Feb. 26, 1929.

1,703,765

T. I. DUFFY

FLEXIBLE CONNECTER

Filed Dec. 13, 1924

3 Sheets-Sheet 1

Fig 1.

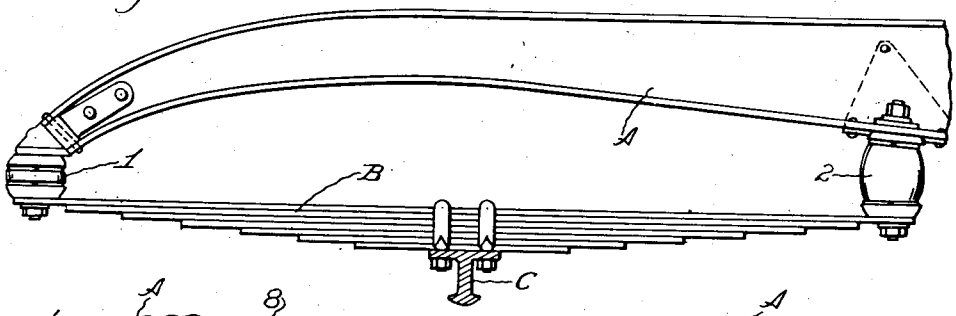


Fig 2

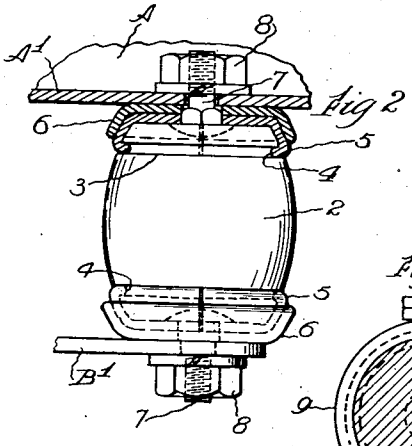


Fig 3.

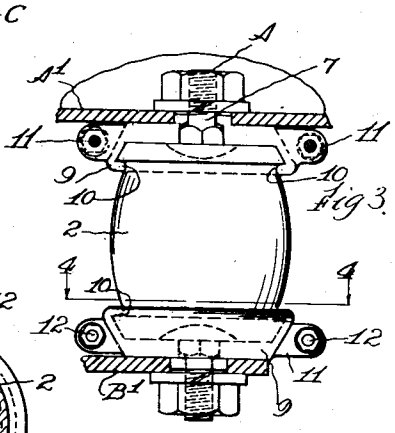


Fig 4

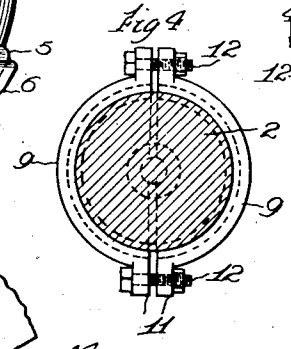


Fig 6.

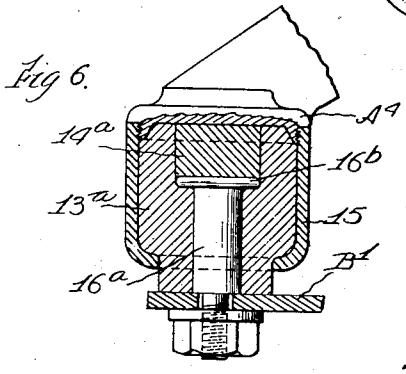


Fig 5.

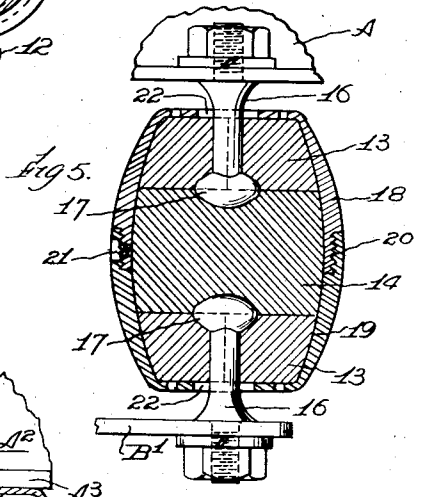
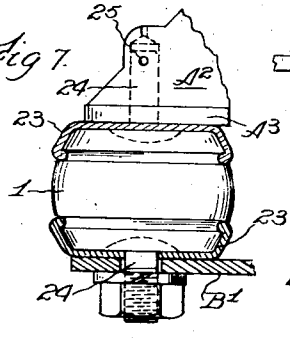


Fig 7.



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FLEXIBLE CONNECTER

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Fig 8.

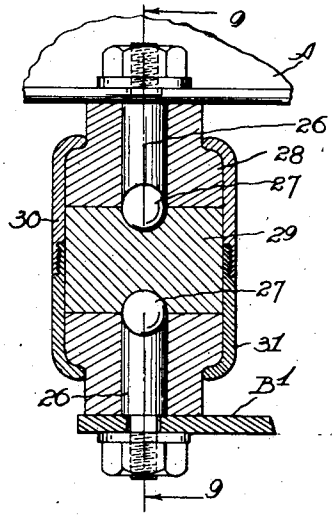


Fig 9.

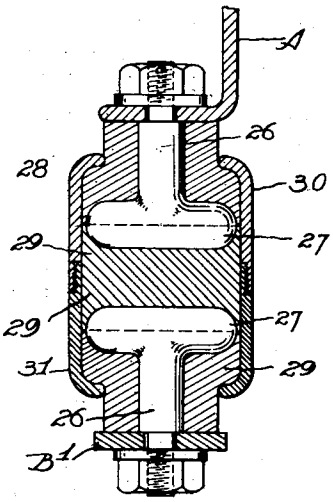


Fig 10.

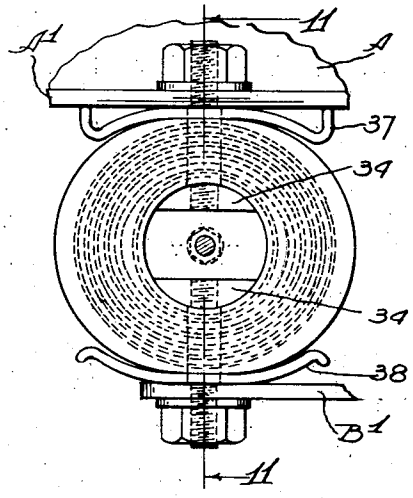
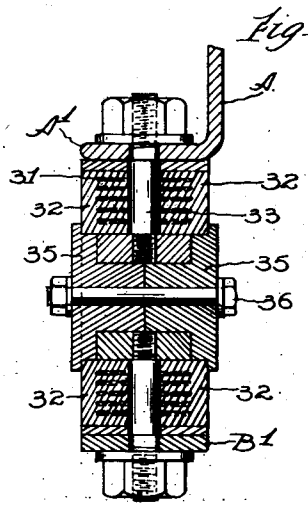


Fig 11.



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T. I. DUFFY

FLEXIBLE CONNECTER

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Fig 12

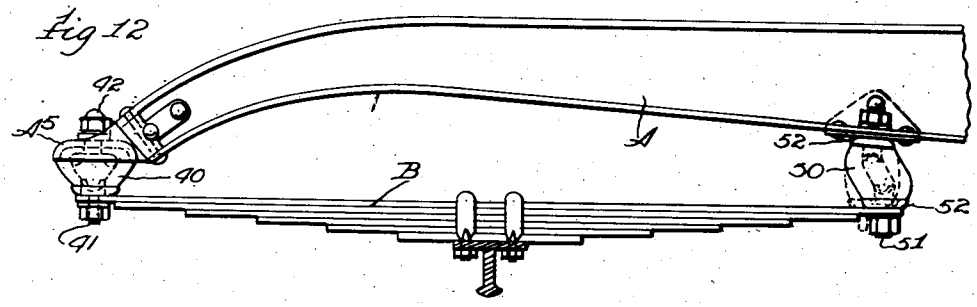


Fig 13

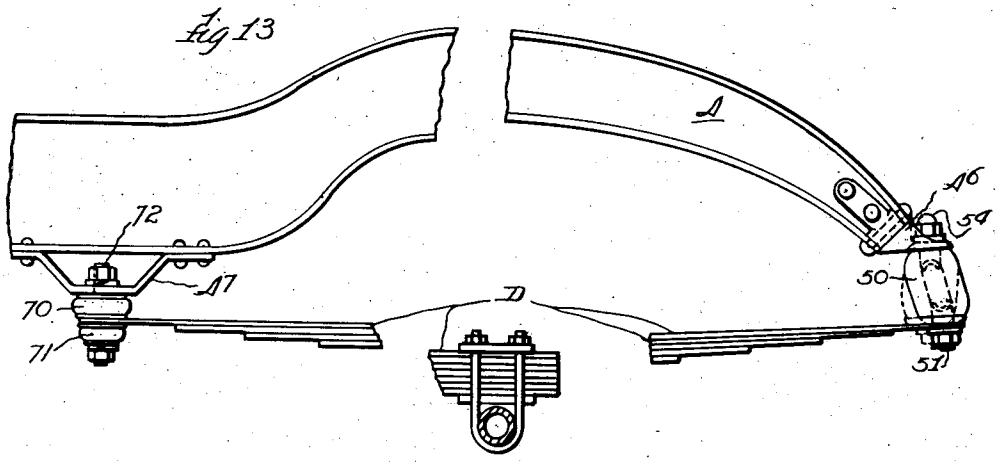


Fig 14

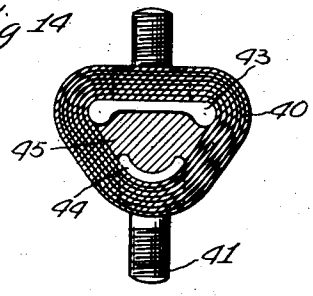


Fig 15

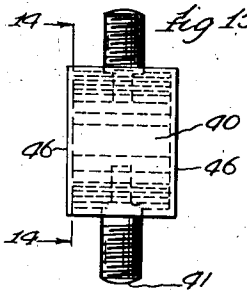


Fig 16

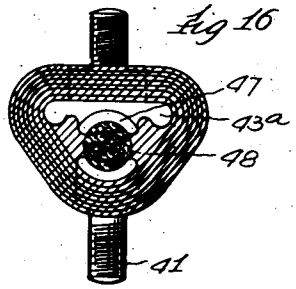


Fig 18

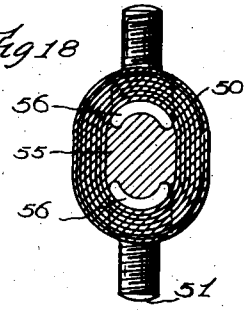
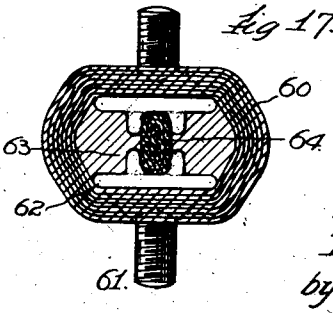


Fig 17.



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Patented Feb. 26, 1929. 1,703,765

UNITED STATES PATENT OFFICE.

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FLEXIBLE CONNECTER.

Application filed December 13, 1924. Serial No. 755,593.

The purpose of this invention is to provide improved means for connecting two members having limited relative movement, particularly when one or both of them is subject to rapid or violent vibration. The invention is illustrated as a connection between the frame and supporting spring of a road vehicle and when thus used its object is to dispense with the more usual metallic pivotal connections and thus eliminate the wear of such connections and the noise incident thereto. As shown in the present application the connecting means is also designed for controlling the flexure and vibration of the spring to some extent in that it tends to oppose excessive recoil of the spring after flexure and also to resist lateral twisting of the spring and side sway of the vehicle in travel. The invention involves certain features and elements adapted to contribute to these objects as well as various details of construction shown in the several alternative forms hereinafter described and illustrated in the drawings while the novel features and combinations thereof are more particularly indicated by the claims.

In the drawings:—

Figure 1 is a side elevation of a vehicle spring and a portion of the frame to which it is secured as viewed from the inner side of the frame and therefore showing the axle on the spring in section.

Figure 2 is a detail view on a larger scale and partly in section showing the flexible connecter for the rear end of the spring of Figure 1.

Figure 3 is a detail view similar to Figure 2 showing a modified form of attaching fittings for the connecter.

Figure 4 is a transverse section taken as indicated at line 4—4 on Figure 3.

Figure 5 is a vertical detail section showing a modified form of the connecter.

Figure 6 is a vertical detail section of another modification of the connecter, this form being particularly adapted to use at the front end of the spring.

Figure 7 is another modified form of front end connecter.

Figure 8 is a vertical detail section in a plane longitudinal with respect to the spring showing a further modification of the connecter.

Figure 9 is a sectional view of the device shown in Figure 8 taken as indicated at line 9—9 on Figure 8.

Figure 10 is a detail side elevation of another form of connecter within the scope of this invention in which the yielding material is reenforced by an embedded fabric.

Figure 11 is a section taken as indicated at line 11—11 on Figure 10.

Figure 12 is a side elevation of the vehicle front spring and a part of the frame using flexible connecters of a modified form.

Figure 13 is a side elevation with a portion broken away showing a rear spring and a corresponding part of the frame held together by flexible connecters, one of which is similar to that shown in Figure 12, while the other is a further modification.

Figure 14 is a vertical detail section of the connecter shown at the front end of the spring in Figure 12, the plane of section being indicated at line 14—14 on Figure 15.

Figure 15 is a front detail elevation of the connecter shown in Figure 14.

Figure 16 is a section similar to Figure 14 showing a modified form of the device.

Figure 17 is a section similar to Figure 16 showing another modification.

Figure 18 is a section similar to Figure 14 but showing the connecter used at the rear end of the spring of Figure 12.

This application represents a further development of the invention shown and claimed in my pending application Serial No. 703,016, filed March 31, 1924. As applied to vehicle springs its primary object is to eliminate the metal shackle of common usage and to produce a steadier spring action under better control than is possible with the older pivotal connections. Referring first to Figure 1 a part of the vehicle frame is shown at A and a spring, B, of the semi-elliptic type which may be understood as a front spring of the vehicle is attached to the frame member by my flexible connecters, 1 and 2. A section of the front axle is indicated at C. The connecter, 2, is shown better in detail in Figuse 2 and comprises a substantially cylindrical block of rubber which is provided with circumferential grooves, 3, adjacent its upper and lower ends for engagement with the inturned ribs, 4, of diametrically divided cap members 5. These metal caps 5, fit snugly into sockets, 6, which prevent them from separating and becoming disengaged from the grooves, 3, and each assembled cap and socket is furnished with an attaching bolt, 7, and nut, 8. By this means the connecter is secured

to the flange, A^1, of the frame member, A, and to the longest leaf, B^1, of the spring, B. The solid rubber of the block, 2, tends to absorb many of the miner vibrations of the spring before they reach the frame, A, at all. The flexibility of the block, 2, permits it to be distorted away from its axis to accommodate the longitudinal movement of the end of the spring, B, as the spring is flexed while at the same time this distortion of the block, 2, involves enough resistance to spring flexure to act as a damping device for preventing excessive recoil.

As a modification of the split caps, 5, shown in Figure 2, I have presented in Figures 3 and 4, a pair of divided socket members, 9, having in-turned lips or flanges, 10, which engage the block, 2, adjacent its ends and the members, 9, are formed with lugs, 11, to receive small clamping bolts, 12, for holding together the assembled halves of each cap. Attaching bolts 7, similar to those of Figure 2 are used for applying the assembled device to the frame and spring.

In the form shown in Figure 5, the parts which are attached to the frame and spring respectively instead of embracing the rubber block are embedded and locked within it. In this case the block consists of three pieces comprising upper and lower sections, 13, and an intermediate section, 14. The attaching members are in the form of studs or posts, 16, having heads, 17, which are embraced between the block, 13, and the block, 14. The rubber blocks are enclosed within the two-part metallic casing or barrel whose upper and lower sections, 18 and 19, are screwed together at 20, for longitudinally compressing the rubber to insure its firm engagement with the heads, 17, of the studs. The set screw, 21, may be inserted to prevent unscrewing of the barrel after the parts have been once assembled. The ends of the barrel are made with ample clearance openings, 22, through which the studs, 16, emerge for attachment to the frame and spring and within which they may tilt somewhat in accommodating spring flexure. In this form of the device it will be noted that the distortion of the rubber due to flexure of the spring, B, will occur mainly in the upper and lower sections, 13, surrounding the posts, 16, while the middle section, 14, acts to support the load and to absorb the vibration.

In Figure 7 the rubber block, 1, is of suitable proportions for connecting the front end of the spring to the frame and the details of this device are similar to those of the connecter shown in Figure 2, except that the metallic caps or sockets, 23, are integral members intended to be placed in the mold during the formation of the rubber block, 1, so that the block is actually molded into these caps, 23. The attaching bolts, 24, are likewise included in the assembly when the rubber is molded. Figure 7 shows the same form of frame terminal, A^2, as Figure 1, this being a cast member providing a downwardly facing flat pad, A^3, which is drilled and threaded to receive one of the studs, 24, which may be locked by a cross pin, 25, if desired.

Figure 6 shows a front end connection similar in theory to that of Figure 5 but because of the very limited distortion required at the front end of the spring I provide only a single stud, 16^a, whose head, 16^b, is pocketed in a block of rubber, 13^a, and retained by a rubber block, 14^a, above the head. The casing, 15, is screwed directly to a thread formed on the special pad, A^4, at the front end of the frame and at its lower end said casing, 15, provides a large clearance opening through which the rubber of the block, 13^a, extends downwardly surrounding the stud, 16^a, to the surface of the spring leaf, B^1.

Figures 8 and 9 illustrate a modification of the same general type as Figure 5 but in this form the studs, 26, are made with T-heads, 27, extending crosswise of the vehicle so as to allow the device as a whole to flex more freely in a longitudinal plane of the vehicle and to quite definitely oppose the lateral distortion which accompanies any twisting of the spring leaf. In this way the device tends to check sidesway or "shimmying" of the vehicle on the road. The T-shaped studs are assembled with sectional rubber blocks comprising upper and lower parts, 28, and a metal block, 29, which are enclosed in a metallic barrel or casing, 30, as in Figure 5. In this form, however, the rubber of the upper and lower blocks, 28, extends through the large clearance openings in the ends of the barrel and completely encases the stems of the studs, 26, up to the surface of the frame and spring respectively, so that these metal parts are not exposed to the weather and the rubber tends to exclude dirt or moisture from them.

Although the principal duty of flexible connecters of this character is performed under load and therefore under compression, there are times when the devices are subjected to tensile strain; even the distortion due to normal spring flexure will cause bending of the rubber block producing tension at one side and frequently the heavy recoil of spring leaf action may throw the connecter into tension for the instant. It frequently happens that the vehicle is designed so that the tractive effort is transmitted wholly or mainly through the springs or that the operation of the brackets imposes similar strain upon the spring shackles. Therefore, it is desirable to re-enforce the rubber material to insure complete safety in its use even though the rubber itself may have sufficient tensile strength to meet all normal requirements. In Figure 10, I have shown a form of connecter which may be manufactured as

a tube of considerable length composed of a layer of woven fabric, 31, and a layer of thin rubber rolled up on a core and then partially vulcanized to cause the rubber to flow into the fabric and form an integral tubular structure. This tube may then be cut into short lengths of from one to two inches and the cut edges of the fabric, 31, may be sealed in by the addition of rubber at 32 and further vulcanizing to render the rubber homogeneous throughout. The annular block with its self contained re-enforcement is then punched to receive the fastening studs, 33, and the applied heads, 34, of the studs are accommodated in the central opening of the block. A central filler of two parts of molded rubber, 35, is inserted between the heads, 34, of the studs and these two parts are secured by an axial bolt, 36. Between the frame flange, A^1, and the rubber connecter, and likewise between the spring end, B^1, and the rubber, I prefer to provide metallic pads, 37 and 38, respectively, which conform approximately to the curved outline of the connector under load and thus distribute the load over a considerable area of the rubber. Such a connecter while adapted to be distorted sufficiently to accommodate the spring under all conditions, also serves as a strong tie member between the running gear and frame of the vehicle.

In Figures 12 to 18 I have shown several forms of connecters embodying the same principle as that of Figure 10. In Figure 12 the connecter, 40, shown at the front end of the spring is of triangular outline instead of approximately circular but may be made in much the same manner as that of Figure 10. However, I prefer in this instance to insert the attaching studs, 41, through suitably punched apertures in the section of tubing immediately after cutting the section from the tube and then to insert a plug, 45, of rubber of somewhat more dense consistency than the ply rubber associated with the re-enforcing fabric. With the parts thus in position I add rubber facing material for the flat lateral surfaces at 46 and complete the vulcanizing so that all the rubber of the device is thus welded into a unit with the metal parts permanently secured in place. As applied to the front end of the frame I have shown one side of the triangle uppermost and lodged within the suitably formed cap pad, A^5, attached to the end of the frame member, A. The upper attaching stud is secured by an ornamental nut, 42, giving a finished appearance to the device. Within the connecter unit the heads of the studs, 41, are laterally extended as shown at 43 and 44 in Figure 14, so as to present broad surfaces for engagement with the re-enforced triangle without danger of tearing when placed under strain. The core, 45, serves principally for supporting the vehicle load as transmitted through these broad heads, 43 and 44, of the studs.

At the rear end of the front spring, B, shown in Figure 12 the connecter, 50, is of elongated or elliptical form but is made from tubing by the process already described for the triangular device of Figure 14. This connecter is shown more in detail in Figure 18 in the position which it assumes before assembly in the vehicle. Under normal load it is distorted rearwardly at the lower end as indicated in the full outline in Figure 12. The dotted outline indicates approximately the position and shape assumed by the connecter at the expected limit of recoil of the spring, B, or at the probable limit of upper flexure of the spring under load. Caps or pads, 52, are provided for seating the upper and lower ends of the connecter at the frame and spring and studs, 51, project from either end for securing the device to said parts. If applied to the rear end of a rear spring as shown in Figure 13 the frame may have a specially formed pad, A^6, recessed to receive the rounded end of the connecter and the ornamental nut, 54, may be used for finish. An interior plug, 55, is shown in Figure 18 serving the same purpose as the plug, 45, in the triangular connecter; in the elliptical form the heads, 56, of the studs, 41, may be exactly similar.

Where the springs are relied upon for transmitting the driving effort or absorbing the braking strains, it is desirable to prevent excessive distortion of the flexible connecters longitudinally of the vehicle and to avoid imposing the entire strain of this work upon the annular or triangular portions of the device. In such cases I propose to form the heads of the attaching studs as shown in Figure 16 for the triangular connecter making both heads concave,—the upper one, 43^a, as shown at 47,—and to insert a comparatively hard plug, 48, which may be made of rubber rolled rather tightly with a layer of re-enforcing fabric but which should not be of entirely non-yielding material. This plug, 48, will tend to transmit the longitudinal strains which are almost of a shearing nature in the connecter while at the same time permitting distortion of the connecter about the center of the plug, 48, as the approximate center of angular movement. As a modification of the structure of Figure 16, Figure 17 shows a connecter in which the upper and lower surfaces are both flattened so that if desired the connecter can be applied directly to a flat surface of the vehicle frame and to the flat upper surface of the spring leaf without the use of any recessed caps or sockets. In this construction a hard plug, 64, is held captive between specially formed heads, 62, on the attaching studs, 61, while the remainder of the interior of the device is filled with softer rubber at 63.

In Figure 13 at the forward end of the rear spring I have shown still another form

of flexible connecter which consists of upper and lower annular rubber pads, 70 and 71, between which the forward end of the spring is clamped and which are themselves held to the vehicle frame by a single attaching bolt or stud, 72, passing through the entire assembly and secured if desired, to the special bracket, A', on the frame member. It will be understood that with these annular pads there is no distortion of the device to be expected transversely of the bolt 72, but that the slight change of angle of the spring leaf is accommodated by vertical distortion of the pads themselves while driving and braking strains are transmitted to the spring directly through the stud, 72.

Experience with flexible shackles of the type embodying this invention has shown that the lateral distortion of the shackle by which it accommodates itself to the elongation or rather the longitudinal movement of one end of the spring which results from flexure of the latter also serves to yieldingly resist this movement and thus tend to dampen excessive spring vibration and to check recoil. At the same time the flexibility of the shackle transversely of the vehicle seems to allow the axles to tilt in accommodating themselves to the road without causing any excessive throw or side sway of the body. This lateral flexibility is rendered less in the transverse direction when the rubber or other elastic material is re-enforced as shown in Figures 10 to 18 by the fabric webbing molded in it and it is also limited to some degree by the T-head form of stud of Figures 8 and 9.

I find that the transverse flexibility of the shackle in either direction may be considerably modified by varying the depth of the cups or sockets which form a part of the attaching means as shown at 5 in Figure 2, at 10 in Figure 3 and at 52 in Figure 12. With a given consistency of rubber and weight of fabric the shackle material may be properly suited to use with springs of various degrees of flexibility by modifying the dimensions of these cups or recesses and particularly where the cups are not relied upon as fastening members, as in Figure 12. This variation in design of the cups requires no other change in the equipment.

While I have illustrated and described the invention entirely as applied to the connection of a vehicle spring and frame it should be understood that its utility is not limited to this field but that wherever it is desirable to connect two members with limited flexibility and avoid the transference of vibration from one to the other, a connection of this nature may be useful. For example, in mounting an automobile motor in the frame of the vehicle the motor vibration would be considerably absorbed by the use of connecters embodying my invention and likewise in attaching the vehicle body to the frame they would serve a similar purpose. But as applied to the vehicle spring problem I find that they have definite advantages in providing spring control which involves the yielding resistance to elongation of the spring, yielding resistance to spring flexure which serves for checking rebound and yielding resistance to excessive oscillation which operates to damp spring vibration and bring the parts to rest sooner than where pivotal connections are used.

I claim:

1. A flexible connecter comprising a body of elastic material and a pair of headed studs having their heads embedded in said material and spaced apart therein, said studs projecting from the material in opposite directions for securement of the parts to be connected and constituting the sole means of attachment of the connecter to said parts, said material being reenforced by a substantially non-extensible fabric embedded therein, and engaged with the studs under their heads.

2. A flexible connecter comprising a body of elastic material, and a pair of headed studs having their heads embedded in said material and spaced apart therein, said studs projecting from the material in opposite directions for securement of the parts to be connected and constituting the sole means of attachment of the connecter to said parts; said material being reenforced by a substantially non-extensible fabric embedded therein and perforated to engage the studs under their heads.

3. In combination with a vehicle frame and a leaf spring, a flexible shackle for connecting them comprising an approximately annular member of elastic material reenforced by substantially inextensible but flexible material together with a pair of fasteners extending therefrom in opposite directions for attachment to said frame, and spring respectively, and a cushion of elastic material interposed between said fasteners within the annular member.

4. A flexible connecter comprising an approximately annular member of fabric reenforced elastic material having a pair of opposite openings and headed studs extending therethrough in opposite directions with their heads within the annular member, with a cushion block of elastic material interposed between the heads of the fasteners.

5. In the combination defined in claim 4, said heads having oppositely concave portions facing each other and a plug pocketed in said concave faces between the heads, said plug being less elastic than the cushion material and adapted to transmit transverse strains from one stud to the other.

6. In the combination defined in claim 4, said reenforcing fabric extending within the annular member in one or more layers approximately parallel to the outline thereof and the edges of said fabric being sealed by

elastic material applied to the lateral faces of the annular member.

7. The method of producing a flexible connecter which consists in forming a tube of laminated rubber and fabric partially vulcanized; cutting said tube into short sections, providing a pair of openings in one section at opposite sides thereof, inserting headed studs in said openings with their heads within the annular reenforced member, adding a filler block of rubber between the heads of said studs and adding rubber to the lateral faces of the annular section; and finally vulcanizing the assembled rubber elements with the studs assembled therein to form a unitary device.

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