Consumer and Corporate Affairs Canada
Consommation et Corporations Canada

(11) (A) No. 1 150 752

(45) ISSUED 830726

(52) CLASS 305-34

(51) INT. CL.^{3} B62D 55/00

(19) (CA) CANADIAN PATENT (12)

(54) SLIDE SUSPENSION

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(73) Granted to Bombardier Inc.
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(21) APPLICATION No. 381,046

(22) FILED 810703

No. OF CLAIMS 14

Canada

DISTRIBUTED BY THE PATENT OFFICE, OTTAWA.
CCA-274 (11-82)

ABSTRACT

A snowmobile suspension system includes a suspension arm structure supporting the rear of the vehicle on the track belt that employs shock absorber assemblies mounted in upright positions laterally on each side of the track belt. The suspension system can accommodate very large vertical deflections and thus enhances the handling characteristics of the vehicle. The shock absorber assemblies are mounted within cowlings on the walls of the track tunnel, have their upper ends pivoted to the vehicle body, and have their lower ends pivoted on pins, which are attached to suspension arm means within the width of the track tunnel.

This invention relates to a new or improved snowmobile suspension system, and particularly to a suspension system for the driving track of a snowmobile, which system can accommodate relatively large vertical deflections of the driving track, and thus provides enhanced ride characteristics for the snowmobile, especially when travelling over rough terrain.

The invention provides a snowmobile comprising: a body having a forward end supported upon steerable ski means and a rear end supported on a driven endless track, a suspension system interposed between said rear end and a ground-engaging run of said track and comprising obliquely arranged arm means having an upper end pivotally attached to said snowmobile body on a transverse axis and a lower end that carries track-engaging support elements, spring means operative to urge said support elements continuously downwardly into engagement with said ground-engaging run to support the weight of said rear end thereon, said spring means being yieldable to permit deflection of the suspension system to accommodate to variations in load, a pair of damper units mounted in said suspension system to dampen such deflections, each said damper unit having a first pivotal attachment at one end to said rear end of the snowmobile and a second pivotal attachment at the other end to said suspension system at a fixed distance from said axis, said fixed distance being less than the length of said arm means, such that in operation, the range of movement of said second pivotal attachment and hence the travel of said damper unit is much less than the corresponding range of deflection of said track engaging support elements.

The damper units are preferably combined hydraulic damper/coil spring shock assemblies mounted in a generally upright orientation on the outboard sides of the track tunnel wall and pivotally attached to a cranked lever means rigid with the suspension arm means. This pivotal attachment is preferably on an axis which is relatively close to the pivotal axis of the suspension arm means of the rear end of the snowmobile so that relatively large deflections of the suspension system can be accommodated by much smaller extensions or retractions of the shock assemblies. With the improved suspension system as herein disclosed, it is in fact possible to accommodate track deflections of over 10 inches.

In the embodiment disclosed, the improved suspension system is applied in a so-called slide suspension wherein the track engaging elements comprise a pair of longitudinally extending laterally spaced slide rails which extend throughout and engage substantially the entire length of the ground-contacting run of the endless track. The arm means comprises front and rear assemblies which extend generally downwardly and rearwardly from pivotal mountings on the snowmobile body. The front assembly includes torsion springs or the like to urge the front part of the suspension downwardly into engagement with the track. The rear assembly (which includes the damper units) preferably also includes means to compensate for slack which would otherwise develop in the endless track upon upward deflection of the suspension. Thus the rear assembly includes a first arm which extends downwardly and rearwardly from the pivotal attachment on the snowmobile body and a second arm which is in a generally upright disposition and has its ends pivotally connected to the rear end of the first arm and the rear portions of the slide rails respectively. The second arm can therefore articulate with respect to the first arm. Furthermore the front and rear on assemblies may include idler wheels or skids adapted to engage against the upper run of the endless track.

An embodiment of the invention will hereafter be described, by way of example only, with reference to the accompanying drawings, wherein:

Figure 1 is a fragmentary side view of a snowmobile partly sectioned to show details of the novel suspension assembly;

Figure 2 is a sectional view taken generally on the line II-II in Figure 1;

Figure 3 is a top perspective view from the front and one side showing portions of the suspension assembly;

Figure 4 is a schematic side view illustrating the suspension action.

A snowmobile 1 having a forward portion supported upon steerable skis (not shown) has its rear portions 2 supported on an endless flexible track 3. The track 3 is driven in conventional manner from an engine and drive transmission (not shown) in the forward part of the snowmobile, and forms an endless loop positioned in a track tunnel 4 of inverted U-shape on the underside of the rear part of the snowmobile.

As best seen in Figure 2, the track 3 has an upper run 5 received between the lateral walls 6 of the tunnel and a lower ground-engaging run 7.

The lower run of the track is contacted by a track-engaging assembly generally indicated at 8. As best shown in

Figure 3, this assembly comprises a pair of longitudinally extending laterally spaced runners 9 with upwardly curved front ends 10. Each runner 9 has a metal rail 11 of I-shaped cross-section, the lower side of which carries a slider shoe 12 at least the under-side of which is of low friction material and is in sliding contact with the ground-engaging run of the track. The runners 9 are laterally inter-connected through three pairs of idler wheel assemblies, namely a forward assembly 13, an intermediate assembly 14, and a rear assembly 15.

The forward idler assembly includes a pair of brackets 16 riveted or otherwise secured to the rails 9 and supporting a transverse tube 17 which forms a bearing support for a pair of rotatable idler wheels 18 positioned on the outboard sides of the runners 9.

Similarly, the intermediate idler assembly comprises a pair of brackets 19 attached to the runners 9 supporting a transverse tube 20 upon which a pair of idler wheels 21 are supported rotatably on the inboard sides of the runners 9.

The rear idler assembly (as is best shown in Figure 3) comprises a pair of brackets 22 mounted at the rear ends of the respective runners 9 and supporting a transverse tube 23 upon which are rotatably mounted idler wheels 24. The connection between the brackets 22 and the tube 23 supporting the rear idler wheels includes a screw-adjustment mechanism 25 by means of which the longitudinal position of the rear idler wheels 24 can be adjusted to provide a desired tension in the endless track. The tube 23 passes through elongated slots 23a in the brackets 22 and is engaged on each end by an abutment 25a carried by an adjustment screw 25b that is in screw-threaded engagement with a tube section 22a of the bracket. As will be evident, rotation of the screw 25b in the clockwise direction will act through the abutment 25a to urge the tube 23 rearwardly in the slot 23a and thus increase the tension applied to the track through the idler wheel 24. Conversely, rotation of the screw 25b in the opposite direction will act to reduce the track tension. A lock nut 25c carried on the screw 25b can be tightened against the tube section 22a to lock the abutment 25a in a selected position of adjustment. As shown in Figure 1, the idler wheels 18, 21 and 24 project slightly below the undersides of the slider shoes 12 and are in rolling contact with the ground-engaging run of the track to relieve some of the frictional load generated by sliding contact of the track with the slider shoes 12.

The track-engaging assembly 8 formed by the runners 9 and the various idler assemblies 13, 14 and 15 is supported beneath the rear part 2 of the snowmobile and pressed downwardly into engagement with the ground-engaging run of the track by a suspension system formed by a forward suspension arm assembly 26 and a rear suspension arm assembly 27. This suspension system is designed to support the weight of the rear part 2 of the snowmobile (and of the operator carried thereon) upon the runners 9, and as will be explained is designed to accommodate deflections of the track-engaging assembly 8 in response to changes in the static or dynamic load. The static load arises from the weight of the snowmobile itself and of the operator supported thereon, whereas dynamic loads are generated by irregularities in the terrain over which the snowmobile travels.

With particular reference to Figures 1 and 3 it will be seen that the forward suspension arm assembly includes a rigid arm structure 28 fabricated by welding from a series of tubular elements comprising transverse horizontal upper and lower tubes 29 and 30 respectively, interconnected by a pair of laterally spaced tubes 31. The tube 29 is pivotally mounted on a transverse horizontal rod 32 attached in the side walls of the track tunnel. The tube 30 is pivotally attached to a rod 33 which in turn is mounted between a pair of brackets 34 suitably attached, as by riveting, to the runners 9.

Thus the arm structure 28 extends downwardly and rearwardly from its forward mounting and is urged to pivot downwardly (i.e. clockwise as seen in Figure 1) by the force of a pair of torsion springs 35. Each torsion spring is coiled about one end of the upper tube 29 and is formed with a cranked arm 36 which engages against a support plate 37 carried at the lower edge of the track tunnel wall 6. A second arm 48 of each torsion spring 35 engages an adjuster cam 39 carried on the respective tube 31. As is more fully described in our earlier Canadian patent Serial No. 986,974 the loading of the torsion springs 35 can be carried in a simple and convenient manner by rotation of the cams 39 using a suitable implement.

Also mounted on the arm structure 28 is a pair of laterally spaced upwardly bowed compensator rods 40 which, as seen in Figure 1, project upwardly above the level of the torsion spring 35 and help support the upper run of the track maintaining it out of contact with the torsion springs.

To prevent excessive downwards displacement of the front end of the track-engaging assembly 8 a stopper bracket 41 is provided. This comprises a metal strap 42 having an elongated opening in which is received the transverse tube 17. The upper end of the strap 42 is connected to an adjustable threaded rod 43 which in turn is attached to a lug 44 carried by the upper tube 29. It should be evident that this arrangement permits upward displacement of the tube 17 (and hence the front of the track-engaging assembly 8), while limiting its downward displacement to the position selected by adjustment of the length of the stopper bracket 41.

Details of the rear suspension arm assembly 27 are shown in Figures 1, 2 and 3. This comprises a first arm structure 45 formed as a welded fabrication and having an upper transverse horizontal tube 46 which is pivotally mounted on a transverse rod 47 carried in the lower edges of the lateral walls 6 of the track tunnel. Rod 47 can be secured selectively in the position shown in Figure 1 or in alternate longitudinally spaced positions indicated at 48. The arm structure 45 also includes a pair of laterally spaced downwardly and rearwardly inclined tubes 49 which are rigidly attached to the top tube 46, and support at their lower ends a horizontal rod 50. A pair of sheet metal brackets 51 are arranged in longitudinally extending positions, and have their forward ends welded to the top tube 46 and their rearward ends welded to respective ones of the side tubes 49. The brackets 51 form bearing supports for opposite ends of a transverse horizontal rod 52 upon which a pair of compensator idler wheels 53 are rotatably mounted. This arrangement is best shown in Figure 2. The idlers 53 support the upper run 5 of the track. Pivotally connected to the rod 50 carried in the lower ends of the side tubes 49 is a second arm structure 54 which extends in a generally upright direction and has its lower end mounted on a transverse horizontal rod 55 carried in the brackets 22.

A pair of cranked lever arms 56 are welded to the top tube 46 and extend downwardly and rearwardly therefrom at an angle to the side tubes 49. The lower end of each cranked lever arm 56 is braced with respect to the arm structure 45 by a strut 57.

Each cranked lever arm 56 is positioned adjacent the inboard side of the respective lateral wall 6 of the track tunnel 4, as is clear from Figure 2, and carries at its lower end a laterally outwardly projecting pin 58. Each pin 58 is pivotally connected to the lower end of an extensible link formed by a combined hydraulic damper/coil spring shock absorber assembly 59. Each assembly 59 is adjustable in respect of its spring and damping characteristics and is positioned in a generally upright orientation, extending upwards from the pin 58 through an aperture 60 in the foot rest flange 61. The major portion of the length of the assembly 59 is received within a cowling 62, and the upper end of each assembly 60 is pivoted on a pin 63 carried on the frame of the snowmobile.

The above described arrangement provides a simplified but rugged structure for interconnecting the shock absorber assemblies 59 to the rear suspension arm assembly 27. The first arm structure 45 is formed as a unitary fabrication which is integral with the cranked lever arms 56. Since the latter are located within the confines of the track tunnel they can be permanently secured to the arm structure 45 as by welding. This avoids the expense of a detachable coupling, such as a splined connection, between the lever arms 56 and the tube 46 which would be necessary were the lever arms mounted on the outboard sides of the tunnel walls 6. Furthermore, the lower ends of the shock absorber assemblies are located at a substantial height above ground level and are therefore not likely to suffer damage through accidental impact with rocks or other extraneous objects.

In operation, the rear end 2 of the snowmobile is supported on the lower run 7 of the track through the track engaging assembly 8, this being pressed downwardly at its forward end by the torsion springs 35 and its rearward end by the damper/coil spring assemblies 59. The spring characteristics of the suspension can be adjusted as explained above by rotation of the cams 39. It can also be adjusted by changing the position of connection of the rod 47 from the location shown in Figure 1 to the alternate locations indicated at 48. As will be evident, changing this position will have the effect of altering the geometry of the rear suspension arm assembly 27, and thus the effective spring characteristics.

Since the arm structure 54 is pivoted at its lower end with respect to the brackets 22 rather than to the tube axle 23, it will be appreciated that adjustment of the tube longitudinally by means of the adjustment mechanisms 25 will not affect the suspension geometry.

For a given static loading on the rear part of the snowmobile, the suspension will have an equilibrium position in which the applied weight will be balanced by the force in the torsion springs 35 and the assemblies 59. However it will be clear that the suspension is adapted to yield upwardly to accommodate to regularities in the terrain over which the snowmobile may travel. Upon upward deflection of the track-engaging assembly 8, the forward arm assembly 26 will pivot in the counterclockwise direction as seen in Figure 1. The track-engaging assembly 8 can thus move upwardly and slightly to the rear. The rear arm assembly 27 can also accommodate such movement. However its first arm structure 45 is somewhat shorter than the forward arm structure 28, and accordingly, in parallel upwards deflection of the track-engaging assembly 8 as illustrated schematically in Figure 4, the second arm structure 54 will articulate slightly with respect to the arm structure 45. Upwards deflection of the rear part of the track-engaging assembly 80 acts through the arms 54 and 55 and the cranked lever arm 56 to compress to damper/coil spring assembly 59, and as is evident from Figure 4, the geometry of the suspension is such that the deflection of the track-engaging assembly 8 is much larger than the compressive deflection of the assembly 59.

During such upwards deflection of the track-engaging assembly 8, the track itself is maintained in a tensioned condition since as the suspension is collapsed upwards, the compensator rods 40 and compensator idlers 53 are pressed upwardly against the upper run 5 of the track, and the rear idler assembly 15 is moved somewhat rearwardly. As is clear from Figure 2, the track tunnel 4 has ample clearance to accommodate such movement of the upper run 5 of the track. The suspension illustrated can accommodate an overall vertical displacement of the track-engaging assembly 8 of more than 11 inches.

As will be evident, deflection of the track-engaging assembly 8 need not be parallel as illustrated in Figure 4, but on the contrary, the suspension can accommodate differential deflection of the front or rear end of the track-engaging assembly in accordance with the dynamic operating conditions encountered.

To prevent damage to the suspension in the event of excessive deflection of the track-engaging assembly, each runner 9 has positioned thereon at longitudinally spaced positions rubber stoppers 64. Upon "bottoming out" of the suspension, as may occur in an overload situation, these stopper 64 will prevent the metal rails 11 being driven against other components of the suspension.

THE EMBODIMENTS OF THE INVENTION IN WHICH AN EXCLUSIVE PROPERTY OR PRIVILEGE IS CLAIMED ARE DEFINED AS FOLLOWS:

1. A snowmobile comprising: a body having a forward end supported upon steerable ski means and a rear end supported on a driven endless track, a suspension system interposed between said rear end and a ground-engaging run of said track and comprising obliquely arranged arm means having an upper end pivotally attached to said snowmobile body on a transverse axis and a lower end that carries track-engaging support elements, spring means operative to urge said support elements continuously downwardly into engagement with said ground-engaging run to support the weight of said rear end thereon, said spring means being yieldable to permit deflection of the suspension system to accommodate to variations in load, a pair of damper units mounted in said suspension system to dampen such deflections, each said damper unit having a first pivotal attachment at one end to said rear end of the snowmobile and a second pivotal attachment at the other end to said suspension system at a fixed distance from said axis, said fixed distance being less than the length of said arm means, such that in operation, the range of movement of said second pivotal attachment and hence the travel of said damper unit is much less than the corresponding range of deflection of said track engaging support elements.

2. A snowmobile according to claim 1 wherein said track is accommodated within an inverted channel-shaped tunnel formed in the rear part of the snowmobile body and having a pair of longitudinal side walls which are spaced laterally from the longitudinal edges of the track, said upper end of the arm means being pivoted with respect to a mounting supported by said side walls, and said damper units comprising combined

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hydraulic damper and spring shock assemblies each mounted outboard of the respective tunnel side wall.

3. A snowmobile according to claim 1 or claim 2 wherein said damper units are arranged in a generally upright orientation.

4. A snowmobile according to claim 2 wherein within the space between said tunnel side walls said arm means supports a pair of pins which project laterally outwardly beyond said side walls and are pivotally attached to respective ones of said shock assemblies.

5. A snowmobile according to claim 4 wherein each said pin is carried on a cranked lever which is rigidly attached to said arm means and lies within the width of said tunnel.

6. A snowmobile according to claim 2 wherein said arm means comprises longitudinally spaced forward and rearward arm assemblies each pivoted to the side walls of said tunnel and to said track-engaging support elements, said spring means comprising torsion springs associated with said forward arm assembly, and said shock assemblies being connected to said rearward arm assembly.

7. A snowmobile according to claim 6 including adjusting means selectively operable to vary the effective stiffness of said torsion springs and said shock assemblies.

8. A snowmobile according to claim 7 wherein said adjusting means comprises means for altering the location of the pivotal mounting of said rearward arm assembly longitudinally of said tunnel.

9. A snowmobile according to claim 7 or claim 8 wherein said adjusting means comprises a cam engaging a radial arm of said torsion spring said cam being rotatable to vary the angular position of said radial arm.

10. A snowmobile according to claim 6 wherein said suspension system includes compensator means to maintain tension in said track during upwards deflection of said support elements, said compensator means comprising compensator elements carried by said arm assemblies and adapted to move the upper run of said track upwardly upon upwards deflection of said support elements.

11. A snowmobile according to claim 10 wherein said arm assemblies extend downwardly and rearwardly between their pivotal mountings on the tunnel and their pivotal attachments to said support elements, one said arm assembly being of fixed length, and the other said arm assembly having first and second arm structures pivotally interconnected, the first arm structure being of a length less than said fixed length and being pivoted to said tunnel, and the second arm structure being pivoted to said support elements and adapted to articulate with respect to said first arm structure during vertical deflections of said support elements.

12. A snowmobile according to claim 6 wherein said rearward arm assembly comprises a unitary arm structure having a transverse upper member carried on a pivotal mounting in said tunnel, and pin means projecting laterally from each side of the unitary arm structure at a location spaced above said track-engaging support elements, said shock assemblies having lower ends pivoted to respective ones of said pin means at locations outboard of the longitudinal side walls of said tunnel.

13. A snowmobile according to claim 12 wherein said unitary arm structure is a welded fabrication said upper member being of tubular form and being pivoted on a transverse rod supported between the side walls of said tunnel, a pair of side tubes extending longitudinally from said upper member, each said pin means being carried on a cranked lever having an upper end attached to said upper member and a lower end braced with respect to a respective one of said side tubes.

14. A snowmobile according to claim 13 further comprising a pair of brackets supported by said side tubes and carrying bearing means that rotatably support a pair of compensator idler wheels for rotation about a transverse axis, said compensator idler wheels engaging the underside of the upper run of the track and being operative to displace the upper run upwardly upon upwards deflection of said track-engaging support elements.

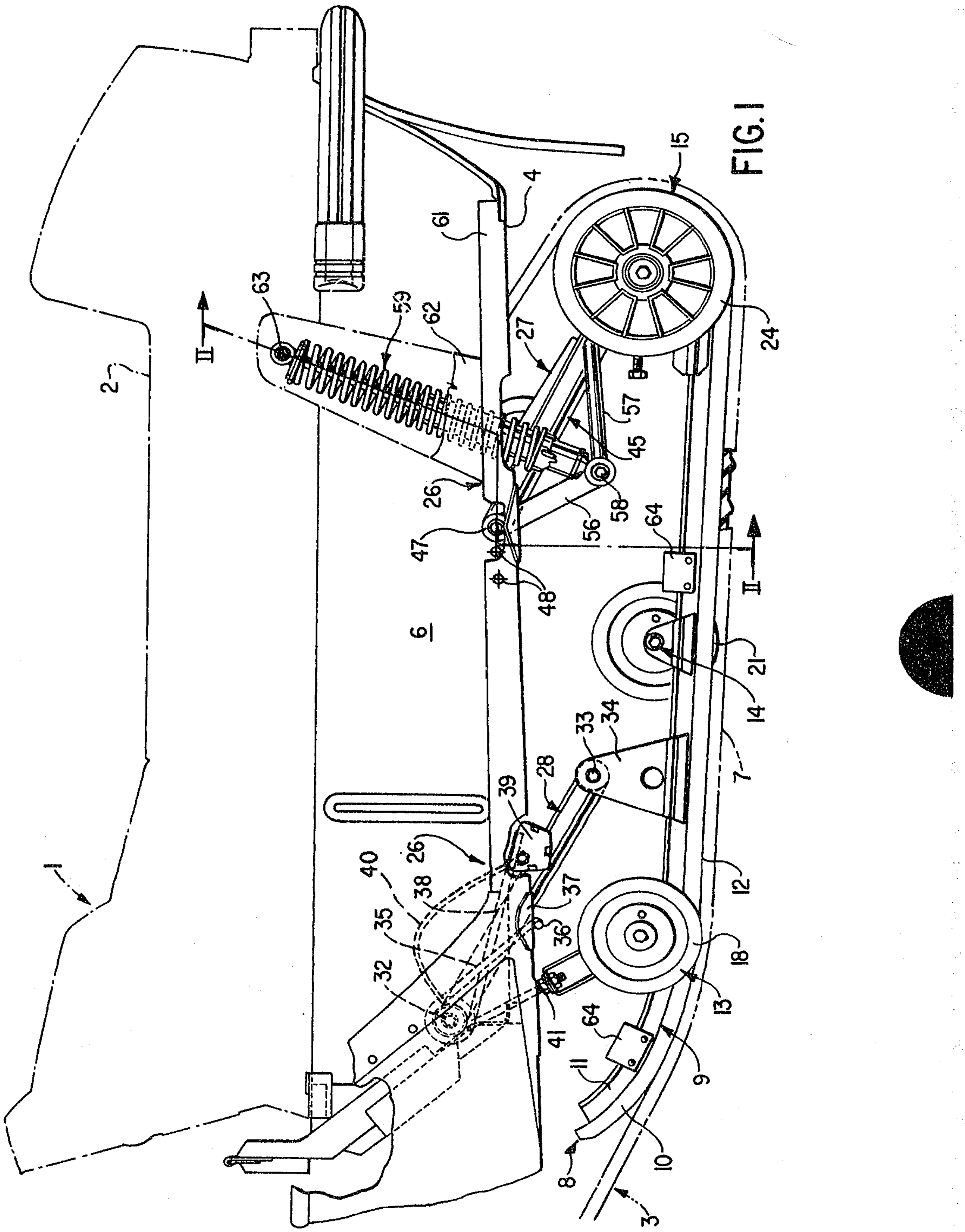

FIG. 1

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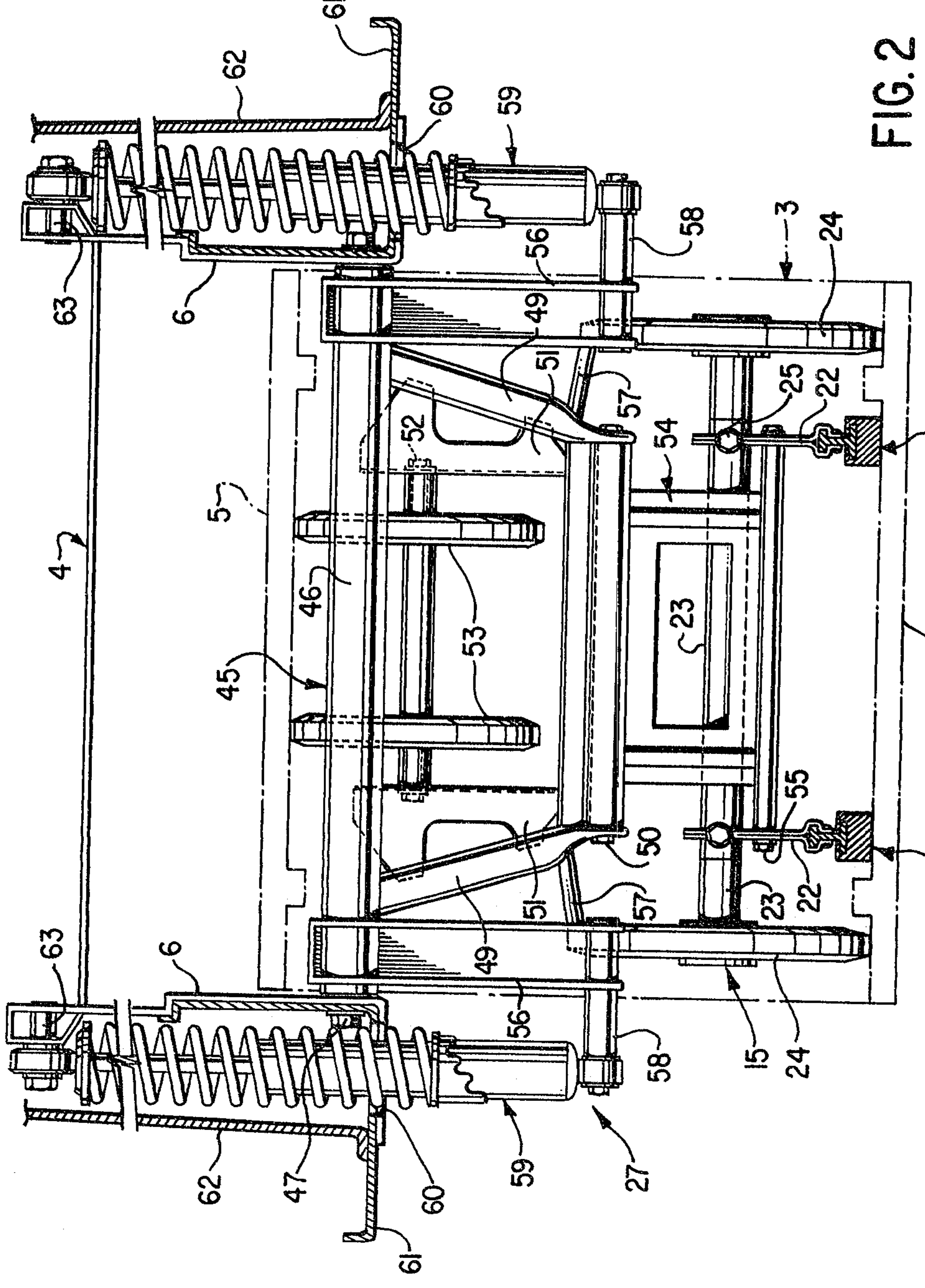

FIG. 2

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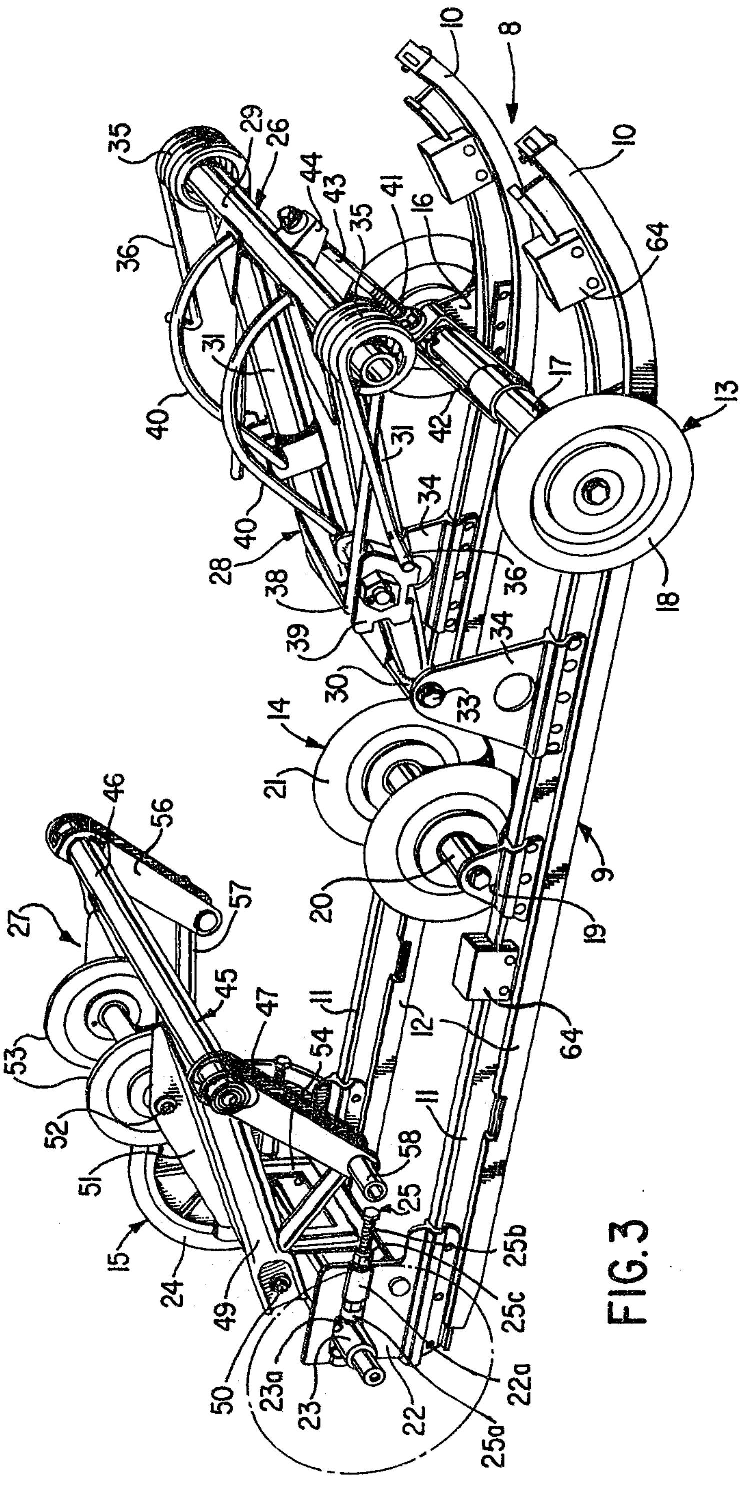

FIG.3

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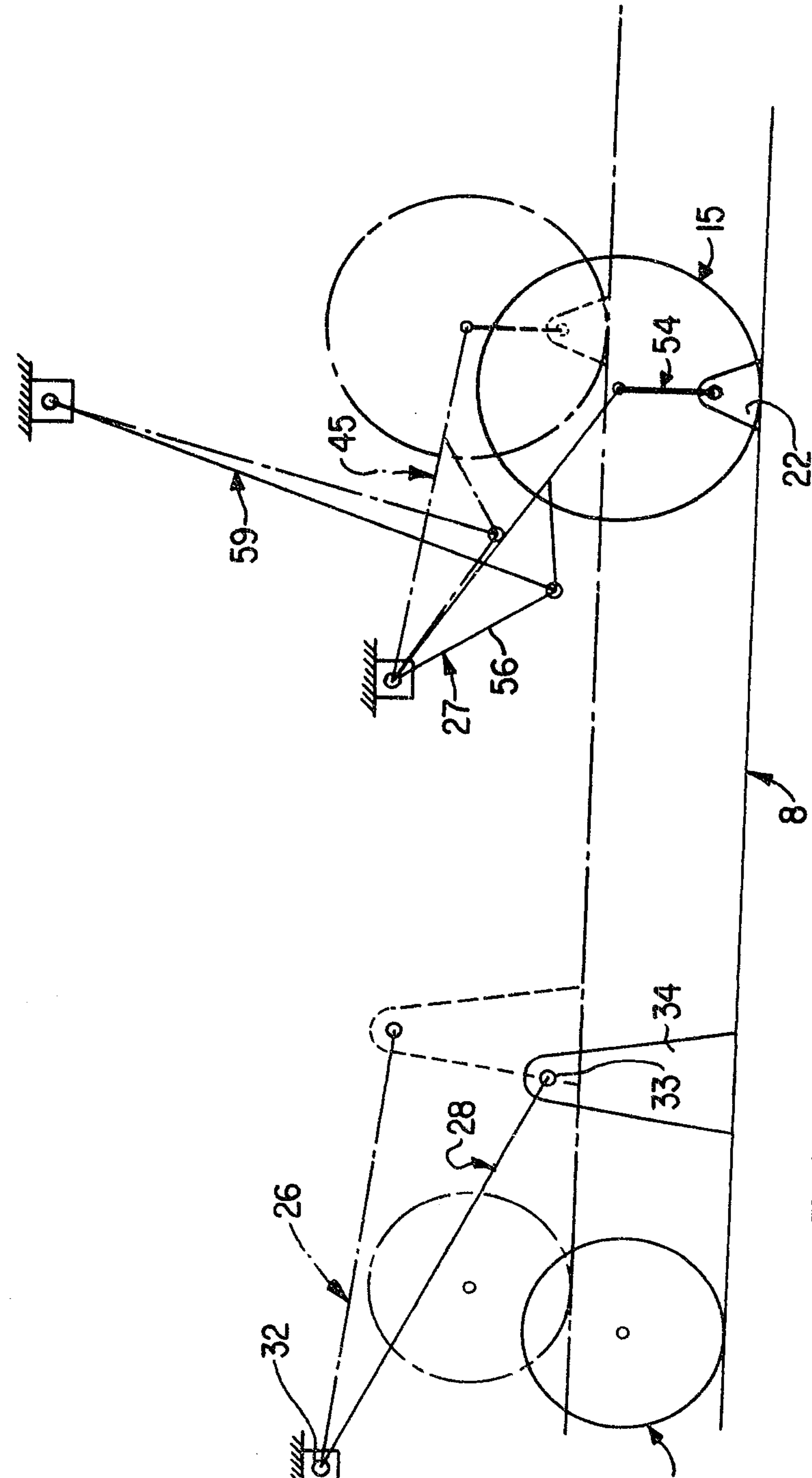

FIG. 4

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