May 20, 1975 W. W. HIGGINBOTHAM Re. 28,423

SNOW VEHICLE FRONT SUSPENSION

Original Filed Oct. 31, 1969 2 Sheets-Sheet 1

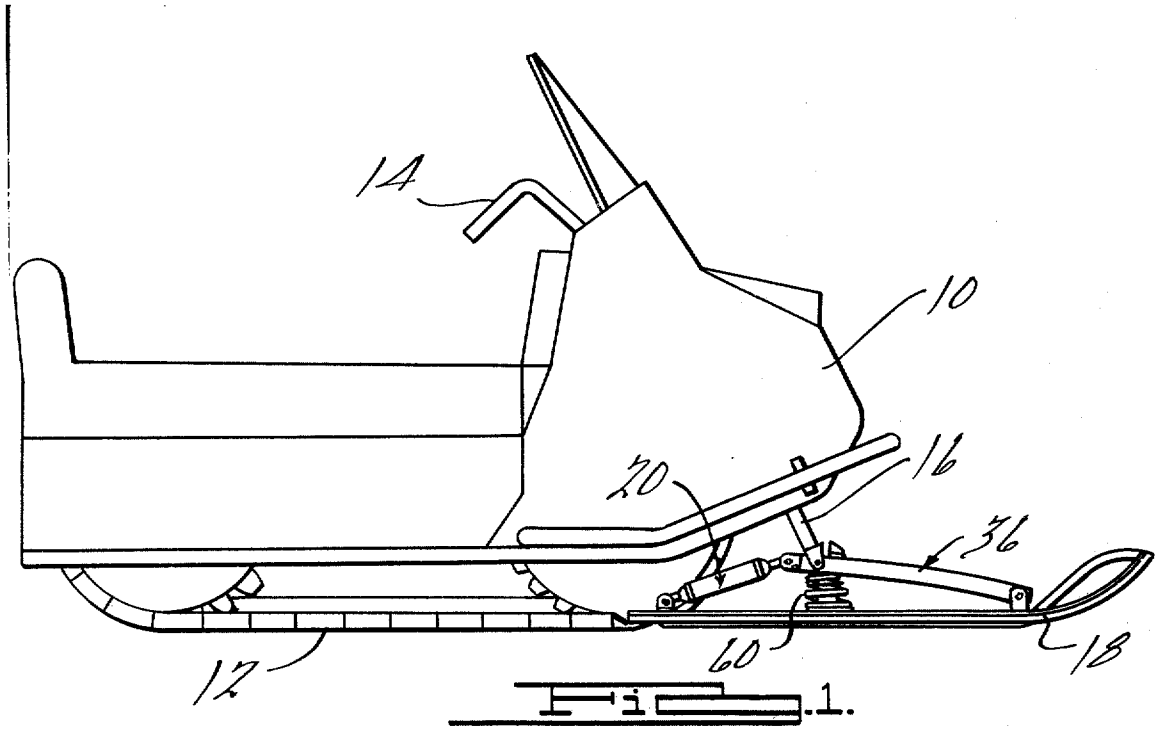


Fig. 1.

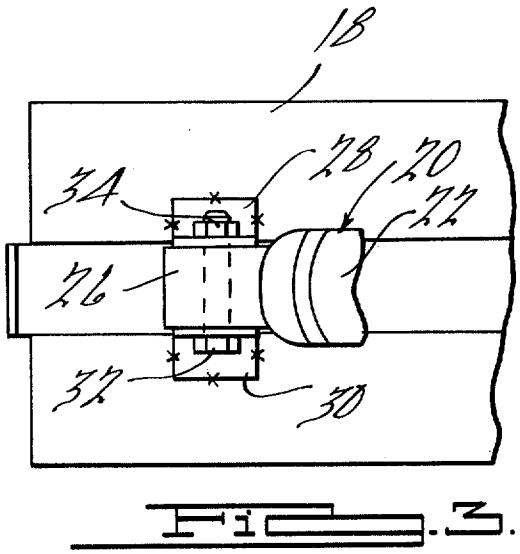


Fig. 3.

INVENTOR.
William W. Higginbotham
BY
Harness, Dickey & Pierce
ATTORNEYS.

May 20, 1975 W. W. HIGGINBOTHAM Re. 28,423

SNOW VEHICLE FRONT SUSPENSION

Original Filed Oct. 31, 1969 2 Sheets-Sheet 2

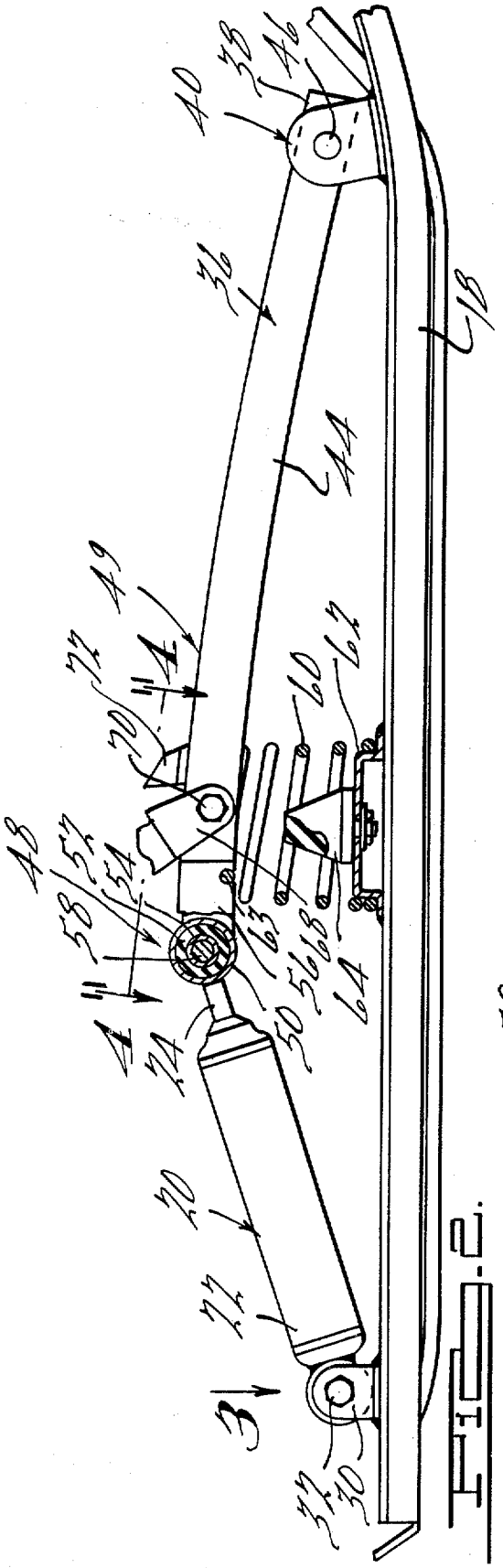


FIG. 2.

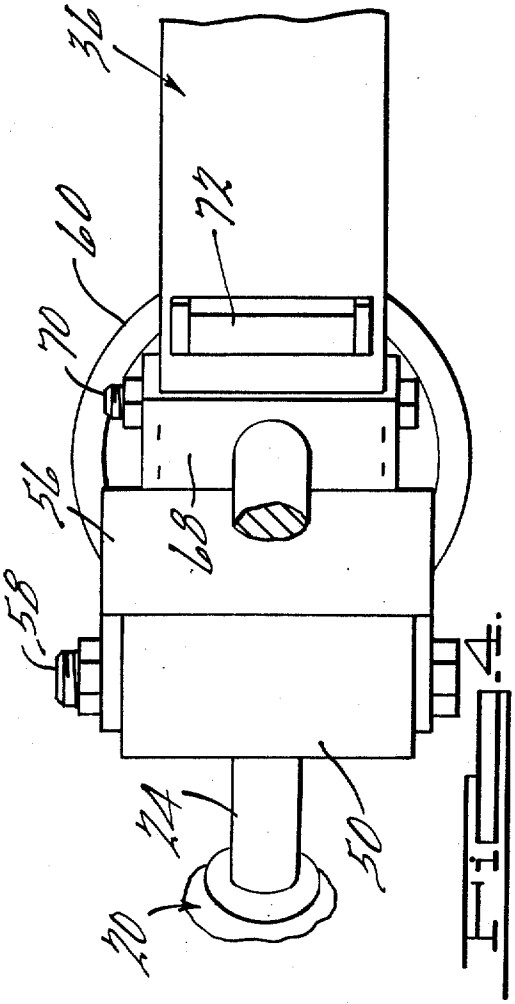


FIG. 3.

INVENTOR.
William W. Higginbotham
BY
Harness, Dickey & Pierce
ATTORNEYS

United States Patent

Re. 28,423
Reissued May 20, 1975

28,423

SNOW VEHICLE FRONT SUSPENSION

William W. Higginbotham, Monroe, Mich., assignor to Monroe Auto Equipment Company, Monroe, Mich.

Original No. 3,623,564, dated Nov. 30, 1971, Ser. No. 872,992, Oct. 31, 1969. Application for reissue Nov. 24, 1972, Ser. No. 309,607

Int. Cl. B62b *17/04;* **B62m** *27/02*

U.S. Cl. 180—5 R **9 Claims**

Matter enclosed in heavy brackets [ ] appears in the original patent but forms no part of this reissue specification; matter printed in italics indicates the additions made by reissue.

ABSTRACT OF THE DISCLOSURE

A ski-mounting assembly for snow vehicles and the like comprising a conventional shock absorber and a rigid arm member disposed longitudinally in line with each other above the ski, the shock absorber and the arm members being connected at the outer ends thereof to the ski by fixed pivots, and being interconnected at the inner ends thereof by a movable pivot, the shock absorber and the arm member extending angularly upwardly toward each other from the fixed pivots at a relatively flat angle with respect to the ski, the arm member being supported by a coil spring preferably disposed substantially at the center of the ski, and means being provided on the arm member preferably directly over the spring for attaching the assembly to the snow vehicle.

BACKGROUND OF THE INVENTION

In conventional practice, the front of a snow vehicle is provided with two parallel, laterally spaced, steerable skis; and road shocks are sustained and absorbed by longitudinal leaf springs mounted on and carried by the skis and attached to the steering shafts. Manifestly, the relative stiffness of the leaf springs and their rate of deflection directly affects and determines the ride characteristics of the vehicle; and the manner in which the springs rebound from shock loads affects not only the ride but also the [steering] *steerability* and control of the vehicle in use. These vehicles are designed and intended to travel cross-country over rough terrain at relatively high speeds; and it has been necessary therefor to use relatively stiff, high rate springs in order to prevent overstressing of the springs under shock loads and to absorb impact stresses encountered in use. Also, the rebound characteristics of essentially stiff leaf springs of the type required and heretofore used sometimes tend to flip the vehicle over under certain operating conditions. Another disadvantage of the conventional mounting is that the leaf springs tend, under certain conditions of use, to develop a harmonic vibration resulting in rhythmic, pulsating up and down movement of the skis which in turn causes the latter to beat against and into the snow. This phenomenon obviously produces a hard jolting ride and also substantially slows the speed of the vehicle. Finally, high frictional resistance to flexure *of* leaf springs also makes for a harder ride.

SUMMARY OF THE INVENTION

The mounting assembly of this invention provides a softer ride, a more controlled rebound, and better steering characteristics. A coil spring having a much lower rate than a comparable leaf spring can be used without danger of overstressing the spring or of the latter taking a permanent set when subjected to shock and heavy impact loads, and this together with the fact that friction present in the conventional leaf spring design is much reduced, results in a softer ride. Moreover, these advantages are obtained without adversely affecting steering of

the vehicle. In fact, the combination shock absorber—coil spring mounting of this invention tends to dampen both impact forces against the skis as well as the resultant rebound so that there is less tendency for an obstruction to throw the vehicle or for harmonic vibrations or motions to develop. As a result, better steering and a more controlled ride is achieved. Another factor bearing on the latter advantage is the fact that it is easier to balance the rate characteristics of the coil spring to the particular vehicle. Of significance also is the fact that the shock absober, when associated with a rigid arm member and in combination with a coil spring in the manner of this invention, provides a low-profile ski mounting that fits readily under the body of the vehicle.

DESCRIPTION OF THE DRAWINGS

FIG. 1 is a side elevational view of a snow vehicle of the type having skis under the front *end* of the vehicle body and showing a ski mounting embodying the invention associated therewith;

FIG. 2 is an enlarged, side elevational view, showing parts broken away and in section for clearness of illustration, of a ski and ski mounting embodying the present invention;

FIG. 3 is an enlarged, fragmentary, top plan view looking in the direction of the arrow **3** in FIG. 2; and

FIG. 4 is an enlarged, fragmentary, plan view taken on the line **4—4** of FIG. 2.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Attention is first directed to FIG. 1 which shows a snow vehicle of a generally conventional type having a body **10** mounted over a power driven endless-belt-type of traction drive **12** and the usual steering mechanism which includes handle bars **14** at the front of the body **10** connected by suitable links to steering shafts **16** which extend downwardly from the body and are connected to the usual front runners or skis **18**. Although only one steering shaft **16** and one ski **18** is shown in the drawing, it will be understood that the vehicle normally is provided with two skis which are disposed side-by-side in laterally spaced relation under the front end of the body **10** and that each ski is connected to a respective one of two mutually operable, laterally spaced, parallel steering shafts **16**. A detailed description of only one ski and its mounting will be given, but it will be understood that both skis are identically mounted and that both are associated in the same manner with the steering shafts **16** and with the body **10**.

More particularly, the ski mounting of this invention comprises a shock absorber [**10**] *20* of the type having a cylindrical body **22** and a piston (not shown) mounted for reciprocation in the body and having a piston rod **24** extending from one end of the cylinder. Any suitable or conventional shock absorber of the type shown that is suitably valved for the purpose at hand can be used; and the one disclosed in the Whisler U.S. Pat. No. Re. 23,421 is a typical example of such a one. In order to adapt the shock absorber **20** for mounting on the ski **18**, the rearward or outer end of the cylinder **22** is provided with fixed bushing **26** which extends longitudinally beyond the cylinder and fits snugly between laterally spaced mounting brackets **28** and **30** surmounting and welded or otherwise permanently and securely affixed to the ski **18** adjacent the rearward end of the latter. A bolt **32** retained by a nut **34** extends between the mounting brackets **28** and **30** and through the bushing **26** to provide a pivot on which the bushing is free to turn, and about which the shock absorber **20** is freely oscillatable.

A rigid arm member **36** is similarly pivotally mounted on the ski **18** at the forward end **38** thereof between the laterally spaced ears of a U-shaped bracket **40** which is

welded or otherwise affixed securely to the ski. Any form of arm **36** that is adequately strong and rigid is suitable for the purpose of this invention. The one here shown is formed of rectangular metal tubing which provides an essentially strong, rigid, but lightweight arm structure. When an arm of this type is used, the mounting bracket **40** conveniently may be of generally U-shaped and mounted with the bight portion thereof on and welded to the ski. As suggested, the arm **36** is disposed between the upstanding ears of the bracket **40**, and a suitable pivot **46** extending between the ears of the bracket **40** and the sides **44** of the arm **36** journal the forward end of the arm for turning or oscillatory movement about the pivot.

The inner or proximate ends of the shock absorber **20** and of the arm **36** are pivotally interconnected as at **48** to form a load supporting means **49** through which the steering shaft **16** is connected to the ski **18**. Both the shock absorber **20** and the arm **36** extend angularly upwardly from their respective pivots **32** and **46** toward each other at a relatively flat angle with respect to the ski **18**, and the pivot mounting **48** is free to move vertically relative to the ski as the shock absorber **20** expands and contracts. Thus, the two end pivots **32** and **46** are fixed or stationary at least insofar as the ski **18** is concerned and the intermediate pivot **48** which interconnects the shock absorber and the arm is free to move under shock and impact loads occurring in use. To this end, the pivot connection **48** preferably is rubber bushed to cushion the shock and impact forces. More particularly, the movable pivot **48** here shown comprises a ring-shaped outer casing **50** which is welded [for] *or* otherwise permanently attached at one side thereof to the end of the piston rod **24**. A rubber sleeve or bushing **52** is provided inside the casing **50**, and a tubular metal liner **54** is provided in the bushing. All of these members are confined between the ears of a U-shaped bracket **56** on and welded to the adjacent end of the arm **36**, and a pivot pin **58** extending between the ears and through the sleeve **54** completes the assembly.

Interposed between the load-supporting means **49** and the ski **18** intermediate the fixed pivots **32** and **46** is a coil spring **60** [on] the lower end of which is wrapped snugly around a suitable spring and bumper support **62** on and welded to the ski **18** and the upper end of which extends through transverse slots **63** in the bottom edges of the bracket **56**. The slots **63** effectively confine and retain the upper end of the spring **60** and, since the spring is normally compressed, they collectively define a neat and inexpensive means for mounting and holding the spring. In use, the spring **60** supports the shock absorber **20** and the arm **36** at a suitable elevation above the ski **18** and it controls to some extent limits oscillatory movement of these members as well as vertical movement of the pivot **48**. Disposed on the support **62** substantially centrally thereof and surrounded by the spring **60** is a resilient bumper **64** which is adapted to be engaged by the arm **36** under extreme load conditions or when the spring bottoms whereby to prevent extreme jar under jumping or other extremely severe conditions of use.

The means of attachment between the steering shaft **16** and the load supporting means **49** is here shown in the form of a U-shaped bracket **68** the bight portion of which is welded to the end of the steering shaft **16** and the arm portions of which embrace the arm **36** adjacent to the bracket **56**. A pivot **70** carried by and extending between the ears of the bracket **68** and through suitably aligned openings in [he] *the* sides of the arm **36** interconnect the bracket and the arm. A stop **72** on and welded to the arm **36** in front of the bracket **68** engages the bracket to limit oscillatory movement of the ski in one direction about the pivot **70** and the bracket **56** engages the steering shafts **16** to limit oscillatory movement of the ski in the opposite direction. It is of course necessary that the ski assembly have some rocking or oscillatory movement about the pivot **70** in order to accommodate the ski to the terrain over which the vehicle moves and it is equally necessary that the pivot connection be essentially rugged and sturdy as the ski **18** must turn with the shaft **16** in order to steer the vehicle. In this connection, *however,* it will be understood that the particular mode of attachment between the steering shaft **16** and the ski assembly is not critical to the invention and that any suitable or conventional mode of attachment can be used for this purpose.

In practice, the skis **18** move across the ground under front end of the body **10** and shock or impact loads on either ski due to the latter striking and passing over an obstruction or otherwise are absorbed by the joint action of the shock absorber **20** and the spring **60**. Under these circumstances, the shock load of course is transmitted upwardly from ski to the vehicle through the load-supporting means **49**. The initial impact causes both the shock absorber **20** and the arm **36** to flatten or to move about their respective pivots **32** and **46** in [he] *the* direction of the ski against the resilient action of the spring **60** and the damping effect of the shock absorber. If the impact is sufficiently great, the arm **36** may even bottom on the bumper **64**. It will be readily appreciated, however, that the spring **60** desirably is sufficiently stiff to absorb most loads of this type and that it will yield sufficiently to permit the arm **36** to contact the bumper **64** only under extreme conditions.

A primary advantage of the ski mounting of this invention is that the spring **60** acting in concert with the shock absorber **20** dampens the action of the suspension so as to prevent the occurrence of critical frequency [vibration] *vibrations* which cause the ski **18** to beat against and to embed in the snow. Also, the improved geometry of the suspension allows the vehicle to go over bumps due to a combination of pivot and lever arm arrangement which provides an equalizer effect. When the front of the ski **18** hits a bump the ski can pivot more or less freely about the pivot **70** until the stop **72** engages the bracket **68**. This prevents the ski **18** or any part of the suspension mounting from coming up and striking against the body of the vehicle, similarly, when the rear of the ski hits a bump the ski can rock on the pivot **70** until the bracket stop **56** engages the mounting bracket **68**. In both situations, engagement of the stops cause the suspension to flatten out against the action of the spring **60** and in both situations the flattening action is damped by the shock absorber **20** to prevent the undesirable beating effect referred to above. Also, as the ski **18** passes over a bump and the shock load moves progressively from the front to the rear of the ski, the lever arm arrangement provides a varying spring rate and particularly, when the rear end of the ski hits the bump, the lever arm gives a lower rate that inhibits the beating action whereby to assist in preventing the development of critical frequency vibrations, provides a softer ride than the conventional leaf spring mounting. An important contributing factor is the fact that a lower rate spring can be used without being overstressed. In general, a coil spring having a load resistance factor of approximately 75 pounds per square inch is satisfactory. It is desirable that the arm **36** be as long as possible to minimize the arcuate motion of its inner end as the arm rocks in use about the pivot **46**. Thus, the arm **36** inevitably is substantially longer than the shock absorber **20**. Conceivably, an even shorter shock absorber than the one shown could be used; and, in this event, it would be desirable to mount the shock farther down in the ski channel than is shown in the drawing. Also, it is desirable that the spring mounting **62** be disposed as close as possible to the center of the ski **18** for optimum distribution of weight and stresses occurring in use. The mounting for attaching the assembly to the steering shaft **16** should be directly over the coil spring **60** for maximum stability and ease of turning. The essentially flat angle normally assumed by the shock absorber **20** and the arm **36** provides a low profile or

silhouette which permits the assembly to fit easily under the front end of the vehicle body.

I claim:

[1. A ski mounting for snow vehicles and the like comprising
a load-supporting means
including
a shock absorber,
a rigid arm member,
a first fixed pivot mounting
connecting one end of said shock absorber to said ski member adjacent to end of the latter,
a second fixed pivot mounting
connecting one end of said rigid arm member to said ski member adjacent to the other end of the latter, and
movable pivot means
interconnecting the other end of said shock absorber and said rigid arm member;
coil spring means
interposed between said load supporting means and a seat on said ski member intermediate said first and second fixed pivot mountings and proximate to said movable pivot means; and
connecting means
associated with said load-supporting means for use in attaching said ski mounting to a snow vehicle.]

[2. The combination as set forth in claim 1 including means for a ski for supporting and retaining the lower end of said spring,
and wherein
the upper end of said spring is confined and retained in recess means in the underside of said load-supporting means.]

[3. The combination as set forth in claim 1 wherein the end of said spring means which seats on the ski member is disposed at substantially the center of said ski member.

[4. The combination as set forth in claim 1 wherein the end of said spring means which seats on the ski member is disposed at substantially the center of said ski member, and wherein said connecting means is mounted on said rigid arm member directly above said spring means, whereby to position said spring normally vertically on said ski.]

[5. The combination as set forth in claim 1 wherein said rigid arm member extends from said second fixed pivot at a relatively flat angle with respect to said ski member, and wherein said load-supporting means has an essentially low silhouette to minimize the vertical height of the ski-mounting assembly and to facilitate placement thereof under said snow vehicle.]

[6. The combination as set forth in claim 1 wherein said rigid arm member is relatively longer than said shock absorber.]

[7. The combination as set forth in claim 6 wherein the end of said spring means which seats on the ski member is disposed at substantially the center of said ski member and relatively closer to said first fixed pivot than to said second fixed pivot.]

[8. The combination as set forth in claim 1 wherein said spring means is disposed directly under said rigid arm member adjacent to said movable pivot means.]

[9. The combination as set forth in claim 8 including a resilient bumper
interposed between said ski member and said rigid arm member and engageable with the latter under extreme load conditions of said spring.]

[10. The combination as set forth in claim 9 wherein said resilient bumper is disposed inside said spring means and under the end of said rigid arm member adjacent to said movable pivot means.]

[11. A mounting for the ski of a snow vehicle comprising

a load-supporting means
including
a shock absorber,
and
a rigid arm member,
said shock absorber and said rigid arm member being pivotally connected to each other; and
a coil spring
positionable under said load supporting means at substantially the point of pivotal connection between said shock absorber and said rigid arm member, the outer ends of said shock absorber and said rigid arm member adapted for pivotal attachment to said ski with point of pivotal interconnection spaced above the ski so that said point of pivotal interconnection is free to move vertically relative to the ski as the shock absorber expands and contracts in use, and said spring adapted to be interpositioned in a normally vertical position between said load-supporting means and said ski to control vertical movement of said pivotal interconnection.]

[12. The combination as set forth in claim 11 including
connecting means
affixed to said rigid arm member substantially above the mounting location for said spring and adapted to attach said ski mounting to the body of said snow vehicle.]

13. A mounting assembly for operatively mounting a steerable ski on a downwardly directed steering shaft, spindle, or the like of a snow vehicle,
said assembly including an elongated arm disposed above and extending generally longitudinally of the ski,
a hydraulic, direct acting telescopic shock absorber including a cylinder member, a piston rod member reciprocable relative to said cylinder member, first attachment means on one of said members and second attachment means on the other of said members,
a first pivot mounting for connecting one end of said arm to the ski,
a second pivot mounting for connecting the opposite end of said arm to one of said attachment means of said shock absorber, the other of said attachment means of said shock absorber being connected to the ski, and
a helical coil spring having upper and lower end portions and adapted to resiliently resist relative pivotal movement between said arm and the ski,
said lower end of said spring terminating adjacent the ski and said upper end of said spring terminating adjacent said second pivot mounting.

14. A mounting assembly for operatively mounting a steerable ski member on a downwardly directed steering shaft, spindle, or the like of a snow vehicle,
said assembly including an elongated arm member disposed above and extending generally longitudinally of the ski member,
a hydraulic, direct acting telescopic shock absorber including a cylinder, a piston rod reciprocable relative to said cylinder, first attachment means on said cylinder and second attachment means on said piston rod,
connecting means for operatively connecting the steering shaft to said arm,
a first pivot mounting for connecting one end of said arm member to the ski member,
a second pivot mounting for connecting the opposite end of said arm member to one of said attachment means of said shock absorber, the other of said attachment means of said shock absorber being connected to the ski member,
movement limiting means interposed between the underside of said arm member and the upper side of the ski member and secured to one of said members for

limiting the relative pivotal movement of one of said members with respect to the other of said members, and

a helical coil spring extending between said arm member and said ski member and cooperable with said shock absorber in controlling movement of said ski member relative to the associated vehicle.

15. A mounting assembly for operatively mounting a steerable ski member on a downwardly directed steering shaft, spindle, or the like of a snow vehicle,

said assembly including an elongated arm member disposed above and extending generally longitudinally of the ski member,

a hydraulic, direct acting telescopic shock absorber including a cylinder, a piston rod reciprocable relative to said cylinder, first attachment means on said cylinder and second attachment means on said piston rod,

connecting means for operatively connecting the steering shaft to said arms,

a first pivot mounting for connecting one end of said arm member to the ski member,

a second pivot mounting for connecting the opposite end of said arm member to one of said attachment means of said shock absorber, the other of said attachment means of said shock absorber being connected to the ski member,

means generally vertically aligned with said connecting means and interposed between said members for preventing excessive relative pivotal movement therebetween, and

a helical coil spring extending between said arm member and said ski member and cooperable with said shock absorber in controlling movement of said ski member relative to the associated vehicle.

16. A mounting assembly for operatively mounting a steerable ski member on a downwardly directed steering shaft, spindle, or the like of a snow vehicle,

said assembly including an elongated arm disposed above and extending generally longitudinally of the ski member,

a hydraulic, direct acting telescopic shock absorber including a cylinder, a piston rod reciprocable relative to said cylinder, first attachment means on said cylinder and second attachment means on said piston rod,

a first pivot mounting for connecting one end of said arm to the ski member,

a second pivot mounting for connecting the opposite end of said arm to one of said attachment means of said shock absorber, the other of said attachment means of said shock absorber being connected to the ski member,

a helical coil spring adapted to resiliently resist relative pivotal movement between said arm and the ski member, and

an annular spring seat disposed generally concentrically of said spring and adapted to operatively support the lower end thereof, said spring seat being secured to the upper side of said ski member.

17. A mounting assembly for operatively mounting a ski on a snow vehicle,

said assembly including an elongated arm disposed above and extending generally longitudinally of the ski member,

one end of said arm being located a first vertical distance away from the ski and the opposite end of said arm being located at a second vertical distance away from the ski,

a hydraulic, direct acting telescopic shock absorber including a cylinder, a piston rod reciprocable relative to said cylinder, first attachment means on said cylinder and second attachment means on said piston rod,

a first pivot mounting for connecting one end of said arm to the ski,

a second pivot mounting for connecting one of said attachment means of said shock absorber to the ski, the other of said attachment means of said shock absorber being connected to said arm, and

a helical coil spring adapted to resiliently resist relative pivotal movement between said arm and the ski,

said coil spring being oriented longitudinally between the forwardmost of said pivot mountings and the end of said arm located at the greater of said vertical distances away from the ski.

18. A mounting assembly for operatively mounting a a ski on a snow vehicle,

said assembly including an elongated arm extending generally longitudinally of the ski member,

a hydraulic, direct acting telescopic shock absorber including a cylinder, a piston rod reciprocable relative to said cylinder, first attachment means on said cylinder and second attachment means on said piston rod,

one of said attachment means lying in a first generally horizontal plane and the other of said attachment means lying in a second generally horizontal plane spaced vertically from said first horizonal plane,

a first pivot mounting for connecting one end of said arm to the ski member,

a second pivot mounting for connecting the opposite end of said arm to one of said attachment means of said shock absorber, the other of said attachment means of said shock absorber being connected to the ski, and

a helical coil spring adapted to resiliently resist relative pivotal movement between said arm and the ski,

said coil spring being oriented so as to extend generally between the ski and said second pivot mounting and being disposed almost entirely between said first and second horizontal planes.

19. A mounting assembly for operatively mounting a steerable ski on a downwardly directed steering shaft, spindle, or the like of a snow vehicle,

said assembly including an elongated arm member disposed above the ski,

said arm including a forwardmost end and a rearwardmost end spaced longitudinally from said forwardmost end,

a hydraulic, direct acting telescopic shock absorber including a cylinder, a piston rod reciprocable relative to said cylinder, first attachment means on said cylinder and second attachment means on said piston rod,

a first pivot mounting for connecting one end of said arm to the ski member,

a second pivot mounting for connecting the opposite end of said arm to one of said attachment means of said shock absorber, the other of said attachment means of said shock absorber being connected to the ski member,

a helical coil spring having upper and lower end portions and adapted to resiliently resist relative pivotal movement between said arm and the ski, and

connecting means for operatively connecting the steering shaft to said arm,

said connecting means being oriented rearwardly of said forwardmost end of said arm and adapted to impart steering movement to the ski in response to rotation of the steering shaft.

20. A mounting assembly for operatively mounting a ski member on a snow vehicle,

said assembly including an elongated arm member disposed above and extending generally longitudinally of the ski member,

a hydraulic, direct acting telescopic shock absorber including a cylinder, a piston rod reciprocable relative

to said cylinder, first attachment means on said cylinder and second attachment means on said piston rod,

a first pivot mounting for connecting one end of said arm to the ski member,

a second pivot mounting for connecting the opposite end of said arm to one of said attachment means of said shock absorber, the other of said attachment means of said shock absorber being connected to the ski member, and

first and second resilient deformable means spaced longitudinally along the ski member and disposed generally between the upper side of the ski member and the arm member for controlling relative pivotal movement of said members,

one of said resilient means fabricated of an elastomeric material and being operatively mounted on the side of one of said members confronting the other of said members, and the other of said resilient means consisting of a helical coil spring and extending generally between said members.

21. An endless track driven snow vehicle comprising a pair of forwardly located steerable skis mounted on the lower ends of a pair of downwardly projecting rotatable steering shafts,

a pair of mounting assemblies for operatively securing each of the skis on one of the steering shafts,

each of said assemblies including an elongated arm member disposed above and extending generally longitudinally of the associated of the skis,

each of said assemblies also comprising a hydraulic, direct acting telescopic shock absorber including a cylinder, a piston rod reciprocable relative to said

cylinder, first attachment means on said cylinder and second attachment means on said piston rod,

a pair of first pivot mountings for connecting one end of each of said arms to the associated of the skis,

a pair of second pivot mountings for connecting the opposite ends of said arms to one of said attachment means of the associated of said shock absorbers, the other of said attachment means of said shock absorbers, being connected directly to the associated skis, and

a pair of helical coil springs adapted to resiliently resist relative pivotal movement between said arms and the associated skis.

References Cited

The following references, cited by the Examiner, are of record in the patented file of this patent or the original patent.

UNITED STATES PATENTS

2,228,538	1/1941	Smith	280—12 R
2,925,873	2/1960	Laporte	180—5 R
1,892,064	12/1932	Markey	244—108
1,891,188	12/1932	Stalb	244—108
2,223,834	12/1940	Seltenreich	244—108
2,700,427	1/1955	Schomers	244—108
3,023,824	3/1962	Bombardier	180—5 X
3,166,338	1/1965	Romsdal	280—21

RICHARD J. JOHNSON, Primary Examiner

U.S. Cl. X.R.

280—25