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(54) **Point drive system**

(57) A drive system for railway points comprises a drive means (26-29, see figure 3) for producing linear motion along a first axis, a drive member 30 operatively connected to the drive means, the drive member being linearly movable along said first axis, a pivoted crank 32 having a profiled end and an output region, and an output member 11 connected to the output region of said crank, said output member being substantially linearly movable along a second axis orthogonal to said first axis for connection to a pair of movable rails 2, 3, such that in use the drive member engages said profiled end causing rotation of the crank thereby causing the output member and said pair of movable rails to move along said second axis. A series of additional cranks 39, 40 may be connected to the drive member 30 to drive the rails along their length in a synchronised manner.

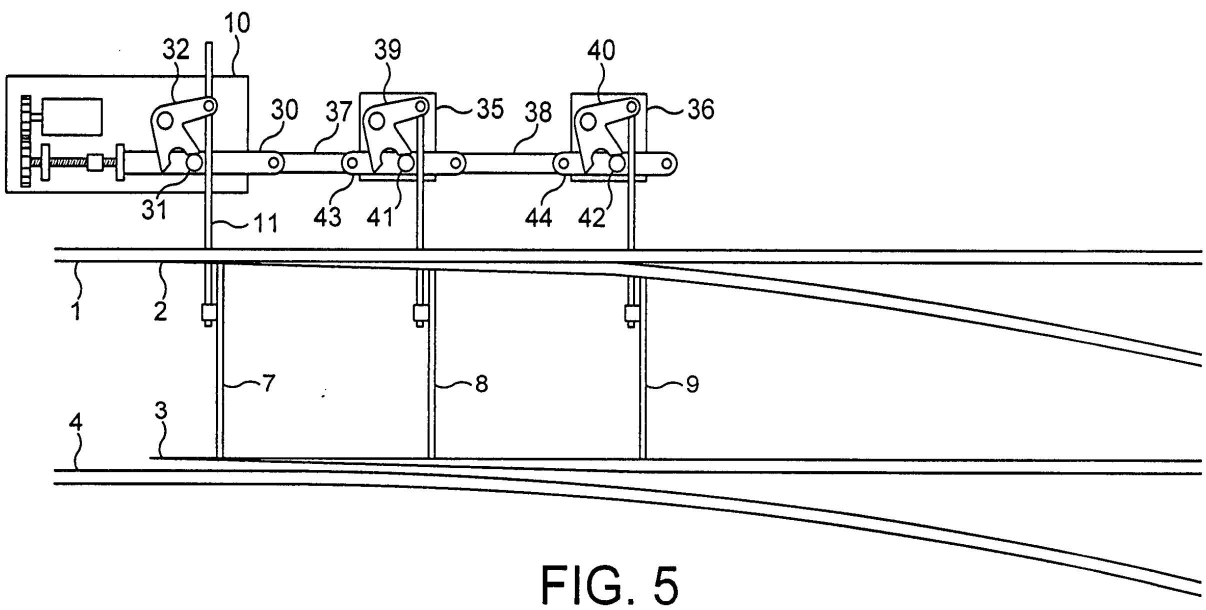

FIG. 5

EP 1 512 603 A2

Description

[0001] The present invention relates to the driving of railway points.

[0002] Referring to Figure 1, a typical railway point comprises two static rails called stock or running rails 1 and 4, and two moveable rails known as switch rails or switch blades 2 and 3. All four rails are supported by a plurality of chairs or baseplates 5, mounted upon sleepers or bearers 6. It is common practice to connect the two moving rails together by means of a series of transversely positioned ties called stretcher bars 7, 8 and 9. The stretcher bars perform the function of maintaining an accurate spaced relationship between the two moving rails, which is commonly known as 'holding the gauge'.

[0003] Normally, the switch blades are moved by means of a remotely operated prime mover, for instance an electromechanical point machine 10. The drive bar 11 from such a machine is connected to the first stretcher bar 7 at the 'toe' of the points 14 and 15, i.e. the position on the track where the points start and the track begins to diverge.

[0004] Assuming for example that a railway vehicle travels from left to right in Figure 1, the points provide two alternative paths or routes: one being a straight ahead route and the other being a divergent one. In geometric terms the divergent route can be described as that of the radius of an arc that strikes a tangent with the straight route at the toe of the points. For reasons of safety and passenger comfort there is a limit to the speed that rail vehicles can pass over the divergent part of the points which is determined by the radius of curvature of the rails. It is axiomatic therefore that the higher the speed of the rail vehicle then the greater the radius of curvature and the longer the length of switch rail required.

[0005] Figure 1 is drawn showing the points set for the divergent route, that is the left hand switch rail 2 is adjacent to its associated stock rail 1; whilst the other switch rail 3 is 'open' and held away from stock rail 4. In order to achieve a smooth transition from the straight ahead route to the divergent route, the moveable switch blades 2 and 3 are tapered over their moveable length, with the taper being thinnest at the toes 14 and 15, and thickest at the other end of the switch blade, known as the heel of the points 16 and 17. The degree and length of taper varies according to the radius of curvature required and is achieved by machining the inside face of the switch rail, this being known as the straight planing or head cut. At a point just beyond the full end of the taper the moveable switch rails 2 and 3 are rigidly attached to fixed rails 12 and 13 respectively. Thus the switch rails, when moved, act as cantilevered beams, with a point load applied to their free ends via point machine 10 and stretcher bar 7. By virtue of the taper formed on the switch rails, their stiffness will vary along their length, from being most flexible at the toes14 and 15, to that of being most rigid at the heel 16 and 17.

[0006] The switch rails 2 and 3 rest on, and slide across, chairs 5 which are attached to, and supported by, bearers 10. However, due to a combination of misalignment and rail flexure, switch rails often do not rest evenly on their chairs, hence the effects of friction caused by rail contact with the chairs varies along the length of the moving switch rail.

[0007] On high speed routes the variability of chair friction combined with increased switch rail flexure (due to increased length) will cause the switch rails to move in an incoherent manner, particularly when operated by a single input such as a point machine attached to the toe of the points. For safe and smooth working it is essential that the 'closed' switch rail (i.e. rail 2 in Figure 1) is positioned completely against its running rail along the whole length of the head cut. Also the open rail 3 must be moved to provide a sufficient gap between it and the running rail to allow free passage for the wheels of passing rail vehicles, particularly at its heel end. It is well established that long switch rails do not move in a coherent and synchronised manner, particularly when there is only one input applied, this being generally to the toe of the points.

[0008] Various methods have been used to overcome this problem which are commonly referred to as either supplementary or back drive systems. Methods currently in use include: multiple point machines placed strategically along the length of the switch rail, hydraulic actuators (rams) acting at various points along the switch rail, torsional drive systems and systems employing a combination of simple cranks and rods.

[0009] The use of multiple point machines is considered expensive and presents difficulties in terms of synchronised operation. Further operational disadvantages occur when electrical power is lost to either one or all of the machines. Should one machine fail for any reason then the switch blades will be distorted temporarily, if not permanently. With a total loss of electrical power it is normal to move the points manually by means of a crank handle inserted into the point machine. For multiple machines this requires either one person to crank over each machine in turn or have personnel positioned at each machine and crank simultaneously. The increased number of machines used leads to a reduction in system reliability.

[0010] Hydraulic actuators are usually driven from a common pump and operate at equal pressure and thrust, however the loads presented to them is often unequal and this can cause the switch blades to move in an incoherent manner and unsynchronised manner. Additionally, hydraulic pipe work alongside the rail track is vulnerable to damage that could result in point failure and possible fire.

[0011] Torsional drives derive their motion from the linear movement of the toe of the switch blades, convert this to rotary movement and then back to linear movement at the other end of a torsion tube or bar. Torsion drives can be used in multiple arrangements, although their overall length is limited due to the loss of linear movement caused by torsional flexure.

[0012] The most common method of providing a multiple input to the switch rails is by use of a number of cranks and connecting rods. Figure 2 illustrates a typical three crank arrangement where the lead crank 18 is connected via one arm to rod 21 and in turn to stretcher 7 and thus receives its drive from the movement of the switch blade toes. The second crank 19 is connected to stretcher 8 via rod 22, with the third crank being connected to the rear stretcher bar 9 via connecting rod 23. The outer arms of cranks 18, 19 and 20 are connected together via rods 24 and 25. Commonly, the opening of the toe of the point blade 15 is approximately 110 mm whilst the clearance needed at the heel 17 for the free passage of rail vehicle wheels is 55 to 60 mm. Since the total movement of the lead crank 18 is almost twice that required by the crank at the heel 20, there has to be some form of lost motion. This is achieved by adjusting the position of the ends of rods 24 and 25 on the outer arms of the cranks so that the drive ratio is progressively reduced along the back drive. This system requires accurate setting up and is very intolerant to the effects of climatic, i.e. temperature, change and a phenomenon known as 'rail creep', where the positioning of the rails tends to drift gradually over time. Like the torsional drive, the system is limited in overall length due to its lack of rigidity, and requires constant adjustment due to climatic changes.

[0013] A further drawback to the known systems described above is their inability to accommodate a train 'run-through', where a train makes an unauthorised movement over the points against the route for which they are set. For example, referring back to Figure 1, if a train were to travel from right to left as shown on the straight ahead route, then the right hand wheels of the train would run into the closed switch blade 2 that abuts against fixed rail 1. Progressive movement of the train's flanged wheels into the closed and locked switch blade will force it away from the fixed rail and permanent damage to the points and point equipment will result.

[0014] It is an object of the present invention to provide a supplementary drive system for operating long railway points in a coherent and synchronised manner which can be manually operated from one position and that locks the switch rail to the adjacent running rail at all supplementary input positions, which is not dependent upon the movement of the switch blade to provide supplementary inputs, and which is tolerant to changes in temperature, rail creep and train run-through.

[0015] In accordance with a first aspect of the present invention there is provided a drive system for railway points comprising: a drive means for producing linear motion along a first axis; a drive member operatively connected to the drive means, the drive member being linearly movable along said first axis; a pivoted crank having an end and an output region; and an output member connected to the output region of said crank, said output member being substantially linearly movable along a second axis orthogonal to said first axis for connection to a pair of movable rails, such that in use the drive member engages said end in moving along said first axis causing rotation of the crank thereby causing the output member and said pair of movable rails to move along said second axis between first and second positions.

[0016] The end of the crank is advantageously profiled to have first, second and third sections. With this arrangement, when the drive member engages the first section of the profiled end, the output member may be locked at said first position. When the drive member engages the second section of the profiled end, the output member may be unlocked so that it may travel along the second axis. When the drive member engages the third section of the profiled end, the output member may be locked at said second position.

[0017] The drive member may engage the end of the crank via a roller attached to the drive member.

[0018] Preferably, the crank includes a clutch arrangement which permits rotation of the output region with respect to the end.

[0019] At least one additional such crank may be provided, connected to the drive member and to a respective output member. Each of these cranks may include an output region of different to the length of the output region of the first said crank.

[0020] The or each output member may be provided with a respective stretcher bar for keeping the rails at a predetermined distance apart.

[0021] In accordance with a second aspect of the invention there is provided a set of railway points comprising a pair of movable rails connected to the above drive system.

[0022] The invention will now be described by way of example with reference to the following figures, in which:-

Figure 1 shows a schematic plan of a conventional points system,
Figure 2 shows a schematic plan of a conventional points drive system,
Figure 3 shows a schematic plan of a drive system according to the present invention;
Figures 4a-c show the operation of an escapement crank for use in the drive system of Figure 3;
Figure 5 shows an embodiment of the drive system using a series of cranks; and
Figure 6 shows a clutch mechanism for use with the drive system of the present invention.

[0023] Referring now to Figure 3, an electro-mechanical point machine 10 comprises a prime mover 26, which in this case is a controllable electric motor. This drives, via reduction gear train 27, a linear ballscrew 28, thus converting the rotary motion of the motor to linear movement of ballnut 29 along an axis running from left to right as shown in the figure. The linear movement of the ballnut is transferred to drive member 30. Roller 31 is attached to the drive member 30, and this engages with the profiled end of crank 32; the crank being free to rotate about fixed pivot 33. The other arm of the crank is connected to the output drive bar 11 via roller 34. Similarly to the apparatus shown in Figure 1, the drive bar 11 is connected to stretcher 7, which transmits the drive from the point machine 10 to switch blades 2 and 3.

[0024] The point machine 10 thus generates two drive outputs which are positioned at right angles to each other. One drive 11 is transverse to the railway track whilst the other, drive member 30, is parallel to it. When the point machine is operating, the transverse drive output is intermittent, whilst the parallel drive is continuous. The phased sequence of drive outputs is achieved by use of the escapement crank 32.

[0025] The interaction between roller 31 and the escapement crank is now described in more detail with reference to Figures 4a-c. It can be seen that the profiled end of the crank comprises three sections, i.e. two outer flat sections and a central indent. In Figure 4a, the right hand flat of the escapement crank is resting against roller 31; in this position the roller restricts any further clockwise rotation of the crank and thus effectively locks and prevent the switch blades from movement.

[0026] A command may now be placed upon the point machine motor 26 which, via the gear train and drive member 30, causes roller 31 to move to the left along the profiled face of the crank. During this movement the crank is prevented from rotating until a point is reached where the roller leaves the flat section of the escapement profile and engages the central indent. Figure 4b shows the escapement in mid position where the crank is now free to rotate about its pivot 33. Under the influence of the motor, the drive member and roller 31 continue to move to the left and engage with the left hand flat on the crank, which will in turn cause the crank to rotate in a clockwise direction about pin 33. This action will also move the point switch blades to the opposite position, i.e. for the straight ahead route. Having rotated the crank such that the left hand flat on the escapement profile is now parallel to the drive slide, crank rotation ceases. Roller 31 continues to move to the left until it reaches the far end of the flat, shown in Figure 4c, at which point power is removed from the motor 26. With the system in this quiescent state the switch blades are held locked by virtue of roller 31 preventing anticlockwise rotation of crank 32. It is therefore clear that there are three distinct positions: a first in which the rails are locked in a 'closed' state, a second where the rails are unlocked and are free to move, and a third where the rails are locked in an 'open' state. This arrangement provides improved immunity against the effects of temperature change. If the roller 31 is engaged with one of the flat sections for example, even if there is stretching or compression of the drive member due to e.g. temperature change, the roller will merely move along the flat section, maintaining the rails in their locked state. Similarly, the system will not be compromised by unwanted movement of the rails, e.g. by 'rail creep'.

[0027] Referring now to Figure 5, a high speed point layout is shown in which two supplementary drive inputs 35 and 36 have been employed in conjunction with a dual output electro-mechanical point machine 10. The supplementary drive units can be used in multiple combination, thus providing as many inputs as required. The units are linked to each other via connecting rod 38, whilst unit 35 receives its input via connecting rod 37 being attached to the drive member 30 of point machine 10.

[0028] The escapement profiles for cranks 32, 39 and 40 are identical; rollers 31, 41 and 42 are also identical and since slides 30, 43 and 44 move in unison, then the cranks will operate in a synchronised manner and they will each provide the same function of holding the switch blades secure.

[0029] As shown in Figure 1 the gap between the open switch rail 3 and fixed rail 4 narrows from the toe 15 to the heel 17, the gap at 17 being approximately half of that at toe 15. The output required from cranks 39 and 40 therefore is less than that required from crank 32. A reduction in output is achieved by reducing the length of crank arms 39 and 40. The shortened crank arms have greater mechanical advantage when compared with crank 32 and therefore are able to provide a higher thrust to the switch blades. In mechanical terms this is very efficient since the increased thrust to the switch blades is directed where the stiffness of the blade is increased due to the increased thickness of the taper.

[0030] A further refinement to the invention is that of making the escapement cranks compliant, that is, they are able to yield under the influence an excessive applied load. The nature of this refinement is to prevent permanent damage to the points and associated operating equipment, for instance the point machine and supplementary drives, in the event of a 'run-through' taking place.

[0031] Referring now to Figure 6, the escapement type crank has two separate arms 45 and 46. Interposed between the arms is a clutch element 47, whose separate halves are keyed to arms 45 and 46 respectively. The arms and the clutch elements are contained by means of a cylindrical sleeve 48 that has a retaining collar at one end and screwed portion at the other. A disk spring 49 is fitted to the sleeve and compressed to the required pressure by means of adjusting nut 50. The pressure set by the disc spring will be such that under normal point operation the two crank arms will remain in their correct angled alignment. However in the event of a 'run-through' then the wheels of the train will act to force the rails into the incorrect position, and if this occurs then the clutch will be caused to slip and the two arms will rotate relative to one another, releasing the rails and so preventing damage to the equipment.

[0032] Although the invention has been described with reference to the embodiments above, there are many other modifications and alternatives possible within the scope of the claims. For example, although the lead crank 32 is shown as being housed inside the point machine 10, it is possible to for the crank to be separate from it, in a similar manner to the other cranks 39 and 40 shown.

[0033] The clutch system used may vary from that shown in Figure 6, and there are many variations that will be apparent to those skilled in the art.

[0034] Means may be provided for manually moving the points in the event of a motor malfunction, in a similar manner to conventional systems.

[0035] The profiled end face of the escapement crank is exemplary only, and it is possible to devise other designs which achieve the desired locking profile.

[0036] Engagement between the crank and the drive member does not have to be via a roller, and indeed any low-friction engagement means could be used.

Claims

1. A drive system for railway points comprising: a drive means for producing linear motion along a first axis; a drive member operatively connected to the drive means, the drive member being linearly movable along said first axis; a pivoted crank having an end and an output region; and an output member connected to the output region of said crank, said output member being substantially linearly movable along a second axis orthogonal to said first axis for connection to a pair of movable rails, such that in use the drive member engages said end in moving along said first axis causing rotation of the crank thereby causing the output member and said pair of movable rails to move along said second axis between first and second positions.

2. A drive system according to claim 1, wherein said end of the crank is profiled to have first, second and third sections.

3. A drive system according to claim 2 arranged such that when the drive member engages the first section of the profiled end, the output member is locked at said first position.

4. A drive system according to claim 2 or 3, arranged such that when the drive member engages the second section of the profiled end, the output member is unlocked so that it may travel along the second axis.

5. A drive system according to any of claims 2 to 4, arranged such that when the drive member engages the third section of the profiled end, the output member is locked at said second position.

6. A drive system according to any preceding claim wherein the drive member engages said end of the crank via a roller attached to said drive member.

7. A drive system according to any preceding claim wherein the crank includes a clutch arrangement, said clutch arrangement permitting rotation of the output region with respect to said end.

8. A drive system according to any preceding claim further comprising at least one additional such crank connected to the drive member and to a respective such output member.

9. A drive system according to claim 8 wherein the or each said additional crank includes an output region of different to the length of the output region of the first said crank.

10. A drive system according to any preceding claim wherein the or each output member is provided with a respective stretcher bar for keeping the rails at a predetermined distance apart.

11. A set of railway points comprising a pair of movable rails connected to a drive system according to any preceding claim.

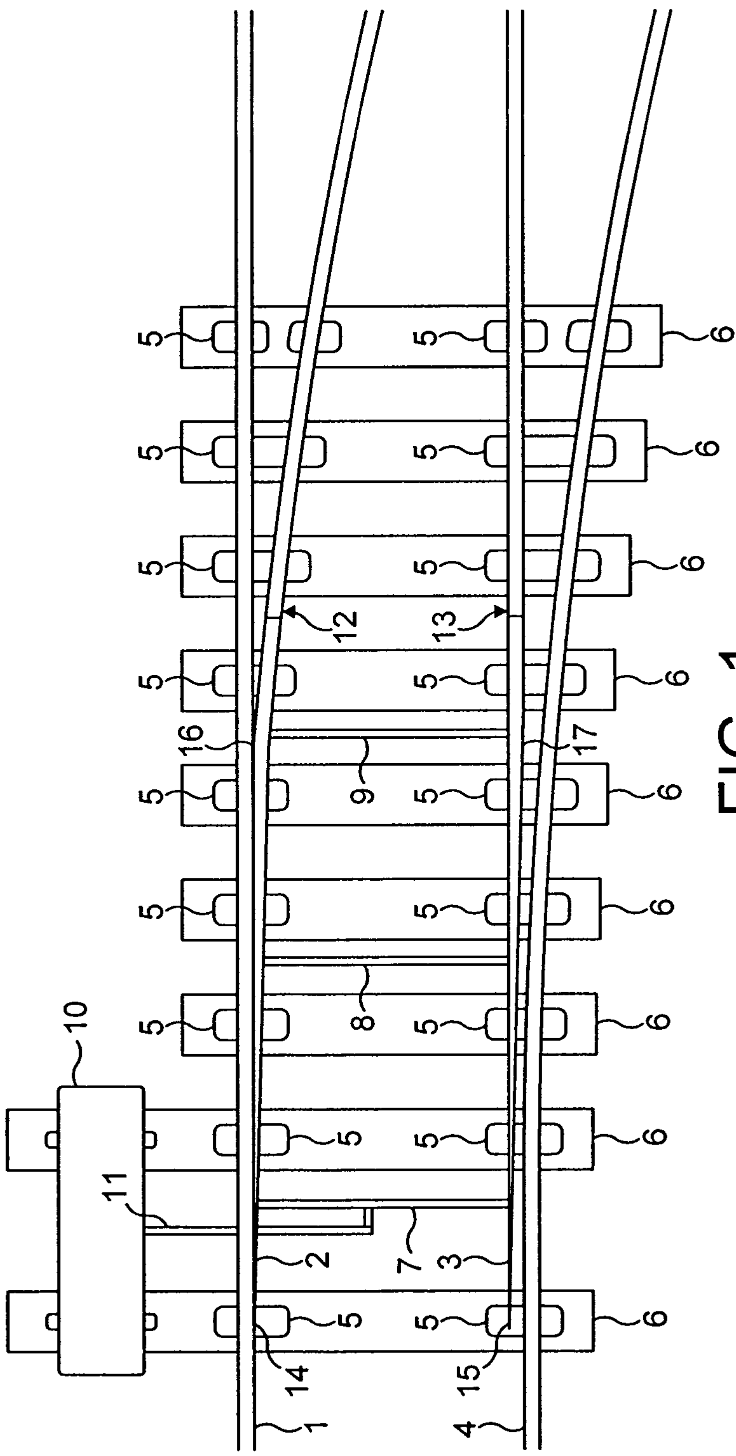

FIG. 1

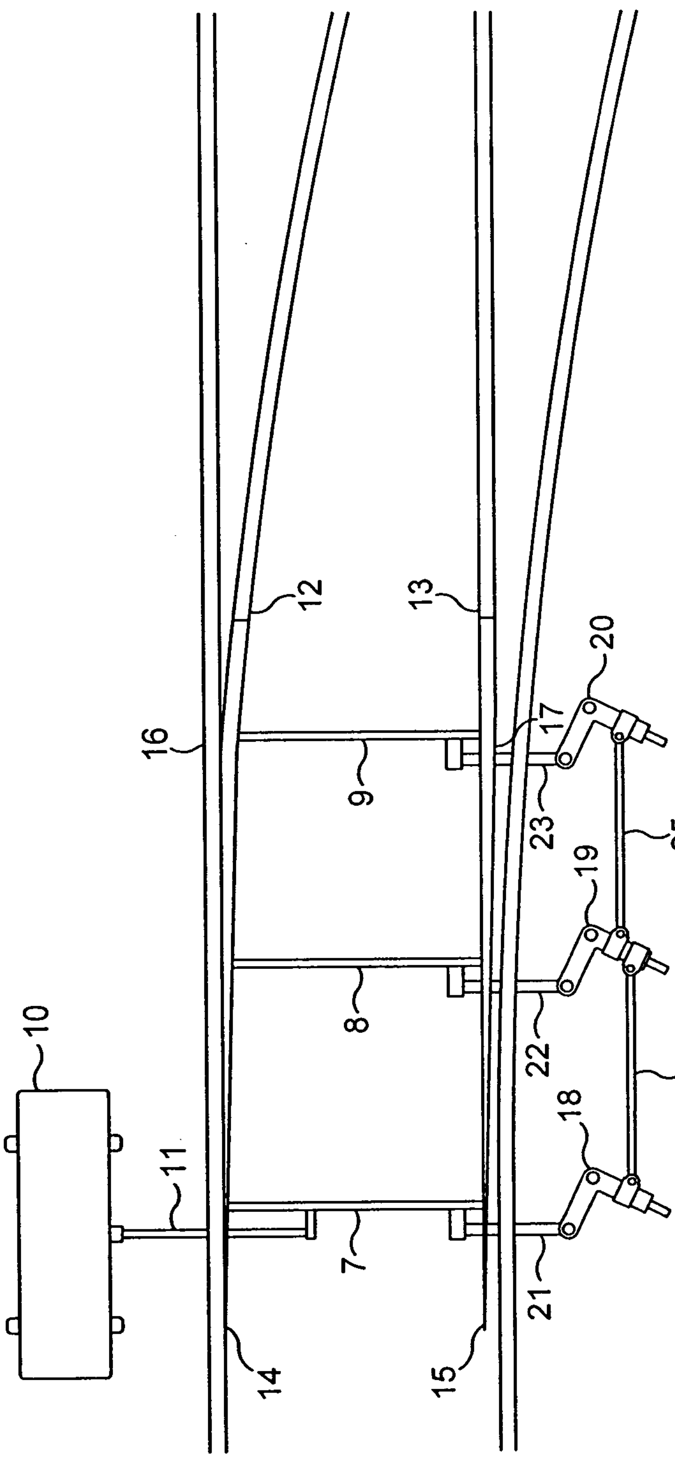

FIG. 2

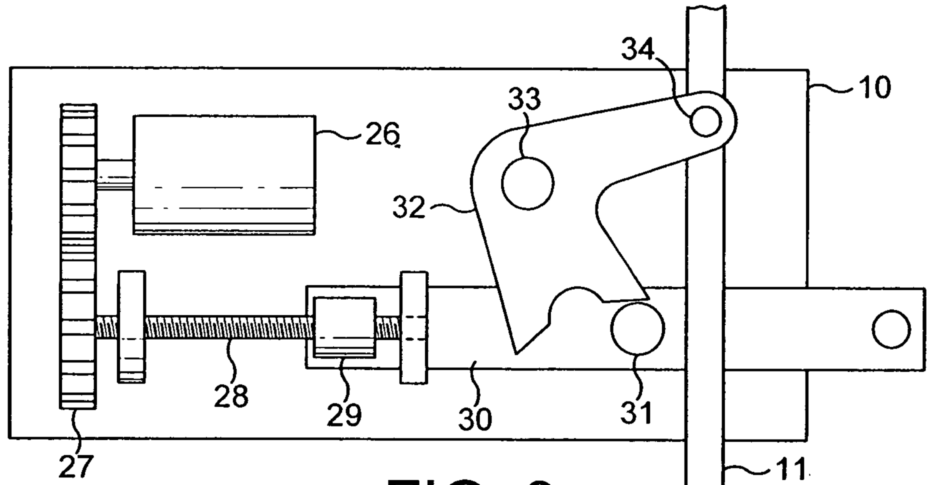

FIG. 3

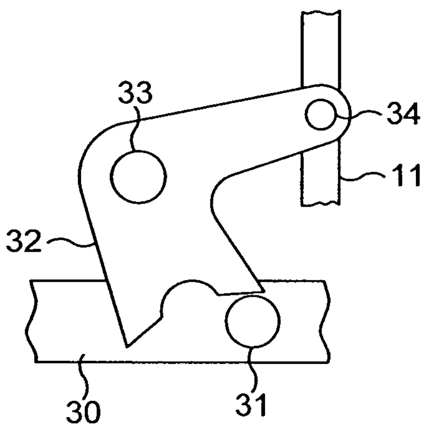

FIG. 4a

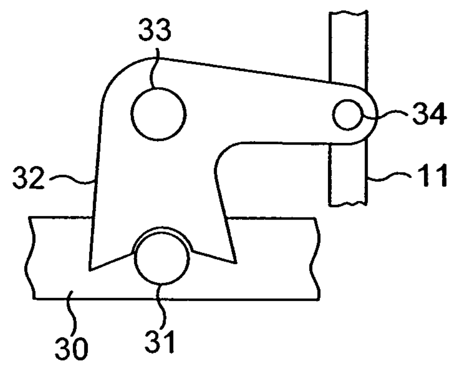

FIG. 4b

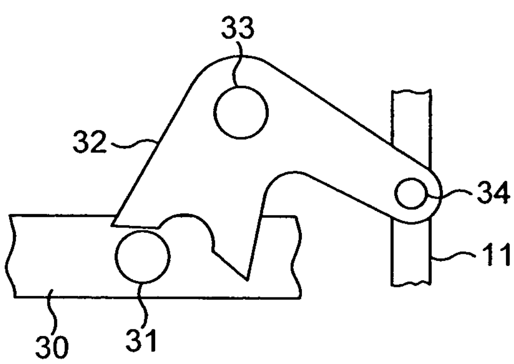

FIG. 4c

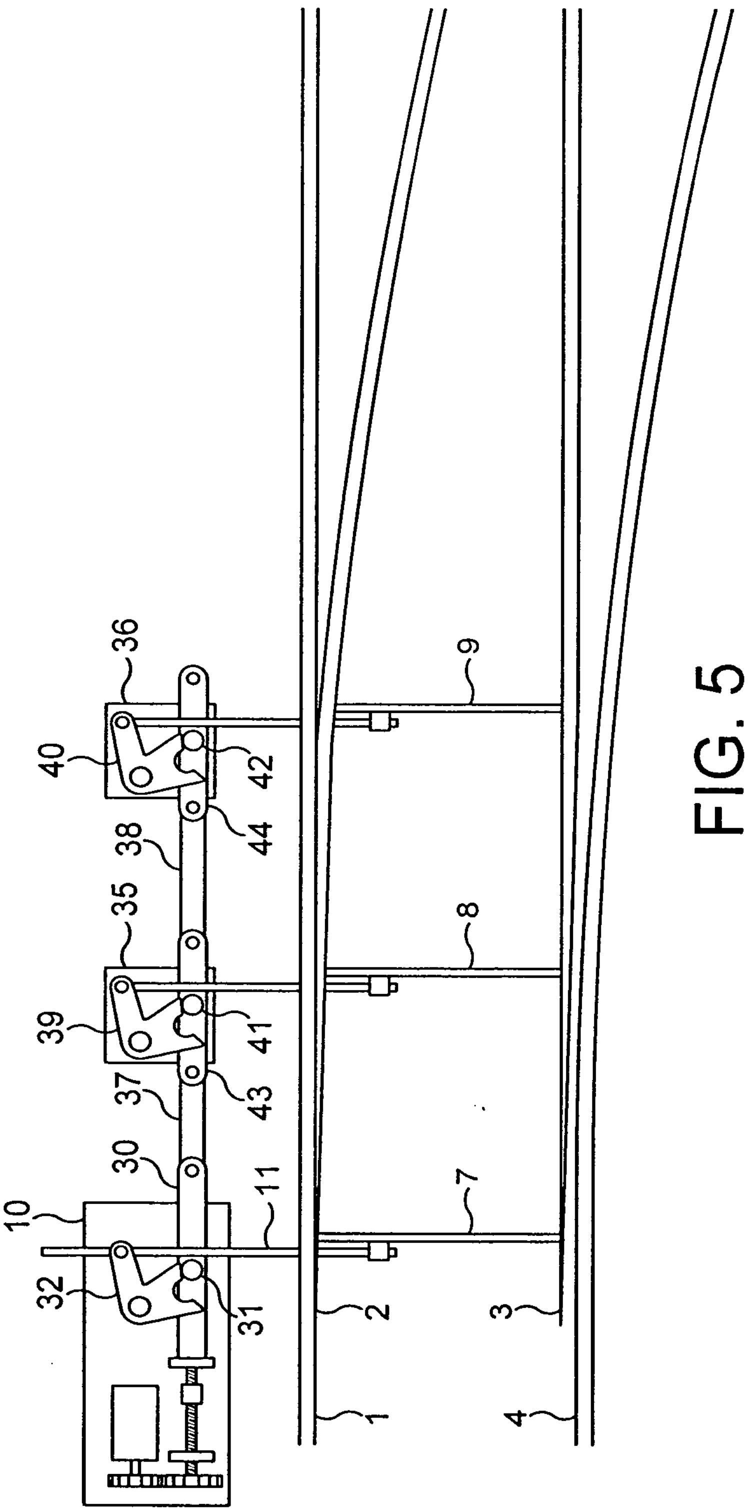

FIG. 5

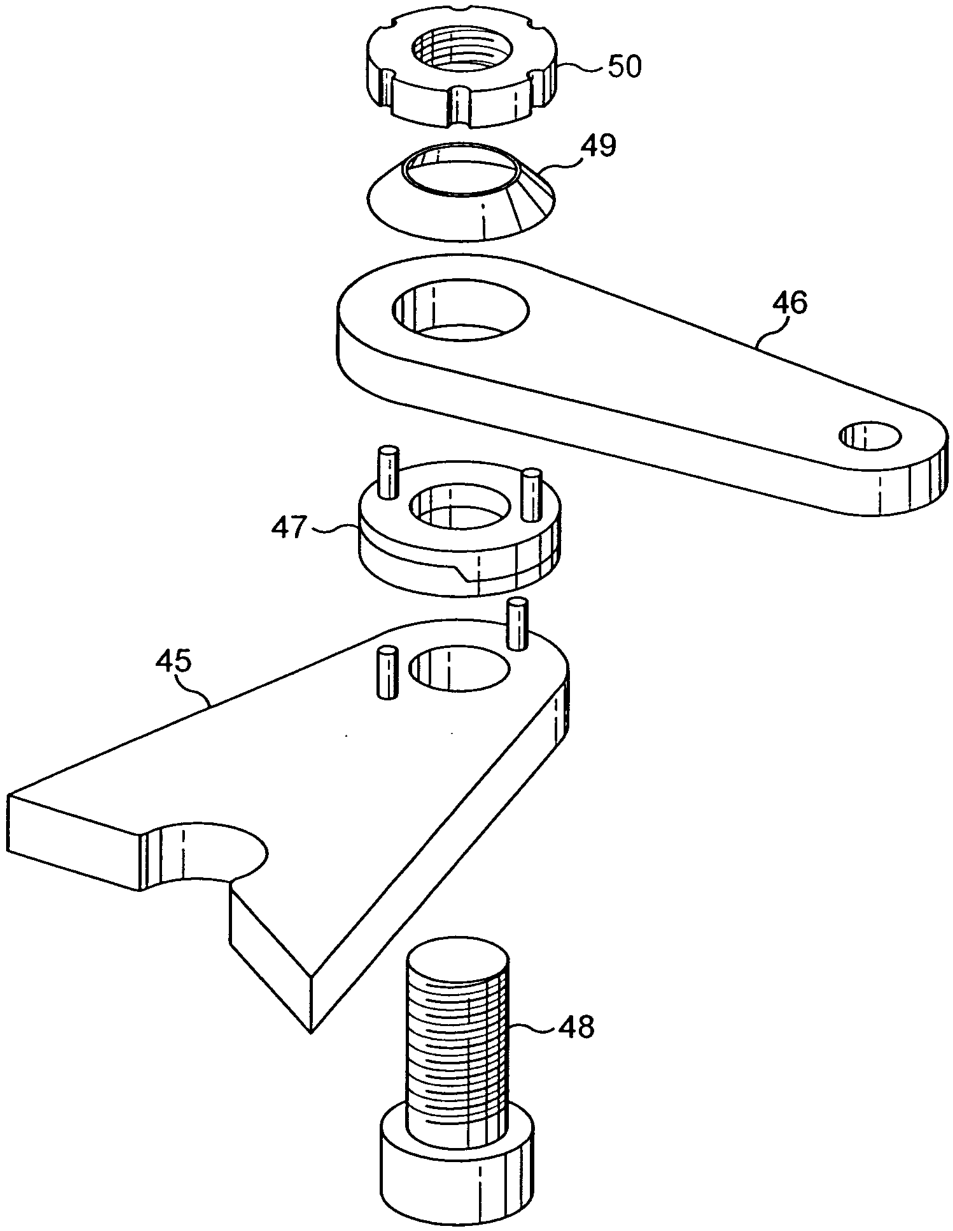

FIG. 6