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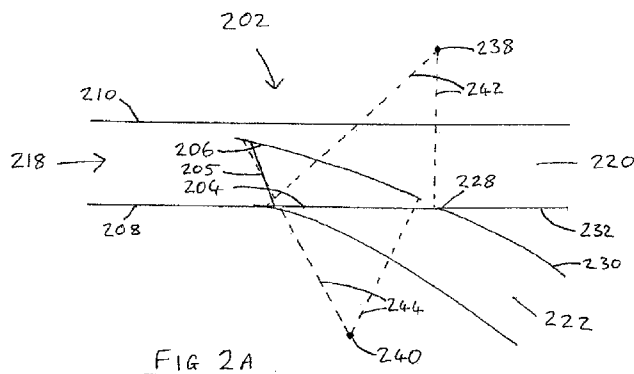
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(54) Title: RAILWAY POINTS



(57) Abstract: A set of railway points (202) comprises two or more movable points blades (204, 206). The points blades (204, 206) are arranged to move at both ends, e.g. in an arc, to provide a continuous rail surface across the set of points (202).

Railway Points

This invention relates to railway points for a railway track junction.

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A set of railway points enable a train or other railway vehicle to transfer between one railway track and another. This can be a simple arrangement in which one "incoming" track branches into two separate "outgoing" tracks, or where multiple tracks cross each other with the points facilitating transfer of a train between the different intersecting tracks. It will be appreciated of course that the labels
10 "incoming" and "outgoing" are arbitrary in the sense that a train may traverse the points in either direction.

In a conventional set of points, movable points blades lie between the incoming stock rails and each pivot about a fixed end. Typically, short converging fixed rail sections extend from the pivots to the region in which the paths of the rails for different branches cross one another. This region is commonly referred to in the art as the "frog". In other arrangements the converging rail sections might be omitted and the pivoting blades extend to the frog.
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The frog includes gaps between the respective converging rail sections (or blades themselves) and between each of them and the corresponding intersection (hereinafter referred to as the "branching intersection") between adjacent rails of the diverging tracks at the other side of the frog. These gaps are necessary to
25 allow a train wheel to cross the area at the required different angles. The minimum size of at least one of the gaps is determined *inter alia* by the radius of the train wheels and the angle at which the branching tracks diverge.

The inventor has appreciated that having such gaps between rails across which
30 train wheels pass results in a number of undesirable consequences. As a wheel passes over a gap, it leaves contact with one rail and inevitably therefore generates an impact when it comes into contact with the rail on the other side of the gap. This impact is significant because of the large weight of the train and therefore, over time, it causes wear on the frog and the train's wheels and suspension

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components, necessitating regular repair and replacement. The impact also causes noise and discomfort for the people travelling on the train.

5 Moreover to avoid having unacceptably large gaps at the frog, the diverging angle of the branching tracks cannot be too small. This places a constraint on the minimum curvature of the branching track at the junction which in turn imposes a restriction on the maximum speed at which a train can safely traverse the set of points.

10 Suggestions have been made to solve this problem by providing a "swing nose frog" as disclosed in US 5,527,005 in which the swing nose itself moves to allow the trains to go on different tracks. There are, however, still disadvantages with the swing nose frog. Small gaps are still present at the joins of the swing nose to the frog and the points blades to the fixed rails at their centre points. Furthermore, the
15 provision of a swing nose on the frog results in three moving components which have to have coordinated movement in order to operate the set of points. Two of these components have to be fully coordinated (the swing nose and whichever points blade is engaged with the fixed incoming rail) with regard to their positioning whenever the set of points is moved from one position to the other. This makes it
20 difficult to achieve a practical implementation which is sufficiently reliable. Swing nose frogs have been used in the USA, Australia, France and Germany, and have been tried in Great Britain, but have not won general acceptance.

25 The present invention provides a set of railway points comprising two or more movable points blades, said points blades each being arranged to move at both ends to provide a continuous rail surface across the set of points.

Thus it will be seen that in accordance with the invention by providing points blades which are movable at both ends, instead of each being fixed at one end to a pivot,
30 they can be arranged so that one end moves translationally to engage the appropriate rail of an incoming track and the other end moves translationally to engage the appropriate rail of the outgoing track (either at the apex of its intersection with the adjacent rail from the diverging track or further along the rail itself), giving a continuous transition between the incoming and outgoing tracks with
35 no gaps present. As will be appreciated from the foregoing discussion, providing a

gapless set of points without a conventional frog reduces the force exerted on the set of points by the wheels of a train traversing them. This will therefore increase the lifetime of the components in a set of points and the wheels and suspension of the train. Moreover the noise generated and discomfort to the passengers of the train will also be reduced.

Railway points in accordance with the invention are considered inherently safer than the swing-nose design taught in US 5.527,005 since they can employ a conventional fixed intersection between the adjacent branching rails which is more robust than the swing nose. Indeed the invention, in at least its preferred embodiments, provides the advantages swing-nose frogs are intended to supply without the disadvantages.

In at least its preferred embodiments, the invention allows trains to traverse the points at greater speed for two reasons. The first reason is that there is no longer a need to restrict speed to reduce the impact arising from gaps at a frog. The second reason is that the minimum angle of divergence for branching tracks is relaxed so the curvature of the branching track can be reduced. This latter consequence is also beneficial from the point of view of allowing greater freedom in designing track layouts. The speed allowed for a train passing through a set of points in accordance with the invention might be comparable to speeds allowed on ordinary railway tracks.

In preferred embodiments:

the points blades are movable between a first position to couple an incoming railway track with a first outgoing railway track and a second position to couple the incoming railway track with a second outgoing railway track;

the set of points comprise a branching intersection where adjacent rails of the first and second outgoing tracks meet;

first and second points blades each comprise an incoming end and an outgoing end; in said first position the incoming end of the first points blade is in contact with a first rail of the incoming track and the outgoing end of the first points blade is in contact with the branching intersection; and

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in said second position the incoming end of the second points blade is in contact with a second rail of the incoming track and the outgoing end of the second points blade is in contact with the branching intersection.

- 5 Although there are 'Y' points in which all the rails of the outgoing tracks are curves, usually one of the outgoing tracks constitutes a straight extension of the incoming track. In this case one of the movable points blades will be straight, and the other curved to match the curve of the branching track
- 10 A curved points blade for connecting a straight incoming rail to a curved outgoing rail provides a smooth transition for the train passing through the set of points. Preferably the curved points blade has a variable radius of curvature along its length; this enhances the smoothness of the transition and hence the safety of the set of points. In some embodiments the radius of curvature decreases along the
- 15 length of the points blade from the incoming end to the outgoing end. This helps match the incoming end of the blade to a straight rail and the outgoing end to a curved rail. Preferably the curved points blade takes the form of one or more cubic splines, i.e. curves which can be described by an equation having as a dominant term $y=ax^3$ where a is a constant. By using splines based on cubic equations,
- 20 crossover points in particular could be much improved. At present as the train begins to leave the old straight track there is a lateral acceleration which is suddenly reversed as it begins to join new straight track. To avoid sudden changes in lateral acceleration, the curvature needs to be gradually decreased, by a mirror-image of the spline mentioned above, followed by a gradual increase and then
- 25 decrease in the opposite curvature. To achieve this comfortably, both sets of points in a crossover, would need to be longer than at present, and with a narrower angle at the frog, and hence with wider gaps in the disengaged position. Gapless points could manage this, whereas conventional points could not.
- 30 There are a number of different arrangements in which the points blades could be moved into and between the two different positions. The points blades could be simply pivoted about a suitable point somewhere along their length, conveniently half way along the length. However in one set of preferred embodiments the first points blade is arranged to be moved on an arc about a first centre, and the second
- 35 points blade is arranged to be moved on an arc about a second centre. Preferably

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the first centre is remote from the line of the first points blade, and the second centre is remote from the line of the second points blade. Preferably both the centres lie outside the railway tracks. Because the incoming ends of the points blades need to move laterally inwards from the incoming rails, the centres are
5 located on the opposite side of the railway tracks from the respective points blades.

In such embodiments the rotation about a centre remote from each points blade rotates the points blade to bring the incoming end into lateral contact with the incoming rail, and provides a component of longitudinal motion to bring the outgoing
10 end into longitudinal contact with the branching intersection. This provides a flush surface between the outgoing end of the points blade and the branching intersection.

Preferably the first centre lies on a line perpendicular to the outgoing end of the first points blade when engaged with the branching intersection. Preferably the second
15 centre lies on a line perpendicular to the outgoing end of the second points blade when engaged with the branching intersection. This means that the outgoing ends of the blades are moved longitudinally so as to ensure a snug fit. The line connecting the centre to the incoming end will generally not be perpendicular to the
20 blade.

The appropriate positioning of the arc centre enables the points blades to be moved into and out of position in a manner which has been already described, i.e. providing a longitudinal motion at the outgoing end of the points blade to bring the
25 outgoing end into longitudinal contact with the branching intersection, and a generally lateral motion at the incoming end of the points blade to bring the incoming end into lateral contact with the incoming stock rail.

In one set of embodiments a physical pivot is provided at the arc centre - e.g. with
30 struts attached to connect to the points blade in order to produce the required motion. The struts could, for example, pass underneath the fixed rails between the sleepers to join onto the points blades. The struts could be attached to their respective points blades at any convenient positions thereon, but preferably one strut is attached to the outgoing end of its respective blade. Preferably the strut

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connecting the pivot to the movable points blade closest to its incoming end is longer than the strut connecting to the points blade nearest its outgoing end.

5 The optimum location of each pivot depends upon the required movement of the outgoing end of the associated movable points blade and its overall length. A suggested overlap of the outgoing end of the movable points blade and the branching intersection is approximately fifteen centimetres. A further fifteen centimetres movement is suggested in order to exceed the clearance of conventional points by a comfortable margin. Thus typical points might be
10 designed to give a total longitudinal movement of approximately thirty centimetres. In one example, the longest strut, the one connecting the pivot with incoming end of the movable points blade, is twice the length of the strut connecting the pivot to the outgoing end of the movable points blade. A movement of thirty centimetres at the outgoing end will result in a total transverse movement of sixty centimetres at the
15 incoming end, the lateral component of which will be about fifty three centimetres. The length of the movable points blade would, in this example, be about one and three quarters that of the shortest strut, so that pivot would be situated at a distance from the junction of the two fixed rails that was four sevenths of the length of the movable points blade. Although this would not be a problem for a solitary set of
20 points, usually there are other tracks in the vicinity. The pivot could be situated nearer the track, with the ratio between the longest and the shortest strut being increased. The limit would be about four to one, given the suggested figures for overlap and clearance. A twelve metre movable points blade would require a pivot situated about one metre fifty centimetres from the track.

25 In another set of embodiments one or both of points blades is arranged to be moved along respective guides. The guides are conveniently arranged to provide the same motion for the points blades as if they were pivoting about the (now virtual) centre. Many different alternatives can be envisaged for how to implement the guides. The guides could, for example, comprise one or more guide rails, one
30 or more guide slots, a cam arrangement or the like. By using such guides it is possible to avoid using struts connecting the pivots to the movable points blades, the longer of which in particular would probably need some of the sleepers to be in different positions. Such guides can also avoid the need for the movable points

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blades to be supported on half chairs, some of them extended, and resulting in much friction.

5 The points blades could be moved with a single motor and appropriate mechanical coupling, one motor per blade, or a series of motors as suits the application. Solenoid actuators or indeed any other actuator could be used instead of a motor. In one set of preferred embodiments, in order to avoid excessive friction, each movable points blade could be moved by a separate electric motor, e.g. a Direct Current motor, so as to have a path of travel including a vertical component so that
10 the motor causes the movable points blade to be lifted very slightly, moved in the appropriate direction, and deposited to rest on suitable supports, e.g. half-chairs. For example each motor could turn a gear which engaged teeth arranged in a flattened ellipse underneath the movable points blade and oriented along a guide. The motors could fit between the sleepers and be wired so that when one was
15 sliding one movable points blade into the engaged position, the other was sliding the other into the disengaged position.

In general it is not essential for the points blades to be moved by the same mechanism; one could have a physical pivot and the other could have one or more
20 guides for example.

For the sake of safety and in order further to smooth the passage of a train wheel across the join between the outgoing end of the points blade and the branching intersection, preferably the outgoing ends of each of the points blades and the apex
25 of the branching intersection are provided with co-operating mating features which give a snug fit between them. The co-operating mating features could comprise a generally horizontal step. The lower step could be provided on the branching intersection and the upper step provided on the outgoing ends of the points blades, thus providing support for the movable points blades as they extend over the gap
30 by the apex of the branching intersection. Alternatively the co-operating mating features may comprise a tongue and groove, e.g. a tongue on the outgoing end of the points blades which fits into a co-operating groove in the branching intersection.

It will be appreciated therefore that as well as creating a snug fit between the
35 outgoing end of the points blades and the branching intersection, the co-operating

5 mating features can enable the points blades to better provide load bearing support for a train traversing the set of points and lateral support for the curved movable points blade against the centrifugal force exerted by the wheels of the train as it is made to follow a curved path. These two features make the join robust, and extremely safe - as safe as ordinary track.

10 The co-operating mating features could also be configured to ensure correct lateral alignment between the outgoing end of the points blade and the branching intersection, thereby giving the required snug fit. In one set of embodiments the co-operating mating features comprise generally vertical co-operating portions. In some embodiments the co-operating features comprise a concave recess in the branching intersection and a convex protrusion on the outgoing end of the points blade. However these features could be interchanged. In some embodiments the co-operating features comprise a tongue portion on one of the branching
15 intersection and the outgoing end of the points blade; and a co-operating groove portion in the other. As mentioned above, such co-operating features will also provide lateral support for the points blade to resist the lateral force from the wheels of the train as they travel along the points blade, especially in the embodiments where a curved points blade is provided.

20 In one set of embodiments, electrical contacts on the movable points blades and fixed rails respectively configured to permit a current flow only if the points blade is in sufficiently firm engagement with the corresponding fixed rail. This could be implemented using quantum tunnelling composite (QTC) switch contacts. The
25 aforementioned current flow could be used to control a safety signal, e.g. by ensuring that a signal governing the section of track containing the points is set to red if no current flows. In a set of embodiments electrical contacts, e.g. QTC contacts, are provided to detect sufficient contact pressure at the ends of each of the points blades. The signalling circuitry may then be configured to give a red
30 signal unless contact at the end of one of the points blades is detected, or could be configured to give a green signal with a supervisor's alarm if only one contact is detected in order to guard against false alarms (e.g. due to fallen leaves), but provide for adequate supervision. The signalling circuitry may be configured to trigger a red signal if simultaneous contact by both points blades was detected
35 since this would indicate one of the blades failing to move which could theoretically

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result say a serious fault such as one of the motors failing and the flexible tie cord between them being broken.

Electrical contacts could be provided on the points blades and fixed rails
5 respectively or suitable self-contained pressure-sensitive switches could be provided on one or other component

Although reference is made herein to two points blades, this should not be construed as limiting: three or more blades could be provided. This could be
10 because composite blades are used rather than unitary ones or because more than three tracks are connected by the points.

Certain preferred embodiments of the invention will now be described, by way of example only, with reference to the accompanying drawings in which:
15

Figs. 1a, 1b and 1c show a prior art example of a conventional set of railway points for a railway track junction;

Figs. 2a, 2b, 3a and 3b show a set of railway points in accordance with the invention;

20 Figs. 4, 5a, 5b, 5c and 5d show different examples of co-operating features on the points blade and apex of the branching intersection; and

Fig. 6 shows an example of a groove in a rail to accommodate the incoming end of the points blade.

25 Figs. 1a and 1b show a conventional set of points 2 in which two movable points blades 4,6 lie between incoming fixed stock rails 8,10 and each pivot about a respective pivot 12,14. The free ends of the points blades are moved together laterally by a motor 16 acting on a tie-bar 17 between two positions in order to connect either one of the outgoing branch tracks 20, 22 to the single incoming track
30 18. In Fig. 1a the points blades are set to connect the single incoming track 18 to the upper outgoing branch track 20. In Fig. 1b the points blades are set to connect the single track to the curved lower branch track 22.

The pivot, or outgoing, ends of the points blades are connected to fixed rails 24,26
35 which meet at a frog 28. The frog is the crossing point between the inner rails

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30,32 of the branch tracks and the converging fixed rail sections 24,26 and is shown in more detail in Fig. 1c. In this conventional set of points the frog has no moving components. A train wheel passing over the frog therefore has to traverse a gap 34 between the fixed rail sections 24,26 and the apex 36 of the inner rails 30,32 of the outgoing branch tracks (the branching intersection).

Figs. 2a and 2b show an embodiment of the invention. The railway junction represented is a single incoming track 218 which branches into two outgoing tracks 220, 222. The set of points 202 control onto which outgoing track a train approaching the junction along the incoming track is directed, or are set depending from which outgoing track a train is approaching the junction. In Fig. 2a the points 202 are set to connect the single incoming track 218 to the straight upper outgoing branch track 220. In Fig. 2b the points 202 are set to connect the single incoming track 218 to the curved lower branch track 222.

The set of points 202 comprises two points blades 204, 206 which are straight and curved respectively. The points blades 204, 206 are connected to respective pivots 238, 240 by struts 242, 244. The pivot 238 for the straight points blade 204 lies outside and above the set of points 202 and the pivot 240 for the curved points blade 206 lies outside and below the set of points 202. The pivots 238, 240 lie on respective lines perpendicular to the outgoing end of the corresponding points blades 204, 206. The outgoing end of each blade is that which engages the apex of the branching intersection 228. The positions of the pivots 238, 240 enable the points blades 204, 206 to be moved along the necessary path between their engaged and disengaged positions. For example in this embodiment, while the respective outgoing ends of the blade 204, 206 move in a longitudinal manner between engaged and disengaged positions, the incoming ends of the blades have a component of lateral movement in order to move them away from the incoming stock rail 208, 210. The positions of the pivots and lengths of the struts 242, 244 depend on the dimensions and configuration of the set of points. It should be noted that for each blade both the outgoing and incoming end is moved when the blade moves between its engaged and disengaged positions.

As will be appreciated, there will, in practice, be a minimum distance for the pivot 238 from the straight blade 204. Taking the gauge of a track to be approximately

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1.40 metres, in order to be sure that the incoming end of the curved movable blade 206 is well away from the stock rail 210, the incoming end of the straight blade 204 must be less than 1.2 m from the fixed stock rail 210. The arc-wise motion of the outgoing end of the blade (204) is 0.3 m. If the strut to the incoming end is four
5 times the length of the strut to the outgoing end, the arc-wise motion of the incoming end will be 1.2 m. This will result in a lateral motion of a little less than 1.2 m.

So if the distance between the pivot 238 and the apex of the branching intersection is d , the maximum length of the longer strut 242 is $d \times 4$. Since the blade 204 is
10 perpendicular to the line to the pivot 238, by Pythagoras' theorem the square of the length of the blade 204 is $4^2 - 1^2 = 15$ so the length of the blade is: $d \times \sqrt{15}$ or approximately $d \times 3.87$. If the blade 204 is 12 metres long, the distance from the apex 228 to the pivot will be $12/3.87 =$ equals approximately 3.1 metres. The gauge is 1.4 metres, so the distance from the stock rail 210 to the pivot 238 will be
15 1.7 m.

Allowing 0.2 m or so for the distance from the stock rail to the edge of the sleepers, the pivot 238 is about 1.5 m from the track.

The struts 242, 244 extending from the pivots 238, 240 pass underneath the
20 respective rails to connect to the points blades 204, 206. They could, for example, be accommodated in a suitable recess beneath the level of the rails. If necessary, allowance can be made between the sleepers of the railway tracks to accommodate the movement of the struts 242, 244, for example vertical slits in the sleepers along the path the struts 242, 244 will take. Although the embodiment is illustrated with
25 the struts 242, 244 connected to the ends of the blades, this is not essential; connection could be made at positions inbetween. It is not essential to have exactly two struts; more struts or a single strut configuration could be used.

Each set of struts 242, 244 is driven by a motor (not shown) to rotate the respective
30 points blade 204, 206 in an arc centred on the pivot. The straight points blade 204 is movable selectively to connect the lower stock rail 208 of the incoming track 218 to the lower rail 232 of the upper (straight) outgoing track 220 which diverges from the branching intersection 228. When in the engaged position (Fig 2a), this enables the train to pass either way through the junction between these tracks 218, 220.

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The curved points blade 206 is used to connect the upper stock rail 210 of the incoming track 218 to the lower rail 230 of the lower (curved) outgoing track 222. When in its engaged position (Fig. 2b), this blade enables the train to pass either way through the junction between these tracks 218, 222. The curved points blade
5 206 is curved to provide a smooth passage between the straight incoming rail 210 and the curved lower outgoing rail 230. For high-speed and crossover points it is desirable that the curved points blade takes the form of a cubic spline, its radius of curvature decreasing from the incoming end which engages with the upper stock rail 210 to the outgoing end which engages with the branching intersection 228.
10 The exact form of the cubic spline is dependent on the dimensions and configuration of the set of points, which will differ between different junctions.

A flexible cord 205 is attached between the points blades 204, 206 towards their incoming ends. This is a safety mechanism to ensure that the points blades 204,
15 206 cannot both be in contact with their respective stock rail 208, 210 at the same time. The flexible cord 205 is short enough that it drags the trailing points blade clear when the leading points blade moves into the engaged position if the trailing points blade fails to move, for whatever reason. A further safety mechanism (not illustrated) is provided by having an electrical contact incorporating a quantum
20 tunnelling composite material between the outer end of each movable points blade and the fixed stock rail (204 and 208; 206 and 210) which allows current to flow only if the movable points blade is firmly pressing against the fixed stock rail. If current fails to flow, the relevant signals will automatically go to 'Danger'. This arrangement could be provided for each blade such that an alarm (but not
25 necessarily a red signal) is triggered unless both contacts exhibit sufficient contact pressure. A danger signal is however triggered if simultaneous contact by both points blades is ever detected.

In an alternative embodiment shown in Figs. 3a and 3b, the set of points 302
30 comprises points blades 304, 306 which are moved by using guides 346, 348, instead of the struts and physical pivots of the previous embodiment. The configuration of the rails and blades is, however, the same as that shown in Figs. 2a and 2b. The guides 346, 348 are positioned to give the same arc motion of the respective points blades 304, 306 between their engaged and disengaged
35 positions. The guides are thus perpendicular to the respective radii from the (now

virtual) arc centres 338, 340, and of a length sufficient to give the required motion. The arrangement of the guides 346, 348 avoids the need for any strut to pass beneath the rails or to have clearance between the sleepers. The points blades 304, 306 are mounted on the guides using motorised wheels (not shown) which, when the points blades 304, 306 are signalled to be moved between their positions, operate to move the points blades 304, 306 as required.

The operation of both embodiments will now be described. Assuming the points 202; 302 are initially set for a train to pass from the incoming railway track 218; 318 to the upper (straight) outgoing track 220; 320, or in the opposite direction, the straight points blade 204;304 is in its engaged position connecting the lower stock rail 208;308 of the incoming track 218;318 to the apex of the branching intersection 228;328, as shown in Figs. 2a and 3a.

Subsequently, to reset the points to allow a train to pass from the incoming railway track 218;318 to the lower (curved) outgoing track 222;322 or in the opposite direction, the straight points blade 204 is moved in a clockwise arc by the motor acting on the struts 242; or the straight points blade 304 is driven by motors or solenoids along the guide rails 346. This moves the blade 204; 304 into its disengaged configuration. At the same time the other points blade 206 is also moved in a clockwise arc by struts 244 or the corresponding blade 306 of the second embodiment is moved by motors or solenoids along its guides, to give a corresponding arc motion. The points blades 206; 306 are therefore moved into their engaged configurations as shown in Figs. 2b and 3b. The operation of the motors and therefore the rotation of the centre points is electrically coupled to ensure that the points blades 204,206 move synchronously. Similarly the motors or solenoids operating the guides 346, 348 are likewise coupled to ensure the points blades 304, 306 move synchronously.

Fig. 4 is a side view showing, purely schematically, an example of horizontal co-operating mating features for the outgoing end of the points blades 404 and the branching intersection 436 respectively. It shows a step arrangement in which the outgoing end of the points blade 404 has an upper step 454 and the branching intersection 436 has a lower step 456 which, when brought together, fit together to provide a snug-fitting arrangement. This ensure a smooth passage through the

gapless set of points and also provides load bearing support for a train passing over the join between the points blade 404 and the branching intersection 436.

5 When a points blade 404 is brought into its engaged position, the co-operating mating features of the outgoing end of the points blade 404 and the branching intersection 436 help to create a gapless transition between the points blade 404 and the branching intersection. The horizontal snugly fitting features shown in Fig. 4 support a train passing over the set of points by transferring some of the weight of the train on the points blade 404 to the branching intersection 436. As the
10 branching intersection is a fixed component, it is better placed to be able to support this load compared to the movable points blade 404 and therefore ensures that there is no vertical gap for a wheel passing over the join between the outgoing end of the points blade 404 and the branching intersection 436. This is why the step 454,456 is on the upper part of the points blade and the lower part of the branching
15 intersection. The horizontal surfaces of the step on 456 and the overhang on 454 are slightly inclined, and similarly the vertical faces, so that if the movable blade 404 became lower, or the apex of the branching intersection higher, than intended, the movable blade would still engage.

20 Figs. 5a, 5b, 5c and 5d are highly schematic plan views showing examples of vertical co-operating mating features for the outgoing end of the straight points blades 504 and the branching intersection 536. The curved points blade (not shown) will have similar features. The features help to align the points blades 504 and the branching intersection 536 when they are in contact and provide lateral
25 support to the wheels of a train passing over the points blade 504, especially in the case of the curved blade (not shown) on which there will be a centrifugal force from the train wheels. These vertical features could be used on their own or in combination with features such as those shown in Fig. 4.

30 Fig. 5a shows a vertical co-operating mating feature for the outgoing end of the straight points blade 504 and the branching intersection 536, in which the outgoing end of the points blade 504 has a convex end 558 and the branching intersection 536 has a co-operating concave end. Fig. 5b shows the same arrangement but with the convex end 564 on the branching intersection 536 and the concave end
35 562 on the outgoing end of the points blade 504.

Fig. 5c shows a tongue and groove arrangement with a semi-circular tongue 566 on the outgoing end of the straight points blade 504 and a co-operating semicircular groove 568 on the branching intersection 536. Fig. 5d shows a similar tongue and groove arrangement, but this time with a square tongue 572 on the branching intersection 536 and a co-operating square groove 570 on the outgoing end of the points blade 504. Of course in both of these examples the tongue and groove could be interchanged between the outgoing end of the points blade 504 and the branching intersection 536.

The vertical co-operating mating features shown in Figs. 5a, 5b, 5c and 5d help to align the outgoing end of either of the points blades laterally with the branching intersection, and help the curved points blade give some lateral support against the centrifugal force exerted on the rail by the wheel of a train passing through the set of points.

Fig. 6 shows an embodiment in which there is groove 674 in the incoming stock rail 610 in order to provide a snug fit for the incoming end of the curved points blade 606. An appropriate allowance is made for the thermal expansion of the points blade 606. A similar groove (not shown) is also provided in the other incoming stock rail just as it begins curve to accommodate the straight points blade. Fairly near to these grooves, and on the corresponding positions on the movable points blades are provided electrical contacts that, as described above, activate danger signals in certain failure situations - e.g. if neither movable blade is in firm contact with a stock rail.

In general, the incoming ends of the points blades will be similar to conventional points blades in that its width tapers in order that it provides a flush lateral engagement with the rail of the incoming track. This ensures a smooth transition for the train wheel when it leaves the fixed incoming rail and transfers on to the points blade or vice versa if it is travelling in the opposite direction.

It will be appreciated by those skilled in the art that only a small number of possible embodiments have been described and that many variations and modifications are possible within the scope of the invention. For example a different mechanism for

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moving the points blades between their positions could be envisaged which, for example, could be mechanically rather than electrically operated. A whole variety of mating arrangements between the points blades and both the incoming rails and the branching intersection could be envisaged, to suit the configuration of the set of points. The invention need not be limited to a simple junction in which one track branches into two tracks, other junction layouts could be fitted with the points blades and mechanism of this invention, e.g. crossover points. Gapless crossings could be constructed in accordance with the invention, though if the crossing were set for one track to cross the other, the setting would need to change for the other track to be used.

Claims:

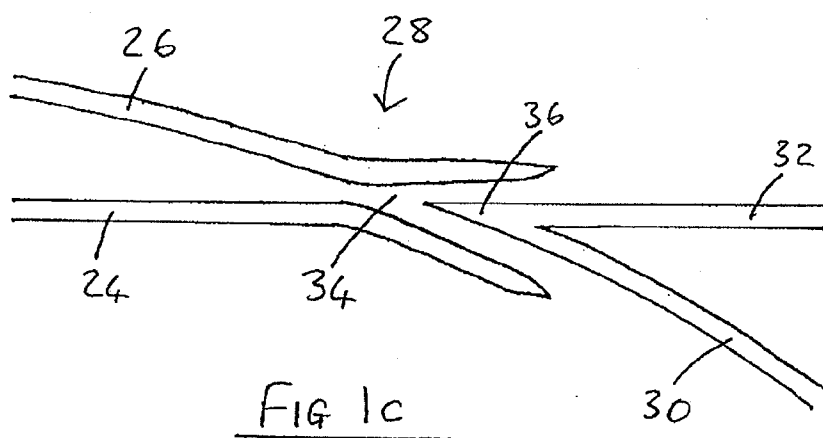
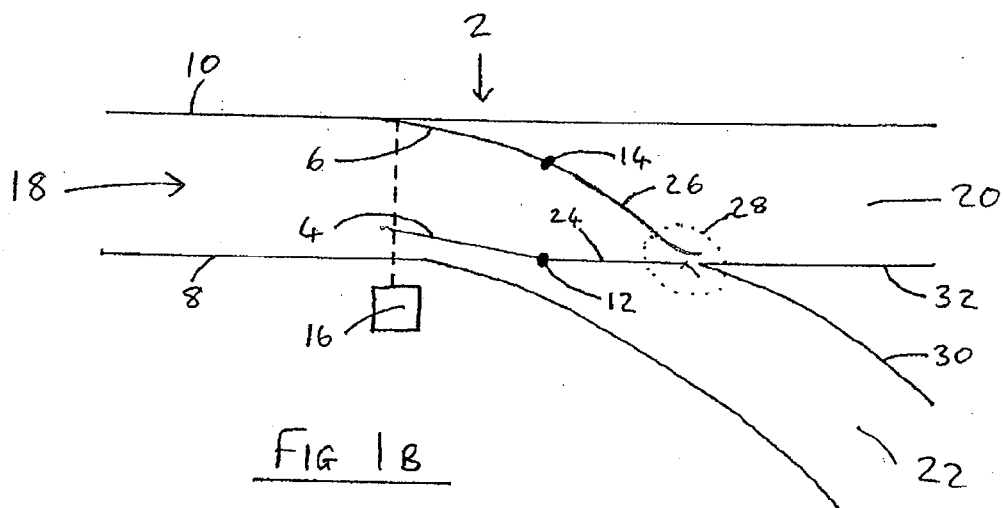
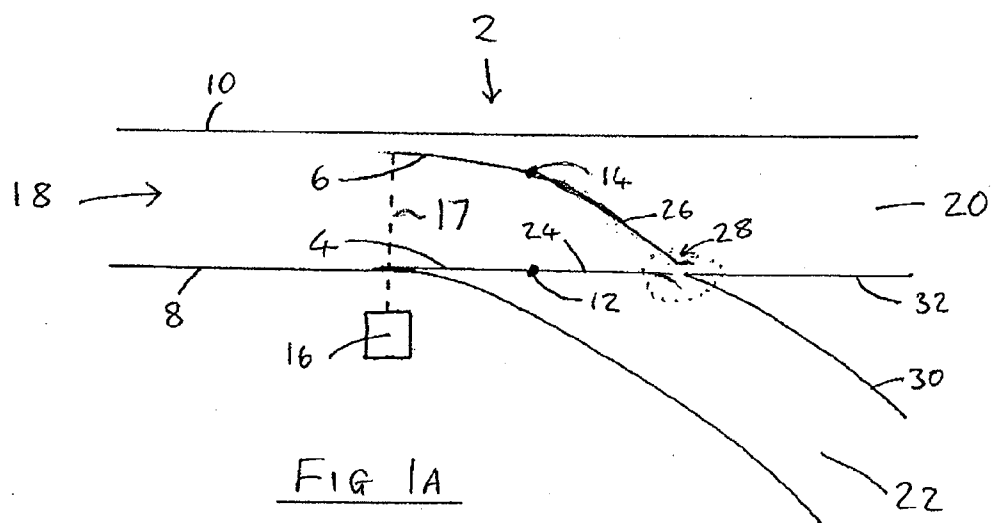
1. A set of railway points comprising two or more movable points blades, said points blades each being arranged to move at both ends to provide a continuous
5 rail surface across the set of points.
2. A set of railway points as claimed in claim 1 wherein:
the points blades are movable between a first position to couple an
incoming railway track with a first outgoing railway track and a second position to
10 couple the incoming railway track with a second outgoing railway track;
the set of points comprise a branching intersection where adjacent rails of
the first and second outgoing tracks meet;
first and second points blades each comprise an incoming end and an
outgoing end;
15 in said first position the incoming end of the first points blade is in contact
with a first rail of the incoming track and the outgoing end of the first points blade is
in contact with the branching intersection; and
in said second position the incoming end of the second points blade is in
contact with a second rail of the incoming track and the outgoing end of the second
20 points blade is in contact with the branching intersection.
3. A set of railway points as claimed in claim 1 or 2 wherein at least one of said
movable points blades has a variable radius of curvature along its length.
4. A set of railway points as claimed in claim 1, 2, or 3 wherein at least one of
25 said movable points blades takes the form of one or more cubic splines.
5. A set of railway points as claimed in any preceding claim wherein the first
points blade is arranged to be moved on an arc about a first centre, and the second
30 points blade is arranged to be moved on an arc about a second centre.
6. A set of railway points as claimed in claim 5 wherein the first centre is
remote from the line of the first points blade, and the second centre is remote from
the line of the second points blade.

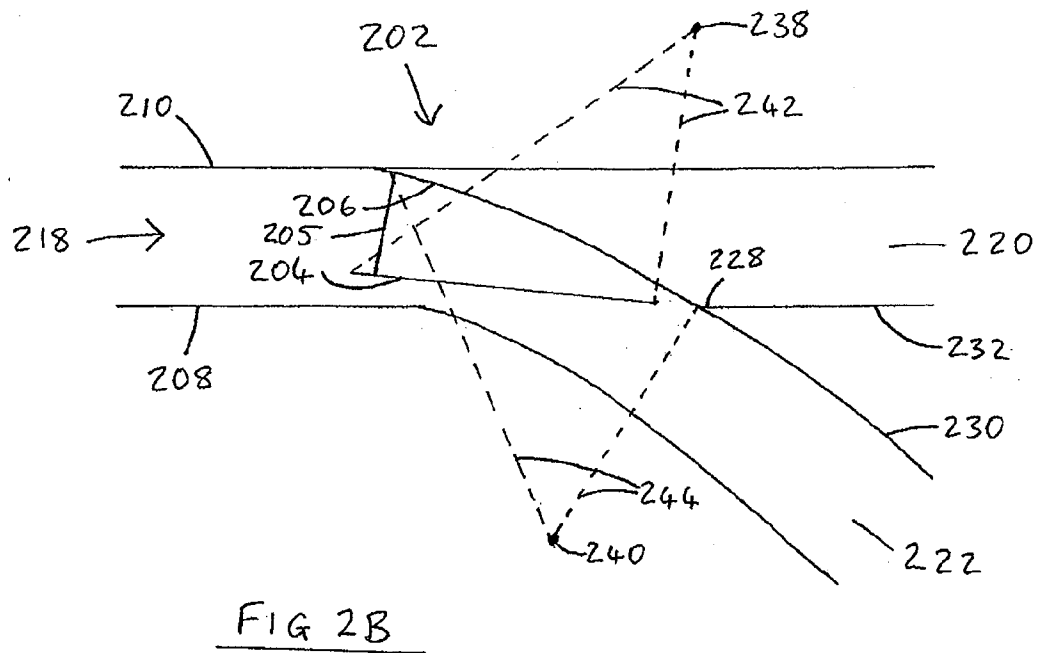
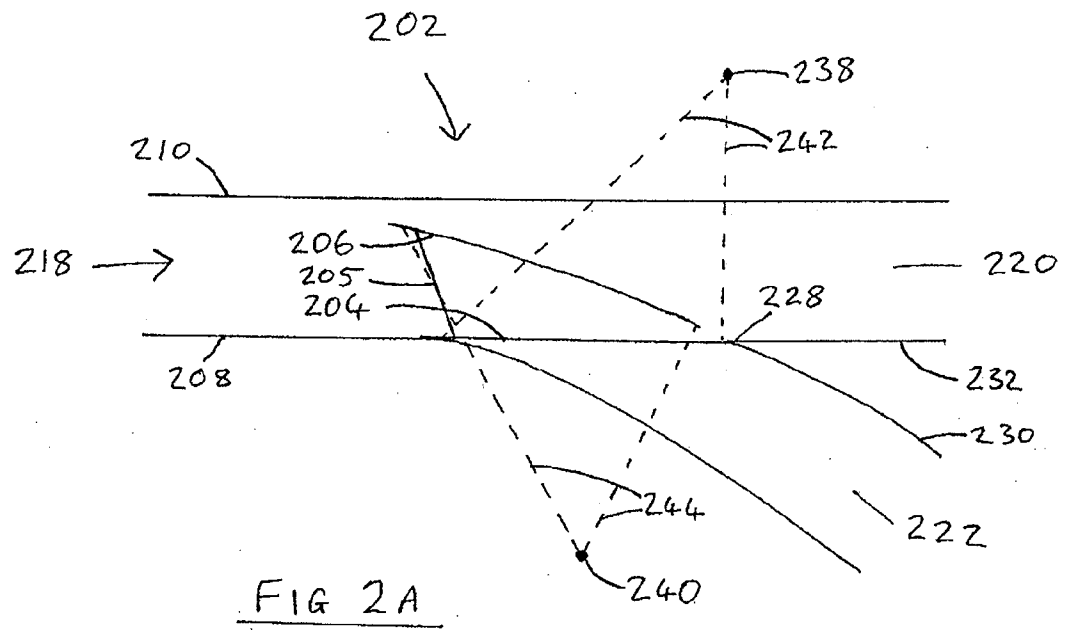
- 18 -

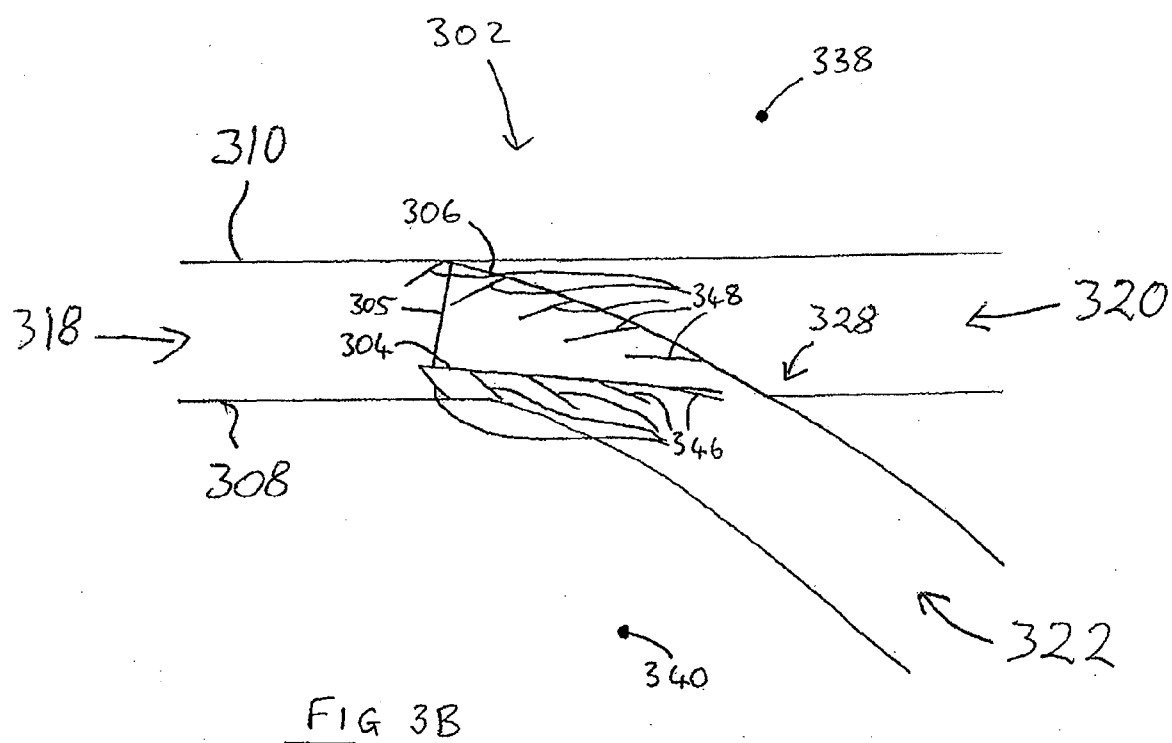
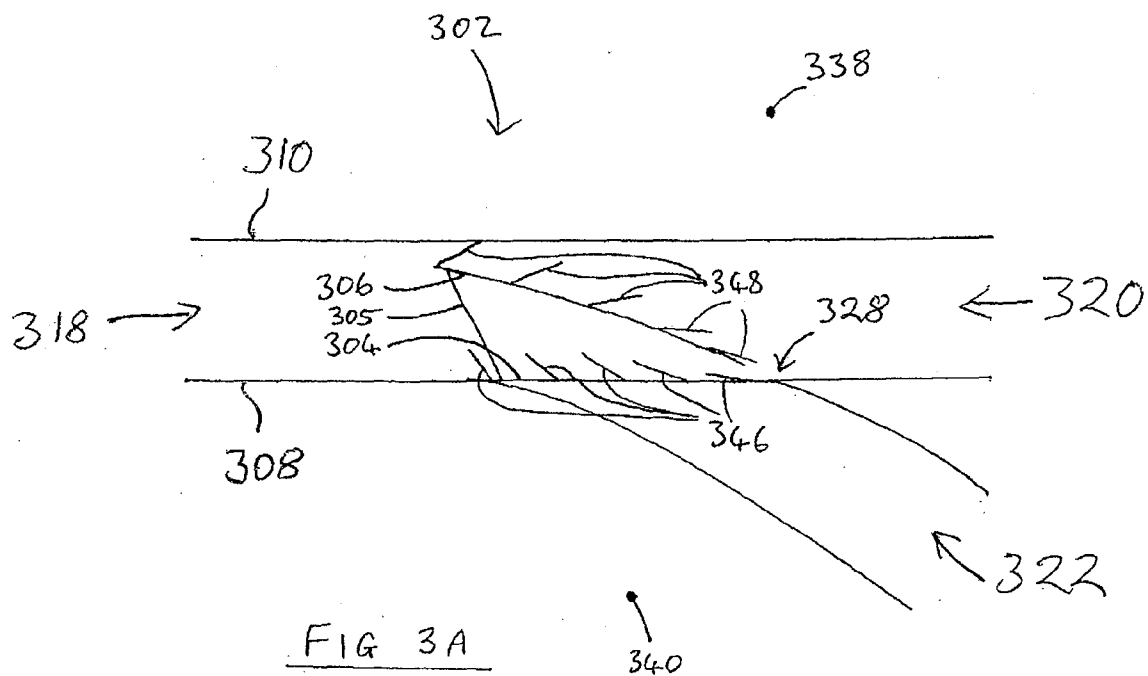
7. A set of railway points as claimed in claim 5 or 6 wherein both the centres lie outside the railway tracks.
- 5 8. A set of railway points as claimed in claim 5, 6, or 7 wherein the first centre lies on a line perpendicular to the outgoing end of the first points blade when engaged with the branching intersection.
- 10 9. A set of railway points as claimed in any of claims 5 to 8 wherein the second centre lies on a line perpendicular to the outgoing end of the second points blade when engaged with the branching intersection.
10. A set of railway points as claimed in any of claims 5 to 9 comprising at least one physical pivot provided at the first and/or second arc centre.
- 15 11. A set of railway points as claimed in claim 10 comprising one or more struts connecting the or each pivot to the or each points blade.
- 20 12. A set of railway points as claimed in claim 11 comprising two or more struts connecting the pivot to the movable points blade wherein the strut attached closest to the incoming end of the movable points blade is longer than the strut attached to the outgoing end of the movable points blade.
- 25 13. A set of railway points as claimed in any preceding claim wherein at least one of the movable points blades is arranged to be moved along one or more guides.
- 30 14. A set of railway points as claimed in claim 13 wherein the or each movable points blade is provided with an electric motor so as to have a path of travel including a vertical component.
- 35 15. A set of railway points as claimed in any preceding claim wherein the outgoing ends of each of the points blades and the apex of the branching intersection are provided with co-operating mating features to give a snug fit between them.

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16. A set of railway points as claimed in claim 15 wherein the co-operating mating features comprise a tongue and groove.
17. A set of railway points as claimed in claim 15 wherein the co-operating mating features comprise a generally horizontal step.
18. A set of railway points as claimed in claim 15, 16 or 17 wherein the co-operating mating features are configured to ensure correct lateral alignment between the outgoing end of the points blade and the branching intersection.
19. A set of railway points as claimed in claim 18 wherein the co-operating mating features comprise generally vertical co-operating portions.
20. A set of railway points as claimed in any of claims 15 to 19 wherein the co-operating features comprise a concave recess in the branching intersection and a convex protrusion on the outgoing end of the points blade or a convex protrusion in the branching intersection and a concave recess on the outgoing end of the points blade.
21. A set of railway points as claimed in any preceding claim comprising electrical contacts on the movable points blades and fixed rails respectively configured to permit a current flow only if the points blade is in sufficiently firm engagement with the corresponding fixed rail.
22. A set of railway points as claimed in any preceding claim comprising means for determining a threshold contact pressure between the movable points blades and corresponding fixed rails respectively.
23. A set of railway points as claimed in claim 22 wherein said means for determining contact pressure comprises a quantum tunnelling composite.







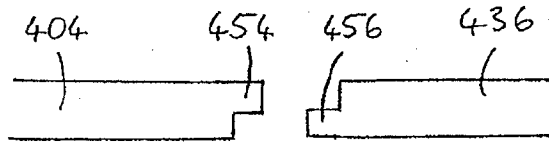


FIG 4

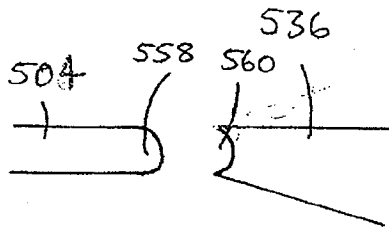


FIG 5A

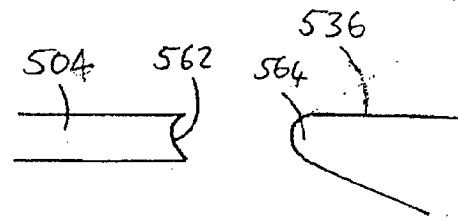


FIG 5B

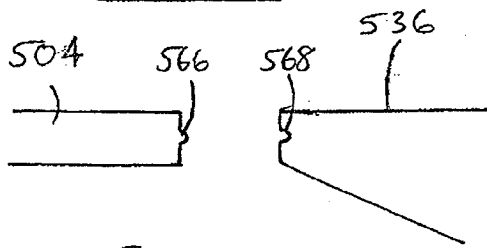


FIG 5C

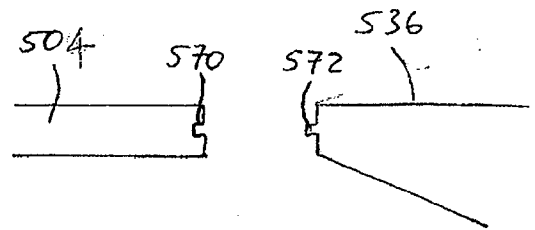


FIG 5D

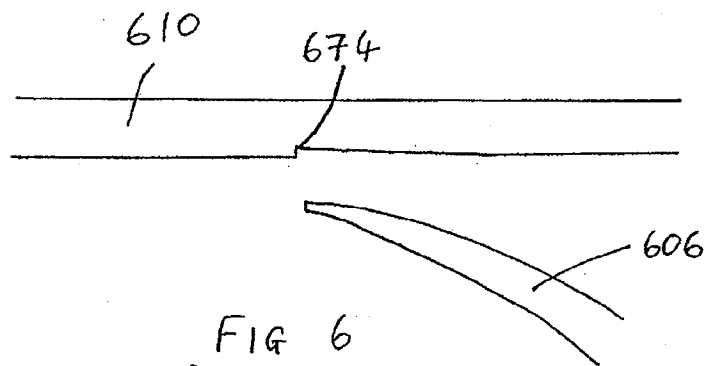


FIG 6

INTERNATIONAL SEARCH REPORT

International application No

PCT/GB2010/051422

A. CLASSIFICATION OF SUBJECT MATTER

INV. E01B7/08

ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

E01B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	GB 14789 A A.D. 1909 (FINLEY WILLIAM PHILANDER [US]) 18 November 1909 (1909-11-18) the whole document	1-4, 13-23
A	DE 694 827 C (BISCHOFF K G) 9 August 1940 (1940-08-09) the whole document	1
A	SU 1 710 629 A1 (PROIZV OB URALMASH [SU]) 7 February 1992 (1992-02-07) the whole document	1

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

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"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

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"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

Date of the actual completion of the international search

26 October 2010

Date of mailing of the international search report

05/11/2010

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Authorized officer

Movadat, Robin

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/GB2010/051422

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
GB 190914789	A	18-11-1909	NONE	
DE 694827	C	09-08-1940	NONE	
SU 1710629	A1	07-02-1992	NONE	