May 11, 1937. C. R. BUSCH 2,079,985

REBOUND REDUCING MEANS FOR CAR-TRUCK SPRINGS

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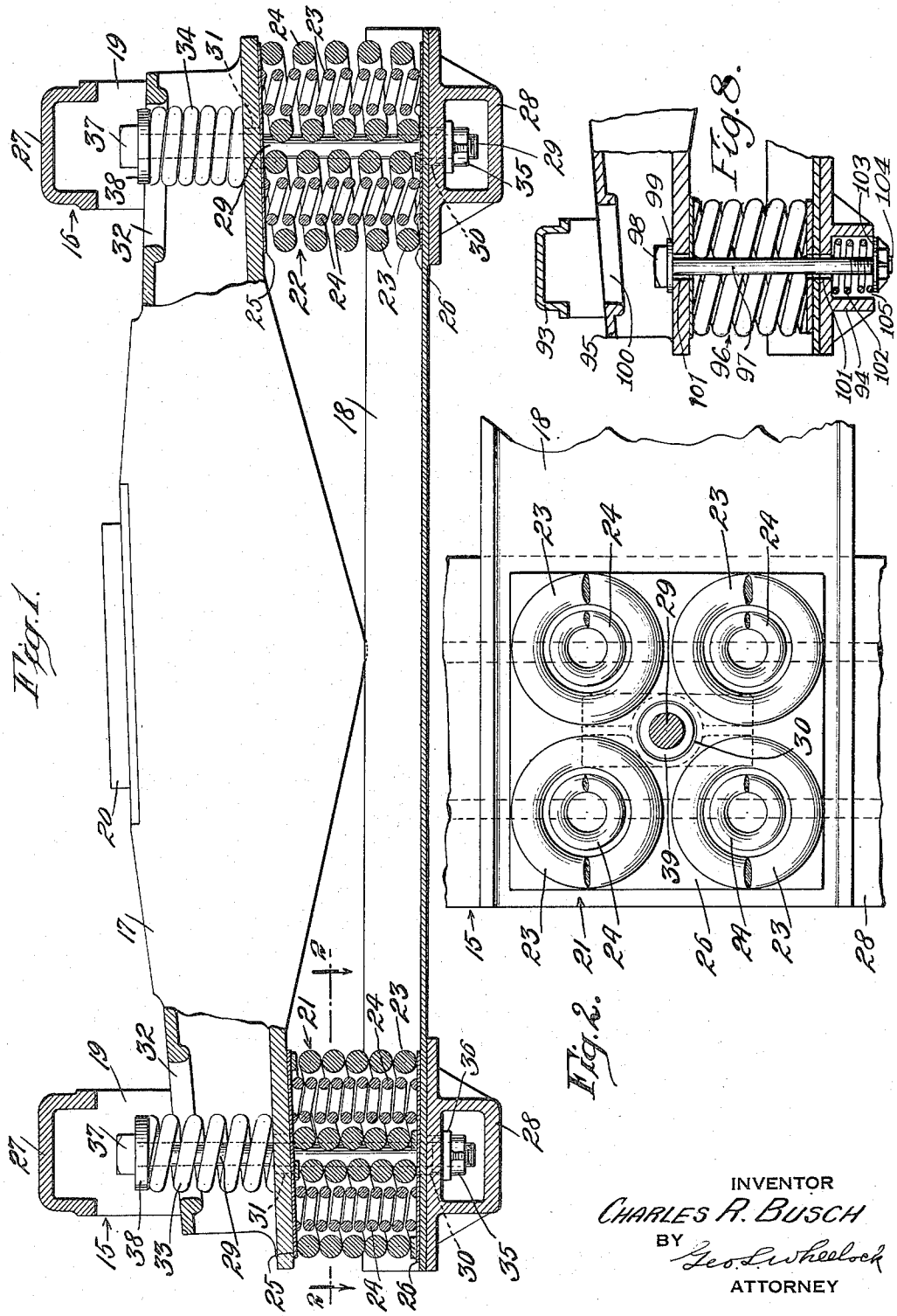


Fig. 1.

Fig. 3.

Fig. 2.

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Fig. 3.

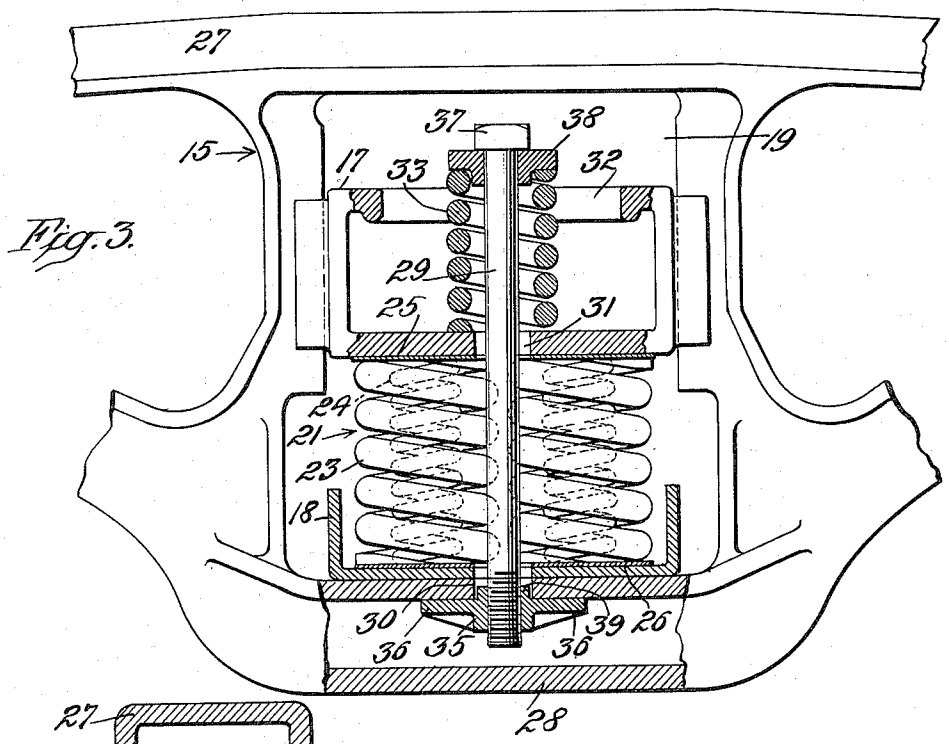


Fig. 4.

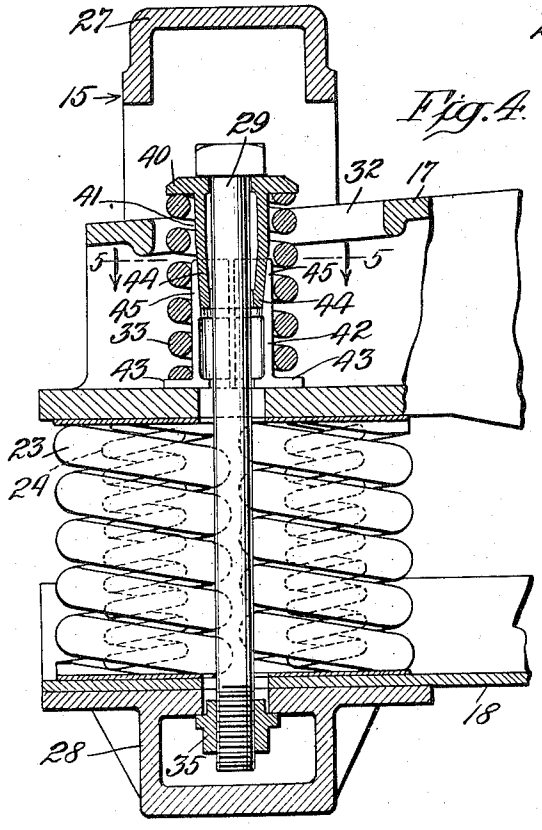
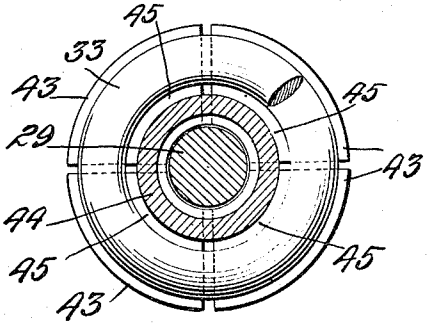


Fig. 5.



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Fig. 7.

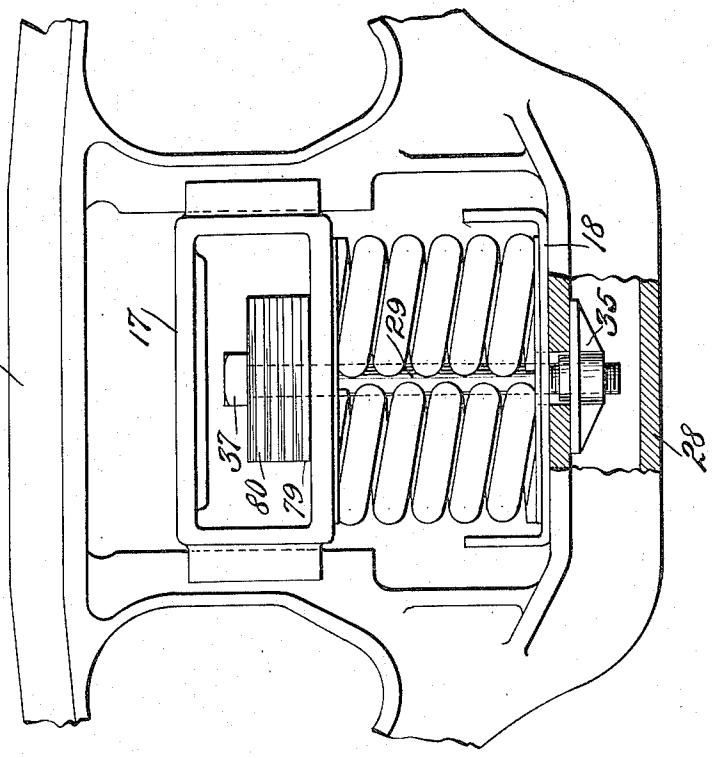
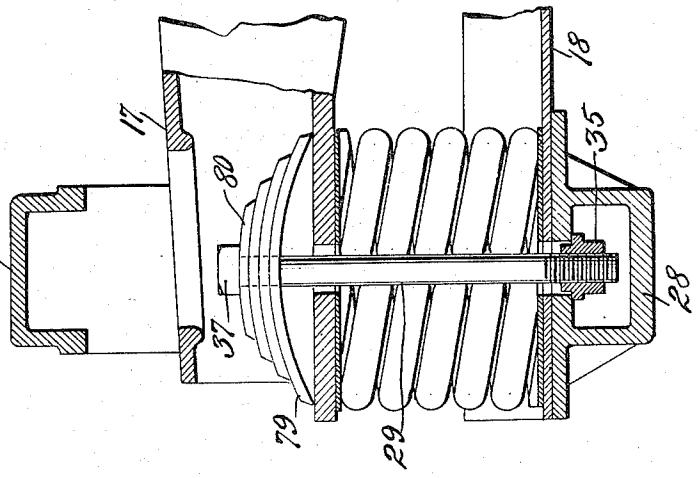


Fig. 6.



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Patented May 11, 1937 2,079,985

UNITED STATES PATENT OFFICE

2,079,985

REBOUND REDUCING MEANS FOR CAR-TRUCK SPRINGS

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Application November 22, 1933, Serial No. 699,119

10 Claims. (Cl. 105—197)

As is well known there has been in the railroad art during the last quarter of a century or more a steady and rapid increase in the demands of the traffic on both railway car equipment and on the roadways. This has been marked by greater weights of engines and cars, greater length of trains, greater speed and greater numbers of trains per unit of time over the roadways. In particular these conditions have imposed greatly on the cars and the car equipment, and requests are constantly being made by railway engineers and others to keep step with the demands required by the conditions stated, and hence there is a constant demand for increased improvement which is ever facing the difficulty of finding the most satisfactory railway car equipment. The conditions referred to not only present themselves on curves, but even upon tangents, inasmuch as on tangents there may be incipient faults in the track equipment which react upon the car equipment more or less injuriously, depending upon the construction of the track equipment and its condition. Therefore, safety as well as economy and many other obvious desideratums demand railway car equipments capable of meeting modern railroad needs. Many of the faults due to the aforesaid conditions are inherent in railway car springs, especially in the springs of freight cars. The type of spring generally used is the helically coiled type which due to the extreme length of the bar of such a spring has proven to be the best for freight car service, as the load on or lading of the car varies greatly from light to full capacity.

Today there are approximately fifty million of such helical springs in use in railway service, and hence important factors to be considered with respect to these alone are their extreme safety, durability and low maintenance cost, and the conditions or increasing demands above stated affect such springs in particular. The increase in trains and speeds have brought into play a definite factor in the performance of a railway car that is extremely detrimental, and which is known as "car-roll", this being traced to the action of the car springs in the last analysis. For example, when the front truck of a car enters a curve the line of force of the center of gravity at the rear truck may shift to a point midway between the side bearing at the inner sweep of the curve and the adjacent outside edge of the center plate, thereby causing the springs at the opposite side of the truck to unload by approximately sixty-six per cent. That is, this may be the effect of static loads, and it can readily be understood that the effects of dynamic loads, with the car running thirty, forty or sixty miles per hour, produce a very similar action should there be low rail joints, track warp or defects in the track equipment.

The single example above given is with respect to the beginning of the car roll, and once the car body is tilted due to the high center of gravity the car body falls back with a teetering motion. This teetering motion is aided materially by the unloading of the car springs, and then the speed of the train sets up a motion termed "harmonic action". Once this action starts, the extent of time during which it continues is determined only by the speed of the train when it reaches a critical point, which may result in damaged ladings, burnt or broken wheel flanges, broken or spread rails, hot boxes, broken springs and frequently derailments. Such a helical spring in a car truck unloads or rebounds with practically the same relative force that is required to compress it, and it does not contain any reactionary forces to break up or reduce this rebound. The helically coiled spring is the most ideal for railway service due to the fact that the overall height of such a spring is limited by the standard coupler height and the fact that four or five million car trucks are designed for this type of spring, there being a number of such springs from four to twelve grouped or assembled in nests known as "spring nests". Heretofore attempts have been made to in a measure take care of the demands on the car equipment by introducing modifications of the spring nests themselves, but the present invention widely departs therefrom by making use of the same spring nests or the like which are now being used.

With all of the above in mind, an object of the present invention is to provide a rebound reducer or absorber which readily may be applied to the present standard car truck using the present springs and truck parts, all of which units are of known design and are improved on a service basis for one hundred years, and to do so without disturbing these parts and with the least number of parts and low weight possible. To this end the preferred improvement consists in a rebound reducer in the form of a helically coiled spring or a coil spring and a friction device, the spring having open or separated coils which when compressed to normal will act instantly, such rebound reducing spring being disposed in opposing relation to the main or truck springs. The rebound reducing springs are preferably set under tension so that as the car supporting springs move downwardly the rebound reducing springs must follow so as to maintain the correct ratio of capacity. In order to operate under tension means are provided for its accomplishment, in the form of a compression adjuster of simple construction which may operate through either the compression or tension members of a truck side frame and such adjuster includes a tension bolt or rod preferably passing through the rebound reducing spring, and through the

truck bolster, the spring nest, the spring plank where and if that is used. In most cases the members of the car truck are not altered and the standard corings, holes, seats, etc. may be employed, so that if desired little if any change need be made in the truck members. While a helically coiled spring is preferred a leaf-spring can be used with the rebound reducer.

As the action of the supporting springs of the car is downward it is necessary to compress the rebound reducing or absorbing spring to a point where its capacity will be sufficient to break up the cycle of rebound which occurs with the usual railway car springs. The point at which the rebound reduction will satisfactorily occur will vary with the capacity of the car springs, but a definite ratio, travel, and free and solid heights of both types of springs should be maintained, and once the cycle of rebound is broken in the railway car springs, the harmonic action of such springs cannot develop.

By locating the rebound reducing means in accordance with the present invention, this not only makes the application thereof a simple one, but affords direct action on the railway car springs. In addition to the absorbing capacity of the rebound reducing means, the location permits added effectiveness because of the leverage created, for as the railway car body is carried on a center plate with two side bearings on each side thereof with a large clearance, it will be understood that when the car enters upon an unlevel track or low joints, the car body will tilt to the low side bearing due to its high center of gravity and the load line will accordingly shift from the center line outward to a point even as far as the side bearing, which action creates a lever arm movement on the opposite rebound reducing spring, thus increasing its capacity in proportion to the low elevation which is encountered.

The preceding pointing out some of the important objects of the present invention, the same consists of certain features of construction and combinations of parts to be hereinafter described and claimed and explained in connection with the accompanying drawings illustrating preferred and modified features of the present invention, and in which

Fig. 1 is a sectional elevation transversely of a railway car truck showing a preferred embodiment of the invention, and wherein the truck bolster is shown in a tilted position such as may occur when a spring nest at one side of the car truck may be compressed and the spring nest at the other side unloaded;

Fig. 2 is an enlarged detail section on the line **2—2**, Fig. 1, in the direction of the arrows;

Fig. 3 is a broken side elevation as viewed from one side of the car truck partly represented in Fig. 1, the view being partly in section;

Fig. 4 is a broken sectional elevation of parts of a car truck showing a modified addition to what is shown in Figs. 1, 2 and 3;

Fig. 5 is an enlarged transverse section on the line **5—5**, Fig. 4, in the direction of the arrows, wherein the truck bolster is omitted;

Fig. 6 shows another modification partly in section and in elevation transversely of a car truck, this modification disclosing an elliptic spring in substitution for the helical rebound reducing spring of the preceding figures;

Fig. 7 is a side elevation of the parts shown in Fig. 6;

Fig. 8 is a modification showing parts in elevation and in section transversely of a car truck, the rebound reducing spring being anchored to the car truck bolster instead of to the compression or tension members of the side frame as in the preceding views.

In the drawings, only parts of the usual members of a railway car truck is shown, for to fully understand the invention it is unnecessary for those skilled in the art to have the other members of the car truck illustrated. Referring to Figs. 1, 2 and 3 the illustrated well known members of a freight car truck body are the side frames **15**, **16**, truck bolster **17**, and spring plank **18**, the side frames **15**, **16** having large openings **19** for receiving and guiding the ends of the truck bolster, and the truck bolster having a center plate **20** on which the bolster of the body of the car rests and is supported in well known manner. Spring nests or clusters of springs **21**, **22** may each comprise four springs **23** made of large gauge spring bar metal, within which are arranged four smaller springs **24** made of spring bar metal of smaller gauge, such spring nests or clusters being confined between end plates **25**, **26**. Such spring nests or clusters are well known in the art. These spring nests may be applied and inserted between the ends of the bolster **17** and the spring plank **18** upon which they rest, in the usual manner. These members are preferably of the usual types of construction, and it is unnecessary to make any substantial changes in them, and preferably no changes, in order to carry out the invention to be described, although it may be possible to omit the spring plank.

In the usual manner each side frame **15**, **16** preferably includes the compression member **27** and the tension member **28** which extend along the upper and lower portions, respectively, of each side frame. The improvements to be described herein are best located between the coincident vertical side planes of each side frame and are anchored to tension member **28**, although in other forms of the invention the anchorage may be otherwise obtained. A bolt or rod **29** which is preferably positioned substantially coincident with the vertical axis of each spring nest **21** or **22** extends through a hole **30** in the upper web of the tension member **28**, through a hole **31** in the bottom of the bolster and a hole **32** in the top of the bolster, which is usually hollow, and as there are two such bolts or rods **29**, one at each end of the truck bolster, a description of the concomitantly associated parts of one of them will suffice for the other.

Each bolt or rod **29** passes through a helically coiled spring, one spring **33** at one end of the bolster having a counterpart spring **34** at the other end. The bars of these helical springs **33**, **34** are preferably of large gauge, say an inch or somewhat less in diameter. Each helical spring **33**, **34** is here shown as being seated at its lower end upon the corresponding end portion of the bottom of the bolster, so that it is located within the hollow of the bolster. These helical springs **33**, **34** will be referred to herein as rebound reducing or absorbing springs, inasmuch as the construction and arrangement of the parts is such that they act to check the rebound which is due to the unloading action of the spring nests **21**, **22**.

In order to anchor each bar or rod **29** in place, that is to provide an abutment or fixation point for each rod **29**, a nut **35** is screwed onto the screw threaded lower end of the rod which screw threaded end extends into the hollow portion of

the tension member 28, while the nut 35 is positioned in such hollow. Each nut 35 is provided with extensions forming wings 36, so that a locking or anchoring member is provided which is of elongated shape, as shown clearly in Figs. 2 and 3. The locking element is inserted into the hollow of the tension member 28 and the bolt or rod 29 is screwed thereinto, it passing at this point through the hole 30. The elongation of the locking element 35, 36 prevents substantial turning thereof when screwing the bolt thereinto inasmuch as the length of the element is greater than the width of the hollow of the tension member in which it is located. The bolt or rod 29 is provided with a head 37 shaped to receive a suitable wrench and such head preferably extends above the bolster for the convenient application of the wrench. A spring centering cap and seat 38 is positioned under the head of each bolt 29 and provides a suitable abutment centering and seating for the upper end of each rebound reducing spring 33, 34. A boss 39 is preferably formed on the nut 35 of the locking element so as to enter the hole 30 in the upper wall of the tension member of the side frame, thereby to center the bolt or rod 29. Clearance is provided between the boss 39 and the wall of the hole 30 and clearance is also provided between the bolt or rod 29 and the wall of the hole 31 in the bolster, inasmuch as under certain conditions it may be necessary for the bolt to have a slight lateral movement when the car truck is in motion.

When the bolts or rods 29 have been screwed into the locking elements at their lower ends they are screwed in sufficiently or adjusted inwardly or outwardly to such position as to set the rebound reducing springs 33, 34 under preferably one inch of initial compression, so that while such springs are under compression their coils are yet open or separated and not jammed together. When the described improvements are properly installed in a car truck, the coils of the rebound reducing springs will be open between the coils and there will be allowed the proper or ordinary clearances between the truck bolster and the tension members of the side frames and between the well known side bearings at opposite sides of the car truck, the condition thus established being that for a light car, that is one with the car body unloaded, which will assure a position of the bolster normal to the truck. When a car body having a truck provided with the present improvements is unloaded, the rebound reducing springs will therefore have been initially set under compression, so that each such spring may either expand or contract under the conditions established by the action of the spring nest, and the rebound reducing springs will act in direct opposition thereto, with the result that even with a light car the teetering thereof is absorbed, reduced or checked, inasmuch as there is a rebound reducing spring at each end of the bolster, the two working together. By referring to Fig. 1 it will be seen that the bolster 17 has been tilted, and this may be due to various forces established by the car running along a track, particularly when a car truck at the rear end of a car body enters a curve, or when there may be warpage of the track either on curves or tangents, and such a tilt of the bolster may be otherwise established by the car body changing its center of gravity. It will be seen that when one end of the truck bolster tilts downwardly, the compression of the spring nest 21 will result, but that on the unloading of such spring nest which causes the rebound, the opposing rebound reducing spring 33 will tend to check or absorb the same. At the same time that one end of the bolster 17 moves downwardly, the other end thereof will move upwardly, as shown in Fig. 1, with the result that the spring nest 32 at that end will expand, while the opposing rebound reducing spring 34 will be contracted and when it expands it will greatly assist the spring nest 21 at the other end of the bolster in returning the same to a position normal to the truck.

In other words, inasmuch as a light car has a high center of gravity, the unloading of the spring nests such as 21, 22 causes the car body to roll and when it begins to roll the unloading of the springs 21, 22 would tend to create a harmonic action thereof, which unless dissipated as by the present improvements, great damage to the ladings, if a car will be loaded, is caused, and in some cases derailments are caused. It will be understood that if a car having a car truck provided with the present improvements is loaded more or less, that the spring nest will be slightly compressed and the rebound reducing springs slightly expanded beyond the normal open position of the coils of springs 33, 34. Each rebound reducing spring will have a more or less definite ratio to the car truck springs, so that whether a car is loaded or unloaded, such springs may compress downwardly, while the rebound reducing springs 33, 34 retard the rebound by breaking it up to the capacity of the rebound reducing springs. It will be noted that the ultimate travel of the rebound reducing springs is greater than the ultimate travel of the car truck springs 21, 22 to prevent breakage of the springs.

In Figs. 4 and 5 of the drawings there is illustrated a modification of the invention as shown in Figs. 1, 2 and 3, such modification residing in means for establishing friction, with a tendency to cause the rebound reducing springs to somewhat balk against any tendency to compress them by the unloading of the spring nests at either end of the bolster. In Figs. 4 and 5 and the remaining figures of the drawings the same reference numerals will ordinarily be used for the principal members of a car truck as have been used in connection with Figs. 1, 2 and 3.

The side frame 15 may as before include the customary compression member 27 and tension member 28 and bolster 17 which is supported by the springs 23, 24 of the spring nest which receives its support from the tension member 28, although resting on the spring plank 18. As before the headed bolt or rod 29 extends approximately midway of the thickness of the side frame so as to extend upwardly approximately coincident with the central vertical axis of the spring nest, its upper end protruding through the opening 32 in the top of the bolster. The upper end of the rebound reducing spring 33 is seated against the cap or flange 40 which is confined under the head of the bolt 29, and integrally with the same there is provided a spreader member 41 forming a male member which is confined within the upper coils of the spring 33. The male member 41 is adapted to act upon a sectional expansion or female member, including in each section a vertical portion 42 provided at its lower end with a base flange 43 which rests upon the bottom of the bolster 17. These sections of the female member are preferably four in number so as to provide a split sleeve which is located within the lower coils of the spring 33 so as to surround

the bolt or rod 29 and to receive the lower end of the male member 41. The male member or spreader is formed with a conical or tapering lower end 44 which engages complementarily tapered upper ends 45 of the vertical portions 42 of the female member.

Inasmuch as the helical coils of the spring 33 are separated or spaced apart when the bolster is in a position normal to the truck and the entire assembly is anchored by the bolt or rod 29 to the tension member 28 of the side frame, it will be seen that if the corresponding end of the bolster should move above such normal position, the spring 33 will be compressed. When pressure is exerted on the assembly the friction device 41, 42 is contracted, inasmuch as the tapered end of the spreader 41 drives into the sections of the female member, which causes the latter to tend to expand the coils of the spring 33, thereby creating a considerable friction force on the respective frictionally engaged surfaces. This action plus the load necessary to compress the spring 33 creates tremendous shock absorbing qualities. Therefore, this modification in Figs. 4 and 5 provides a friction rebound absorbing or checking means against extraordinary upwardly directed loading forces. As the spring 33 is seated upon the flanges 40 and 43 it causes the friction units to release from each other by the expansion of such spring when the load is released.

Inasmuch as in the modification illustrated in Figs. 6 and 7 some of the parts are the same as in Figs. 1 to 5 inclusive, the same reference numerals are used for corresponding parts. The side frame includes the usual compression member 27 and tension member 28, together with bolster 17, spring nest 18, bolt or rod 29 having the wrench head 37, and the nut 35, whereby the bolt 29 and hence the abutment member 37 are anchored in a fixed position relatively to the tension member 28. The only structural difference between what is disclosed in Fig. 1 and in Figs. 6 and 7 is that in the latter the rebound reducing spring which opposes the supporting springs for the bolster is of the semi-elliptic type of laminated spring leaves. In this modification the longer semi-elliptic leaf 79 rests at its ends upon the bottom of the bolster, while the shorter leaf 80 abuts the head 37 of the bolt or rod 29. The laminated elliptic spring has the bolt or rod 37 passed through the middle thereof and it also is to be set under initial compression, so that the bolster 17 may compress the elliptic spring 79, 80 when it is shifted above its position normal to the truck and will be acted upon by such elliptic spring on the rebound of the spring nest supporting it. Preferably the elliptic spring extends longitudinally with the bolster in this modification, inasmuch as it is located in the hollow of the bolster. On account of the required length of the semi-elliptic spring 79, 80 its ends will extend somewhat beyond the opposite sides of the side frame.

In Fig. 8 a further modification is illustrated wherein a rebound reducing spring is positioned at the tension member of the side frame. The compression member 93 and tension member 94 are the same as previously, except that it may be necessary to specially form the tension member or to cut a hole in the bottom thereof. Bolster 95 and spring nest 96 may be of the usual type and construction. A bolt or rod 97 is provided with a head 98 at its upper end, such head resting upon a washer 99 upon the bottom of the bolster and below the usual aperture 100 in the top thereof. Through this aperture the bolt 97 may be inserted so that it will extend through an opening drilled in the bottom of the bolster in a position substantially coincident with the central vertical axis of the spring nest 96.

The tension member 94 usually has the hole 101, and through this hole the bolt or rod 97 extends downwardly. Surrounding the rod 97 there is located within the tension member 94 a rebound reducing spring 102 of helical type, while a nut 103 is screwed upon the screw threaded lower end 104 of the rod, so that the spring 102 is confined between such nut and the upper web of the tension member 94. In order to locate spring 102 within the tension member of the side frame, its lower portion is provided with a hole or channel 105.

It will be noted that in the modification, Fig. 8, the anchorage of the rod 97 is established at the bolster, so that the nut 103 provides an abutment for the spring 102 which always moves with the bolster, that is it is immovable relatively to the bolster when the rebound reducing means are in action.

It is to be distinctly understood that the invention included in the described and illustrated improvements does not necessarily mean that any change is required in the arrangement or construction of the spring nests which are now or may be employed for supporting a car truck bolster.

The salient principle of the present invention resides in the following: As the weight of an empty car body or the normal load imposed by it on the truck bolster compresses the supporting springs to a certain extent, such compression is somewhat assisted by the rebound reducing spring of the present invention. Inasmuch as the rebound reducing spring is initially compressed, for say one inch, or more or less depending upon the spring itself, especially if the same is of the helical type, the coils thereof are not jammed up to each other and any additional load on the truck bolster will further compress the supporting springs but the rebound reducing spring will expand by its own action, while on the other hand, and most important, any movement of the bolster upwardly from its position normal to the truck, as where its car is unloaded and contains no ladings, will be resisted all the greater by the rebound reducing spring the further the bolster moves up, and this is true whether or not the car is loaded. This action is especially valuable in connection with a bolster which tilts endwise relative to its position normal with the truck.

Whether or not a spring plank is omitted from the usual car truck equipment, it is obvious that the described and illustrated improvements are susceptible to more or less modification as will be clear to those skilled in this art, and the invention is not restricted except as defined in the appended claims.

What I claim as new is,—

1. In a car truck, the combination of a side frame, a relatively movable bolster, supporting springs on the side frame for the bolster, a bolt abutting the side frame, and a member coacting with a hole in the side frame and holding the bolt in such abutting relation, the bolt extending up into and terminating in the hollow interior of the bolster, a fixed abutment on the bolt, and a rebound reducing spring located between the

abutment and bolster and bearing on both in opposition to the supporting springs, such reducing spring free to expand or contract at all times whether the bolster is shifted either above or below its position normal to the truck.

2. In a car truck, the combination of a side frame, a relatively movable bolster, supporting springs on the side frame for the bolster, a bolt abutting the side frame, and a member coacting with a hole in the side frame and holding the bolt in such abutting relation, the bolt extending up into the bolster, the bolster having a hole of relatively much larger diameter than the bolt to permit such extension and to space the bolt from the bolster, a fixed abutment on the bolt, and a rebound reducing spring located between the abutment and bolster and bearing on both in opposition to the supporting springs, such reducing spring free to expand or contract at all times whether the bolster is shifted either above or below its position normal to the truck.

3. In a car truck, the combination of a side frame, a relatively movable bolster, supporting springs on the side frame for the bolster, a bolt resisted against upward movement by the tension member of the side frame at a point approximately midway of the opposite lateral surfaces of the thickness of such member, the bolt extending up into the bolster, a fixed abutment on the bolt, and a rebound reducing spring located between the abutment and bolster and bearing on both in opposition to the supporting springs.

4. In a car truck, the combination of a side frame, a relatively movable bolster, supporting springs on the side frame for the bolster, a bolt held in abutting relation with the side frame, means for so holding the bolt directly between the compression and tension members of the side frame at approximately the middle plane between the opposite sides of such members, the bolt extending up into the bolster, a fixed abutment on the bolt, and a rebound reducing spring located between the abutment and bolster and bearing on both in opposition to the supporting springs.

5. In a car truck, the combination of a side frame and a relatively movable bolster constituting two members of a car truck, supporting springs on the side frame for the bolster, an abutment on one of such members and immovable relatively thereto, a rebound reducing spring located between the abutment and the other member and bearing on both of them in opposition to the supporting springs, and being free to expand or contract, and cooperating, individually rigid, elements associated with the rebound reducing spring tending to limit the degree of compression thereof.

6. In a car truck, the combination of a side frame and a relatively movable bolster constituting two members of a car truck, supporting springs on the side frame for the bolster, an abutment on one of such members and immovable relatively thereto, a rebound reducing spring located between the abutment and the other member and bearing on both of them in opposition to the supporting springs, and being free to expand or contract, and means associated with the rebound reducing spring tending to limit the degree of compression thereof, such means including friction members, one of which is expansible, and the rebound reducing spring being helical and acted on by the expansion member.

7. In a car truck, the combination of a side frame and a relatively movable bolster constituting two members of a car truck, supporting springs on the side frame for the bolster, an abutment on one of such members and immovable relatively thereto, a rebound reducing spring located between the abutment and the other member and bearing on both of them in opposition to the supporting springs, and being free to expand or contract, at all times with respect to the position of the bolster normal to the truck inasmuch as the reducing spring is set under an initial compression, together with means surrounded by that spring tending to limit the degree of its compression when under load.

8. In a car truck, the combination of a truck side frame, a relatively movable truck bolster, supporting springs for the bolster supported by the tension member of the side frame, a bolt or rod anchored to the bolster and depending therefrom within the supporting springs, an abutment on the lower end of the bolt, and a rebound reducing spring bearing on the tension member of the side frame and the abutment in opposition to the supporting springs, such reducing spring free to expand or contract at all times with respect to the position of the bolster normal to the truck and with respect to the tension member.

9. In a car truck, the combination of a side frame and a relatively movable bolster constituting two members of the car truck, a supporting spring-nest on the side frame for the bolster, a body in the nature of a bolt held in a definite position on one of such members against relative movement to such member in one direction, and said bolt located on a line substantially coincident with the central vertical axis of the spring nest, the other member having a hole with a diameter which is so much greater than that of the bolt-like body as to permit the free passage of and a lateral movement of the bolt, and said bolt provided with an abutment, and a rebound reducing spring located entirely beyond the horizontal planes of the spring nest and between the abutment and said other member and bearing on them in opposition to the supporting springs, and free from action on the lower plate of the spring nest, such reducing spring free to expand or contract at all times whether the bolster is shifted either above or below its position normal to the truck.

10. In a car truck, the combination of truck side frames, a bolster between the frames and tiltable relatively thereto, springs resting on the side frames for tiltably supporting the bolster from both ends, adjustable abutments, means supporting the abutments immovably with respect to the bolster in a predetermined adjusted position, each abutment located on a line substantially coincident with the central vertical axis of the supporting springs corresponding therewith, and rebound reducing springs located entirely beyond the horizontal planes of the supporting springs and bearing upon the side frames and the abutments with a tendency to move the bolster in a direction opposite to the direction in which the supporting springs act, each such reducing spring being free from action on the extreme lower ends of the supporting springs and free to expand or contract at all times whether the bolster is tilted on the supporting springs either above or below its position normal to the truck.

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