

Dec. 22, 1942.

E. H. PIRON

2,305,732

RAILWAY SPRINGING SYSTEM

Filed May 24, 1938

4 Sheets-Sheet 1

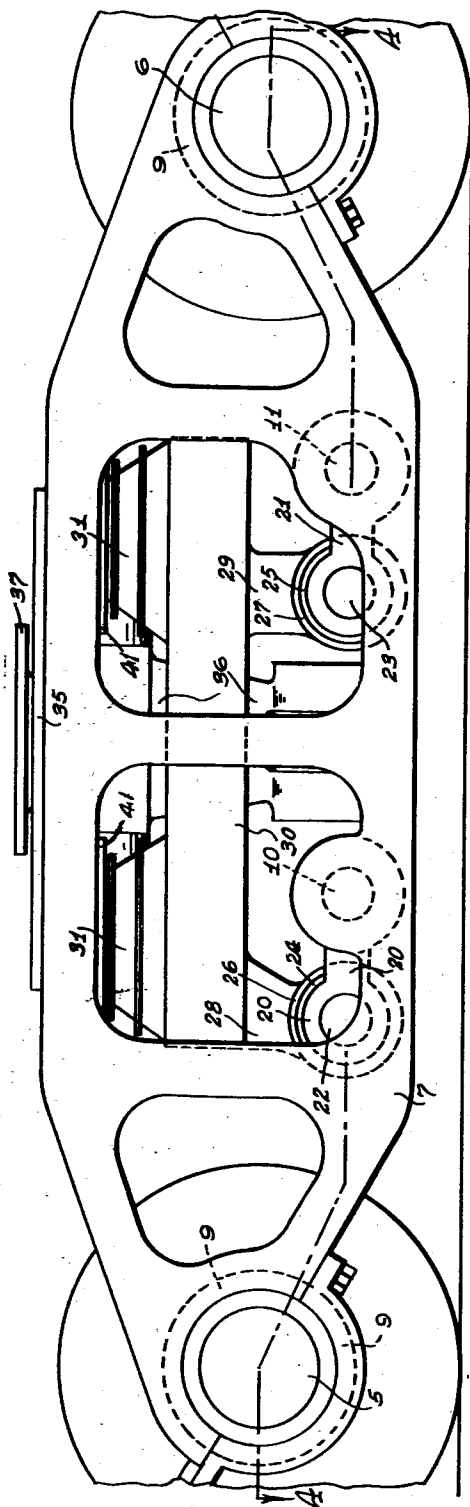


Fig. 1.

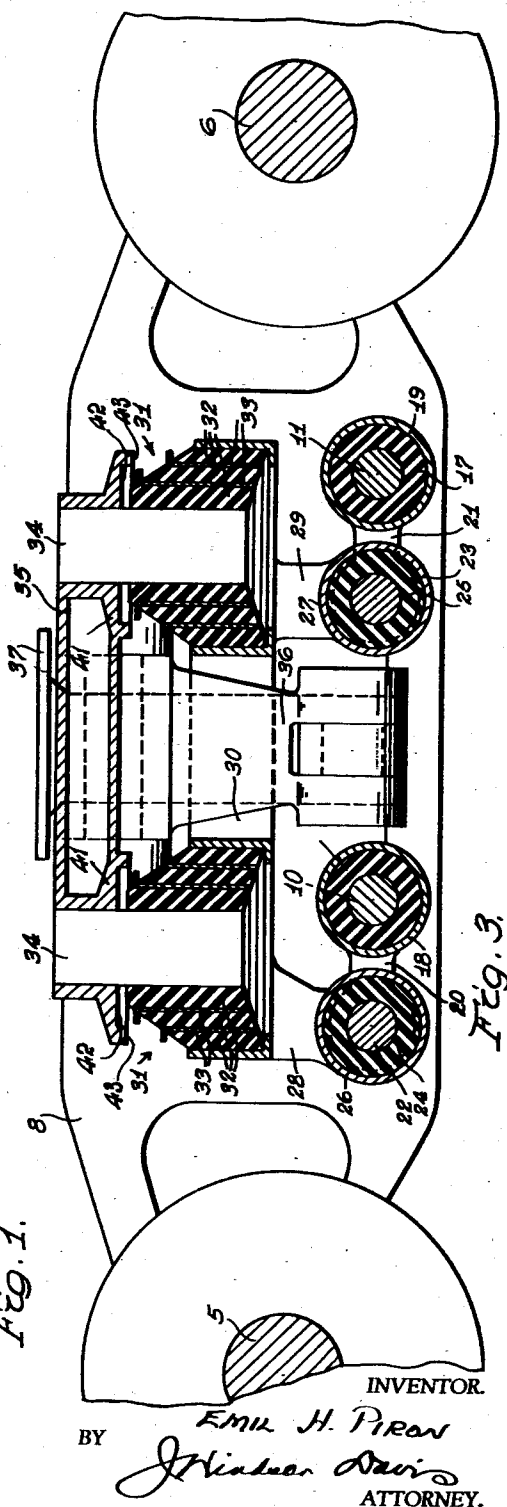


Fig. 3.

INVENTOR.
EMIL H. PIRON
BY *Wm. H. Davis*
ATTORNEY.

Dec. 22, 1942.

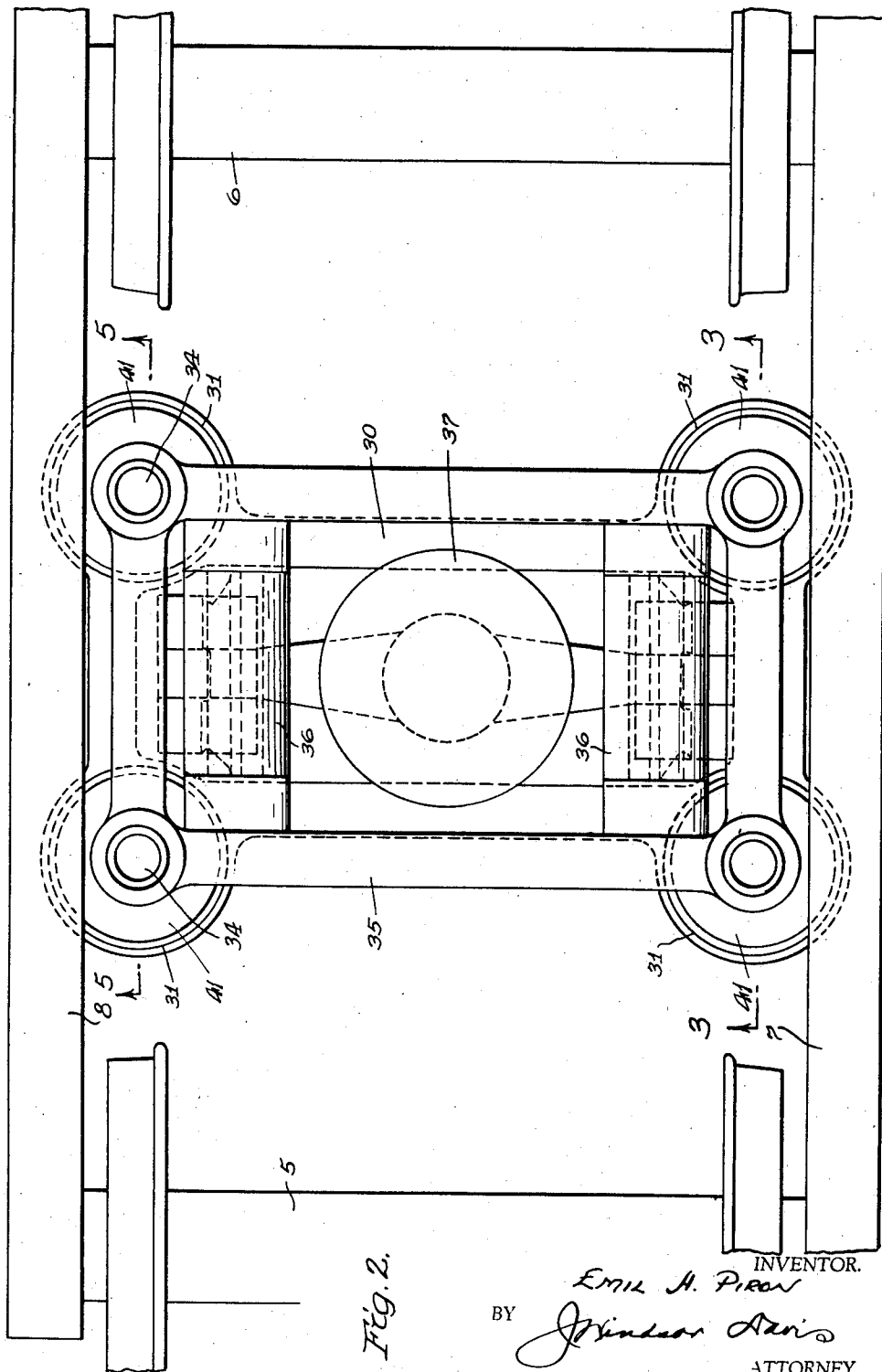
E. H. PIRON

2,305,732

RAILWAY SPRINGING SYSTEM

Filed May 24, 1938

4 Sheets-Sheet 2



Dec. 22, 1942.

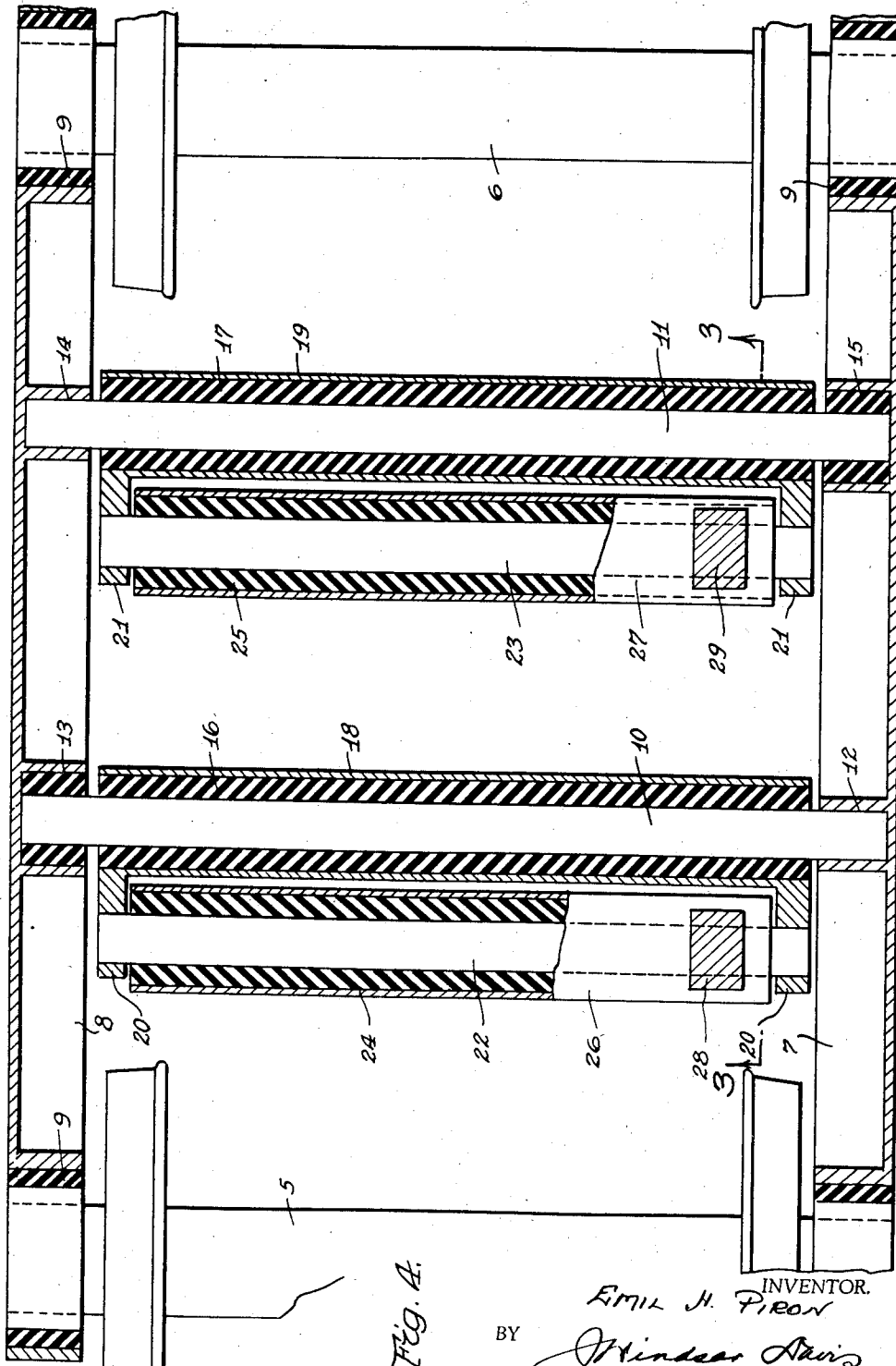
E. H. PIRON

2,305,732

RAILWAY SPRINGING SYSTEM

Filed May 24, 1938

4 Sheets-Sheet 3



INVENTOR

EMIL H. PIRON^{INVENTOR}

BY

Windsor Davis
ATTORNEY

ATTORNEY.

Dec. 22, 1942.

E. H. PIRON

2,305,732

RAILWAY SPRINGING SYSTEM

Filed May 24, 1938

4 Sheets-Sheet 4

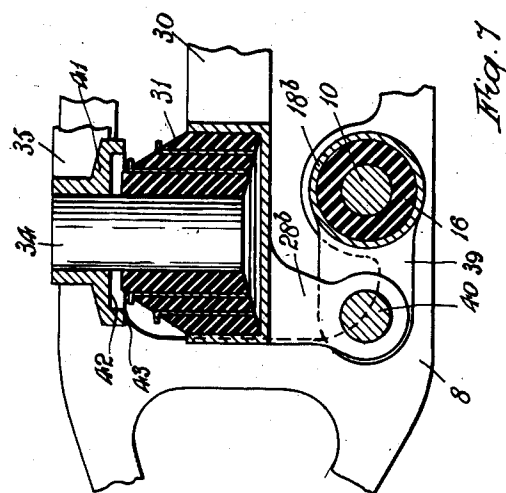


Fig. 7

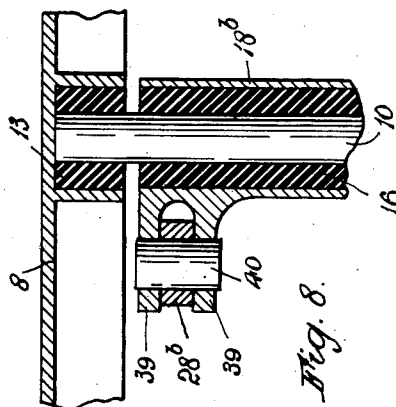


Fig. 8

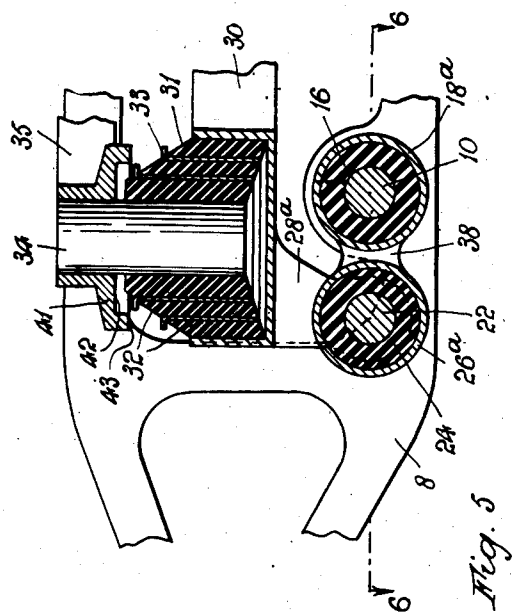


Fig. 5

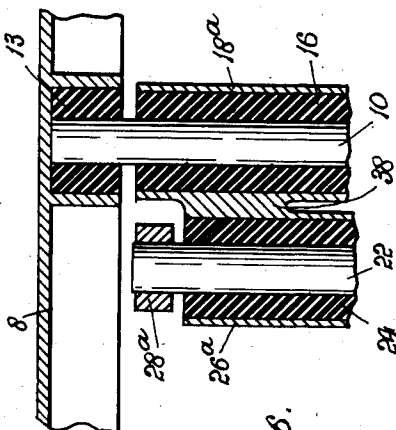


Fig. 6

INVENTOR
EMIL H. PIRON
BY *J. Hinder* *Attorney*
ATTORNEY

UNITED STATES PATENT OFFICE

2,305,732

RAILWAY SPRINGING SYSTEM

Emil H. Piron, New York, N. Y., assignor to
Transit Research Corporation, New York, N. Y.,
a corporation of New York

Application May 24, 1938, Serial No. 209,778

17 Claims. (Cl. 105—194)

This invention relates to the springing systems of trucks and similar structures, and more particularly of heavy duty rail trucks wherein the problems of springing do not appear to have been as fully appreciated or met to the extent obtained in many types of road vehicles. It has been the general practice to use comparatively hard springs in such trucks in order to avoid the tendency found in soft springs to tilt under the action of centrifugal force when the truck is negotiating a curve; and also it has been generally considered in the rail truck engineering field that soft springing is more or less of a luxury rendered unnecessary by the fact that the trucks travel on smooth rails and do not have to meet the same requirements of resiliency which obtain in a road vehicle. The applicant has determined that to a very considerable extent such contention is a fallacy and that there are decided advantages, in a structure such as a rail truck, in providing for such soft springing action with comparatively considerable amplitude of vertical distortion in the springing system, provided that the tendency to tilt previously referred to is adequately prevented or counteracted.

In road vehicles, the said tilting tendency has in many cases been markedly overcome by means of stabilizers comprising a system of cross shafts and levers linking the sprung body to the unsprung axle housing and operating to relieve the springs from the side strain resulting from centrifugal force when the vehicle is rounding a curve.

It is an object of this invention to secure a similar result, especially in heavy duty rail vehicles, but by the use in combination with the main vertical or bolster springs of a system of torsion springs assisting in the support of the vehicle body and also by reason of their general design and relationship thereto acting as stabilizing means in the desired manner. The present invention may be used to advantage in road vehicles in place of such stabilizers, or, if desired, in combination therewith.

Broadly stated the general object of the invention may be said to provide a springing system more particularly for rail trucks which is characterized by its admitting of a high degree of vertical resiliency without any corresponding increase of rolling tendency, and more particularly the combination in a truck such as a rail car truck of load supporting vertical springs of the type disclosed in my Patent No. 2,171,069 issued August 29, 1939, filed May 31, 1935, with double torsion springs such as disclosed in my Patent

No. 216,455 issued Oct. 1, 1940, wherein the springing system of the first mentioned springs is supported by the second mentioned springs on the truck frame for vertical movement therein, the axes of the said double torsion springs extending transversely of the said frame whereby the vertical resiliency of the combination is that of the first mentioned plus the second mentioned springs, the lateral resiliency relative to the truck being merely that of the first mentioned springs.

A further object is to provide such torsion springs involving the use of rubber or a similar material as the elastic medium and so constructed that the actual torsion in the rubber is reduced to a low degree relative to the amplitude of reaction of the springs.

Anent this object, it is further proposed to provide a dual form of torsion spring in which a pair of single torsion springs are coupled together in series in such manner that the burden of the load may be shared by the rubber torsion elements of both springs of the dual spring whereby the torque in an individual member of the dual spring is divided and is therefore less in each than would be necessary in a single torsion spring for the same amplitude of motion.

A further object is to provide such a construction wherein a load member of a rubber torsion spring is not rotatable and therefore admits of its application or assembly in the vehicle without mechanical articulation with consequent freedom from noise, lost motion, hunting motion, and wear or the necessity of lubrication.

The invention also contemplates in a truck the combination of an articulated main frame whereby side members of the frame operate as equalizer bars with an articulated mounting of the dual torsion springs, this arrangement including a resilient support for the vertical bolster springs of the truck. The invention further contemplates the inclusion in the combination just referred to of a swing bolster carried by the said bolster springs and forming a part of the yielding load carrying structure.

Still further objects subsidiary to the aforesaid objects or resulting from the invention as it may be carried into effect will become apparent as the same is hereinafter further disclosed.

In carrying the said invention into effect, I may provide the novel construction and arrangement of parts wherein a rail truck may comprise side frame members connected to front and rear axles by means of elastic journals or articulations, the said side frame members being spanned at the two points intermediate their length by a

pair of transverse rods one of which has an elastic articulate connection with one of the frame members and the other a similar connection with the other frame member, the transverse rods being otherwise rigidly connected to the frame, such as in the manner disclosed in my Patent No. 2,216,455. These cross members form the fixed non-rotatable cores of elastic rubber torsion springs the outer shells of which are connected by short levers to the core rods of similar torsion springs, whereby dual torsion springs are formed, the outer shells of the last mentioned torsion springs being connected at their ends by fixed brackets or supports to a second frame or platform on which are mounted vertical springs, such as of the type disclosed in my Patent No. 2,171,069. These vertical springs in turn carry the load or body of the truck, as through the medium of a bolster which may be swingably mounted in a third frame supported by the last mentioned vertical springs.

All of which is more particularly described and ascertained hereinafter, by way of example, having reference to the accompanying drawings, wherein:

Fig. 1 is a side elevation of a rail truck embodying the springing system of the present invention;

Fig. 2 is a plan of the same;

Fig. 3 is a vertical sectional detail view taken on a plane indicated by the line 3—3 in Figs. 2 and 4;

Fig. 4 is a horizontal sectional view through the truck taken on a plane indicated by the line 4—4 in Fig. 1;

Fig. 5 is a fragmentary vertical sectional view on the line 5—5 of Fig. 2 showing a somewhat modified arrangement of the parts;

Fig. 6 is a horizontal section taken on the line 6—6 of Fig. 5;

Fig. 7 is a similar view to Fig. 5 showing a still further modified arrangement of the parts; and Fig. 8 is a horizontal sectional view thereof.

Similar characters of reference indicate similar parts in the several figures of the drawings.

5 and 6 are the truck axles which carry the side frame members 7 and 8 and form therewith the main truck frame, the side frame members being shown in the illustrated arrangement as having rubber bushings 9 housed therein and surrounding the axle ends to provide elastic articulation at these points between the said side frame members and the axles, whereby the said side frame members may operate to a desired extent as equalizer bars independently movable relative to their normal common plane under the influence of unequal forces directed against the truck wheels, especially in a vertical direction.

10 and 11 are cross members or rods extending transversely of the frame, the rod 10 being rigidly and non-rotatably secured at 12 to the frame member 7, the other end of the said rod 10 engaging in a rubber or similar bushing or torsion element 13 suitably mounted and secured in the frame member 8 to provide an elastic articulation at that point between the said rod 10 and the frame member 8.

Suitably spaced from the rod 10, and also spanning the frame, is a similar rod 11 in this case rigidly and non-rotatably secured at 14 to the frame 8 at one end and having an elastic articulation by means of the rubber mounting 15 by which it is connected to the frame member 7 at the other end.

This method of mounting the rods 10 and 11

facilitates the equalizer bar action of the frame members previously referred to and prevents the said rods 10 and 11 from interfering with or unduly restricting such action while the elastic nature of the articulations lends itself to the promotion of reflex forces therein tending to stabilize the frame structure in its operation and avoid loose mechanical connection of the cross members which might otherwise be necessary in a frame of this type. The rods 10 and 11 form the cores of elongated torsion springs 16 and 17 formed of rubber or similar material encasing the said rods, preferably through the major portion of their lengths between the frame members, and enclosed in shells 18 and 19 to which the outer surfaces of the rubber are suitably secured or bonded to insure the torsional resistance of the rubber to relative rotation of the shells and the core rods as will be well understood.

From the ends of the shells 18 and 19 extend short arms or levers 20 and 21 in a substantially horizontal direction, or in a direction more nearly approaching a horizontal direction than a vertical direction, and these arms 18 and 19 carry rods 22 and 23, respectively, fixedly secured thereto and forming the cores of further elastic torsion springs 24 and 25, somewhat shorter than but similar to the first mentioned torsion springs 16 and 17, and similarly provided with outer shells or casings 26 and 27, respectively. This torsion spring 24, connected through the arms 20 to the torsion spring 16 in the manner shown, provides in combination a dual torsion spring assembly in which the burden of applied forces may be shared by the rubber torsion elements 24 and 16, and advantages which will be further discussed. This condition also obtains in the dual torsion spring formed by the connection of the torsion spring 25 through the arms 21 with the torsion spring 17.

The shells 26 and 27 of the dual torsion springs referred to are respectively provided with rigid uprights or pedestals 28 and 29 supporting a frame or platform 30 common thereto, which may be considered as the secondary frame and which in turn is shown as carrying vertical rubber springs 31 preferably comprising alternate concentric elastic cylindrical layers of rubber 32 and with at least one concentric stiff cylinder of metal 33 therebetween and provided with axial upright shafts 34 on the upper ends of which a bolster frame 35 is mounted. The bolster frame is shown as carrying pendant swing members which in turn carry the swing bolster 37.

The most desirable riding qualities in a truck or vehicle requires a degree of vertical spring deflection considerably greater than that which may be effectively secured by the vertical bolster springs alone within the limit allowable by the increased tendency of such springs to tilt or roll when their action is too soft, but, this tendency not being a characteristic of the torsion springs referred to, the use of the said torsion springs in series with the bolster springs, and especially in the manner described therein, provides the increased amplitude of movement sought together with the soft action provided by the distributed forces in the rubber elements of the dual springs, as well as impulse absorption under the conditions of operation prevailing in this system.

The arm 20 being fixedly connected to the shell 18 and the rod 22 of one of the dual torsion springs (as is the arm 21 fixedly connected to the shell 19 and rod 23 of the other dual spring), and the uprights 28 and 29 fixedly connecting

the shells 26 and 27 of the said dual springs to the bolster frame 35, it will be seen that there are no mechanical articulations or joints subject to friction or wear or requiring lubrication, or capable of becoming noisy in operation, and shackles or other similar connecting, supporting or motion controlling links are rendered unnecessary.

Furthermore, the dual springs as described may make use of the articulated cross frame members described in my Patent No. 2,216,455, hereinbefore referred to, by utilizing them as the non-rotative members of one of the elements of each of the dual springs, while still retaining the advantages of the articulated cross bracing of the frame secured thereby.

Of course, the precise method of coupling the two torsion elements of the dual spring together may obviously be varied from that shown in Figs. 1 to 4; and in Fig. 5, as an example of such variation, I show one of these dual springs having the core rods 10 and 22 and rubber torsion elements 16 and 24, the shell 18a of the element 16 in this case being fixedly connected by a web 38 to the shell 26a of the torsion element 24, and the bolster frame pedestal 28a fixedly connected to the core rod 22 of the last mentioned torsion element. The operations and advantages of the first described dual spring assembly are similar in the instant example, as will be readily understood. It is simply required that either the core rod or the shell of one of the torsion elements of the dual torsion spring be connected to the core rod or to the shell of the other torsion member thereof, the unconnected rod or shell of the first torsion member being non-rotatably secured to the frame and the unconnected core rod or shell, as the case may be, of the second torsion member non-rotatably attached to the bolster frame or other member carrying the vertical springs.

It will be further seen that the utilizing of the dual torsion springs transverse of the frame in the manner described operates as a stabilizer in a highly efficient manner while providing for a very high degree of vertical distortion of springing system, thereby securing the effect of very soft vertical springs without the disadvantages usually attendant on the use of such soft springs. Consequently any practical desired amount of vertical resiliency in the system may be secured without increasing lateral resiliency thereof beyond that provided by the bolster springs themselves.

While, for the sake of illustration and convenience of design, the secondary frame shown as supported by two sets of dual torsion springs, the number of such springs which may be used may vary from one to any number which may be considered necessary or desirable, according to the design and size of truck or structure and the particular use to which it is intended to be put.

Although the improved springing system has been described as applied to a rail car truck, for which application it is primarily intended, it may nevertheless be advantageously adapted to such vehicles as automobiles, motor trucks, motor buses, trolley buses, and other vehicles wherein a soft spring action capable of a relatively high degree of vertical distortion without any corresponding high degree of lateral distortion is desirable.

However, the characteristics of operation of the improved springing system are of a special value in a rail car truck and particularly suited

to the conditions obtaining in the operation of such a truck, although the desirability of such a form of springing does not appear to have been heretofore properly appreciated; and the effect of the improved springing system is to transfer the action of lateral forces to the road with a given lateral displacement of the body, independent of the softness of the springs in a vertical direction, with a vertical oscillation frequency as low as possible and a lateral or rolling oscillation frequency of a desirable value. This action is obtained by the cooperative combination of a vertical springing system which is also responsive to rolling operations and the supporting system of torsion springs responsive to vertical oscillations only, which is diametrically the opposite of the usual characteristics found in rail truck springing systems.

It will be observed that the twisting action of the stabilizer elements which is commonly provided for in stabilizer constructions such as are found in automobiles and other road vehicles, wherein it is desirable to conserve as much lateral flexibility as possible while merely reducing exaggerated lateral tipping of the body, is not found in this present springing system so that it does not particularly lend itself to meeting the conditions imposed by highly irregular road beds such as are met with in automobile operation.

While I prefer to utilize in this springing system the dual form of torsion springs as the vertically resilient stabilized support for the bolster springs, it will be apparent that single torsion springs may be used in place thereof, although without the same advantages of distributed torque hereinbefore described and with certain limitations inherent in such changed design which may limit its field of application but which would not by any means preclude its use. Such an arrangement is shown in Figs. 7 and 8, wherein the single torsion spring comprises the core rod 10, rubber torsion element 16 and the outer shell 18b, the latter being provided with integral arms 39 carrying the pin 40 by means of which mechanical connection to the bolster frame pedestal 28b is affected. The dual springs, however, avoid the mechanically articulated linkage which is necessary to connect such a single torsion spring with the secondary frame.

A form of stop plate such as is described in my Patent No. 2,068,279, dated January 19, 1937, may be used with the rubber springs 31 to material advantage, as an element in the springing system described herein, such a stop plate 41 being shown in Figs. 1, 2, 3, 5 and 7 as having stops or abutment faces 42 and 43 arranged to progressively contact the upper flanged ends of the metal cylinder 33 as the stop plate is depressed by loading, whereby the innermost cylinder of rubber in the spring 31 having the greatest unit shear loading and thereby being deflected more rapidly than the surrounding cylinder of rubber will, upon loading to a sufficient extent, permit the stop 42 to contact the flanges of the next to the innermost metal cylinder whereupon the next surrounding cylinder of rubber will then continue deflection until the flange of the cylinder surrounding it is contacted by the stop 43 of the plate 41 whereupon the outermost cylinder of rubber will be the only one subject to further deflection.

In this way the strain can be varied until the maximum load is reached and by choosing the various areas and points of travel at which the successive cylinders of rubber are taken out of

action, in the manner described, the load deflection curve may be varied from the typical straight shear curve to a curve which turns upwardly on a new slope following elimination of activity in each cylinder of rubber in the spring.

It will be apparent that this varying of the deflection curve will modify the deflection curve of the springing system described as a whole, and that a cooperative action will result between the stop plate, the concentric rubber springs and the sprung stabilizer springs, the result being a springing system wherein springs have a certain characteristic load deflection ratio curve in response to vertical motions of the supported body differing from that of the bolster spring's per se, and a load deflection ratio curve of a different or of a stiffer character in response to the rolling motions of the body.

This invention may be developed within the scope of the following claims without departing from the salient features of the said invention, and it is desired that the specifications and drawings be read as being merely illustrative and not in a limiting sense, except as necessitated by the prior art.

What I claim is:

1. In a truck structure, in combination, a main frame, a secondary frame, torsion springs extending substantially across and supporting said secondary frame on said main frame, a bolster frame having a laterally swingable bolster mounted therein, and four rectangularly grouped load carrying vertically distortable springs carried by said secondary frame and supporting said bolster frame.

2. In a truck structure, in combination, a main frame, a secondary frame, a pair of cross members in one of said frames, each cross member being rigidly connected at one end to its frame and resiliently connected at its other end to the frame with the order of said connections reversed with respect to the different members, an elastic torsion spring element surrounding said cross members, torque arms connecting said element with the other of said frames, vertically distortable springs carried by said secondary frame, and a load carrying member mounted on said last named springs.

3. In a truck structure, in combination, a main frame, cross members forming part of said main frame and having articulated connection therewith to provide for distortion of the frame about substantially diagonal points, elastic torsion spring elements surrounding said cross members, a secondary frame, torque arms connecting said elements with said secondary frame, vertically distortable springs carried by said secondary frame, and a load carrying member supported by said vertically distortable springs.

4. In a truck structure, in combination, a main frame, a pair of torsion springs carried by and extending substantially across said main frame, a second pair of similar torsion springs carried by and coupled in series to the first mentioned springs, a substantially rectangular secondary frame carried by said second pair of springs, vertically distortable springs carried by said secondary frame with one at each corner thereof, and a substantially rectangular load carrying member supported at each of its corners by said last named springs.

5. In a truck structure, in combination, a main frame composed of side members and fore and aft members, articulated means connecting respective ends of said side members to respective

ends of said fore and aft members, a secondary frame, a torsion spring carried by and extending substantially across one of said frames, a second similar torsion spring carried by the other of said frames and coupled in series to the first mentioned spring, vertically distortable springs carried by said secondary frame, and a load carrying member mounted on said last named springs.

6. In a truck structure, in combination, a main frame, cross members forming part of said main frame and having articulated connection therewith to provide for distortion of the frame about substantially diagonal points, elastic torsion elements surrounding said cross members, torsion springs parallel to and coupled in series to said torsion elements, a secondary frame carried by said torsion springs, vertically distortable springs carried by said secondary frame, and a load carrying member mounted on said last named springs.

7. In a truck structure, in combination, a main frame, a secondary frame, a torsion spring comprising a tubular rubber torsion element secured to inner and outer members extending transversely of one of said frames, one of the members being secured to said frame, a similar torsion spring having one of its members connected to the free member of the first mentioned torsion spring and its other member connected to the other of said frames, vertically distortable springs carried by said secondary frame, and a load carrying member mounted on said last named springs.

8. In a truck structure, in combination, a main frame composed of side members and fore and aft members, articulated means connecting respective ends of said side members to respective ends of said fore and aft members, a secondary frame, a torsion spring comprising a tubular torsion element secured to inner and outer members extending transversely of one of said frames, one of the members being secured to said frame, a similar torsion spring having one of its members connected to the free member of the first mentioned torsion spring and its other member connected to the other of said frames, vertically distortable springs carried by said secondary frame, and a load carrying member mounted on said last named springs.

9. In a truck structure, in combination, a main frame, a pair of torsion springs each comprising a tubular torsion element secured to inner and outer members extending transversely of said main frame, one of the said members of each torsion spring forming a cross member of said frame and having articulated connection therewith to provide for distortion of said frame about substantially diagonal points, a pair of similar torsion springs each having one of its members connected to the free member of the first mentioned torsion springs and its other member connected to the secondary frame, vertically distortable springs carried by said secondary frame, and a load carrying member mounted on said last named springs.

10. In a truck structure, in combination, a main frame, a secondary frame, torsion springs supporting said secondary frame on said main frame, said torsion springs having relatively movable members in direct non-articulate connection with respective said frames and secured one to the other by elastic material, vertically distortable springs carried by said secondary frame, and a load carrying member supported by said last named springs.

11. In a truck structure, in combination, a main frame, a secondary frame, springs having inner and outer concentric stiff cylindrical members and at least one concentric stiff member therebetween and elastic members between and connecting said cylindrical members, said springs being carried by said secondary frame, a load carrying member supported by said springs, stop means carried by said inner member for contact with at least one of the intermediate stiff members to limit deflection of the elastic member therewithin, and springs having vertical resiliency only supporting said secondary frame on said main frame.

12. In a truck structure, in combination, a main frame articulated for distortion about substantially diagonal points, a secondary frame, torsion springs supporting said secondary frame on said main frame and having their axes transverse of said truck, springs carried by said secondary frame, a load carrying member supported by said last named springs, said springs each comprising concentric load imposing and load receiving members with alternate cylinders of rubber and metal therebetween of progressively increasing height towards the load imposing member, and stop means movable with the load imposing member for progressively contacting the metallic cylinders as said stop means is depressed under loading.

13. In a truck structure, a main frame, a secondary frame, torsion springs supporting said secondary frame on said main frame and having their axes transverse of the truck, said torsion springs each having a rigid core, said cores each being rigidly connected at one end to the main frame and resiliently connected at the other end to said main frame with the order of said connections reversed with respect to different cores, load carrying vertically distortable springs carried by said secondary frame, and a laterally swingable bolster carried by said last named springs.

14. In a truck structure, a main frame composed of side members and fore and aft members articulated for distortion at the points of connection between respective side and fore and aft members, a secondary frame, torsion springs supporting said secondary frame on said main frame and having their axes transverse of said

truck, each torsion spring including a part connected to opposite side members of the main frame to resist distortion thereof, vertically distortable springs carried by said secondary frame, and a load carrying member supported by said vertically distortable springs.

15. In a truck structure, a main frame composed of side members and fore and aft axles, resilient means articulately connecting respective ends of the side members to respective ends of the axles for distortion at such points of connection and for yieldingly opposing such distortion, a secondary frame, springs having vertical resiliency only supporting said secondary frame on said main frame, springs having vertical and lateral resiliency carried by said secondary frame, and a load carrying member supported by said last named springs.

16. In a truck structure, a main frame composed of side members and fore and aft members, resilient means articulately connecting respective ends of the side members to respective ends of the fore and aft members, said resilient means permitting distortion of the main frame about said connections, a secondary frame, torsion springs extending substantially across and supporting said secondary frame on said main frame, each torsion spring embodying a member rigidly connected to one side member and having resilient means at its other end articulately connecting it to the opposite side member whereby it yieldingly opposes distortion of the main frame, vertically distortable springs carried by said secondary frame, and a load carrying member supported by said vertically distortable springs.

17. In a truck structure, a substantially rectangular frame articulated at the four corners thereof and adapted to be distorted by articulation at said corners, a secondary frame, a torsion spring carried by and distortable about an axis transverse to the main frame, said torsion spring having a part thereof operating to stabilize the main frame against distortion, a second torsion spring axially parallel to and coupled in series to the first mentioned torsion spring, means connecting the second spring to said secondary frame, vertically distortable springs carried by said secondary frame, and a load carrying member supported by said last named springs.

EMIL H. PIRON.