounted on a respective single-sided arm (2,3).

12. A bicycle according to claim 11, wherein each arm is integral with a respective frame member (2,3).

13. A bicycle according to any of claims 1 to 12, wherein the steering actuator (8) operates to turn the front wheel (7) by indirect means.

14. A bicycle according to claim 13, comprising a hub (91) on which the front wheel (7) is rotatably mounted, the hub (91) being pivotally mounted on the first frame member (2), the steering actuator (8) being connected to the hub (91) by cables or rods.

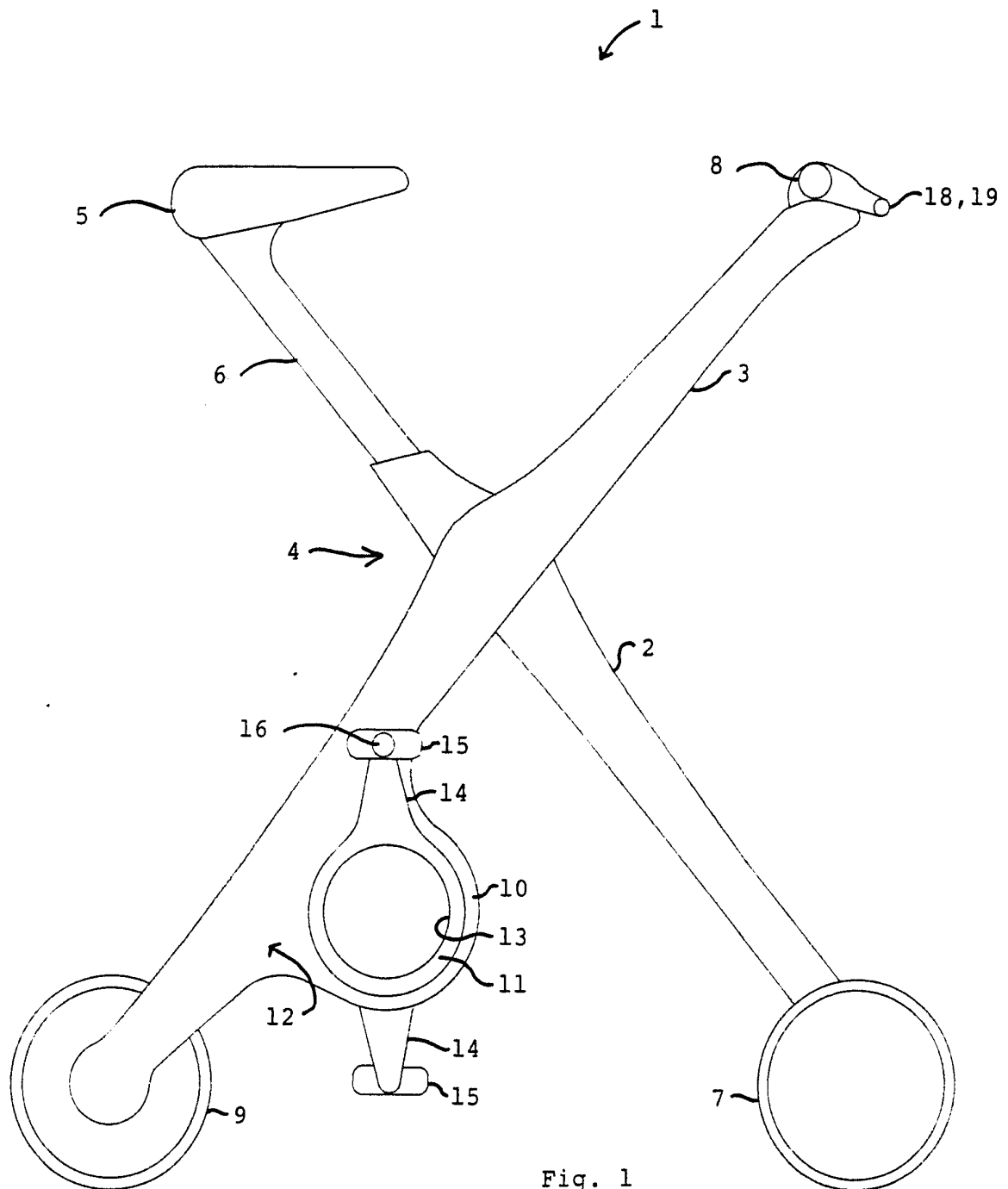
15. A bicycle according to claim 14, wherein the steering actuator (8) is connected to the hub (91) by cables (104,105), and further comprising an automatic tensioner (118) for maintaining tension in the steering cables (104,105).

16. A bicycle according to any of claims 1 to 15, further comprising a pedal (15) mounted on each of a pair of crank arms (14) connected to a front cog (11), the front cog (11) being drivingly connected to the rear wheel (9) by a belt (17).

17. A bicycle according to any of claims 1 to 15, further comprising a pedal mounted on each of a pair of crank arms connected to a front cog, the front cog being drivingly connected to a double-cog which is drivingly connected to the rear wheel (9) by a belt (17) or chain.

18. A bicycle according to claim 16 or claim 17, wherein the belt (17) passes over an idler (140) mounted on or close to the second frame member (3) between the front cog (10) and the rear wheel (9).

19. A bicycle according to claim 18, wherein the idler (140) is eccentrically mounted for allowing adjustment of tension in the belt (17).



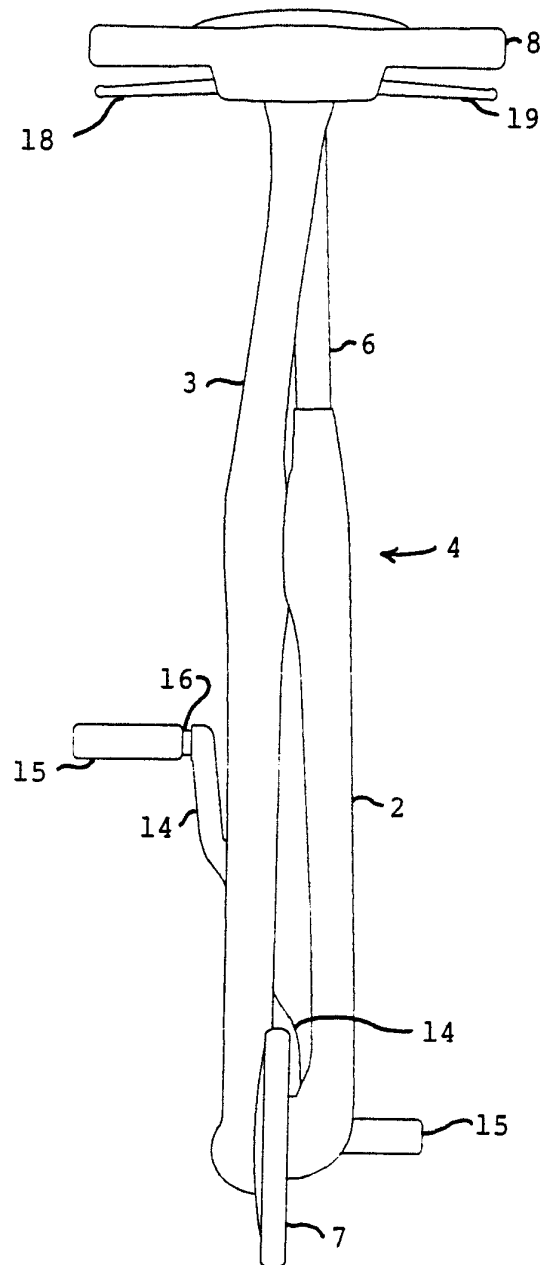


Fig. 2

3/14

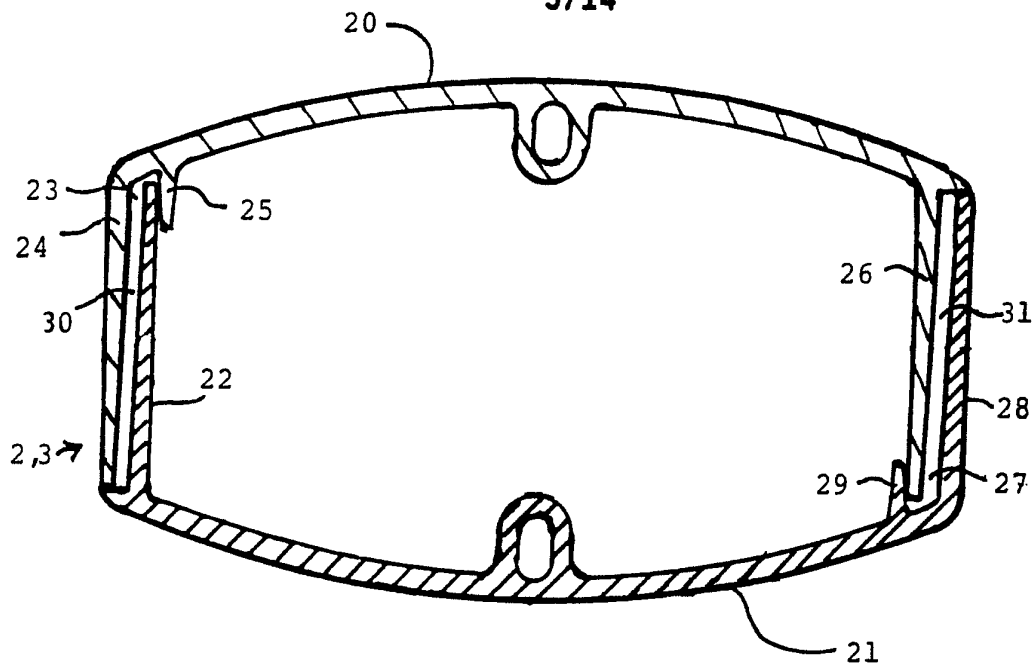


Fig. 3

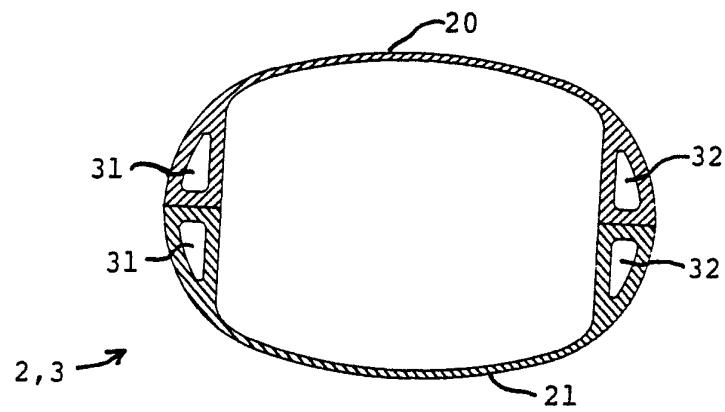


Fig. 4

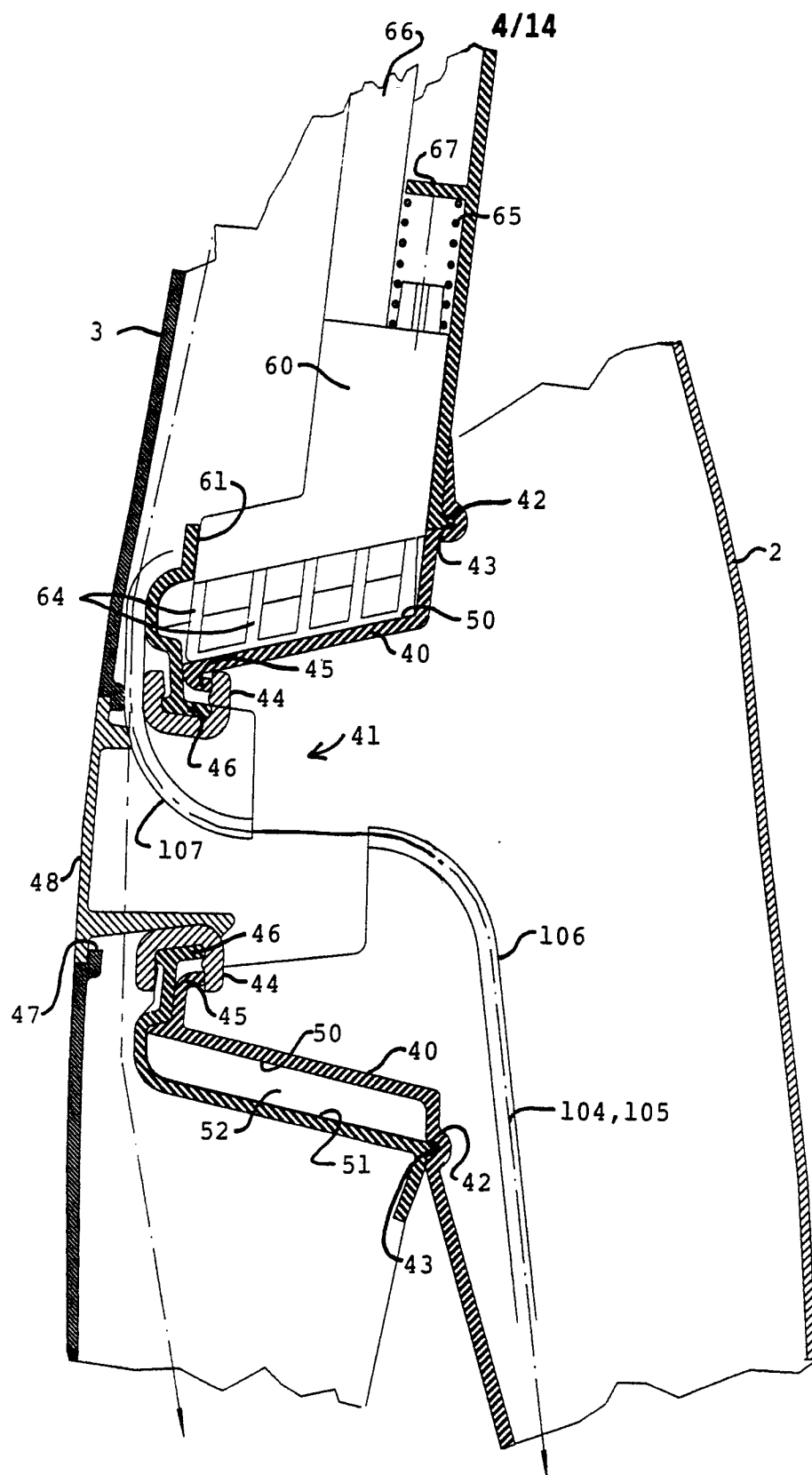


Fig. 5

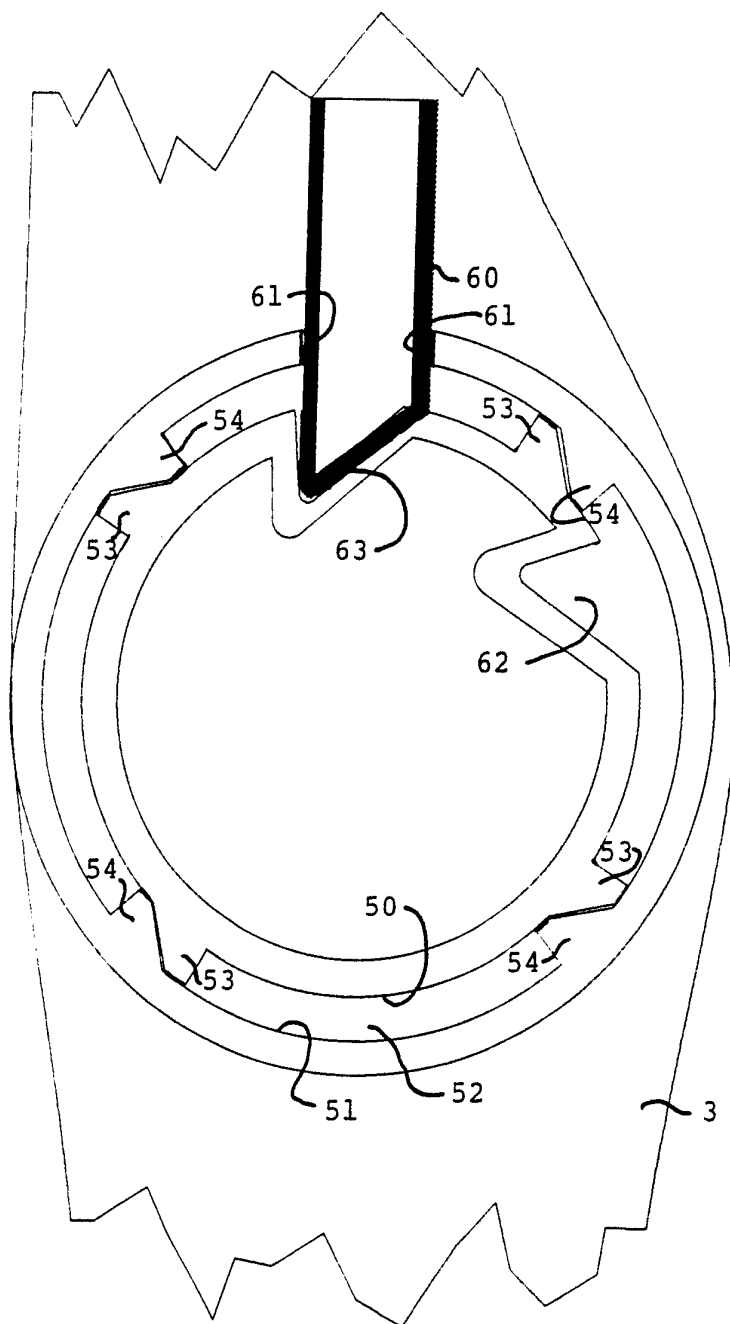


Fig. 6

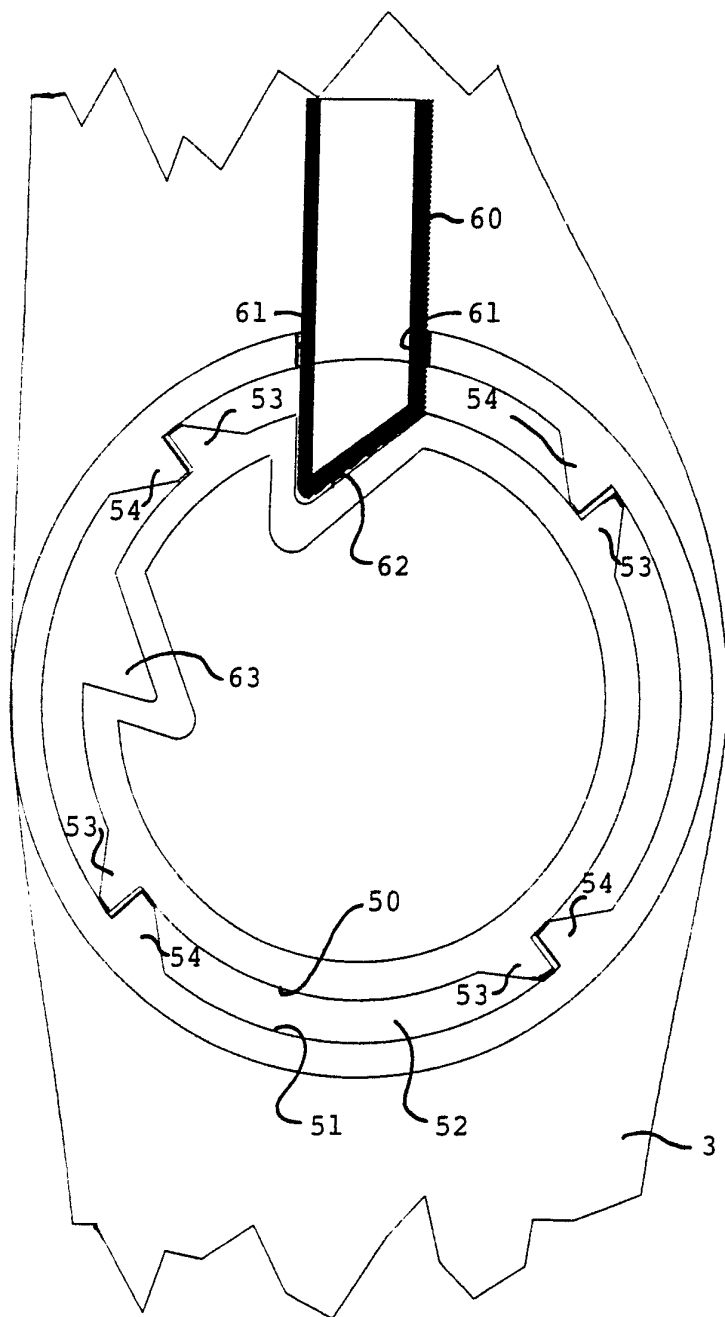


Fig. 7

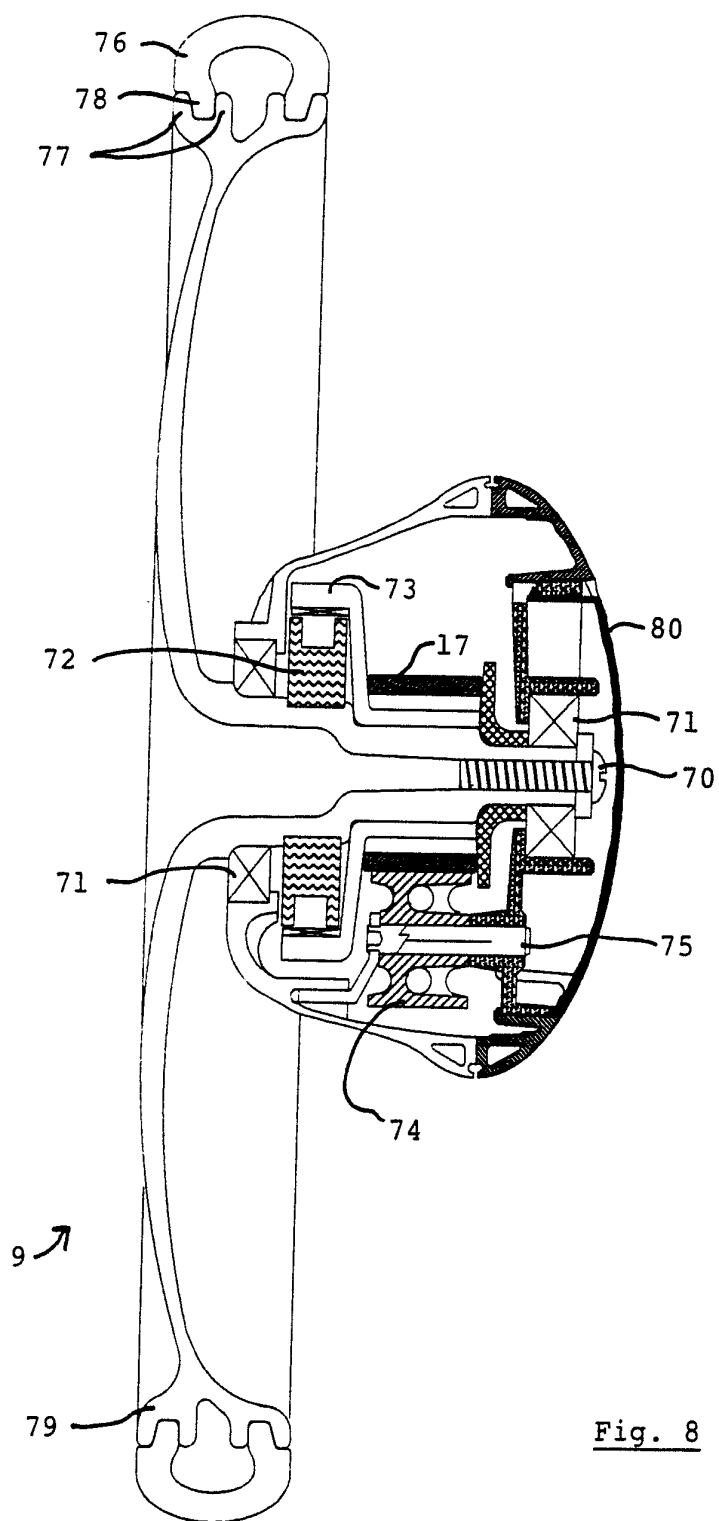
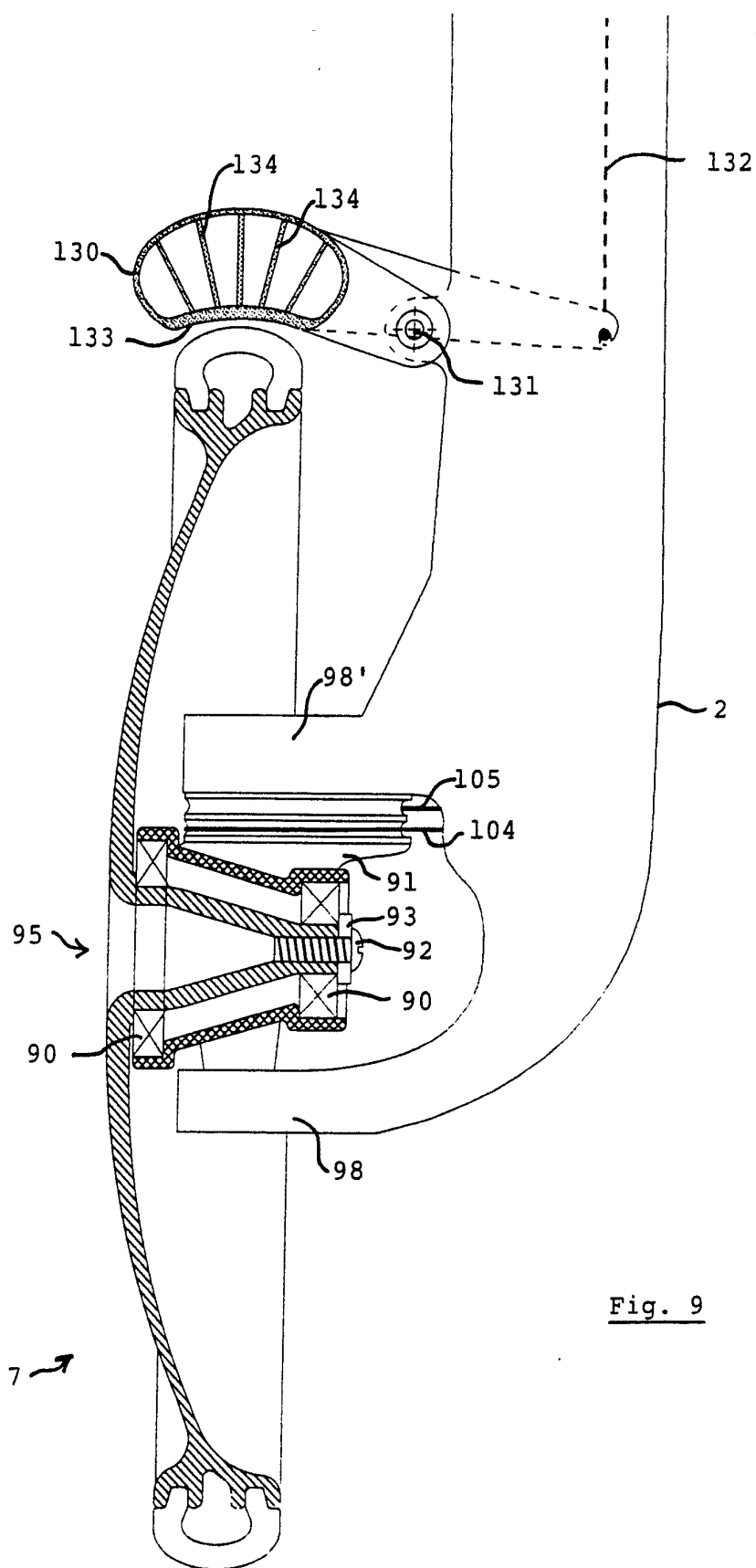


Fig. 8

8/14

Fig. 9

9/14

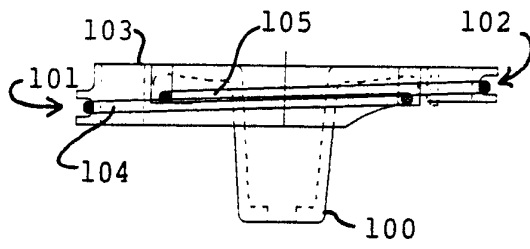


Fig. 11

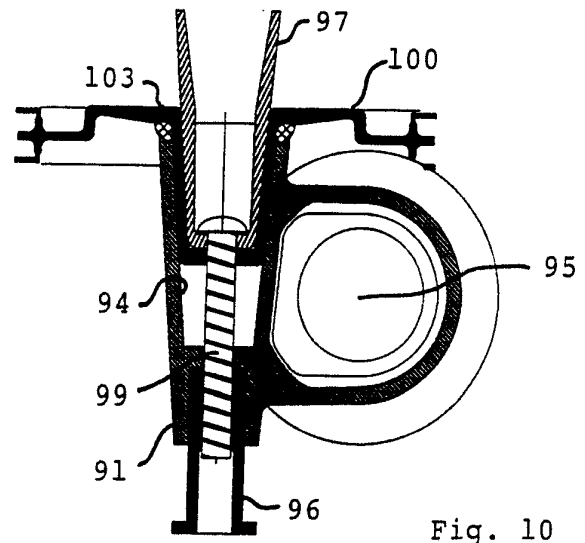


Fig. 10

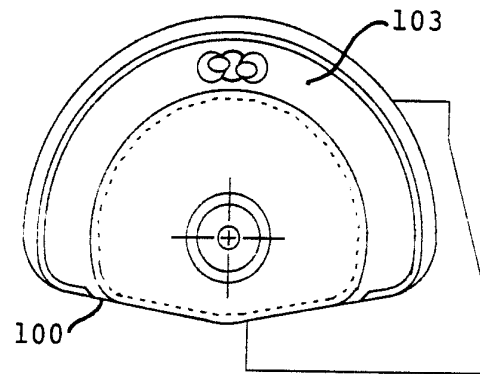


Fig. 12

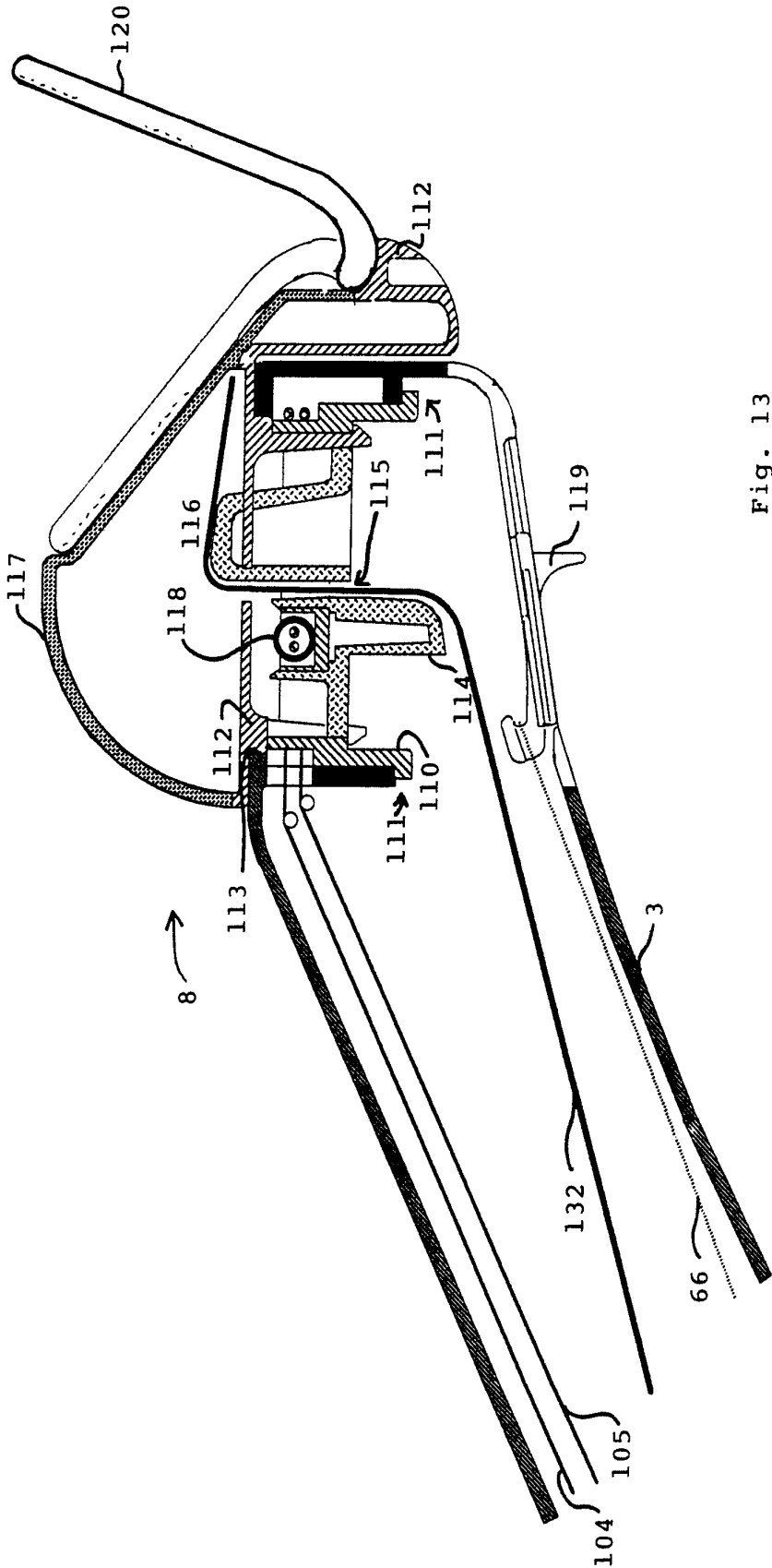


Fig. 13

11/14

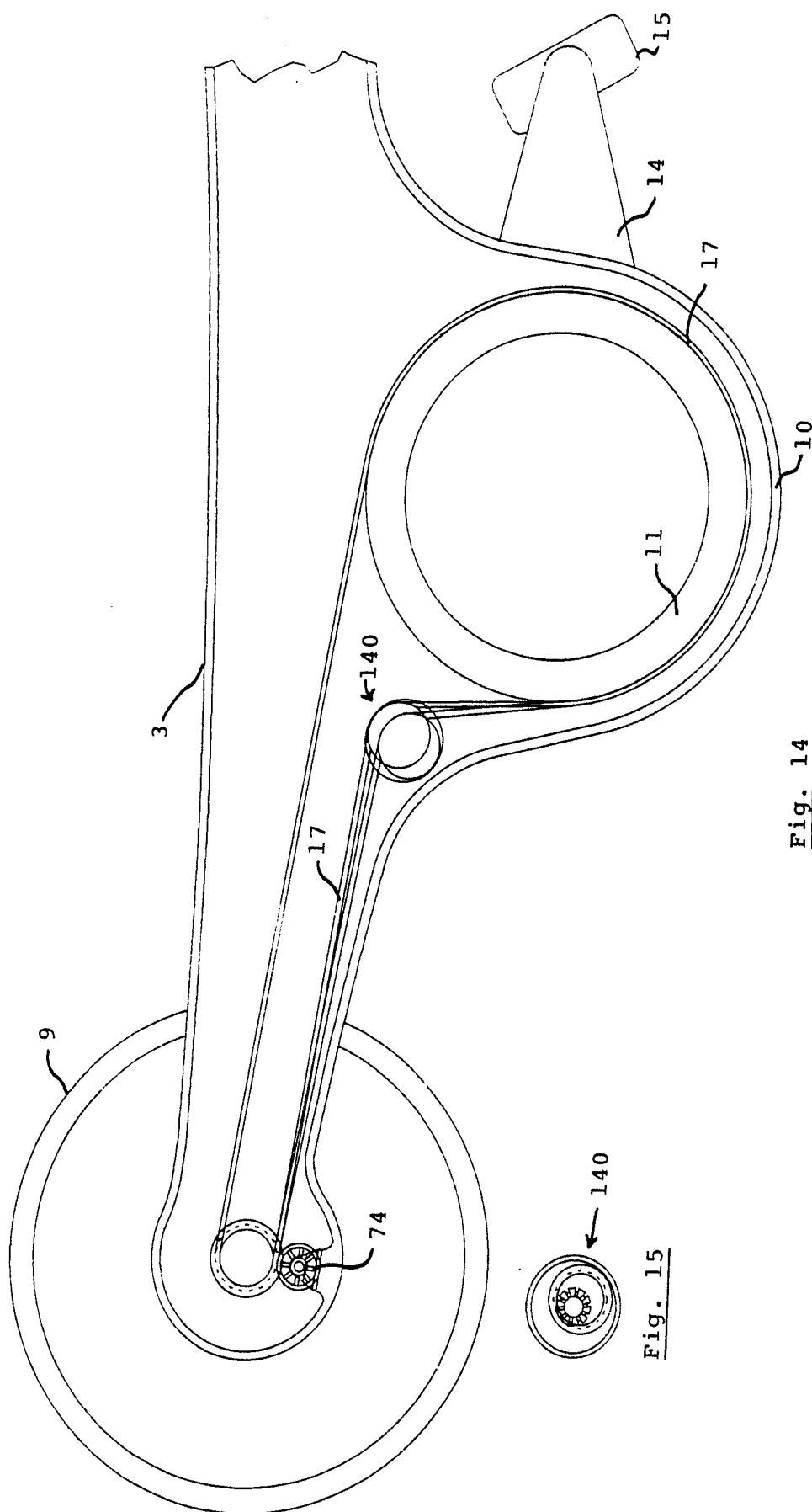


Fig. 14

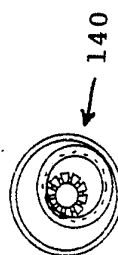


Fig. 15

12/14

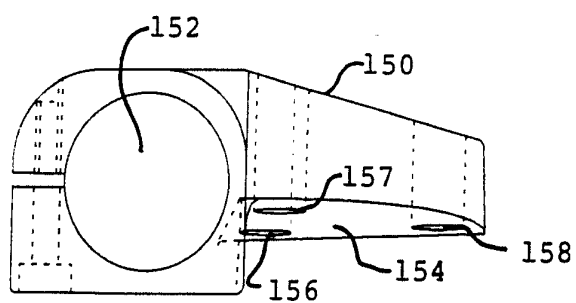


Fig. 16

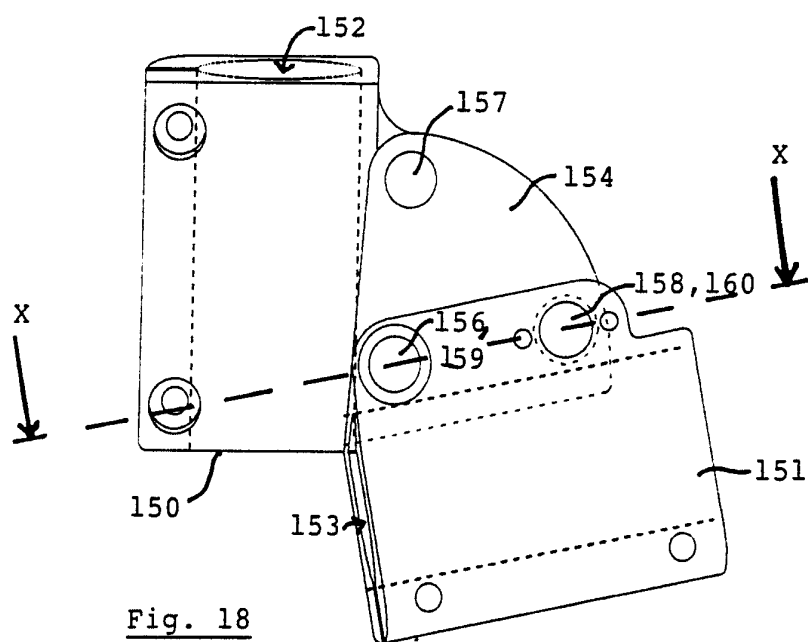


Fig. 18

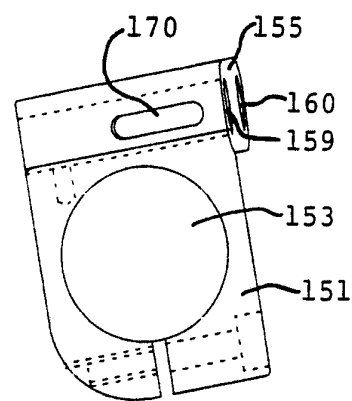


Fig. 17

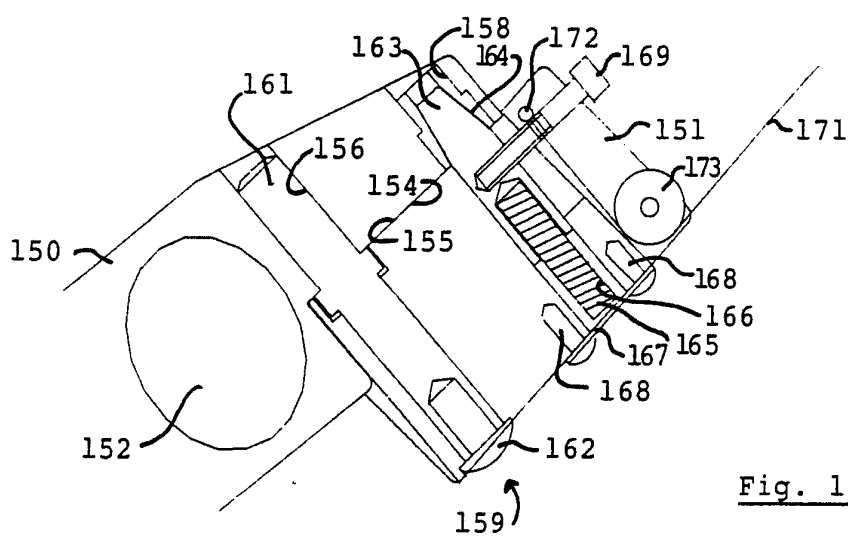


Fig. 19

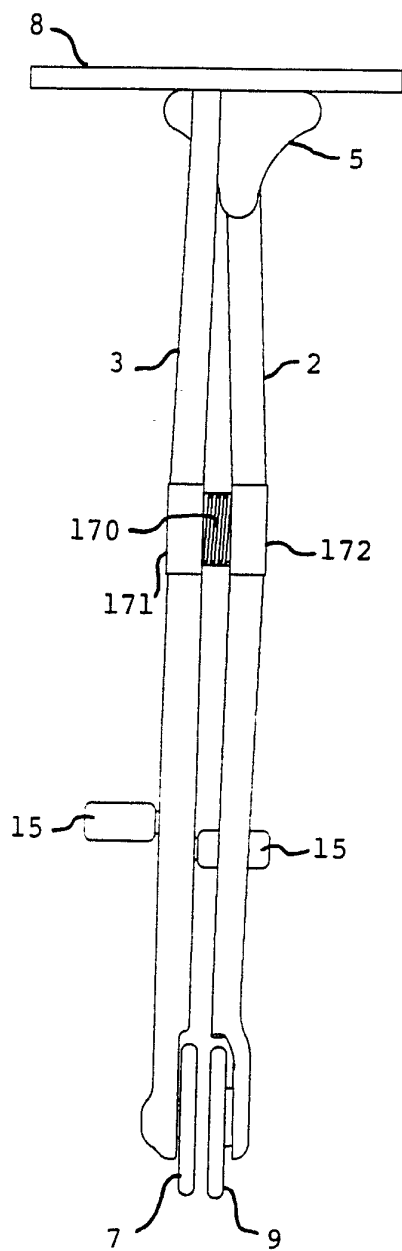


Fig. 20

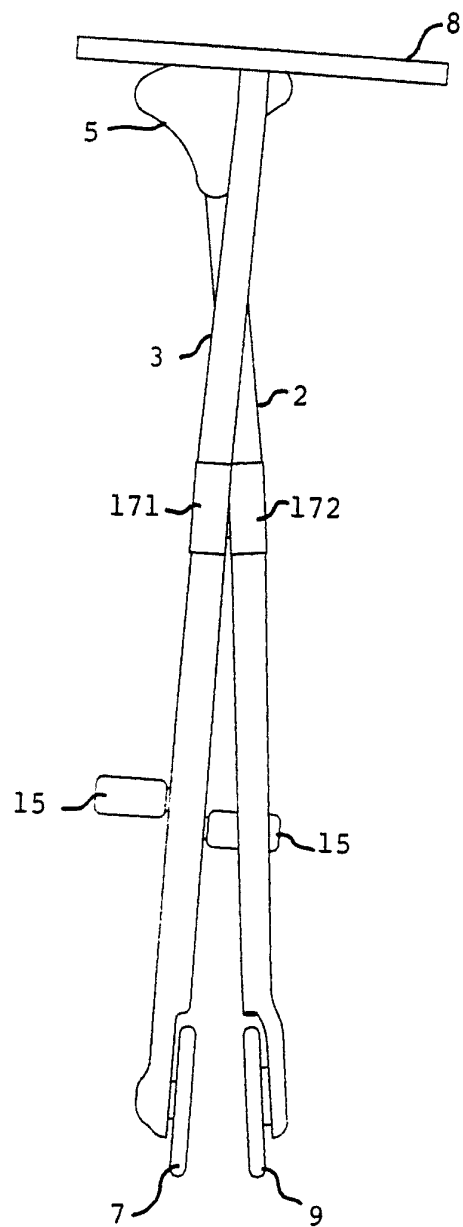


Fig. 21

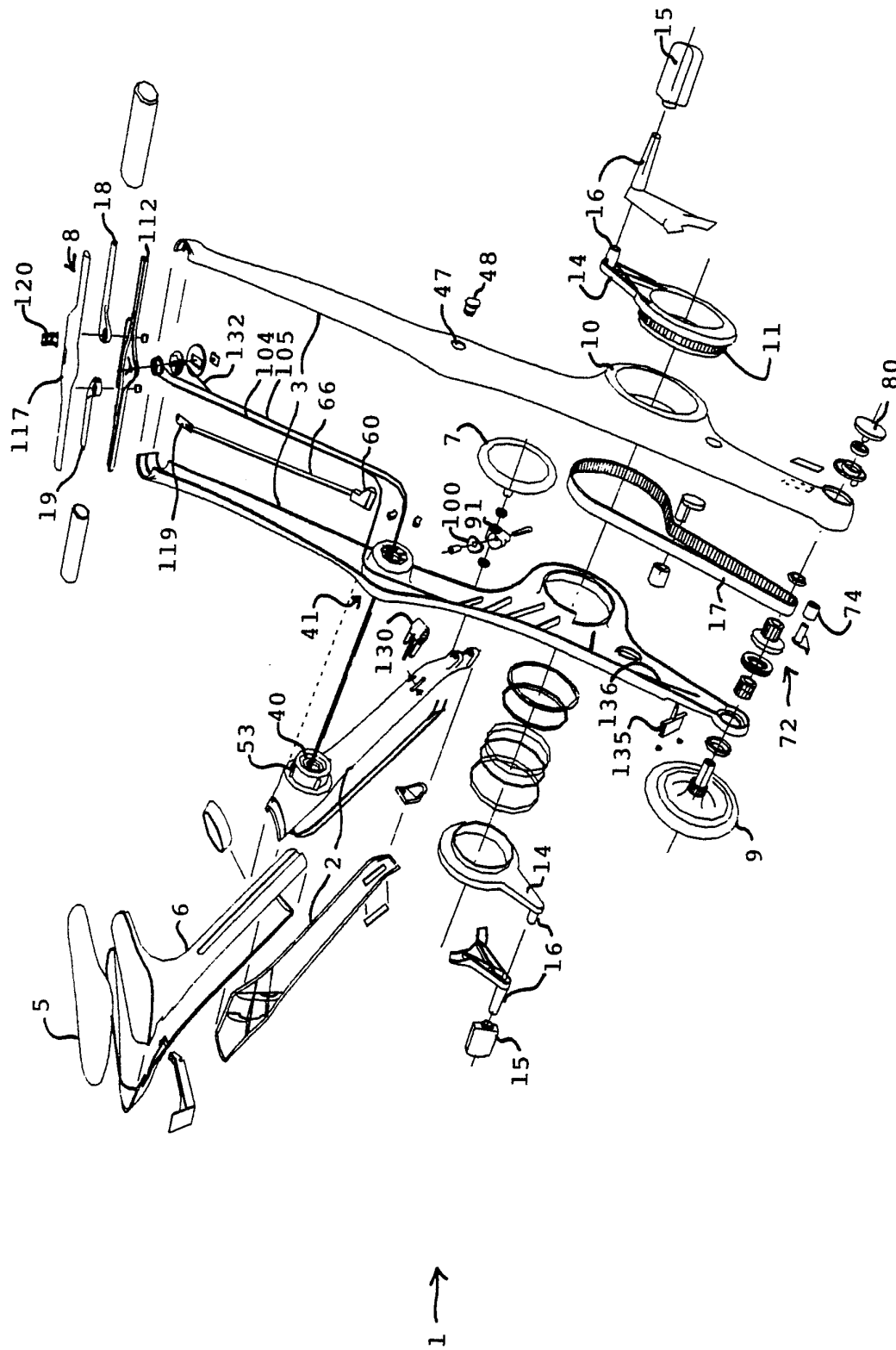


Fig. 22

INTERNATIONAL SEARCH REPORT

International Application No

PCT/GB 91/01307

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all)⁶

According to International Patent Classification (IPC) or to both National Classification and IPC

Int.Cl. 5 B62K15/00

II. FIELDS SEARCHED

Minimum Documentation Searched⁷

Classification System

Classification Symbols

Int.Cl. 5

B62K

Documentation Searched other than Minimum Documentation
to the Extent that such Documents are Included in the Fields Searched⁸III. DOCUMENTS CONSIDERED TO BE RELEVANT⁹

Category ^o	Citation of Document, ¹¹ with indication, where appropriate, of the relevant passages ¹²	Relevant to Claim No. ¹³
X	US,A,3 419 283 (D.E.NEWLAND) 31 December 1968 see column 2, line 47 - column 2, line 61; figures 1-4	1,7,16
A	---	17
X	DE,A,3 838 802 (G.A.HILBER) 23 May 1990 see column 2, line 47 - column 4, line 15; figures 1-4	1,13
A	---	14
X	FR,A,927 215 (H. BENDER) 3 October 1947 see page 2, line 59 - page 2, line 81; figures 7-10	1,2
X	DE,C,406 128 (P.TRENN) 18 November 1924 see the whole document	1
A	---	16
	--- -/--	

^o Special categories of cited documents :¹⁰^{"A"} document defining the general state of the art which is not considered to be of particular relevance^{"E"} earlier document but published on or after the international filing date^{"L"} document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)^{"O"} document referring to an oral disclosure, use, exhibition or other means^{"P"} document published prior to the international filing date but later than the priority date claimed^{"T"} later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention^{"X"} document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step^{"Y"} document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.^{"&"} document member of the same patent family

IV. CERTIFICATION

Date of the Actual Completion of the International Search

05 NOVEMBER 1991

Date of Mailing of this International Search Report

11 NOV 1991

International Searching Authority

EUROPEAN PATENT OFFICE

Signature of Authorized Officer

FRANKS B.G.

III. DOCUMENTS CONSIDERED TO BE RELEVANT (CONTINUED FROM THE SECOND SHEET)		
Category *	Citation of Document, with indication, where appropriate, of the relevant passages	Relevant to Claim No.
A	FR,A,335 834 (E.PRUDON) 15 February 1904 see page 1, line 45 - page 2, line 80; figures ---	1,13-16

ANNEX TO THE INTERNATIONAL SEARCH REPORT
ON INTERNATIONAL PATENT APPLICATION NO. GB 9101307
SA 49919

This annex lists the patent family members relating to the patent documents cited in the above-mentioned international search report.
The members are as contained in the European Patent Office EDP file on
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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US-A-3419283		None	
DE-A-3838802	23-05-90	None	
FR-A-927215		None	
DE-C-406128		None	
FR-A-335834		None	