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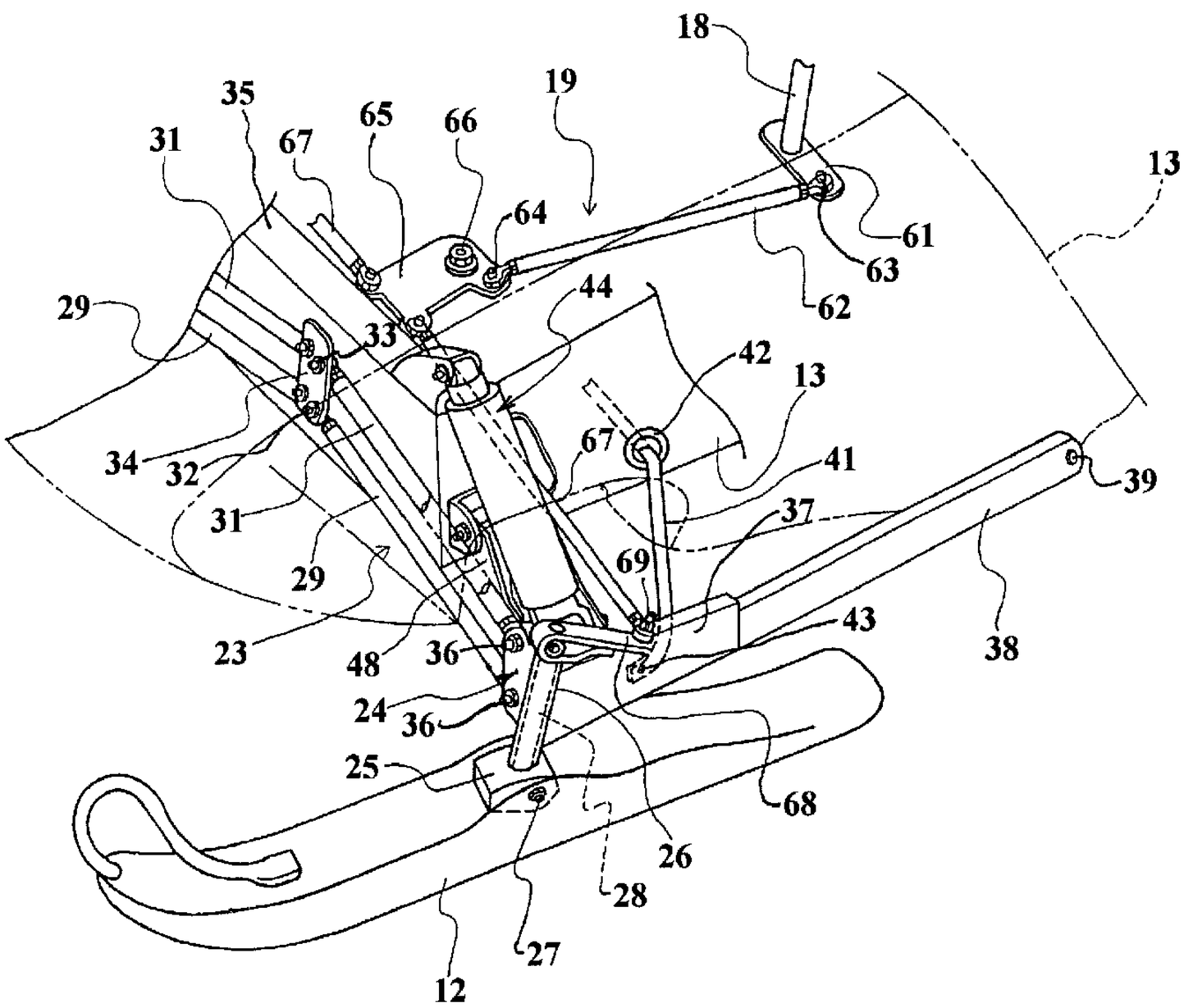

(57) Abrégé/Abstract:
A front ski suspension assembly for a snowmobile, wherein the suspension is partially enclosed within the periphery of the body but in an open side area of the body so as to be protected from the elements, insulated from the heat of the engine, and nevertheless in the air for cooling. The suspension includes a linkage system that loads the shock absorber elements so as to permit large ski travels with relatively short shock absorber lengths.

FRONT SUSPENSION FOR SNOWMOBILES

ABSTRACT OF THE DISCLOSURE

A front ski suspension assembly for a snowmobile, wherein the suspension is partially enclosed within the periphery of the body but in an open side area of the body so as to be protected from the elements, insulated from the heat of the engine, and nevertheless in the air for cooling. The suspension includes a linkage system that loads the shock absorber elements so as to permit large ski travels with relatively short shock absorber lengths.

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FRONT SUSPENSION FOR SNOWMOBILES

BACKGROUND OF THE INVENTION

This invention relates to an improved front suspension for the front, steering skis of a snowmobile.

It is the normal practice in snowmobile construction to employ independent front suspension systems for suspending each of the front skis for suspension movement relative to the frame of the snowmobile. In addition to providing a spring arrangement, the suspension also incorporates a hydraulic shock absorber for damping the shocks encountered as the snowmobile travels along the terrain. The type of front suspension most conventionally employed positions the shock absorber so that it extends in a generally vertical direction and so that its line of action is generally in line with the movement of the front ski which it suspends. Steering of the front ski is permitted by rotary motion of one of the shock absorber elements.

There are a number of disadvantages with this type of construction. First, because the shock absorber is positioned generally in line with the line of movement of the front ski, the shock absorber is projected outwardly of the body of the vehicle. Although it is possible to conceal the shock absorber within the body of the vehicle, this provides an unsightly appearance and also can adversely effect the wind resistance of the snowmobile. Furthermore, it is desirable to maintain relatively large suspension travels for the front skis so as to provide a smoother, more comfortable ride. This is further complicated by the aforenoted positioning of the shock absorber.

It has been proposed, therefore, to mount the shock absorber internally of the body and load the shock absorber means of a mechanism that includes a linkage for reducing the actual movement of the shock absorber in response to a given

motion of the front ski. That is, the linkage system provides a reduction in the travel of the shock absorber relative to that of the front ski. This permits a more compact shock absorber to be employed, and also permits, through the use of varying linkage systems, a nonlinear damping arrangement, which is desirable.

With these types of arrangements, and specifically those which have been proposed, however, the shock absorber is mounted in the interior of the body cowling and in proximity to the driving engine. As is well known with this type of vehicle, there is considerable loading on the shock absorber. As a result of the frequent compressions and expansions of the shock absorber, the fluid in the shock absorber tends to be heated. This heat, coupled with the heat that radiates from the engine, has the effect of changing the characteristic of the shock absorber. This is because the viscosity of the fluid for damping is dependent upon temperature, and hence the shock-absorbing capabilities may be diminished at a time when they are needed the most.

SUMMARY OF THE INVENTION

This invention provides an improved front ski suspension system for a snowmobile. Further, this invention provides a snowmobile front ski suspension system and associated body arrangement wherein the shock absorber will be exposed to the atmosphere, but nevertheless confined within the general area encompassed by the body so as to be protected from damage. Further this invention provides an improved front ski suspension system for a snowmobile wherein the shock absorber is loaded by a linkage system which permits greater travel of the ski than movement of the shock absorber, and wherein the shock absorber is oriented in such a way that it will not increase the overall size of the snowmobile, nor will it require placement of the shock absorber in proximity to the engine.

A first feature of this invention is adapted to be embodied in a snowmobile and a front ski suspension arrangement. The snowmobile has a frame assembly, and a front body cover encloses at least in part the frame assembly of the front end of the snowmobile. A pair of front skis are provided, which are suspended relative to the frame by a pair of front suspension systems. The front suspension systems include respective hydraulic shock absorber elements. The body is formed with a recessed portion at the rear of the extreme front end thereof and at the sides thereof in which the major portion of the hydraulic shock absorber elements extend so that the hydraulic shock absorber elements are exposed to the air for cooling, but are protected by the body without being enclosed within it.

Another feature of the invention is also adapted to be embodied in a snowmobile front ski suspension arrangement for a snowmobile that has a frame assembly. The suspension arrangement comprises a pair of parallel link members pivotally connected at one end to the frame and extending transversely outwardly for a pivotal connection at the other end thereof to the front ski support. A trailing arm is connected at its front end to the ski support and extends longitudinally to a rearward pivotal connection on the frame. A shock absorber element is provided, and it extends in a plane that is generally parallel to the plane containing the front links, but is disposed at an angle to the horizontal. One end of the shock absorber is pivotally connected to the frame, and the other end of the shock absorber is connected to the front ski suspension system through a linkage system for changing the degree of movement of the front ski suspension element relative to that of the shock absorber.

More particularly, in accordance with the present invention there is provided a snowmobile and front ski suspension arrangement comprising a snowmobile frame assembly, a front body cowling enclosing at last a forward portion of the frame assembly at a front of the snowmobile, a pair of front skis, a pair of front suspension systems for suspending the front skis for suspension movement relative to the frame at the front of the snowmobile, each of the front suspension systems including a respective ski support member supporting the respective ski for steering movement about a steering axis, a pair of upper and lower arms each pivotally connected at one end to the ski support member and at its other end to the frame assembly, a respective hydraulic shock absorber element and linkage means for loading the hydraulic shock absorber element upon relative movement of the respective ski support member relative to the frame assembly, the linkage means comprising a first link having a pivotal connection at any one end to the respective ski support member and a pivotal connection at the other end thereof to one end of a second link, the second link having a pivotal connection at the other end thereof to the frame assembly and a further pivotal connection between the linkage means and one end of the respective hydraulic shock absorber element, each side of the body cowling formed with a recessed portion to the rear of an extreme front end thereof into which at least a major portion of the respective shock absorber element extends, and means for pivotally connecting the other ends of each of the respective shock absorber elements to the frame assembly.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a perspective view taken from the front and one side of a snowmobile having a front ski suspension system constructed in accordance with an embodiment of the invention.

Figure 2 is an enlarged perspective view taken generally in the same direction as Figure 1, but looking from a somewhat higher location and with the snowmobile body and portions of the frame shown in phantom so as to more clearly illustrate the front suspension and steering system.

Figure 3 is a front perspective view of the same portion of the suspension system shown in Figure 2, but in this view the body is removed, as to more clearly show the construction.

Figure 4 is a top plan view looking downwardly on the front suspension system with portions broken away and shown in section.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT OF THE INVENTION

Referring now in detail to the drawings and initially to Figure 1, a snowmobile having a front suspension system constructed in accordance with the invention is identified by the reference numeral 11. Since the invention deals primarily with the front suspension system for the front skis 12, the general overall construction of the snowmobile 11 will be described only generally. However, it will be readily apparent to those skilled in the art how the invention may be utilized with a wide variety of types of snowmobiles.

The snowmobile 11 is comprised of a frame assembly, shown partially and identified generally by the reference numeral 13. A front body cowling 14 is mounted on the frame assembly 13 in a known manner in forward position to a rider's seat 15. A handlebar assembly 16 is provided at the front of the seat 15 and is protected by a windshield 17

which forms a portion of the front body cowling 14. The handlebar 16 is coupled to a steering shaft 18 for steering of the front skis 12 in a manner which will be described. The steering system is indicated generally by the reference numeral 19.

A drive belt assembly, indicated generally by the reference numeral 21 and including a ground-engaging drive belt 22, is disposed at the rear of the frame assembly 13 and beneath the seat 15. This drive belt assembly 21 is suspended relative to the frame 13 in any conventional manner.

An internal combustion engine (not shown) of any known type is provided in the snowmobile 11 for driving the drive belt 23 through a known type of transmission. Although it is not shown, this internal combustion engine is positioned forwardly of the seat 15 and behind the front engine body cowling 14. The engine is mounted in any suitable manner in the frame assembly 13.

Referring now in detail to the suspension system for the front skis 12, this suspension system is indicated generally by the reference numeral 23. The construction of the suspension system 23, which is basically the same at each side of the snowmobile 11, will now be described by primary reference to Figures 2-4, although portions of it also appear in Figure 1. The suspension system associated with the left front ski 12 will be described, and except for the steering connection, it is the same as that for the right front ski. Those skilled in the art will readily understand from the description of the construction at one side how the remaining side is constructed and arranged.

Each front ski 12 is connected to a ski support member, indicated generally by the reference numeral 24. This connection is provided in part by a block element 25 positioned at the lower end of a tubular member 26 of the ski support 24. The block element 25 is pivotally connected to the ski 12 by a pivot pin 27. This permits pivotal movement

of the ski 12 relative to the ski support 24 about the axis formed by the pivot pin 27. In this manner, the ski 12 may follow the terrain as the snowmobile 11 travels along uneven territory. If desired, some form of resilient cushioning mechanism and positive stop may be provided for controlling this pivotal movement.

The block 25 is affixed to the lower end of a ski steering post 28 that is journaled for steering movement in the tubular member 26 for steering of the front ski 12. This steering mechanism will be described in more detail later and, as has been noted, is indicated generally by the reference numeral 19.

A pair of suspension links comprised of a lower link 29 and an upper link 31 have pivotal connections 32 and 33, respectively, at their inner ends to a suspension support plate 34. The plate 34 is affixed suitably to a front cross member 35 of the frame assembly 13.

The outer ends of the suspension links 29 and 31 are pivotally connected to the ski support 24 by means of a further pair of pivot pins 36. The links 29 and 31, and their associated pivotal connections to the frame 13 and ski suspension element 24, forms a parallel linkage system so that upon suspension movement, the steering axis of the front skis 11 is maintained in the same angular relationship to the ground.

To provide fore and aft rigidity for the suspension system, each ski support 24 has a rearwardly extending portion 37 which functions as the forward portion of a leading arm assembly. This portion 37 is connected to a rigid arm 38, which, in turn, is pivotally connected by a pivot pin 39 to the frame 13. As a result of this connection, the suspension will permit large degrees of vertical movement of the ski 12 relative to the frame assembly 13 while at the same time maintaining the generally upright posture of the ski shaft 28 and the steering axis for the front skis.

Although the front skis 12 are supported for independent movement relative to each other, an anti-sway bar, indicated generally by the reference numeral 41, may be mounted in resilient grommets 42 in the frame assembly 13. The anti-sway bar 41 has a rigid connection, as by fasteners, 43 to the respective leading arms 38 at each side of the frame assembly. This arrangement will provide anti-roll characteristics for the suspension system, depending upon the diameter of the bar 41 and the resilience of the respective supports.

The front ski suspension systems 23 further include a cushioning and damping assembly for controlling the movement of the ski 12 relative to the frame 13 when obstacles are encountered. This arrangement includes a hydraulic shock absorber, indicated generally by the reference numeral 44, and which has an internal damping system of any desired type. The shock absorber 44 is surrounded by a coil compression spring (not shown) which is loaded in a well-known manner.

The shock absorber 44 is comprised of a cylinder assembly 45 in which a piston (not shown) reciprocates. A piston rod 46 is connected to this piston and extends through one end of the cylinder 45, this being the upper end in the embodiment illustrated. This end of the piston rod is connected by means of a pivot connection 46a to a shock absorber support bracket 35a that is either affixed to or formed rigidly with the front frame cross member 35.

The lower or cylinder end 45 of the shock absorber 44 is connected to the ski suspension system by means of a linkage system which will be described. This linkage system is constructed in such a way so as to provide for a greater degree of movement of the front ski 12 relative to the frame 13 than the actual degree of compression of the shock absorber 44 and the associated spring.

This linkage assembly is indicated generally by the reference numeral 47 and is comprised of a wishbone shaped lower A arm 48 that is pivotally supported to a bracket 49 fixed to the frame,

and specifically the cross member 35, as by welding. A pivot bolt 51 provides a pivot axis for this lower A arm 48. At its outer end, the A arm 48 carries a further pivot bolt 52, which, in turn, passes through a trunnion 53 formed on the shock absorber cylinder assembly 45 so as to provide a connection to it.

A further adjustable length link 54 has a hyme joint 55 at one end thereof, which provides a pivotal, spherical connection to the pivot bolt 52 and, accordingly, the outer end of the lower A arm 48. The outer end of the link 54 has a further hyme joint pivotal, spherical connection 56 to a pivot bolt 57, which provides a pivotal connection to a bracket 58 that is welded or otherwise affixed to the front of the leading arm 37.

As a result of this connection, it should be seen that upward movement of the ski 12 when it encounters a load or obstacle will cause the link 54 to experience a tension force from the pivot bolt 52. Since the link 54 is only loaded in tension, it can be relatively small and light in weight. This movement is translated into pivotal movement of the A arm 48 and compression of the shock absorber 44 and the spring associated with it. By means of this linkage system 47, it is possible, as has been noted, to provide a reduction in the degree of axial movement of the shock absorber 44 relative to the movement of the ski 12.

The positioning of the shock absorber 44 and its associated spring in a transverse direction generally parallel to the plane of the suspension arms 29 and 31 permits the shock absorber 44 to be mounted exteriorally of the body 14 and away from and insulated from the engine compartment by the body 14. As clearly seen in Figures 1, 2 and 3, the shock absorbers 44 extend upwardly and inwardly from their lower pivotal connection 56 to the linkage assembly 47 to their upper pivotal connection to the frame 35a. However, the body 14 is provided with a pair of recesses 59 on either side thereof, as best seen in Figure 1, which permits the major portion of the shock absorber 44 to be exposed to the air, but nevertheless protected from direct air

flow and foreign objects by the body 14. Thus, the shock absorber 44 may operate without

overheating and is protected from the transmission of any heat from the engine.

The steering arrangement for the front skis 12 will now be described primarily by reference to Figure 3. It will be seen that the lower end of the steering shaft 18 carries a steering arm 61 which is affixed for rotation with the steering shaft 18 in any known manner. A link 62 is pivotally connected by a connection 63 at one end to the steering arm 61. The opposite end of the link 62 is connected by means of a pivotal connection 64 to a bell crank 65 that is pivotally mounted on the frame 13 by means of a pivot bolt 66. A pair of drag links 67 have pivotal connections at one end to this bell crank 65. The opposite ends thereof are pivotally connected to steering arms 68 by means of pivot bolts 69. The steering arms 68 are affixed in a suitable manner to the upper end of the ski shaft 28. Accordingly, when the steering shaft 18 is rotated, the steering mechanism 19 will cause steering movement of the skis 12. The pivotal connection between the links 67 and the bell crank 65 and steering arms 68 is of a spherical type so as to accommodate suspension movement while at the same time permitting the steering operation.

Thus, from the foregoing description, it should be readily apparent that the described suspension system permits the use of shock absorbers that are protected from the elements but also disposed in such a way that air can readily reach them and cool them. In addition, they are separated from the engine by the body and hence will not become overheated. In addition, the linkage system which loads the suspension element permits large ski travels without having large shock absorbers that would interfere with the body or suspension movements.

Of course, the foregoing description is that of a preferred embodiment of the invention, and various changes and modifications may be made without departing from the

spirit and scope of the invention, as defined by the appended claims.

Claims

1. A snowmobile and front ski suspension arrangement comprising a snowmobile frame assembly, a front body cowling enclosing at last a forward portion of said frame assembly at a front of said snowmobile, a pair of front skis, a pair of front suspension systems for suspending said front skis for suspension movement relative to said frame at the front of said snowmobile, each of said front suspension systems including a respective ski support member supporting the respective ski for steering movement about a steering axis, a pair of upper and lower arms each pivotally connected at one end to said ski support member and at its other end to said frame assembly, a respective hydraulic shock absorber element and linkage means for loading said hydraulic shock absorber element upon relative movement of the respective ski support member relative to said frame assembly, said linkage means comprising a first link having a pivotal connection at any one end to the respective ski support member and a pivotal connection at the other end thereof to one end of a second link, said second link having a pivotal connection at the other end thereof to said frame assembly and a further pivotal connection between said linkage means and one end of the respective hydraulic shock absorber element, each side of said body cowling formed with a recessed portion to the rear of an extreme front end thereof into which at least a major portion of the respective said shock absorber element extends, and means for pivotally connecting the other ends of each of the respective said shock absorber elements to said frame assembly.

2. The snowmobile and front ski suspension arrangement of claim 1, wherein each recessed portion at each side of said body cowling extends in an upwardly direction and wherein the hydraulic shock absorber elements are disposed so that they extend in a generally upward direction.

3. The snowmobile and front ski suspension arrangement of claim 2, wherein the hydraulic shock absorber elements are inclined inwardly in a direction from their pivotal connection to said linkage means toward their pivotal connection to the frame assembly.

4. The snowmobile and front ski suspension arrangement of claim 1, wherein each linkage means includes at least one adjustable length link.

5. The snowmobile and front ski suspension arrangement of claim 1, wherein each of the suspension systems further includes a leading arm connected at its forward end to the respective ski support member and at its rearward end to said frame assembly.

6. The snowmobile and front ski suspension arrangement of claim 5, wherein each recessed portion at each side of said body cowling extends in an upwardly direction and wherein the hydraulic shock absorber elements are disposed so that they extend in a generally upward direction.

7. The snowmobile and front ski suspension arrangement of claim 6, wherein the hydraulic shock absorber elements are inclined inwardly in a direction from their connection to said linkage means toward their pivotal connection to the frame assembly.

8. The snowmobile and front ski suspension arrangement of claim 7, wherein each linkage means includes at least one adjustable length link.

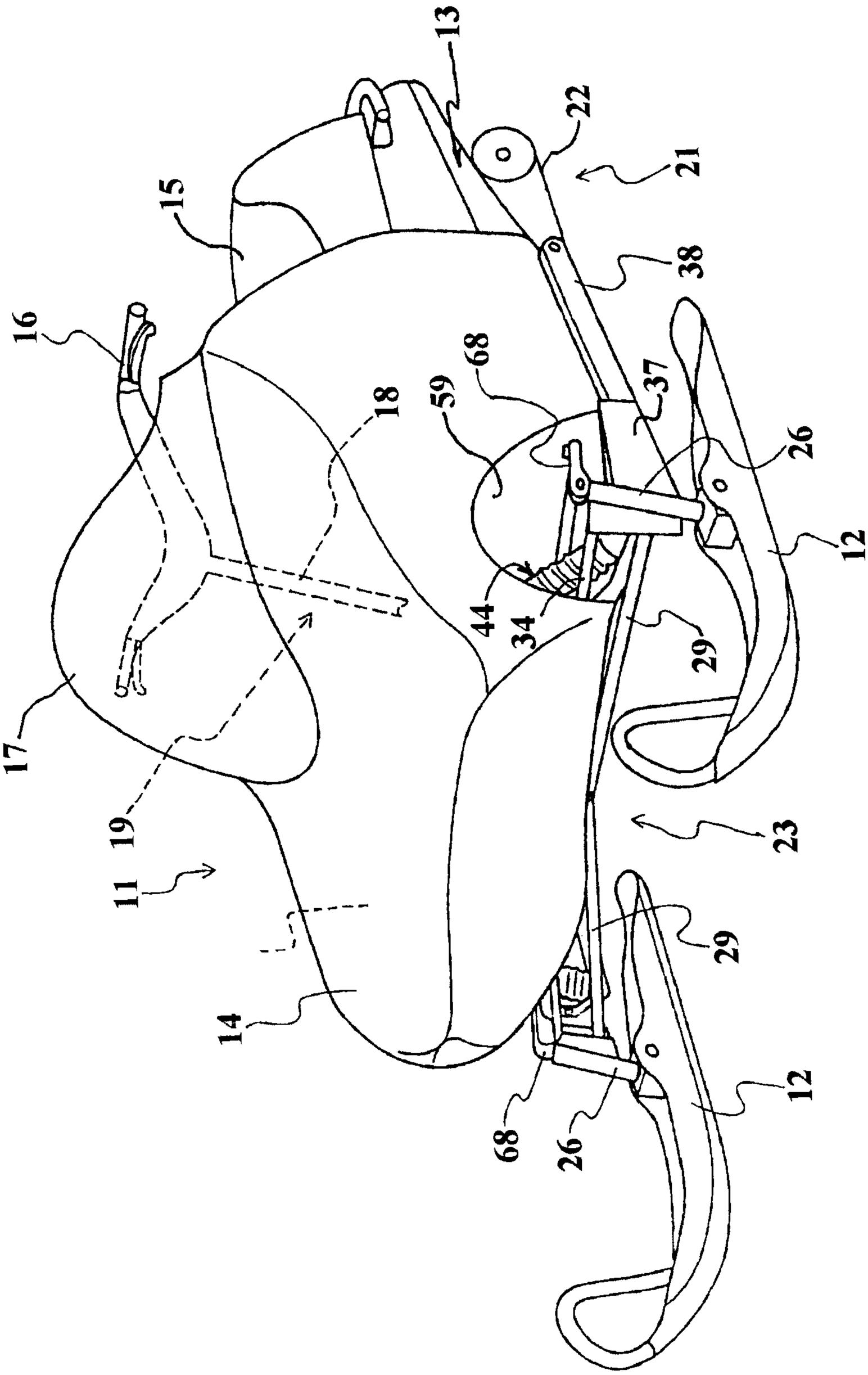

FIG. 1

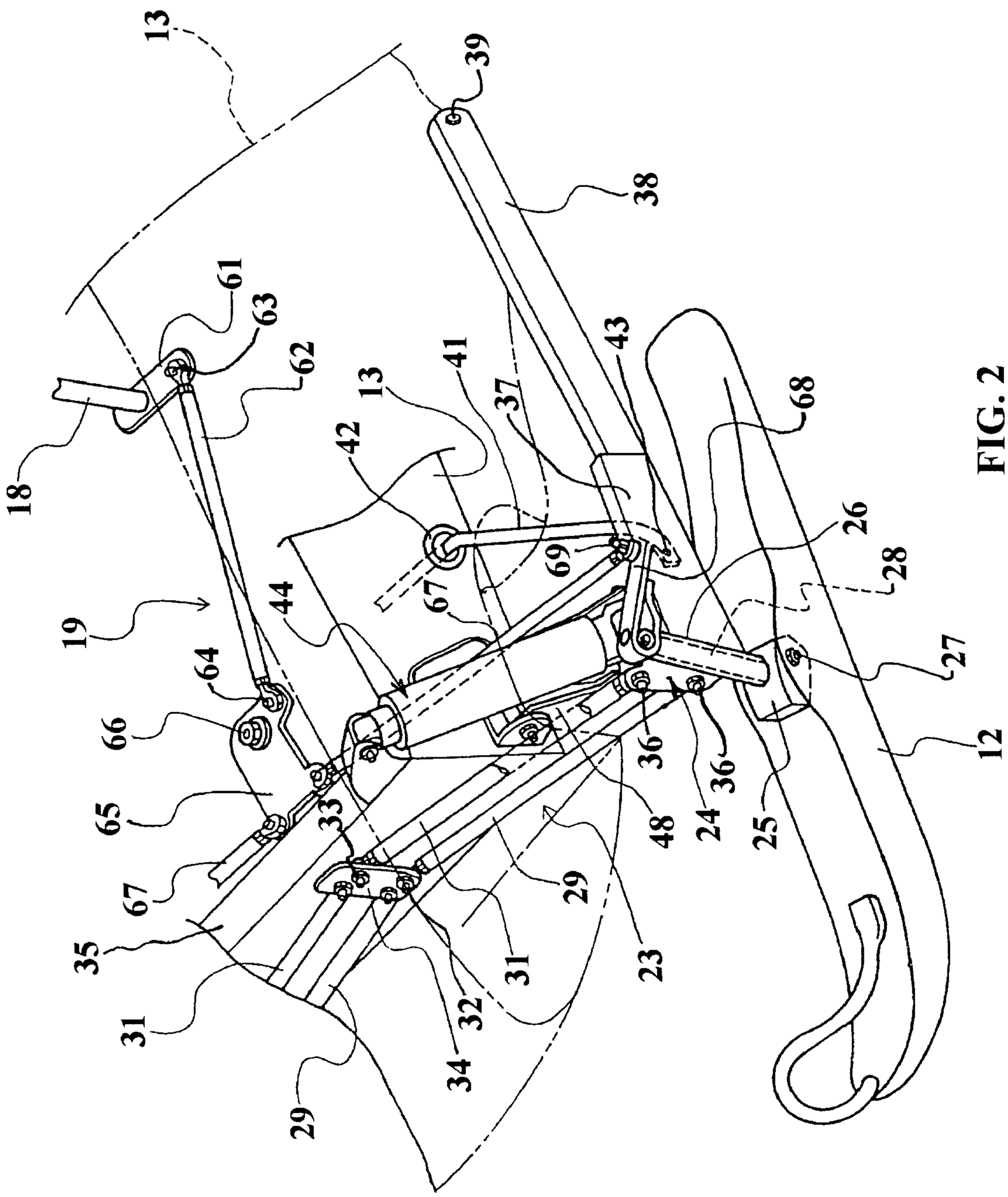

FIG. 2

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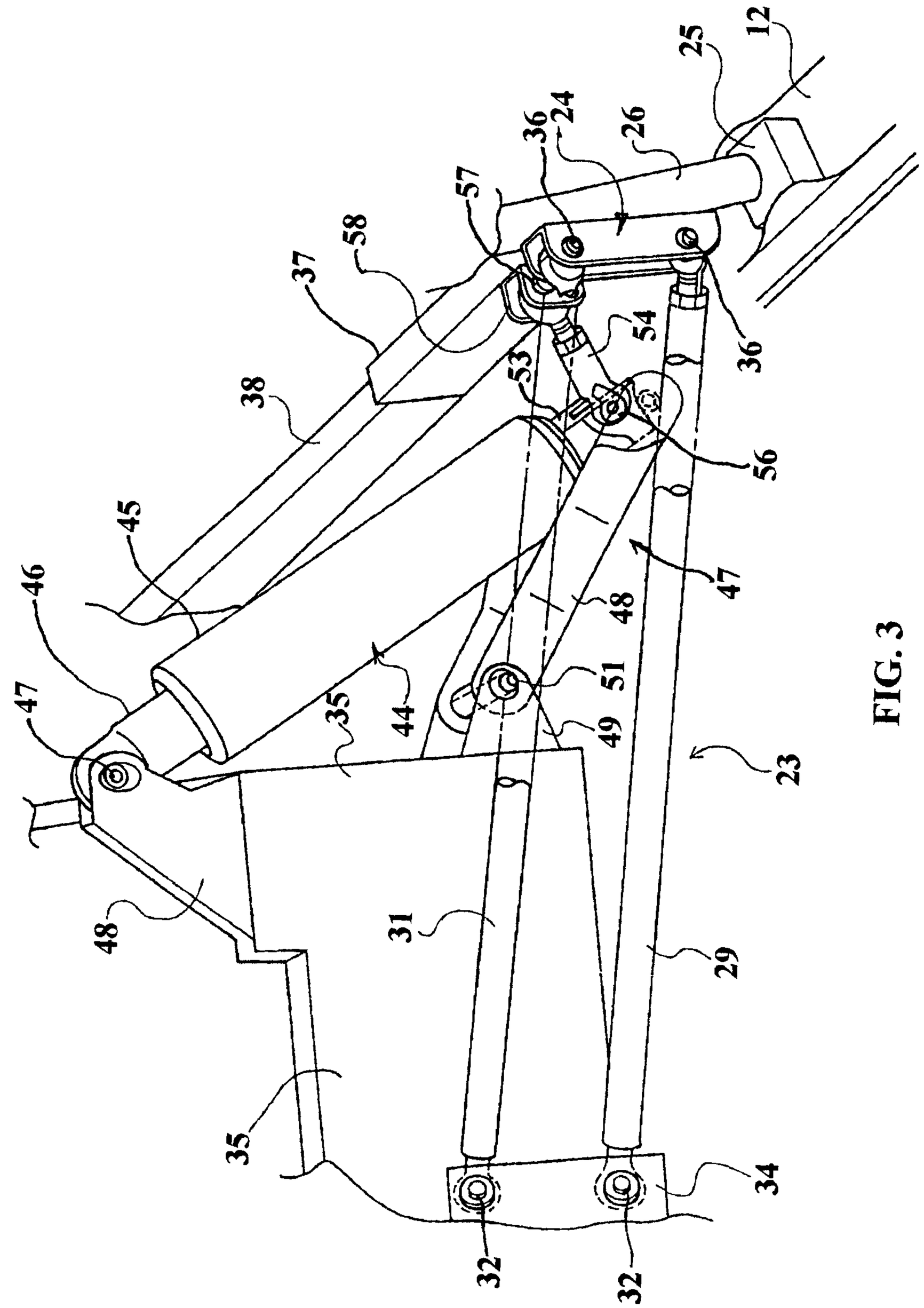

FIG. 3

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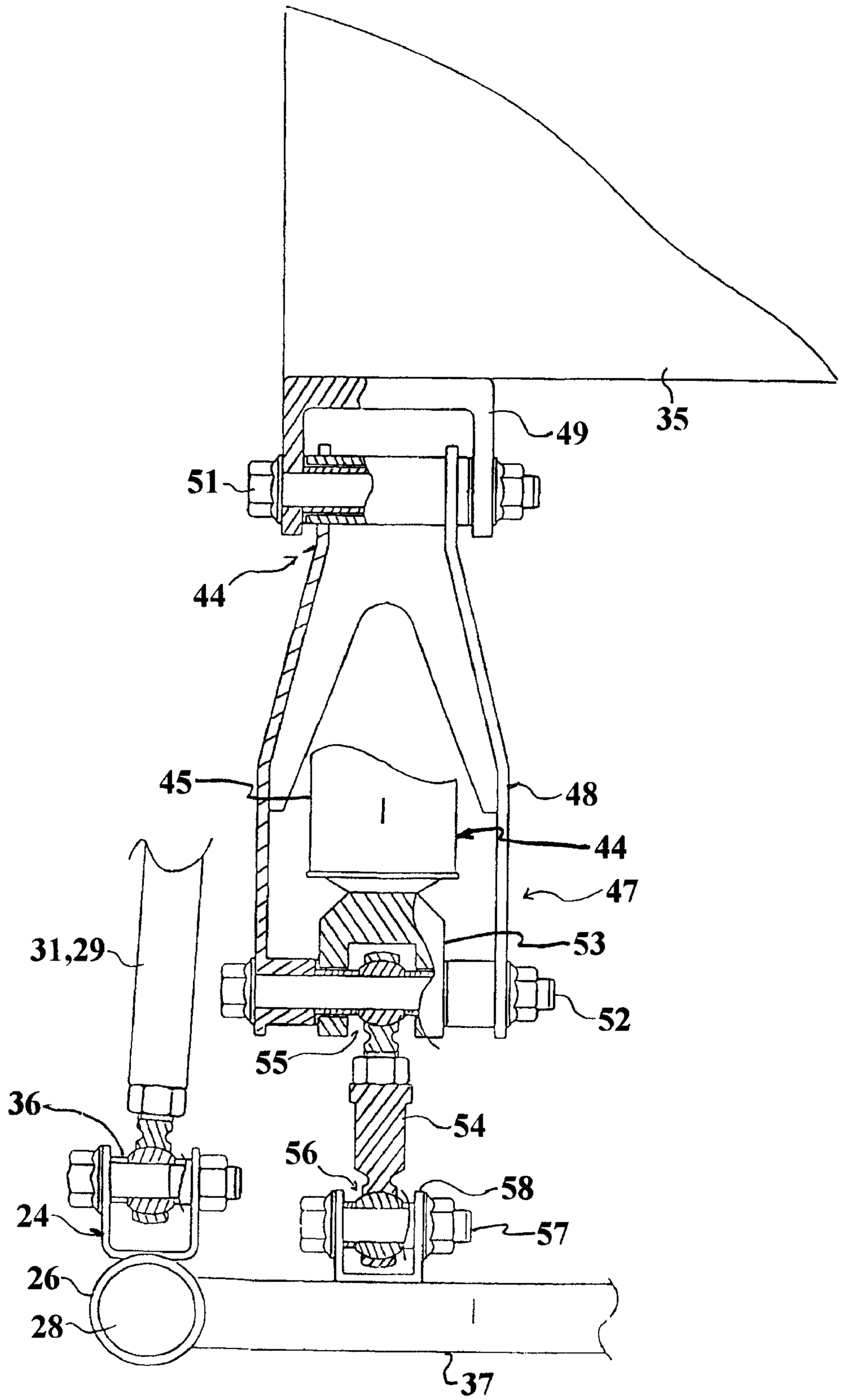
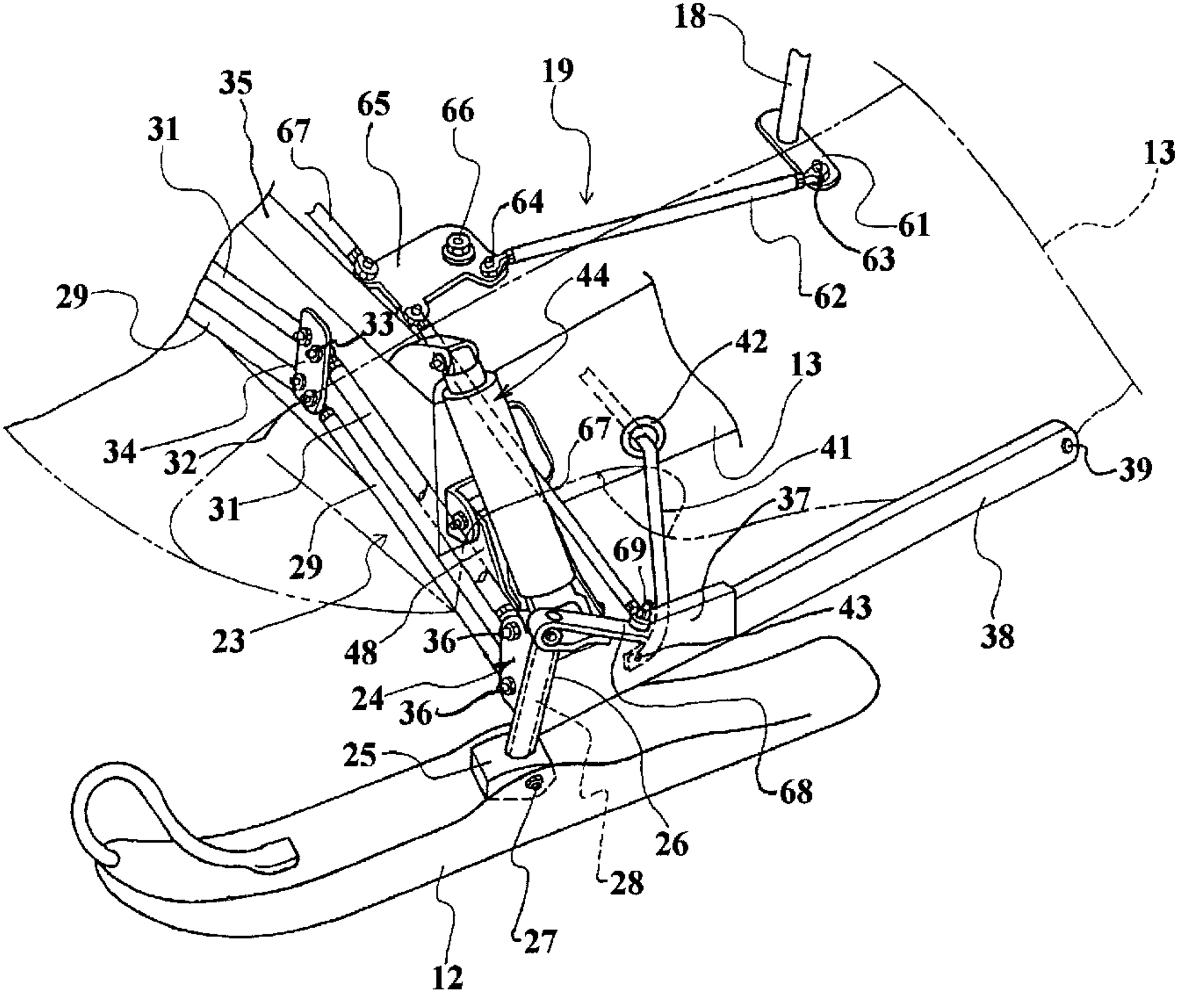


FIG. 4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