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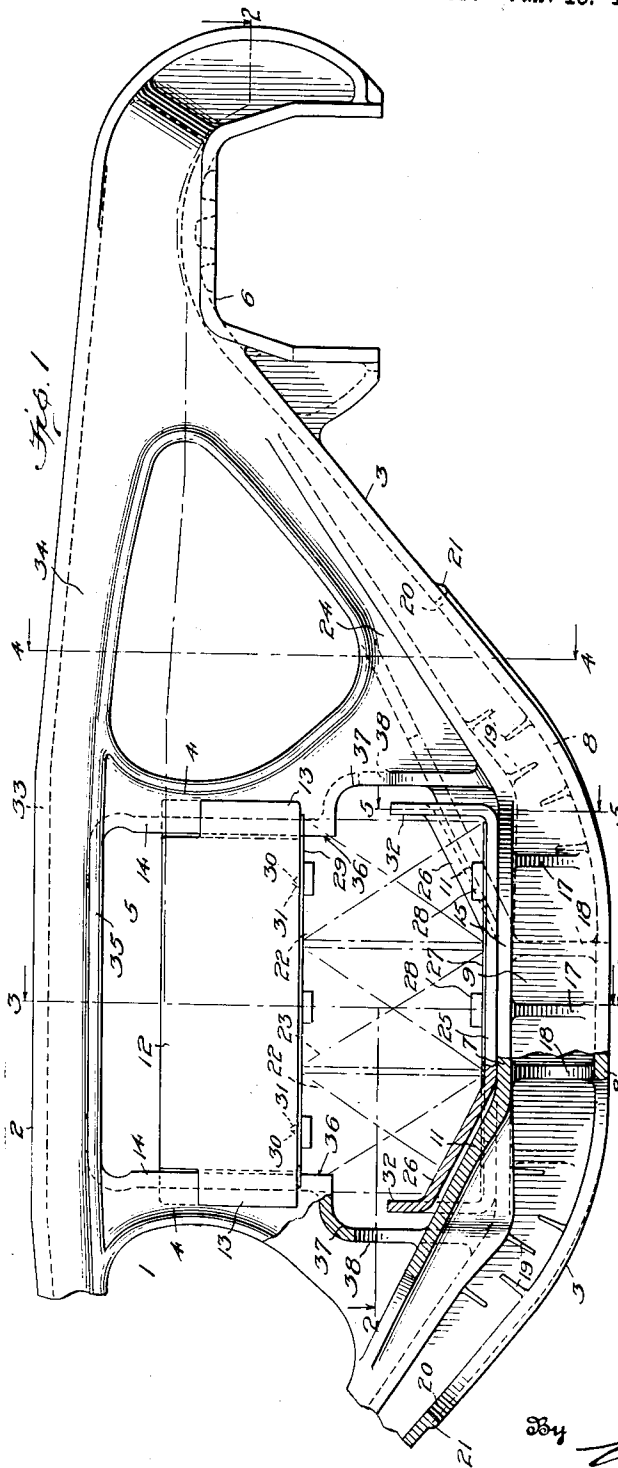
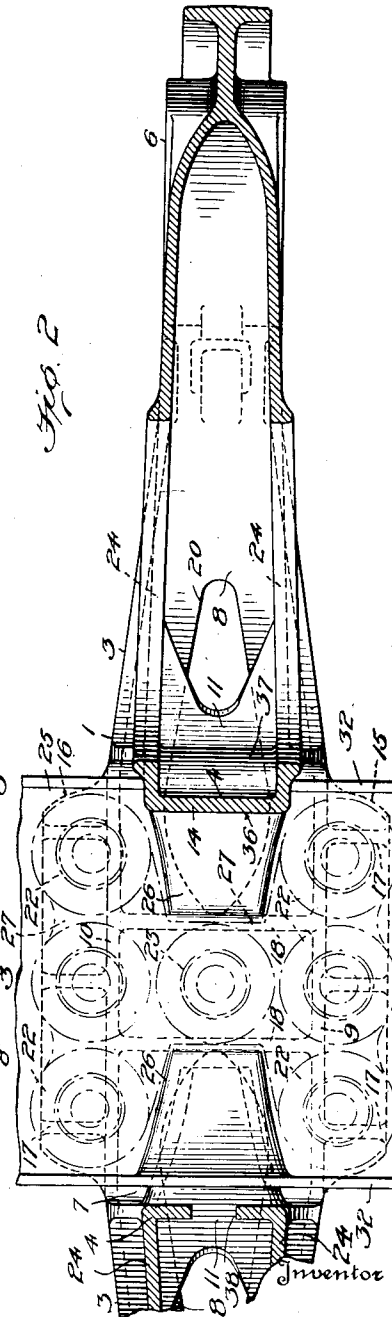
D. S. BARROWS

1,652,808

CAR TRUCK

Filed Jan. 19, 1927

3 Sheets-Sheet 1



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Dec. 13, 1927.

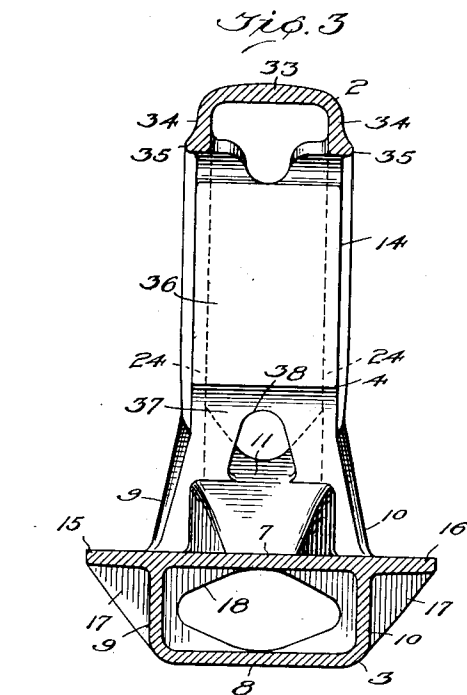
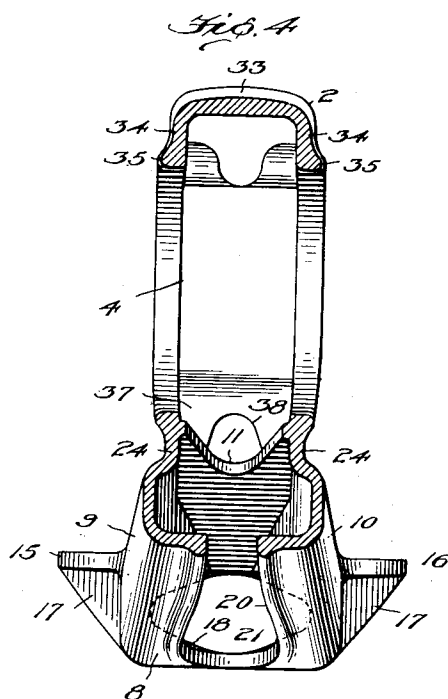
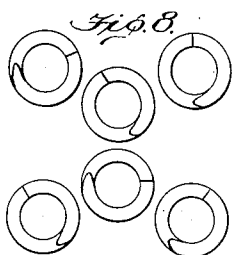
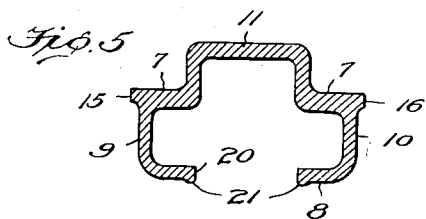
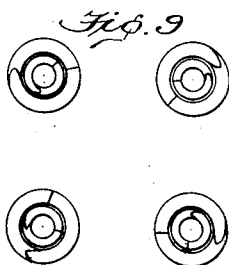
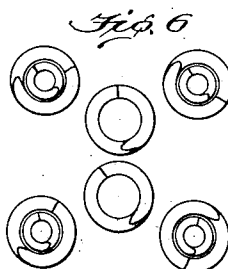
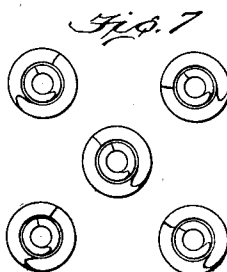
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1,652,808

CAR TRUCK

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3 Sheets-Sheet 2



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Dec. 13, 1927.

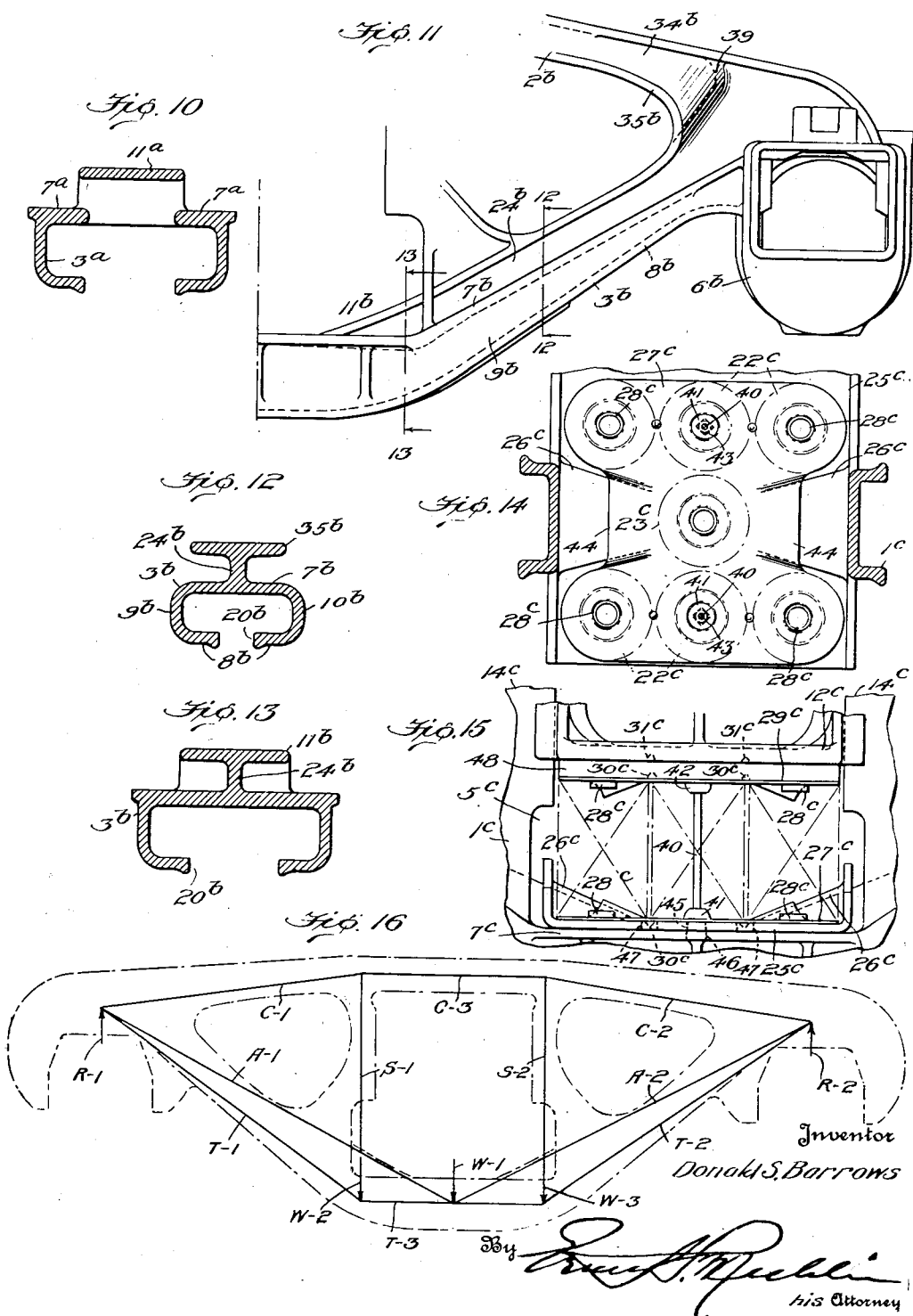
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CAR TRUCK

Filed Jan. 19, 1927

3 Sheets-Sheet 3



UNITED STATES PATENT OFFICE.

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CAR TRUCK.

Application filed January 19, 1927. Serial No. 162,137.

This invention relates to railway car trucks and, more particularly, to the construction of the side frames, bolsters and spring planks thereof as well as the connection between said members and the spring arrangements for supporting said bolsters.

The principal object of my invention, generally considered, is the improvement in car trucks and particularly the construction of the side frames, spring planks, spring plates, bolsters and the arrangement of the bolster springs whereby increased strength of the frames and increased capacity of the bolster springs are secured.

An object of my invention is the provision of car trucks formed with side frames in which the tension member between the bolster guide columns is reinforced at the critical points adjacent the junctions with said bolster guide columns as well as rigidly supported and strengthened by reinforcing portions extending upwardly from near the center of the spring plank seat portion diagonally upward and outward past the bolster guide columns toward each end of the frame and forming, in effect, a supplemental truss directly supporting the spring plank seat portion of the frame adjacent the center thereof, the spring plank being formed so as to interlock with said spring seat portion reinforcement and adapted to support a nest of springs.

Another object of my invention is to provide in an integral side frame construction a plurality of truss structures, at least one of said trusses having the inclined portions meeting substantially on the transverse center line of said side frame and at least one of the other trusses having the angular portions disposed outside of the strut portions of said side frame.

An additional object of my invention is the provision of a side frame having a tension member which is, in effect, a central horizontal beam between the bolster guide portions of the frame supported at its ends by diagonal end portions of the tension member and additionally supported near its center by other diagonal portions extending above the main diagonal end portions of the tension member and converging outwardly with respect thereto.

A further object of my invention is the provision of a side frame for railway car trucks in which the tension member at the junction with the bolster guide columns is

reinforced by triangular embossments extending upwardly along the longitudinal center line of the frame between the spring plank seat portion of the tension member and the inner walls of the bolster guide columns.

A still further object of my invention is the provision of a railway car truck in which the spring plank seat portions of the side frames thereof are substantially square in plan and support nests of springs substantially H-shape in outline, the uprights of said H's extending longitudinally of the frames on either side of the longitudinal center lines thereof and the cross parts of the H's lying substantially at the centers of the spring plank seat portions.

An additional object of my invention is the construction of the parts of a truck, such as the side frames, bolster and spring plank, so that the side frames are very much stronger than usual at critical portions thereof such as the junctions between tension members and bolster guide columns and the spring plank interlocks with the spring plank seat portion of the frame without the use of the usual squaring lugs, said bolster being formed to facilitate its insertion and removal with respect to the frame by decreasing the depth of the front or outer guide lugs to agree with the decreased depth of the window opening beneath the bolster guiding portions of the guide columns.

Another object of my invention is the provision of spring plates for H-shaped spring groupings, said spring plates being constructed for properly positioning the springs and also for interlocking with an associated spring plank or bolster.

A further object of my invention is the minimizing of the deflection incident to the middle or spring seat portion of the tension member of the side frame by incorporating in the frame a double truss system, one truss being approximately a simple triangle carrying a central load, the other being of the three panel type having two vertical struts and carrying two concentrated loads at the junctions with said struts.

A specific object of my invention is the provision of car trucks formed with side frames in which the tension member between the bolster guide columns is reinforced at the critical points adjacent the junctions with said bolster guide columns, as well as rigidly supported and strengthened, by an upward embossment along the longitudinal center

line of the frame extending from near the center of the spring plank seat portion diagonally upward and outward through the bolster guide columns toward each end of the frame and forming, in effect, a supplemental truss directly supporting the spring plank seat portion of the frame adjacent the center thereof, the spring plank being similarly formed so as to interlock with said reinforcement and adapted to support a nest of springs arranged substantially H-shape in plan with the uprights of the H arranged as two longitudinal rows on either side of the longitudinal center line and a transverse row arranged substantially along the longitudinal center line of the spring plank, said transverse row comprising one or more spring units depending on the capacity desired and the bolster supported by said nest of springs being formed with front or outer guide lugs of reduced depth to facilitate insertion and removal thereof over the embossed portions of the spring plank seat.

Other objects and advantages of the invention relating to the particular arrangement and combination of the various parts will become apparent as the description proceeds.

Referring to the drawings illustrating my invention, the scope whereof is defined by the appended claims:

Figure 1 is a side elevation of a truck, particularly showing a portion of a side frame thereof with its associated spring plank, bolster and nest of springs.

Figure 2 is a plan of a portion of the truck, parts of a side frame thereof being shown in section on the line 2-2 of Figure 1, looking in the direction of the arrows.

Figure 3 is a transverse sectional view on the line 3-3 of Figure 1 looking in the direction of the arrows.

Figures 4 and 5 are transverse sectional views on the correspondingly numbered lines of Figure 1 looking in the direction of the arrows.

Figures 6, 7, 8 and 9 are diagrammatic illustrations of alternative or modified spring arrangements.

Figure 10 is a transverse sectional view corresponding to Figure 5 showing a slightly modified form of the tension member of my improved side frame.

Figure 11 is a partial side elevation of a side frame with integral journal boxes and showing a further embodiment of my invention.

Figures 12 and 13 are transverse sectional views on the correspondingly numbered lines of Figure 11 looking in the direction of the arrows.

Figure 14 is a plan of the end portion of a spring plank and spring arrangement illustrating a further embodiment of my invention, a portion of the side frame adjacent

said spring plank being shown in horizontal section.

Figure 15 is a partial side elevational view of the embodiment shown in Figure 14.

Figure 16 is a diagram illustrating the theory of truss design for the side frame of my invention.

Referring to the drawings in detail, like parts being designated by like reference characters and first considering the embodiment illustrated in Figures 1 to 5, inclusive, there is shown a portion of a truck comprising a side frame 1 preferably formed of cast steel, although it will be obvious that certain advantages of my invention may be obtained when using frames of other than cast construction. Said frame 1 comprises a compression member 2, a tension member 3, and bolster guide columns or strut portions 4 spacing intermediate portions of said compression and tension members, leaving a window opening 5 therebetween. The compression and tension members, in the present embodiment, are shown joined to each other and to a jaw shaped portion 6 adjacent each end of the frame which portions 6 are adapted to embrace and be connected to associated journal boxes (not shown) or, if desired, journal boxes may be integrally connected to the ends of said frame.

The tension member 3, between the bolster columns, is generally box shape in cross section and comprises an upper web 7 forming a spring plank seat portion, a lower web 8 and side webs 9 and 10, respectively. For rigidifying and strengthening the side frame and particularly the tension member and the junction between the tension member and bolster guide columns, said tension member is upwardly convoluted or embossed, preferably along the longitudinal center line of the frame adjacent the junctions with the bolster guide columns, to form upper diagonally disposed web portions 11 which start near the center of the spring plank seat portion or upper web 7 and extend diagonally upward through the bolster guide columns toward the ends of the frame. This construction results, in effect, in a bifurcation of the upper web portion of the tension member producing a triangular or inclined reinforcement at the junction between the tension member and bolster guide columns and, in addition, forms embossments with which the spring plank is adapted to engage, thereby obviating the necessity of the usual squaring lugs. This reinforcement also has the effect of reducing the effective depth of the window opening 5 for the insertion of the bolster 12, thereby making it desirable to decrease the height of the front or outer guide lugs 13 to correspond with the depth between the bolster guiding portions 14 of the bolster guide columns 4 and the reinforcement 11. The rear or inner bolster

guides may be of normal depth, if desired.

For providing an adequate spring supporting area, the upper web 7, between the bolster guide columns or spring plank seat portion, is laterally extended beyond the webs 9 and 10 as indicated at 15 and 16. These extensions 15 and 16 are preferably braced with respect to the webs 9 and 10 by triangular gusset portions 17. The webs of the box-shaped portion of the tension member may likewise be braced interiorly by gusset portions 18, as shown most clearly in Figure 3. In addition to the interior gusset portions 18, a plurality of cracking ribs 19, to retard cooling of the metal upon casting and thereby obviate the formation of imperfections, adjacent the junctions between the horizontal portion of the tension member and the diagonal end portions beyond the window opening 6, may be employed.

Considering the tension member in general, it will be seen that the main portion thereof is substantially horizontal between the bolster guide columns 4 at its upper surface and curved at its lower surface and particularly beneath said bolster guide columns. This portion of the tension member also decreases in depth from the central part toward the ends thereof. The spring plank seat portion or upper web 7 is extended diagonally upward from the side of the window opening 5 toward the ends of the frame, the lower web 8 curving beneath the bolster guide columns and extending diagonally upwardly and slightly converging with respect to the diagonal portion of the upper web 7. The lower web 8, however, may be apertured as indicated at 20, the edges of said apertured portion being preferably reinforced by beading 21. Said apertured portion 20, as will be apparent, facilitates core removal and decreases the weight of the frame.

The extreme upper portion 11 of the tension member, or that portion convoluted, bifurcated or branching from the main web 7 adjacent the central portion thereof, is preferably of less width than the main portion of the tension member and may be of a width corresponding substantially with one of the spring units 22. Although it is shown adjacent the longitudinal center line of the frame, it may be formed as two spaced portions extending upwardly and outwardly, the spring units now positioned on either side thereof being disposed therebetween. That is, the end spring units, instead of being widely spaced on either side of the reinforcement, as shown in Figure 2, may be moved toward the longitudinal center line to occupy the space now taken by the reinforcement 11, and be spaced as close thereto and to each other as the springs, shown in Figures 6 and 8, on the longitudinal center line of the spring plank. This reinforcement,

and particularly the upper web thereof, is preferably extended from the outer edge of the central spring unit 23 diagonally upward and outward toward the ends of the frame at a slightly smaller angle than the diagonal portions of the web 7 so that it is slightly convergent with respect to said web. The web 11 may be bifurcated with the ends gradually tapering and merging into upright webs 24 extending from the upper surface of the web 7, said point of mergence corresponding approximately with the point of contraflexure, or being approximately half-way between the bottom of the respective bolster guide column and the adjacent junction between the tension and compression members. Beyond the point of contraflexure, the loss of the reinforcing web portion 11 may be compensated for by increasing the depth of said web portions 24, the upper edges of which are outwardly beaded as illustrated, until the same merge with the compression member 2. It will be seen that the web portions 24 are more closely spaced than the side webs 9 and 10 until said latter webs, due to the narrowing of the main portion of the tension member, converge to the same distance apart, causing a disappearance of the webs 7 and a mergence with the webs 24 adjacent the junctions with the compression member.

The only reason that there is a point of contraflexure at any point in the diagonal end portions of the tension member is that the frame, as a whole, is one casting with rigid joints at the junctions of the members thereof. If the members were pin-connected at the junctions, when the frame was loaded normally or not merely in a horizontal direction, angular variations would occur at all panel points or pin connections. Since with a cast frame, no such variations are possible because of the rigid junctions between the members, flexure in said members is induced instead of angular variations therebetween, said flexure occurring in varying degrees in each member, the diagonal portions of the tension member being flexed to a double or S curve so that, where the center of curvature shifts from one side of the member to the other, a point of contraflexure is produced. In the present embodiment, these points are approximately half way between the bottom of a bolster guide column and the adjacent junction with the compression member.

The web 7, and particularly the diagonal end portions thereof, preferably extends toward the ends of the frame at approximately an angle such that, if continued, it would unite with the lower web 8 adjacent the upper inner corner of the box engaging portion 6 of the frame. Said web, however, gradually merges into the web 24 so that it terminates short of any union with the

web 8. The loss of the web 7 is preferably compensated for by gradually increasing the thickness of the lower web 8 from adjacent the end of the web 7 to the junction between the web 8 and the journal box engaging portion 6.

From a consideration of Figures 4 and 5 particularly, it will be seen that, adjacent the lower ends of the bolster guide columns and for some distance outwardly thereof, the tension member is generally shaped as an inverted hollow T in cross section, the upper reinforcing web 11 and the side webs 24 being narrower than the intermediate web 7 and the side webs 9 and 10. On account of the upstanding substantially triangular embossment 11 at each lower corner of the bolster opening, interlocking engagement is provided for between the spring plank 25 and said reinforcement by forming upward corrugations 26 adjacent the ends of said spring plank to register and interlock with the triangular reinforcing portions 11 of the side frame. These corrugations 26 decrease the effective area for supporting the springs 22 and 23 and, therefore, said springs are preferably arranged as an H in plan with two longitudinal rows on either side of the longitudinal center line of the frame and a central spring or transverse row on the longitudinal center line of the spring plank 25. For a seventy ton truck, each longitudinal row may comprise three double coil spring units 22, as indicated most clearly in Figure 2, with a central double coil spring unit 23, no springs being positioned over the inclined or corrugated portions 26 of the spring plank and the reinforcing portions 11 of the side frame. For fifty ton trucks, instead of using seven spring units, six only need be employed, as indicated in Figure 6, each longitudinal row of springs comprising two double coil spring units with two single coil spring units positioned on the longitudinal center line of the spring plank. The arrangements for a forty ton truck are diagrammatically illustrated in Figures 7, 8 and 9 in which five, six and four unit nests of springs are shown. The first arrangement corresponds with that for the seventy ton truck omitting the intermediate spring units of the longitudinal rows of springs.

Although, for a forty ton truck, five spring units may be used as indicated in Figure 7 yet what is considered a more desirable arrangement of springs is illustrated in Figure 8, in which six single coil spring units are employed, which may be spaced as shown in Figure 6 for the fifty ton truck. As an additional embodiment showing the spring arrangement for a forty ton truck, four spring units only may be employed as illustrated in Figure 9, said units being double coils, each arranged at

an extreme corner of the substantially square spring plank seat portion of the frame. It will be apparent that this latter spring arrangement gives a capacity, when standard spring units are employed, corresponding with that of the normal of A. R. A. spring arrangement for fifty ton trucks. Of course, for forty and fifty ton trucks, the outer or extreme spring units may be moved closer together to correspond with the standard spacing of springs and the decrease in size of the bolster opening for lighter frames.

Referring now to the embodiment of my invention illustrated in Figure 10, which is a section corresponding to that illustrated in Figure 5, it will be seen that the tension member adjacent and inwardly of the bolster guide columns need not involve any vertical webs connecting the diagonal web portion 11^a with the bifurcated spring plank seat portion 7^a of the horizontal portion of the tension member 3^a. The only change, therefore, between the embodiment illustrated in Figure 10 and that illustrated in Figures 1, 2 and 5 is the omission of the vertical webs 24 which, in the first embodiment, connect the diagonal web 11 with the horizontal web 7, between the bolster guide columns.

Referring now to the embodiment of my invention illustrated in Figures 11, 12 and 13, a frame is there disclosed involving integral boxes 6^b connected adjacent the junctions between the compression member 2^b and the tension member 3^b, in lieu of the jaw-shaped portions 6 of the first embodiment adapted for connection with journal boxes. Another change with respect to the first embodiment is that the top web or upper diagonal portion 11^b of the tension member 3^b is curved slightly rather than being straight, it being permissible in either embodiment to either slightly curve this upper web portion or extend the same straight from near the center of the spring plank seat portion toward the adjacent end of the frame. Another variation in the present embodiment over that of the first embodiment is that the web 11^b is connected to the main portion of the tension member comprising an upper web 7^b, side webs 9^b and 10^b and a bottom web 8^b, by a single preferably vertical web 24^b preferably centrally disposed rather than by a pair of webs 24 extending from the sides of the web 11 to the adjacent sides of the bifurcated portions of the web 7. In other words, in the present embodiment, the upper diagonal portions of the tension member are substantially T-shape rather than U-shape in cross section, said section, when combined with the main portion of the tension member, forming an inverted goblet shape, as illustrated in Figures 12 and 13, where the web 8^b is apertured as indicated at

20^b. This section gradually changes to a composite box and T-shaped section outwardly of the apertures 20^b and continues to the junction with the compression member 2^b.

5 The web 24^b may continue upwardly or outwardly over the journal box 6^b or, if merely a jaw-shaped portion such as shown in the first embodiment is employed, over said portion. The compression member 2^b 10 may be formed with intermediate portions substantially as shown in the first embodiment illustrated in Figures 1 to 5, inclusive, the end portions, however, involving a converging of the side flanges 34^b thereof to 15 finally unite as indicated at 39 thereby involving a change in the end portions of the compression member from U to T-shape in cross section. The upper flanges or web portions 11^b of the tension member may curve 20 around at the junction with the compression member and merge with flanges or outwardly extending beading 35^b on the compression member. Except as specifically described in connection with the present embodiment, the 25 construction may correspond with that of the first embodiment.

Although the nest of springs may be directly supported on the spring plank, which may be specially formed for the purpose, 30 yet a preferred construction involves the use of a spring plate 27 formed generally H-shape in outline with the ends of the uprights of the H embracing the upwardly corrugated portion 26 of the spring plank 25 to 35 thereby maintain said spring plate in proper position. For a seventy ton truck, each spring plate 27 is formed with seven spring positioning collars or flanges 28 spaced to correspond with the desired spacing of the 40 spring units 22 and 23. For fifty and forty ton trucks, the spring plates are correspondingly modified to correspond with the spring groupings illustrated in Figures 6 to 9, inclusive. Likewise, an upper spring plate 29 45 may be employed with each nest of springs, said upper spring plate desirably corresponding with the lower spring plate 27 except that it is advantageously provided with a desired form of positioning means 30 engaging in corresponding apertures 31 in the 50 bolster 12, in accordance with usual practice. Although the lower spring plate may also be formed with positioning means engaging in corresponding apertures in the spring plank as is customary, yet such a construction is 55 not necessary on account of the H-shape of said plate involving a proper positioning of the same, if accurately formed, without the necessity of auxiliary positioning means. 60 Although no spring retaining means is illustrated for connecting the spring plates and holding the springs in assembled position therebetween before insertion, it is obvious that such could be employed, if desired. 65 Because of the weight of the assembled springs

22 and 23, it might be quite difficult to insert them in place, an easier way being the insertion of the spring units, one at a time, after the spring plates are positioned.

Referring now to the embodiment of my 70 invention illustrated in Figures 14 and 15, a portion of a frame 1^c is there disclosed, the window opening 5^c of which is wider than that of the first embodiment so that the nest of springs may be inserted and removed as a 75 unit. In order that this may be effected, the distance between the bolster guiding portions 14^c of the frame is greater than the longitudinal length of the nest of springs so that said springs 22^c and 23^c may be held 80 in assembled position between spring plates 27^c and 29^c, said plates, in the present embodiment, being shown retained in assembled relation with respect to one another by retaining bolts 40 extending through the cen- 85 tral or intermediate spring units of the longitudinally disposed rows of springs, the heads of said bolts being received in the spring locating collars 41 for said springs, said collars, for that purpose, being em- 90 bossed to a sufficient degree for receiving said heads and apertured for receiving the shanks of the bolts. The registering collars 42 of the other spring plate are preferably similarly formed for receiving the nuts 43 95 in accordance with usual practice. The other spring positioning collars 28^c may be formed merely as cylindrical flanges of normal size for properly positioning the springs. 100

Although it is permissible to construct the spring plates 27^c and 29^c as shown in the first embodiment, yet it is preferable, in the present embodiment, on account of the 105 greater stiffness required therefor, because of the retaining means 40, to form the intermediate portion thereof along the longitudinal center line of the frame of greater width than that corresponding to the diameter of the central spring unit 23^c those portions 44 of the plates on either side of said 110 central unit and registering with the upwardly embossed portions 26^c of the spring plank 25^c being correspondingly embossed, thereby facilitating the proper nesting of 115 the spring plate 27^c with the spring plank 25^c. The upper spring plate 28^c need not be formed with corresponding embossments but, for the sake of uniformity and interchangeability, it is preferable to form said 120 spring plates of identical construction.

In order to allow for compression of the springs due to the load of the car, the spring plank 25^c and the spring plank seat portion 7^c may be provided with registering aper- 125 tures 45 and 46 in accordance with well known practice. Both spring plates are desirably, though not necessarily, formed with positioning means 30^c, those in the present embodiment being shown as conical bosses 130

adapted for reception in apertures or pockets 31° in the bolster 12° and 47 in the spring plank 25. The arrangement illustrated in these figures is very well adapted for the application of a simple liner or shim 48 between the upper spring plate 29° and the bolster 12° after said springs have taken a set in service, whereby it is possible to readily maintain the required height of the car body and associated couplers. Except as specifically described in connection with the modification illustrated in these figures, the construction may correspond with that of the first embodiment.

It will be clear that the advantage of the present embodiment over that of the first embodiment is that the nest of springs may be assembled at any convenient place before insertion under the bolster and the nest, as a whole, with its associated spring plates and retaining means, applied as a unit between the spring plank and the bolster. The only disadvantage of the present embodiment with respect to the first embodiment is that it involves handling a nest of springs of a relatively large weight.

Although only the arrangement corresponding with the seven spring unit nest is illustrated, it will be obvious that spring plates and retainers may be similarly used with any of the spring groupings illustrated in Figures 6 to 9, inclusive. In Figures 6 and 8, the retainers may either extend through the springs disposed on the longitudinal center line of the spring plank or inwardly and outwardly thereof on the longitudinal center line of said spring plank. In the arrangement illustrated in Figure 7, the spring retainers may occupy the same relative positions as with the seven spring unit nest or one retainer only may be employed extending through the central spring unit. In the arrangement shown in Figure 9, one or two spring retainers may be employed either positioned centrally of the four spring units or disposed along the longitudinal center line of the spring plank.

The spring plank 25 may be of uniform width corresponding with the width of the end portions thereof or may be of reduced width between the side frames, if desired. If of reduced width, the enlarged ends can be formed when using a blank of uniform width by reducing the height of the flanges 32 at the widened ends. These flanges may be still further reduced at the corrugations 26 to permit insertion and removal of the spring plank with respect to the frames 1.

In the present embodiment, the compression member 2 is illustrated as of a special U-section with an upper web 33 and depending flanges 34, the lower edges of which are preferably formed with beading 35 as most clearly shown in Figures 3 and 4. The horizontal or transverse section of the bolster

guide columns and particularly the bolster guiding portions 14 thereof desirably correspond substantially with the compression member except that the inner or bolster guiding portions 36 thereof may be flat instead of convex as shown for the compression member. The compression member and particularly the special shape or cross section thereof is not here described in detail nor claimed because this particular shape is made the subject matter of a separate application. The outwardly offset or lower portions of the bolster guide columns 4 may be laterally widened as indicated at 37 and bifurcated at 38 to permit the inclined reinforcing web 11 to pass therethrough.

Referring now to Figure 16, I have there shown a diagram to illustrate the theory of truss design by which the present side frame was constructed. The outline of the frame is illustrated diagrammatically by dot and dash line and the lines of force for the simple compression and tensile stresses in the frame are indicated by heavier lines extending approximately along the neutral axes of the various members. It should be pointed out that, in accordance with the present invention, I am attempting, as far as constructional limitations will permit, to eliminate the deflection incident to the middle or spring seat portion of the tension member, which is normally a relatively shallow semi-fixed beam, by incorporating in the main structure a double truss system, the main truss being a conventional three panel truss having two vertical members S^1 and S^2 corresponding to the bolster guide columns and carrying two approximately equal concentrated loads W^2 and W^3 at points approximating the intersection of the tension member with said bolster guide columns and the junctions between the horizontal and inclined portions of said tension member. The other or auxiliary truss approximates a simple triangle carrying a central load W^1 at the intersection of its tension members A^1 and A^2 , the compression member or members of said truss being common with the main truss and involving end compression portions C^1 and C^2 exteriorly of the bolster guide columns and an intermediate compression portion C^3 between the bolster guide columns. The end portions of the tension member of the main or three panel truss are indicated respectively at T^1 and T^2 and the intermediate or horizontal portion at T^3 . The reactions from the journals of the truck wheels (not shown) are designated by R^1 and R^2 .

From the foregoing, it will be seen that the compression portions of both trusses are embodied, in the first modification, as the compression member 2, the tension portions of the main truss are embodied as the main portions of the tension member indi-

cated by the web 7 and those portions of the member therebeneath. The vertical or strut portions of the main truss are indicated by the bolster guide columns 4. Considering the auxiliary truss, it will be seen that the tension members A^1 and A^2 thereof are embodied as the upper inclined webs 11 and the connecting webs 24, although as before pointed out these portions may be considerably varied in cross section and location. It will be seen that, with a grouping of springs as illustrated in Figures 1 and 2 the loads W^2 and W^3 would each approximately represent the capacity of two adjacent springs while the load at W^1 , theoretically carried by the auxiliary truss system described, represents the capacity of from one to three or more springs depending on the desired capacity of the truck.

Of course, it will be understood that the frame will not function in exactly this theoretical manner because the auxiliary truss will probably not carry all the springs on the longitudinal center line of the spring plank as some of the capacity thereof will create a central load on the beam portion T^3 . In other words, the distribution of the load between the main and auxiliary trusses will depend upon the relative deflections of said trusses and, as they are formed in one casting, it is impossible to exactly analyze the actual distribution. The theory of supporting loads transmitted from the bolster, however, is as shown in Figure 16 and, although in practical application it may not be possible to calculate the exact stresses on the various parts from this diagram, yet the application of this theory of design in the construction of the frame before described involves an increase in strength of said frame for a given amount of metal, because said metal is applied most advantageously for carrying the load distributed from the bolster by the spring arrangements heretofore mentioned.

From the foregoing description of a preferred embodiment of my invention taken in connection with the accompanying drawings, it will be seen that I have provided a truck involving a number of important improvements in side frame, spring plank and bolster design together with an improved spring arrangement. The spring group, in a preferred form thereof, is substantially square in outline with three springs on a side and the column springs omitted, a portion of the tension member being carried on a straight line or easy curve from beyond the bolster guide columns to near the center of the spring plank seat portion and more particularly to just beyond the center spring unit or transverse group of springs. This leaves a center flat portion on the spring plank seat portion of the frame of relatively narrow

width and provides means for directly supporting said spring plank seat portion at substantially the center thereof. This construction also serves to increase the diagonal depth of the tension member at the base of each bolster guide column, not by downward or outside projections or convolutions, as heretofore, but by upward or inside truss portions or reinforcements, thereby greatly stiffening the frame or permitting a decrease in weight thereof for a given strength.

The spring plank is designed to correspond with the construction of the spring plank seat portion and is preferably provided with corrugations corresponding to the upward embossments formed by the reinforcement described, thereby obviating the necessity of the usual squaring lugs and making it permissible to form the spring plank seat portion of the frame generally flat, although it will be obvious that the usual squaring lugs may also be used if desired. The bolster is preferably formed with rear or inner guides of full depth and front or outer guides decreased in depth to suit the window opening, which opening also corresponds with that required for the removal and insertion of the spring plank.

Although I have shown my invention embodied in a frame having members generally U or partially U shape in cross section, it is obvious that I do not wish to be limited to such construction, and said invention may be embodied in a frame in which the members are generally I, H, T or other shape in section.

Having now described my invention, I claim:

1. A side frame comprising a compression member, a tension member, struts spacing intermediate portions of said members and leaving a window opening therebetween, that portion of the tension member, beneath the window opening, being widened to form a spring plank seat portion, said tension member outwardly of said spring plank seat portion comprising inclined end portions, each of which consists of upper and lower portions angularly disposed with respect to each other.

2. A side frame comprising a compression member, a tension member, struts interposed therebetween and spaced to leave a window opening, that portion of the tension member, beneath the window opening, being laterally widened for supporting bolster springs, the tension member extending toward the ends of the frame from the spring supporting portion thereof to form diagonally disposed end portions, each end portion comprising a plurality of sections, one of said sections starting from near the center of the spring supporting portion and another section starting from near the adjacent end of

the spring supporting portion and each extending directly toward the adjacent end of the frame.

3. A side frame comprising a compression member, a tension member, struts spacing intermediate portions of said members and leaving a window opening therebetween, that portion of the tension member, beneath the window opening, forming a spring supporting portion, said tension member outwardly of said spring supporting portion comprising sloping end portions which are composed of transverse webs angularly disposed with respect to each other.

4. A side frame comprising a compression member, a tension member, bolster guide columns interposed therebetween and spaced to leave a window opening, that portion of the tension member, beneath the window opening, being adapted for supporting bolster springs, the tension member extending toward the ends of the frame from the spring supporting portion thereof to form diagonally disposed end portions, each end portion comprising a plurality of sections, one of said sections starting from near the center of the spring supporting portion and another section starting from near the adjacent end of the spring supporting portion and each extending directly toward the adjacent end of the frame.

5. A side frame comprising a compression member, a tension member, bolster guide columns spacing intermediate portions of said members and leaving a window opening therebetween, that portion of the tension member, beneath the window opening, being adapted to support a nest of springs comprising an intermediate spring and end springs, said tension member being generally horizontal beneath said springs with end portions thereof extending diagonally outward and upward beyond those portions for supporting the end springs, another portion of said tension member extending diagonally outward and upward immediately beyond a portion thereof for supporting an intermediate spring.

6. A side frame comprising a compression member, a tension member, bolster guide columns interposed therebetween and spaced to leave a window opening, that portion of the tension member, beneath the window opening, being adapted for supporting bolster springs, the tension member extending towards the ends of the frame from the spring supporting portion thereof and consisting of an upper web portion and another web portion disposed therebeneath, said portions starting from different parts of the spring supporting portion of the tension member and converging at their upper and outer ends.

7. A side frame comprising a compression member, a tension member, bolster guide

columns spacing intermediate portions of said members and leaving a window opening therebetween, that portion of the tension member, beneath the window opening, having an upper web portion adapted for supporting bolster springs, said portion between the bolster guide columns being substantially square in outline and adapted to support a spring on the transverse center line thereof and two longitudinal rows of springs on opposite sides of the longitudinal center line thereof, that portion of the web beyond the central spring being bifurcated with the central portion thereof extending straight upwardly and outwardly toward the ends of the frame with those portions thereof on opposite sides continued horizontally to underlie the end springs of the longitudinal rows of springs and then continued diagonally outward and upward toward the ends of the frame.

8. A side frame comprising a compression member, a tension member, bolster guide columns interposed therebetween and spaced to leave a window opening, that portion of the tension member, beneath the window opening, being adapted for supporting bolster springs, said tension member outwardly of said bolster springs comprising an upper web extending directly from approximately the center spring of said bolster springs and an intermediate web portion extending directly outward and upward from the end springs.

9. A side frame comprising a compression member, a tension member, bolster guide columns spacing intermediate portions of said members and leaving a window opening therebetween, that portion of the tension member, beneath the window opening, forming a spring supporting portion, said spring supporting portion comprising a horizontal web substantially H-shape in plan, those portions of the web between the ends of the uprights of the H being raised and extended directly diagonally upward and outward toward the ends of the frame to increase the diagonal depth of the tension member at the base of the bolster guide columns.

10. A side frame comprising a compression member, a tension member, bolster guide columns interposed therebetween and spaced to leave a window opening, that portion of the tension member, beneath the window opening, being constructed for supporting bolster springs, the strength of said tension member beneath the bolster guide columns being increased by raising the intermediate portion of the upper web thereof to form a section beneath each bolster guide column substantially like a hollow inverted T.

11. A side frame comprising a compression member, a tension member, bolster guide columns spacing intermediate por-

tions of said members and leaving a window opening therebetween, that portion of the tension member, beneath the window opening, being adapted to support bolster springs, said portion comprising a single web adjacent the central portion of the bolster opening and having a transverse portion thereof extending diagonally upward and outward from the intermediate part thereof between the bolster guide columns, the main portion of said web, at each bolster guide column, extending diagonally upward and outward to converge with respect to the intermediate portion thereof.

12. A side frame comprising a compression member, a tension member, bolster guide columns interposed therebetween and spaced to leave a window opening, that portion of the tension member, beneath the window opening, being formed for supporting bolster springs, the main portion of said member between the bolster guide columns being horizontally disposed with a portion thereof adjacent the longitudinal center line of the frame raised above the main portion and carried through the bolster guide columns to merge with the main portion near the center of the spring supporting portion.

13. A side frame comprising a compression member, a tension member, bolster guide columns spacing intermediate portions of said members and leaving a window opening therebetween, that portion of the tension member, beneath the window opening, having an upper web portion adapted for supporting bolster springs, said portion between the bolster guide columns being substantially square in outline and adapted to support an intermediate spring and two longitudinal rows of springs on opposite sides of the longitudinal center line thereof, that portion of the web beyond the intermediate spring being upwardly embossed with the central portion thereof extending directly upwardly and outwardly toward the ends of the frame with those portions thereof on opposite sides continued horizontally to underlie the end springs of the longitudinal rows of springs and then continued diagonally outward and upward toward the ends of the frame.

14. A side frame comprising a compression member, a tension member, bolster guide columns spacing intermediate portions of said members and leaving a window opening therebetween, that portion of the tension member beneath the window opening being generally box shape in cross section and having an upper web portion adapted for supporting bolster springs, said portion between the bolster guide columns being substantially square in plan and adapted to support an intermediate spring adjacent the longitudinal center line of the frame and two longitudinal rows of springs on oppo-

site sides of said center line, that portion of the web beyond the intermediate spring being upwardly embossed with that portion adjacent the longitudinal center line of the frame extending directly upwardly and outwardly toward the ends of said frame, those portions of the web on opposite sides continued horizontally to underlie the end springs of the longitudinal rows of springs and then continued diagonally outward and upward toward the ends of the frame at a steeper angle than the central portion thereof.

15. A side frame comprising a compression member, a tension member, bolster guide columns spacing intermediate portions of said members and leaving a window opening therebetween, that portion of the tension member, beneath the window opening, being generally box shape in cross section and having an upper web portion adapted for supporting bolster springs, said portion between the bolster guide columns being substantially square in plan and adapted to support an intermediate spring adjacent the longitudinal center line of the frame and two longitudinal rows of springs on opposite sides of said center line, that portion of the web beyond the intermediate spring being upwardly embossed with that portion adjacent the longitudinal center line of the frame extending directly upwardly and outwardly toward the ends of said frame, those portions of the web on opposite sides continued horizontally to underlie the end springs of the longitudinal rows of springs and then continued diagonally outward and upward toward the ends of the frame at a steeper angle than the central portion thereof, the lower web of the tension member being curved beneath the bolster guide columns and continued upwardly and outwardly toward the ends of the frame at a steeper angle than those of the other web portions.

16. A side frame comprising a tension member, said member being, in effect, a central horizontal beam portion supported at each end by diagonal end portions and adjacent its center by other diagonal portions.

17. A side frame comprising a compression member, a tension member, bolster guide columns spacing intermediate portions thereof, that portion of the tension member, between the bolster guide columns, comprising a beam supported by said columns and diagonal end portions of the tension member merging with the ends thereof, the central portion of said beam portion of the tension member being directly supported by other diagonal portions extending outwardly and upwardly through the bolster guide columns.

18. A side frame comprising a compression member, a tension member, struts spacing intermediate portions of said members and leaving a window opening therebetween,

that portion of the tension member, beneath the window opening, being adapted to support bolster springs and reinforced by inclined bracing portions extending longitudinally of the frame from either side of the central portion thereof to the struts.

19. A side frame comprising a compression member, a tension member, struts spacing intermediate portions of said members and leaving a window opening therebetween, that portion of the tension member, beneath the window opening, being adapted to support bolster springs and reinforced by inclined bracing portions extending from said tension member on either side of the central portion thereof longitudinally of the frame, intersecting said struts and continuing above those portions of the tension member beyond the window opening.

20. A side frame comprising a compression member, a tension member, bolster guide columns spacing intermediate portions of said members, leaving a window opening therebetween, that portion of the tension member, beneath the window opening, being generally horizontal and reinforced by upwardly and outwardly inclined portions, each of said portions extending, from a point between the lower portion of a bolster guide column and the center of the tension member beneath the window opening, upwardly and outwardly past said bolster guide column toward the corresponding end of the frame above the main portion of the tension member, said main portion following the lines of said reinforcement toward the end of the frame.

21. A side frame comprising a compression member, a tension member, bolster guide columns interposed therebetween and spaced to leave a window opening, that portion of the tension member, beneath the window opening, being adapted for supporting bolster springs, the deflection normally incident to the intermediate portion of said spring supporting portion being minimized by auxiliary truss members extending upwardly and outwardly from near the central portion of said spring supporting portion above the inclined end portions of the tension member toward the ends of the frame.

22. A side frame comprising a compression member, a tension member, bolster guide columns interposed therebetween and spaced to leave a window opening, the construction, adjacent the junctions between the bolster guide columns and tension member, being reinforced by auxiliary diagonal tension members which cut across the lower corners of the bolster opening and extend upwardly and outwardly toward the ends of the frame.

23. A side frame comprising a compression member, a tension member, bolster guide columns spacing intermediate portions of

said members and leaving a window opening therebetween, that portion of the tension member, beneath the window opening, forming a seat for supporting the bolster springs, said seat being reinforced by diagonal tension members cutting across the same and extending upwardly and outwardly toward the ends of the frame.

24. A side frame comprising a compression member, a tension member, bolster guide columns spacing intermediate portions of said members and leaving a window opening therebetween, that portion of the tension member, beneath the window opening, being generally box shape in cross section with upper and lower web portions, said lower web portion curving beneath the bolster guide columns and continuing to the junctions with the compression member, the upper web portion continuing upwardly and outwardly toward the ends of the frame but terminating short of the junctions with the compression member, the loss of said upper web portion being compensated for by increasing the thickness of the lower web portion.

25. In a car truck, in combination, a side frame formed with compression and tension members spaced at intermediate portions thereof by bolster columns leaving a bolster opening therebetween, the tension member, beneath the bolster opening, being formed with a spring seating portion substantially square in plan, and a nest of springs supported on said spring seating portion, said nest being arranged with three spring units on a side omitting the units at the bolster columns.

26. In a car truck, in combination, a side frame comprising compression and tension members spaced at intermediate portions thereof by bolster guide columns, leaving a window opening therebetween, that portion of the tension member, beneath the window opening, being laterally widened with the junction between it and the bolster guide columns reinforced by upwardly embossed portions extending along the longitudinal center line thereof from near the center through the bolster guide columns toward the ends of the frame, a nest of springs supported on said portion, said springs being arranged in two longitudinal rows lying on each side of the upwardly embossed portions and a central spring positioned between said rows and embossed portions.

27. In a car truck, in combination, a side frame comprising a compression member, a tension member, bolster guide columns interposed therebetween and spaced to leave a window opening, that portion of the tension member, beneath the window opening, being formed for supporting a nest of springs and reinforced with respect to the bolster guide columns by triangular upward embossments between the ends of said portion and the

bolster guide columns, said embossments lying along the longitudinal center line of the frame and a row of springs positioned on each side of said embossments and longitudinally disposed with respect to the frame, other springs disposed along the transverse center line of said frame and a bolster supported on said springs, said bolster being formed with rear guiding lugs extending the full depth thereof and with front lugs of reduced depth to permit insertion and removal thereof over the reinforcing embossments.

28. In a car truck, in combination, a side frame comprising a compression member, a tension member, bolster guide columns spacing intermediate portions of said members and leaving a window opening therebetween, that portion of the tension member, beneath the window opening, being formed with embossments extending from the ends thereof to the bolster guide columns, a spring plank supported on said tension member and formed with corrugations interlocking with the embossments to maintain said plank in proper relation with respect to the frame, a nest of springs supported on said spring plank and arranged substantially H-shape in plan, the uprights of said H lying longitudinally of the frame on opposite sides of the corrugations of the spring plank and the cross part of the H lying longitudinally of the spring plank between the embossments thereof.

29. In a car truck, in combination a side frame comprising a compression member, a tension member, bolster guide columns spacing intermediate portions of said members and leaving a window opening therebetween, that portion of the tension member, beneath the window opening being formed with embossments extending from the ends thereof to the bolster guide columns, a spring plank supported on said tension member and formed with corrugations interlocking with the embossments to maintain said plank in proper relation with respect to the frame, a nest of springs supported on said spring plank and arranged substantially H-shape in plan, the uprights of said H lying longitudinally of the frame on opposite sides of the corrugations of the spring plank and the cross part of the H lying longitudinally of the spring plank between the embossments thereof, a bolster supported on said nest of springs, said bolster being formed with rear guides of full depth and with front guides of reduced depth to agree with the reduced depth of the window opening adjacent the bolster guide columns.

30. In a car truck, in combination, a side frame formed with compression and tension members spaced at intermediate portions thereof by bolster guide columns, leaving a bolster opening therebetween, the tension

member, beneath the bolster opening, being formed with a spring seating portion adapted to support a nest of springs comprising a spring disposed on the transverse center line of said frame, the spring seating portion of said frame being reinforced by members extending upwardly and outwardly therefrom on either side of said spring and between the springs of the nest transversely disposed with respect to said spring.

31. In a car truck, in combination, a side frame comprising compression and tension members spaced at intermediate portions thereof by bolster guide columns, leaving a window opening therebetween, that portion of the tension member, beneath the window opening, being laterally widened for supporting a nest of springs arranged in two longitudinal rows with a spring positioned on the transverse center line of the frame, said spring supporting portion of the tension member being reinforced by inclined members extending upwardly and outwardly therefrom between the endmost springs of the longitudinal rows of springs.

32. In a car truck, in combination, a side frame comprising a compression member, a tension member, bolster guide columns interposed therebetween and spaced to leave a window opening, that portion of the tension member, beneath the window opening, being formed for supporting a nest of springs and reinforced by inclined portions extending upwardly and outwardly from intermediate springs of said nest of springs toward the ends of the frame, said spring seat portion being extended longitudinally of the frame in a substantially horizontal plane to provide for supporting the end springs of said nest of springs.

33. A nest of bolster springs formed as two rows with a central spring positioned directly between intermediate springs of said rows making a nest substantially H-shape in plan.

34. A nest of springs substantially H-shape in plan, the uprights of said H being formed as two rows of spring units and the cross part of said H comprising a transverse row of spring units.

35. A nest of springs substantially H-shaped in plan, and formed as two rows of spring units adapted to extend longitudinally of an associated frame with another row of units forming the cross part of the H adapted to extend transversely of the frame, spring plates positioned one above and one below said nest of springs and retaining means extending through said spring plates for holding the springs together before assembly with said frame.

36. A bolster formed with front or outer guide lugs extending from the lower portion thereof and terminating short of the upper

portion to facilitate insertion and removal of said bolster with respect to associated side frames.

37. A bolster formed with rear guide lugs extending the full depth thereof and front guide lugs of reduced depth to permit insertion of said bolster in the window opening of a side frame which is of reduced size.

38. A truck bolster comprising inner guide portions adapted to cooperate with the bolster guide columns of a side frame and extending the full depth of the bolster and outer guide portions extending only part of the bolster depth and terminating short of the upper portion thereof to facilitate insertion and removal with respect to a special side frame.

39. A spring plank formed with triangular corrugations at the sides thereof near the ends, said corrugations serving to interlock with corresponding embossments on the spring plank seat portion of a side frame.

40. A spring plank substantially U-shape in cross section and formed near each end thereof with triangular corrugations flaring upwardly from near the longitudinal center line thereof, said corrugations serving to interlock said spring plank with correspondingly formed portions on an associated side frame.

41. A spring plate for a nest of springs formed generally H-shape in outline and provided with spring positioning collars on the uprights and cross-piece of said H, the outline of said H between the upper and

lower ends of said uprights being curved to engage corresponding corrugations on either side of an associated spring plank and properly position said plate.

42. A spring plate for a seven unit nest of springs formed generally H-shape in plan and provided with three spring positioning collars on each upright and a spring positioning collar on the cross-piece thereof, said plate being adapted to engage bosses on the spring plank between the uprights thereof for maintaining said plate in proper position.

43. A spring plate for a nest of springs comprising a flat portion generally H-shape in outline and provided with spring positioning collars for properly locating said springs and corrugated portions extending between the upper and lower ends of the uprights of said H for interlocking with corresponding corrugations on the sides of an associated spring plank.

44. A spring plate for a seven unit nest of springs formed generally H-shape in plan and provided with a row of spring positioning collars on each upright and a spring positioning collar on the cross-piece thereon, an intermediate spring positioning collar on each upright being adapted to engage retaining means for connecting said spring plate with another spring plate associated therewith.

In testimony whereof I affix my signature.

DONALD S. BARROWS.