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YIELDABLE MOUNTING LADDER

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FIG. 1

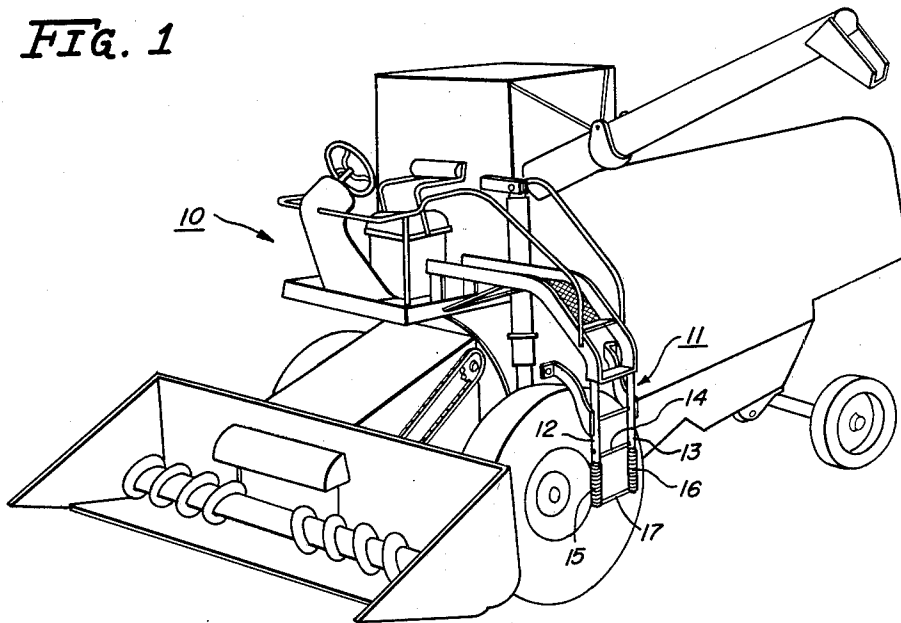


FIG. 3

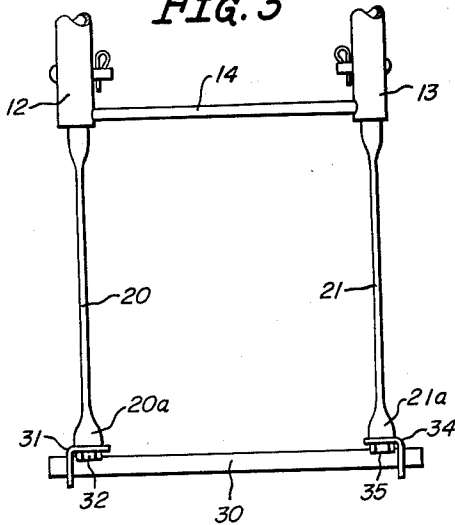
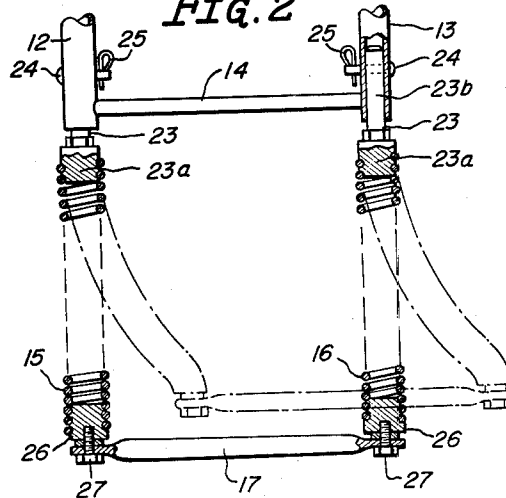


FIG. 2



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YIELDABLE MOUNTING LADDER

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This invention is directed to a yieldable mounting ladder, and more particularly to such a ladder with a flexible means or portion which is substantially more rigid along the axis of the ladder than in a plane perpendicular thereto, thus maintaining the utility as a ladder even though the flexible portions thereof are displaced from the reference position.

It will become apparent from the subsequent explanation that the mounting ladder or vertical access means of the present invention finds utility in many places. It will be convenient, however, to explain the principles and describe a preferred structural embodiment thereof in connection with a machine, such as a crop-treating machine, which travels over terrain that is irregular or bumpy. Certain of these machines, such as combines, are equipped with leveling means to maintain the main working platform and associated components in a substantially horizontal alignment notwithstanding the deviation of the ground plane upon which the machine is proceeding from such horizontal alignment. When a vertical access means, such as a ladder, is affixed to the side of the combine which is displaced nearer the terrain in such instance, forward progress of the combine can force the ladder to engage the ground and bend the lower portion thereof backwardly, either breaking or permanently bending the ladder and thus necessitating the repair thereof.

Previous attempts to eliminate such problem and still maintain the requisite access means for the equipment operator have not been successful. In general such attempts have been directed only to an optimum condition in which the obstacle or terrain is encountered head-on. In practice the retarding forces applied are frequently far from such an optimum condition, and transverse bending or breaking forces are applied to the ladder to either deform or fracture the same.

It is therefore a primary object of the present invention to provide a vertical access means for a machine which is deflectable from a reference position in any direction throughout the full 360° of possible traverse.

A more specific object of the invention is the provision of a yieldable mounting ladder for farm equipment which travels over irregular terrain, which ladder is deflectable from the usual vertical position in any direction substantially normal to the vertical axis of the ladder to maintain the integrity of the structure even after the equipment encounters obstacles which might otherwise break or deform the ladder.

The foregoing and other objects of the invention are realized, in one embodiment, by a vertical access means or ladder which includes a first substantially rigid portion and a second flexible portion, coupled to the first portion. The first portion of the ladder can be of conventional construction in which a pair of spaced-apart rail members are transversely interconnected by spaced-apart rungs. In accordance with the inventive teaching, a pair of spaced-apart flexible members are respectively connected to the rail members, and at least one transverse rung member is connected between the flexible members. Thus the flexible portion of the ladder forms, in effect, an extension of the first portion, but an extension which is readily deflectable in a plane substantially perpendicular

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lar to the vertical axis of the members, that is, to the axis of the ladder.

The flexible members are so constructed that the force required to deflect such members in the vertical direction is much greater than the force required to deflect them in the transverse direction, or in a plane substantially normal to the vertical axis of the ladder. That is, a man's weight (e.g., 200 pounds) applied to the lowest rung of the ladder will not force the bottom rung downwardly, and the operator can mount the ladder in conventional manner. However, as the lowermost part of the ladder encounters an obstacle, whether head-on or at an angle with respect to the heading of the machine, a force equal to a man's weight is sufficient to deflect the lower portion of the ladder out of alignment with the upper or rigid portion, permitting the equipment to pass such obstacle without any damage to the ladder. By providing flexible means such as coil springs or torsion members, the relative vertical stability with respect to the easy transverse displacement of the lower ladder portion is easily provided.

The best mode contemplated for carrying out the invention will now be described. To enable those skilled in the art to make and use the invention, such description is set forth in connection with the accompanying drawing, in the several figures of which like reference numerals identify like elements, and in which:

FIGURE 1 is a perspective illustration of an agricultural machine on which a preferred embodiment of the present invention is mounted;

FIGURE 2 is a partial detailed showing, taken on an enlarged scale with respect to FIGURE 1, to better illustrate the embodiment there shown; and

FIGURE 3 is a detailed showing of another embodiment of the invention.

FIGURE 1 depicts an agricultural or other unit 10, which for the present purposes is illustrated as a combine, and to which a vertical access means 11, depicted as a mounting ladder, is attached. Such access means includes a first or rigid portion comprised of a pair of vertical spaced-apart rail members or side pieces 12 and 13, between which are connected a plurality of spaced-apart rungs 14. In accordance with the present invention, a movable or flexible portion is attached to the fixed portion of the ladder. Such movable portion, in a preferred embodiment better illustrated in FIGURE 2, includes a pair of spaced-apart spring members 15 and 16, respectively connected at their upper ends to side pieces 12 and 13, and connected at their lower ends by another rung 17. The connections of the flexible ladder portion to the fixed portion can be accomplished by a pair of connectors 23, each of which includes a lower portion 23a affixed to a respective spring member, and an upper cylindrical portion 23b received in one of the side pieces. A stud or fastening element 24 is inserted through corresponding indexing apertures in each spring member and side piece, and a cotter pin 25 or other suitable retainer is utilized to prevent accidental removal of the fastening elements. Another fastener arrangement, including a connector 26 and a bolt 27, joins rung 17 to the lower segments of spring members 15 and 16.

The flexible means or springs 15 and 16 can be constructed to withstand the application of considerable force in a vertical direction, as by a man stepping on lower rung 17, without effecting any displacement of the springs and thus preventing downward movement of rung 17. For example, in one embodiment the springs were provided with sufficient vertical strength to withstand a force of 1000 pounds applied along the axis of the spring (which is also the reference vertical axis of the ladder) with substantially no elongation. In the same embodi-

ment, a force of approximately 200 pounds was sufficient to displace the bottoms of the springs and lower rung 17 in a plane substantially normal to the reference vertical axis. Thus whenever the ladder encounters an obstruction, such as hilly terrain, a rock, etc., the lower portion of the ladder is readily deflected out of the effective line of travel of the obstruction, and further is returned to the original position as illustrated in the drawing by the spring action of the flexible members after the obstruction has been passed. It is important to note that the flexible portion of the ladder is readily pivotable in any direction, to avoid any deformation or breakage of the ladder when the obstacle is encountered upon a line other than a straight head-on approach.

FIGURE 3 shows another embodiment of the invention in which the coil springs 15 and 16 are replaced by torsion members, or "torsion bars," 20 and 21. "Torsion bar" or "torsion member," as used herein, refers to a generally linear pre-stressed metallic member which is substantially unelastic along its length but is flexible or bendable in a plane perpendicular to its length axis, and which resumes its original shape after the stresses are removed. Such members are of increasing use in environments such as automotive assemblies in which they replace the spring arrangement previously used to minimize the motion transmitted from a wheel to the frame as the wheel strikes a bump or other obstruction.

Each of the torsion members supports lowest rung 30 by a coupling arrangement including an angle member. For example, an angle iron 31 is provided below the enlarged portion 20a of member 20, which portion is bored and tapped to receive the extremity of a bolt 32 after passing through an aperture in the horizontal (as viewed in FIGURE 3) portion of angle member 31. The vertical portion of angular connector 31 is apertured to receive an end of rung 30 which can be affixed therein by welding, a press fit, or other suitable means. Another angle member 34 and a bolt 35 are similarly disposed to couple the lower portion 21a of member 21 to the other end of rung 30.

Thus the torsion members provide the same type of operation as do the coil springs, inasmuch as a man stepping upon the lowermost rung 17 does not displace rung 17 downwardly but can step up to the next rung 14. Further, when the lower flexible portion of the ladder strikes an object, the torsion members flex and enable the ladder to be deflected rearwardly or in any direction as required to avoid bending or breaking the lower portion of the ladder.

Although the flexible or yieldable portion of the novel mounting ladder has been illustrated connected below the upper or fixed portion, it is evident that the relative positions of the two can be transposed. In such event, when the lower fixed portion of the ladder strikes an obstruction, such portion is deflected out of the line of such obstruction as the flexible members yield as explained hereinabove. Other constructions are also possible, with a first fixed portion, a second flexible portion coupled to the first, and a third fixed portion positioned below and coupled to the flexible portion of the ladder. Having explained the salient concept of providing the flexible members which afford rotation in any direction upon the encountering of an object, other constructions and modifications will doubtless be suggested to those skilled in the art,

It is thus evident that the present invention has fulfilled a long-sought need in this art, that of a vertical access means for equipment which is deflectable in any direction out of the path of obstacles encountered by the ladder and which is nevertheless of sufficient strength along the axis of the ladder to resist deformation or elongation when the weight of a man is applied to the lowermost rung. The invention is simple to fabricate and is readily installed on existing as well as upon new equipment.

While only preferred embodiments of the invention have been illustrated and described, it is apparent that alterations and modifications can be made therein, and is therefore the intention in the appended claims to cover all such modifications and alterations as may fall within the true spirit and scope of the invention.

What is claimed is:

1. For use with a machine which travels over rough and irregular terrain, an access means disposed at the side of said machine generally parallel to a vertical reference axis, comprising: a first portion including a pair of spaced-apart rail members and a plurality of rung members connected between said rail members at intervals to provide a structure substantially rigid in all directions; and a second portion coupled to said first portion, including a pair of flexible rail members respectively connected to said pair of rail members and at least one rung interconnected between said flexible rail members, said flexible rail members being displaceable by a force of given magnitude in any direction in a plane substantially perpendicular to said reference axis, and said members being displaceable along said reference axis only by a force of a magnitude substantially greater than said given magnitude.

2. A mounting ladder disposed at one side of mobile equipment and oriented generally parallel to a vertical reference axis, comprising: a first portion including a pair of spaced-apart rigid side pieces interconnected by a plurality of rung members; and a second portion, connected to said first portion, including a pair of spaced-apart flexible members respectively connected to said side pieces, and another rung having one end connected to one of said flexible members and another end connected to the other of said flexible members, said flexible members being constructed with a spring constant of a value such that, upon the application to said rung of a force equal to a man's weight applied substantially parallel to said reference axis, there is substantially no movement of said flexible members, and upon the application to said second portion of the ladder of a force equal to a man's weight applied substantially perpendicular to said reference axis, said flexible members are readily deflected.

3. A mounting ladder according to claim 2 in which each of said flexible members comprises a coil spring.

4. A mounting ladder according to claim 2 in which each of said flexible members comprises a torsion member.

5. A mounting ladder according to claim 4 in which an angular member and a bolt intercouple each of said torsion members with an end portion of said rung.

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