ABSTRACT: A roll protection frame, for mounting on a tractor or similar machine, which is fabricated to provide a maximum cross-sectional area of material in critical locations for adequate strength to protect the vehicle operator if the vehicle should roll over, and which has a reduced cross section in locations requiring less strength to eliminate excessive weight. The front of the frame is wider than the rear portion thereof so as to provide a more even distribution of impact forces when the vehicle is overturned. The frame is detachable and pivotally mounted on the machine and a hydraulic cylinder arrangement may be removably attached thereto for pivoting the frame, together with the operator's seat and console, to provide access to the machine components beneath the frame. The provision of a double holding valve within the removable tilting cylinder will allow the protection frame to be tilted and maintained in any desired position, without allowing it to fall over when it passes the center of gravity.
3,578,377

TILT OVER ROLL PROTEON FRAME WITH POWER TILTING MEANS

BACKGROUND AND SUMMARY OF THE INVENTION

This invention relates generally to a tilt-over roll protection frame for mounting on a tractor, or other similar machine, and a means for tilting the frame and maintaining it in the tilted position.

Many vehicles, such as cross-country trucks, have been provided with tiltable cabs which allow access to the vehicle engine and other components for the performance of maintenance and repair. When such cabs have been provided with power actuating means for tilting, these have generally been designed and located beneath the floor of the cab as an integral part thereof and are not movable from one vehicle to another.

Many off-the-road vehicles, such as earth moving tractors, etc., have been provided with roll protection frames which are fabricated from round or square tubing having uniform sections. The tubing used must be sized so as to provide maximum strength for the critical locations, thereby adding excessive weight since the same size material is also present where less strength is required.

In tests of roll protection frames mounted on earth-moving vehicles which were purposely overturned, it was found that when such a vehicle is overturned, it is supported by the earth-moving blade or bucket and the rear portion of the vehicle track. The gravitational force to be exerted on the rear post of any roll frame which has a uniform width throughout the length thereof. This application of force to only the rear post of the roll frame causes it to fail and the vehicle's weight is then transferred to the front post which will then also fail, thereby allowing the entire frame structure to collapse, crushing the operator.

In the present invention, the roll protection frame has been tapered from front to rear along both sides thereof so that the angle of the taper is equal to an angle, relative to the longitudinal axis of the vehicle, created by an imaginary line extending from the outside edge of the bulldozer blade or the loader bucket, as the case may be, to the outside edge of the track at the rear of the machine. This allows the weight of the machine to be equally distributed between the front and rear posts of the frame, diminishing the possibility of failure of either of the posts.

It is also well known that the addition of excess weight to the upper portion of a vehicle adversely affects the center of gravity of the vehicle by raising it, thereby increasing the tendency of the vehicle to overturn. On the other hand, the roll protection frame provided on a vehicle must have adequate strength at the points of application of large stresses so that the vehicle operator can safely escape without any danger that the weight of the overturned vehicle will crush him due to collapse of the roll frame. It has been discovered that the suitable selection and placement of materials will allow a sufficient size and strength of material to be placed at the highly stressed areas of the frame, while the areas subject only to low stresses can be manufactured with less heavy material. Further, when the various parts of the frame are joined at the points of lowest stress, the possibility of failure of the frame is diminished.

With the use of this invention, several previously unavailable features are available. First, the entire roll protection frame, operator's seat, and console may be entirely assembled before placement of the frame on the vehicle. This obviates the necessity for assembly personnel to get on and off the vehicle several times. Second, the roll protection frame and the parts attached thereto may be easily attached to and removed from the vehicle for ease in handling during shipment. Third, by removing the pins holding the frame to the vehicle on one side, the entire frame, seat, and console may be quickly and easily tilted to the other side to provide access to the machinery below the frame for maintenance and repair.

In this invention, a removable hydraulic cylinder may be attached between the vehicle and the frame so that, when the holding pins are removed from one side of the frame, the tilting mechanism may be manually actuated and the roll frame tilted to, and held in, any desired position. The small weight and simplicity available in the tilting mechanism will allow it to be attached to any machine for repair and maintenance in the field and will also allow it to be inexpensively manufactured so that the owner of a single machine can afford to purchase it and the owner of a plurality of machines can use a single mechanism to tilt the roll frame on all of his machines.

It is therefore an object of this invention to provide an improved roll protection frame.

It is also an object of this invention to provide a roll protection frame which is tapered in such a way that when the vehicle is on its side, the weight of the vehicle is evenly distributed on the front and rear posts of the frame.

It is also an object of this invention to provide a roll protection frame which is fabricated in such a way as to provide sufficient strength at the points of application of large stress while reducing excess weight at the points of application of low stress.

It is also an object of this invention to provide a roll protection frame which is easily fixed upon and removed from a vehicle.

It is a further object of this invention to provide a roll protection frame which may be tilted to provide access to the machinery components beneath the frame.

It is also an object of this invention to provide a means for tilting such a frame.

It is a further object of this invention to provide a roll protection frame tilting apparatus which will maintain the frame in any desired tilted position, without danger of the frame falling over in either direction as it passes the center of gravity.

It is a still further object of this invention to provide a roll protection frame which produces increased operator safety.

It is also an object of this invention to provide a roll protection frame to which is fixed the operator's seat and console.

It is also an object hereof to provide a roll protection frame to which may be mounted a sun shade, logging sweeps, or other, similar apparatus.

Other objects and advantages of the present invention will become apparent from the following description and claims as illustrated in the accompanying drawings which, by way of illustration, show preferred embodiments of the present invention and principles thereof and what are now considered to be the best modes contemplated for applying these principles. It is recognized that other embodiments of the invention utilizing the same or equivalent principles may be used, and structural changes may be made as desired by those skilled in the art, without departing from the present invention and purview of the appended claims.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is an elevation of the roll protection frame of the present invention, illustrated as being mounted on a tractor;

FIG. 2 is a rear view of the roll protector frame with the tilting tool attached thereto;

FIG. 3 is a view similar to FIG. 2, but with the frame rotated to its maximum tilt position;

FIG. 4 is a view of the console support frame which may be integrally formed with the roll protector frame, taken along a line IV—IV in FIG. 1;

FIG. 5 is a detailed view of the frame tilting mechanism;

FIG. 6 is a sectional illustration of the frame tilting tool taken along a line VI—VI in FIG. 5;

FIG. 7 is a sectional illustration of the structure utilized to hold the tilting tool to the frame, taken along a line VII—VII of FIG. 5;

FIG. 8 is a plan view of the roll protector frame, which is partly broken away for illustrative purposes, showing the frame mounted on the tractor;

FIG. 9 is a detailed illustration of the structural make-up of the roll protector frame;

FIG. 10 shows a typical cross section of the posts of the roll protector frame;
3,578,377

FIG. 11 is an elevation of one of the front posts of the roll protector frame, illustrating the structure utilized for mounting a sun shade or logging sweep thereon; FIG. 12 is an elevation of the roll protector frame mounted on a tractor, utilizing logging sweeps.

DETAILED DESCRIPTION OF THE INVENTION

Referring now to FIG. 1, a tractor generally indicated by phantom lines at 20, is shown having a roll protection frame 22 mounted thereon. The frame 22 consists of a front structural member 24 and a rear structural member 26 longitudinally spaced from each other and rigidly interconnected by a pair of structural members 28 at the top of the frame.

As shown in FIG. 8, the front members 24 are more widely spaced than are the rear members 26, thereby causing the roll protection frame to be tapered from front to rear. The angle of taper on each side of the roll protection frame corresponds to the angles created by imaginary lines illustrated as lines 29 extending from the outside edges of the bulldozer blade 25 or the loader bucket, as the case may be, to the outside edges of the tracks 27 at the rear of the machine. Thus, if the machine should roll over, it would come to rest on the upper outside edge of the bulldozer blade, the outside edge of the track at the rear of the machine, and also on the upper ends of the front member 24 and a rear member 26 so that the weight exerted on the frame 22 would be evenly distributed in the frame and diminishes the possibility of failure.

Referring again to FIGS. 1 and 2, the front structural member 24 consists of a pair of posts 30 integrally formed with a crossbeam 32. The rear structural member 26 consists of a pair of posts 34 integrally formed with a crossbeam 36 and an X-shaped member 38. The posts 30 and 34 are secured by pins 40 to brackets 42 and 42a, respectively, which are welded to the tractor frame main frame 44.

Additional structural strength is effected by securing the front posts 30 to brackets 42 by suitable means such as bolts 43. A top plate 46, welded to crossbeams 32 and 36 and to the members 28, acts as a brace to keep the top section from parallelogramming and also as an overhead protection from falling objects.

A console support frame 48, shown in FIGS. 1 and 4, extends between—and is fastened to—platform support brackets 50 which in turn are secured by pins 40a to brackets 42b welded to the main vehicle frame 44.

For reasons to be explained later the pins 40 and 40a on the left side of the frame are all axially aligned, and those on the right side of the frame are also axially aligned.

Channels 52 extend between and are bolted to the brackets 50 and the front posts 30. A crossbar 54 is secured to the channels 52 at each of the ends of the crossbar. Channels 56 are attached to the crossbar 54 and extend rearwardly to the X-shaped member 38 to which they are attached. The frame assembly thus formed supports the operator's platform 60, seat 62, and console 64. The console support frame 48 supports the operating levers and controls (not shown) in such a way that the roll protection frame 22 can be tilted with a minimum of disconnecting of parts.

Referring now to FIGS. 9 through 11, the roll frame is shown to be a fabricated unit designed to provide a maximum cross-sectional area of material in critical locations, thereby providing adequate strength where it is needed, without excessive weight in locations requiring less strength.

FIG. 9 shows a typical cross section of the structural members 24 and 26 which are fabricated from rolled sections 66 and steel plates 68. Steel castings 70 and 72, fabricated onto the structural members 24 and 26 respectively, provide the necessary mounting devices for fastening the frame 22 to the brackets 42 and 42a. Continuous strips of the rolled sections 66 form the outside surfaces of the members 24 and 26 and the inside surface of member 24 and have their ends welded to the castings 70 and 72. The continuous strips eliminate transverse welded joints in the highly stressed areas such as the corners.

With respect to the inside surface of member 26, which has the X-shaped brace 38, continuous strips 66 are also used and the joints 74, formed by the rolled sections on the inside surface of member 26, are also in low stressed areas as illustrated in FIG. 9.

Due to manufacturing practices, it may be necessary to fabricate the steel plates 68 in several pieces. As shown in FIG. 9 however, the joints, as indicated at 76, are also in low stressed areas.

In FIGS. 1 and 11, it is shown that corner castings 78 may be secured to the front corners of members 24, for mounting either a sun shade 80, or logging sweeps which will now be described.

Referring now to FIG. 12, a pair of intermediate members 82 are longitudinally spaced off and rigidly interconnected to the castings 78 by structural members 84. The intermediate members 82 consist of a pair of posts 86 integrally formed with a crossbeam 88. The distance between the posts 86 is slightly greater than the distance between the posts 30 to maintain the tapered feature which was described with reference to FIG. 8. The posts 86 are secured to brackets 82a by pins 40a and contain suitable means so that the console support frame 48 can be attached thereto, in which case the brackets 50 may be deleted when intermediate members are provided.

Logging sweeps 90, secured to the front of the crossbeam 88 extend forward to an attachment with the machine radiator guard.

Thus, if it is desired to utilize the machine with logging sweeps, the console frame is fixed to the intermediate members 82 rather than to the brackets 50 and the entire roll protection frame may still be tilted over in a manner to be presently described.

Now with reference to FIGS. 3 and 5 through 7, there is shown a means for tilting over the roll protection frame for access to the machinery components situated beneath the frame.

As an example of the size and character of this invention, the frame 22 to be tilted can weigh up to 4,500 pounds and can be tilted approximately 70°—to a position such as that shown in FIG. 3. In the exemplary case, the center of gravity of the frame is such that the frame would tend to fall due to gravity when it is at approximately 50°. In order to keep the frame from free-falling the remaining distance, whether it is being pivoted away from or toward the vehicle, a means must be provided which can not only tilt the roll frame but also is capable of holding it in any desired position. It is also desirable to have such a system which may be easily attached when needed and easily removed when the maintenance work is completed.

As shown in FIG. 3, the roll protection frame 22 may be tilted or pivoted on the axially aligned pins 40 and 40a on the left side of the machine after the pins 40 and 40a on the right side of the machine and the bolts 43 on both sides of the machine are removed. If the machine is provided with logging sweeps, the sweeps 90 must be detached from the cross beam 88. Of course, if desired, the structure utilized to tilt the frame could be utilized so as to pivot the frame toward the right side of the machine, meaning that the left side pins must be removed and the right side pins will act as the pivot points.

Side tilting is effected by a tilt mechanism 170, pivotally connected at 172 to the bracket 42a and at 174 to a lug 176 which is suitably fixed to or integral with the casting 72 of the rear post 34.

The tilt mechanism 170 is basically a hydraulic cylinder 178 which is secured within mountings 180 which in turn, are retained between support plates 182 by bolts 183. A clevis eye 184, attached to the rod of the cylinder 178, extends into a slot 186 in the lug 176, to which it is pivotally connected with a pin 174, as best shown in FIG. 7. An aperture 188, in one of the plates 182, allows the pin 174 to be inserted to attach the tilt mechanism 170 to roll frame structure 22.

In order to tilt the roll protection frame 22 from the upright position of FIG. 2 to the tilted position of FIG. 3, fluid is directed from a pump 190 (FIG. 3) or other suitable means,
through a conduit 192 to the head end of the cylinder 178. Extending the rod causes the lug 176, and thus the frame 22, to pivot counterclockwise on the pins 40 and 40a on the left side of the machine. As the center of gravity of the frame goes over center, the cylinder 178, either with a built-in double-holding valve or a separate double holding valve (neither of which are shown), then retains the frame from free-falling over.

Complete tilting is accomplished by continued pumping of the fluid to the head side of the cylinder 178.

To return the frame 22 to the upright position of FIG. 2, fluid is transmitted from the pump 190 to the rod end of the cylinder 178 via a conduit 194, thus retracting the rod and causing clockwise rotation of the frame 10. The previously described double acting valve will also prevent the frame from free-falling in this direction as the center of gravity goes over center. When the frame reaches the upright position, pins 40 and 40a and bolts 43 may then be replaced and the tilt mechanism 170 removed.

It can readily be seen that the tilt mechanism 170 and the pump 190 may be relatively simple devices and of such light weight that they may be easily transported, fastened to, and removed from the roll protection frame.

Thus has been illustrated and described preferred embodiments of a tilt over roll protection frame which is structured so as to provide sufficient strength in the areas of great stress while reducing the weight in areas of lesser stress and also shaped so as to provide an even distribution of force when the vehicle is tipped over. In the embodiments illustrated, the protector frame and the operator console are easily tilted so as to provide ready access to the machinery beneath the frame and console and the means for tilting it are relatively simple to manufacture and easy to attach to and remove from the frame. While illustrated and described as specific embodiments, the invention is, of course, capable of variation and modification within the purview of the following claims, as will be obvious to those skilled in the art. For example, the holding pins could be replaced by any suitable means which would perform the same function, or the protector frame could have an environmental cab mounted thereon.

We claim:

1. In combination a vehicle having a front end and a rear end of different transverse dimensions and a roll protector frame mounted thereon, said frame being tapered from front to rear along lines parallel to imaginary lines drawn from the outside edge on the front of the vehicle to the outside edge on the rear of the vehicle, said roll protector frame comprising structural members detachably fixed to said vehicle by means on each side of the roll frame, said means on one side being axially aligned, said structural members being so mounted relative to the vehicle that removal of the means from the structural members on the other side of the roll frame allows the roll frame to be pivoted about the axially aligned means on the structural members on the other side of the roll frame.

2. The invention of claim 1 wherein said structural members comprise front and rear structural members, the front member being of a different width than the rear member, means interconnecting the front and rear members along the sides of said roll frame, and means for tilting said frame relative to the vehicle.

3. The invention of claim 1 wherein said interconnecting means connect the front member with the rear member along lines parallel to imaginary lines extending from the outer edges of the front end to the outer edges of the rear end.

4. The invention of claim 1 wherein the front and rear members are fabricated in sections, providing a greater quantity of material in areas of high stress than in areas of low stress in the roll frame.

5. The invention of claim 4 wherein the abutting ends of said sections are joined at areas of low stress.

6. The invention of claim 1 including a lug mounted on said frame, and said frame tilting means fastened to said lug and to said vehicle, and means for powering said tilting means.

7. The invention of claim 6 wherein said frame tilting means comprises a hydraulic cylinder and piston rod fixed between the roll frame lug and the vehicle.

8. The invention of claim 1 wherein the outer and inner surfaces of said front and rear members comprise strips of rolled sections and the front and rear surfaces of said front and rear members comprise steel plates.

9. The invention of claim 1 wherein the tilting means comprise a hydraulic cylinder.

10. The invention of claim 1 including an operator's seat and a console fixed to the roll frame.

11. The invention of claim 1 wherein said means on the other side of the roll frame comprises axially aligned removable means at the lower ends of the front and rear members for fastening the roll frame to the vehicle, whereby, when the removable means are removed from the lower ends of the front and rear members on said other side of the roll frame, the roll frame may be tilted, relative to the vehicle, about the axially aligned means remaining on said one side of the frame.

12. The invention of claim 1 including an operator's seat and a console fixed to the structural members.

13. The invention of claim 1 wherein the highly stressed surfaces of the frame are formed from rolled strips and the lightly stressed surfaces of the frame are formed from plate members.

14. The invention of claim 1 including a lug fixed to one of the structural members on one side of the frame, a hydraulic cylinder fixed to the vehicle and having a piston rod fixed to said lug, and means to pressurize said cylinder at one end or the other thereof, thereby tilting said frame away from or toward the vehicle.

15. The invention of claim 1 including means fixed to said frame to which a sun shade or logging sweeps may be attached.

16. The invention of claim 1 including console means fixed to said frame.

17. The invention of claim 1 including seat means fixed to said frame.