Oct. 20, 1953 D. WILLISON 2,656,182

CUSHIONING DEVICE

Filed June 23, 1951 2 Sheets-Sheet 1

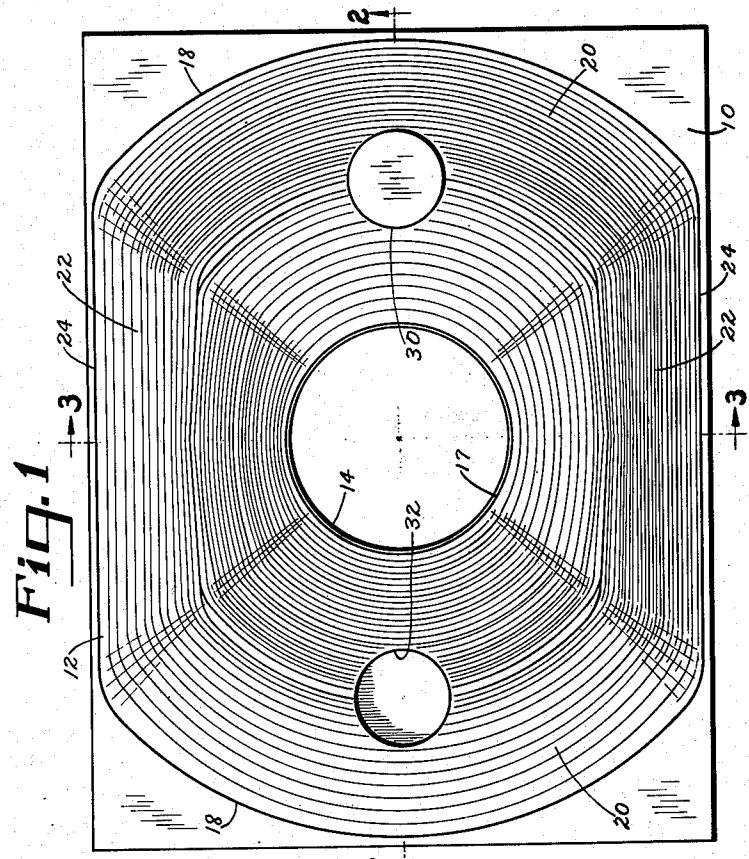


Fig. 1

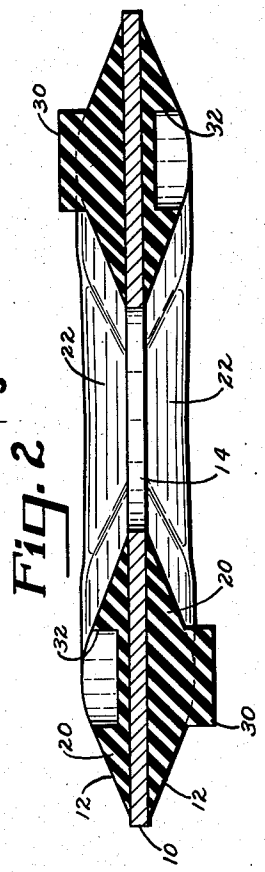


Fig. 2

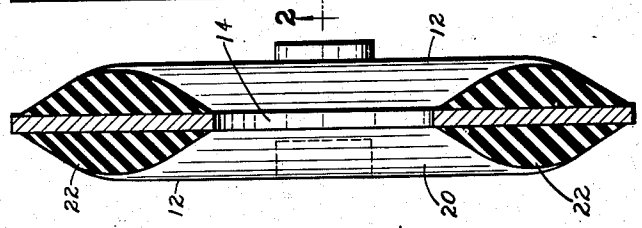


Fig. 3

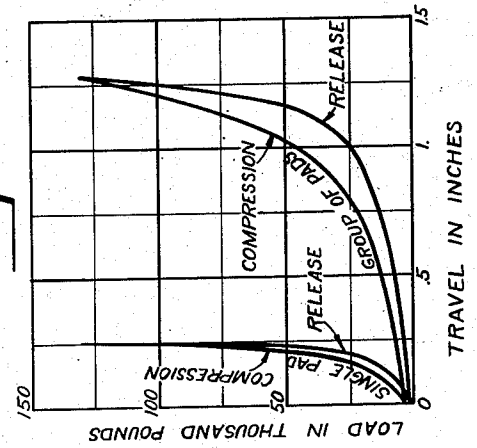


Fig. 4

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Fig. 5

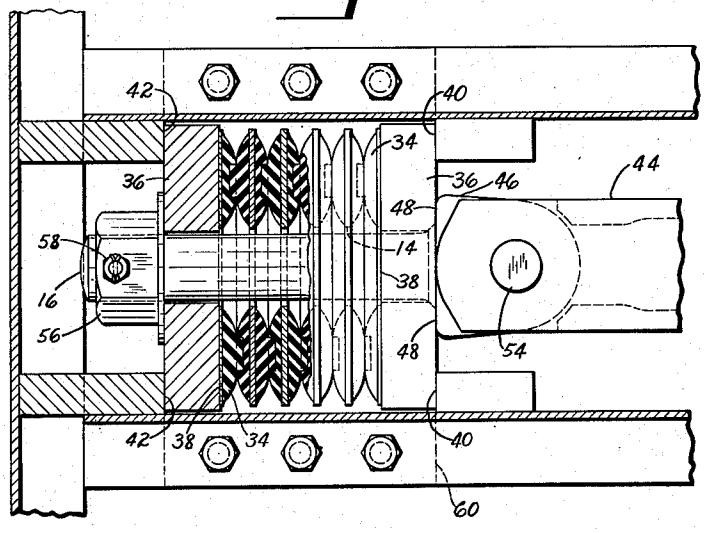
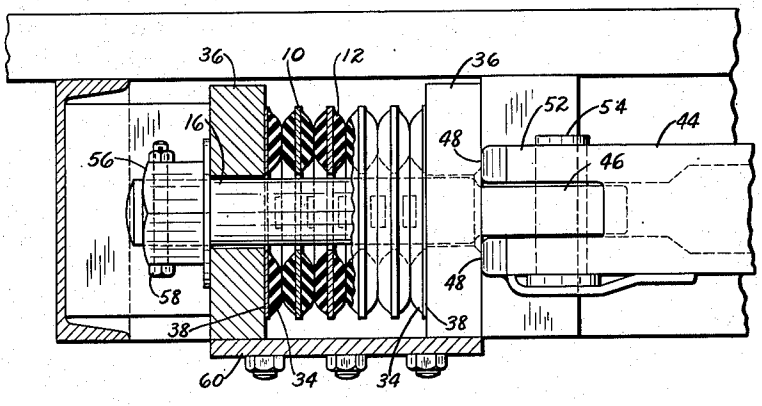


Fig. 6



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CUSHIONING DEVICE

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13 Claims. (Cl. 267—63)

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This invention relates to cushioning mechanism for industrial or mine cars and more particularly to a resilient pad for use in such a mechanism.

In the past the usual mine car cushioning mechanism or draft gear, as it is generally called, comprised a simple helical spring. However, with the advent of larger mine cars the cushioning capacity of the draft gears has had to be correspondingly increased. Helical springs of sufficient capacity to cushion properly the larger cars would have to be greatly increased in size and would require a larger pocket size in the car, thereby decreasing the load-carrying space in the latter. Moreover, corrosion conditions are extremely bad in most mines and the life of steel springs is relatively short.

I have devised a cushioning pad which, when assembled with a series of similar pads, provides a simple, compact and durable cushioning mechanism having cushioning capacity several times that of a coil spring type of draft gear for use in a draft gear pocket of given size in industrial or mine cars. This pad therefore permits holding the pocket size in the car to a minimum, yet provides a gear which has adequate cushioning capacity to protect the largest size mine cars now being constructed.

The pad comprises a metallic plate to a side of which is bonded a ring-like rubber cushion of novel construction. The pad has a central opening therethrough to receive the tail bolt or similar member of the draft rigging of a car to enable operation of the car through a rotary dump while coupled to adjacent cars.

Accordingly, it is an object of my invention to provide a new and improved resilient pad of high cushioning capacity made of rubber or similar material bonded to a metallic plate.

More specifically, it is an object of my invention to provide a resilient pad of a high cushioning capacity for use in a cushioning mechanism for industrial or mine cars, comprising a metallic plate and a rubber cushion of ring-like shape bonded to the plate.

Other objects and advantages of my invention will be apparent from the following description taken in conjunction with the drawings in which:

Fig. 1 is a plan view of a cushioning pad embodying my invention.

Fig. 2 is a sectional view taken along line 2—2 of Fig. 1.

Fig. 3 is a sectional view taken along line 3—3 of Fig. 1.

Fig. 4 is a graph illustrating the compression characteristics of a single pad embodying my invention and of a group of pads.

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Fig. 5 is a plan view, partly in section of a draft gear made up of a group of pads of the type shown in Fig. 1.

Fig. 6 is an elevational view, partly in section, of the arrangement shown in Fig. 5.

Referring particularly to Figs. 1, 2 and 3, it will be seen that my cushioning pad comprises a thin metallic plate 10 to the opposite sides of which a ring-like rubber cushion 12 is bonded or otherwise secured. Plate 10 is rectangular in shape and of such dimensions as to be accommodated in the majority of conventional draft gear pocket constructions in industrial or mine cars. A central opening 14 is provided in plate 10 for receiving the usual tail bolt 16 (Figs. 5 and 6) used for connecting the coupler to the cushioning mechanism of the car to enable operation of the car through a rotary dump while coupled to adjacent cars.

As best seen in Fig. 1, rubber cushion 12 is formed with its inner peripheral edge 17 concentric about opening 14, while portions of the outer peripheral edges are also concentric about the opening as at 18 on the wider portions 20 of the pad. However, the outer peripheral edges of the narrower portions 22 are straight as at 24. Thus it will be seen that the cushion comprises a pair of circular end portions which are joined to flattened side portions, the circular end portions being of greater width as measured in a direction radially of the cushion than the average width of the side portions.

This configuration of the rubber cushion has been particularly devised for use in a draft gear pocket which is rectangular in transverse section with the dimensions thereof in the transverse direction being greater than that in the vertical direction. Moreover, it utilizes to a maximum the cushioning properties of the rubber per unit volume thereof.

The bond between the rubber and the plate prevents flow of the base portion of the cushion outwardly along the surface of the plate during compression of the rubber. This restriction of the flow of the rubber is highly important in determining the cushioning properties of the pad. The bond stress is greatest along the peripheral edges of the cushion and in order to protect the bond it is important that the inner and outer sides of the rubber be sloped gradually around the entire cushion from the surface of the plate to the top or ridge of the cushion. This causes the rubber to fold or crease during compression of the pad substantially along a line spaced a sufficient distance back from the peripheral edges of the cushion to assure protection of the bond.

Without the gradual sloping of the rubber the crease during compression of the pad will occur at or very close to the peripheral edges of the cushion and will thereby cause a high bond stress at the edges, which will result in rapid failure of the bond under repeated shock loadings. The feature of gradually sloping the sides of the rubber cushion to the ridge thereof has been disclosed in the copending application of Donald Willison and Hubert L. Spence, Serial No. 138,614, filed January 14, 1950.

I have found from lengthy endurance tests that the slope of the sides of the cushion should be less than about 30 degrees, but preferably no greater than about 23 degrees when the pads are subjected to repeated loadings which compress the rubber to about 45 per cent compression (pads compressed until rubber thickness equals 100 per cent minus 45 per cent, or 55 per cent of the thickness as measured at the crest of the ridge when the pad is under no load).

While the slope of 23 degrees is applied on the sides of the wider portions **20**, it cannot be maintained on the sides of the narrower portions **22** because of the dimensional limitations of plate **10**. Thus, if the sides of portions **22** were sloped at an angle of 23 degrees to the plate, the thickness of the rubber at the crest of these sections would be considerably less than the thickness at the crest of wider portions **20**. This would result in portions **20** carrying the bulk of the compressive load applied to the pad since portions **22** would be inactive in resisting the load until portions **20** had been compressed a substantial amount. Consequently, the load-carrying ability of the pad would be materially decreased, because the compression of portions **20** would determine the size of the load.

I have found that by forming the sides of the narrower portions **22** at a somewhat steeper slope than 23 degrees, 32 degrees for instance, and also holding the thickness of the rubber at the ridge thereof to a lesser dimension than that at the ridge of wider portions **20**, the bond between the rubber and the plate will not be injured during compression of the pad. With the cushion thus formed, the narrower portions thereof are compressed only to about 38 per cent compression while the wider portions **20** are compressed 45 per cent. Thus, while the steeper slope of 32 degrees on portions **22** would not provide satisfactory protection of the bond against the high bond stresses which would be set up if the rubber were compressed to about 45 per cent, these portions are now compressed only to about 38 per cent compression while the wider portions are being compressed to about 45 per cent. In this manner the bond stress which is induced along the peripheral edges of portions **20** and **22** is about the same and a cushioning pad of high durability as well as high cushioning capacity has been obtained.

It will be appreciated that in certain cases the relative length and width of plate **10** may be different from that shown, in order to fit the draft gear pocket in the car. Thus, in certain instances the cushion may be somewhat more elongated in appearance than shown, while in other cases it may approach the shape of a true ring. In either event, the slope of the sides of the narrower portions of the cushion should be such that the thickness of the rubber at the crest of the ridge is somewhat less than that at the crest of the ridge of the wider portions. This will assure that the narrower portions of the cushion which have the more steeply sloped sides will be compressed to a lesser degree than the wider portions when the latter have been compressed to about 45 per cent, thereby protecting the bond between the rubber and the plate.

The pad is provided with integral dowel means **30** and corresponding openings **32** for interlocking engagement with the recess and dowel of an adjacent pad to maintain a series of pads in alignment, as shown in Figs. 5 and 6. Preferably the dowel is formed at the crest of the ridge of the cushion, and one dowel and one recess are formed on each cushion with the dowel on one cushion disposed directly opposite the recess in the cushion on the other side of the plate. The dowels fit snugly in the recesses so that as the pads are compressed the dowels deflect in unison with the cushion bodies, thereby avoiding any abrasion of the rubber. This dowel construction has also been disclosed in the aforementioned application of Donald Willison and Hubert L. Spence.

In Figs. 5 and 6 there is shown a typical application of a series of pads to a conventional mine car draft rigging. The pads are arranged face-to-face with dowels **30** extending into recesses **32**. The end pads **34** have a rubber cushion on one side only so that there is rubber-to-rubber contact throughout the entire group of pads. Followers **36** are interposed between the plates **38** of end pads **34** and front and rear stops **40** and **42**, respectively, of the draft gear pocket. Plate **38** may be formed of thinner gage metal than plate **10**, since it is subjected to a smaller stretching force by the single cushion bonded thereto. The coupler shank **44** is operatively connected to the rigging by the tail bolt **16** to enable rotation of the coupler about its longitudinal axis with respect to the car. This permits revolving the car to an upside down position in a rotary dump while the car remains coupled to adjacent cars of a train. The tail bolt extends through central openings in followers **36** and through openings **14** in the pads and is formed at its forward end with a head portion **46** having shouldered engagement with front follower, as at **48**. The coupler shank is formed with a bifurcated end portion **52** which is pivotally connected to head **46** by a vertical pin **54**. The tail bolt is secured to the unit by a nut **56** which is locked in place by means of auxiliary bolt and nut means **58**. A transverse plate **60** secured to the car frame underlies the pads and followers to support the same.

The pads are preferably placed under an initial compression of about 5,000 pounds and this is effected by adjusting nut **56** until the desired load has been applied. It will be seen in Fig. 5 that the pads are shown in full contact with adjacent pads. This results from the initial load applied to the pads which takes up the clearance which would exist between opposing ridges of portions **22** of the cushions if the pads were uncompressed.

While it will be seen in Fig. 6 that the height of the pocket in the car is such as to allow the use of a pad of greater height than has been illustrated, in other car constructions the height of the pocket limits the dimension of the pad to that as shown in the drawings.

It will be understood that more or less pads than have been illustrated in Figs. 5 and 6 may be used to form the cushioning mechanism, depending on the cushioning capacity required. A typical arrangement using five pads (four

whole pads having double cushions, and two single cushion end pads) has a dynamic cushioning capacity of about 4,000 foot-pounds, which is several times the capacity of a helical spring for use in the same pocket size.

In Fig. 4 is shown a graph of the load-travel characteristics of a single cushioning pad and of a group of pads. The single pad and the group of pads have been initially subjected to a load of about 5,000 pounds, which corresponds to the condition of the pads when applied to the draft rigging of a car. The top or compression curve in each instance illustrates the variation of travel with compressive load as the latter is slowly applied to the pads. The release portion of the curve represents the load-travel characteristics as the load is gradually withdrawn. The area between the two curves represents energy absorbed by the rubber. This absorption is approximately 40 per cent of the total work applied to the pads and serves to decrease the recoil between two cars as they come together for coupling. It will be noted that the curve for the group of pads is considerably extended in the horizontal direction as compared with that for the single pad, showing the added travel which is obtained for a given load.

In a cushioning mechanism or draft gear made up of my cushioning pads there are no metallic stops to limit the amount of compression or travel of the gear. Therefore, under blows of unusual severity the rubber in portions **20** of the pads may be compressed more than 45 per cent and in portions **22** may exceed the 38 per cent value. I have referred to these compression percentages and slope angles to illustrate my discovery that for a given degree of durability or service life there is a certain approximate relation between the slope of the rubber periphery and the amount of allowable compression. I have maintained this relationship throughout the different portions of my pad so that the bond stress at the peripheral edges of the cushion is substantially of the same value and a pad of maximum shock cushioning capacity and durability is produced.

It will be seen that I have provided a cushioning pad which is simple and yet durable, and when a group of such pads is arranged in the form of a cushioning mechanism a compact unit results which very adequately cushions the shocks incident to the service conditions to which it is subjected.

The terms and expressions which I have employed are used as terms of description and not of limitation, and I have no intention, in the use of such terms and expressions, of excluding any equivalents of the features shown and described or portions thereof, but recognize that various modifications are possible within the scope of the invention claimed.

I claim:

1. A cushioning pad for a shock cushioning mechanism, comprising a plate having a rubber cushion secured to a side thereof, said plate having a central opening therethrough, said cushion being ring-like in shape and having its inner and outer sides sloped gradually upwardly from the surface of said plate, the sides of certain portions of said cushions being more steeply sloped than the adjacent sides, and the crest of said more steeply sloped portions being disposed at a lesser height above said plate than the crest of the adjacent portions.

2. A cushioning pad for a shock cushioning mechanism, comprising a plate having a rubber cushion secured to a side thereof, said cushion being ring-like in shape and having portions which are of lesser width than adjacent portions, the sides of said cushion being sloped gradually upwardly from the surface of said plate, the thickness of said cushion at the crest of said portions of lesser width being less than the thickness at the crest of adjacent portions.

3. A cushioning pad for a shock cushioning mechanism, comprising a plate having a cushion in the form of a ring-like ridge of rubber bonded to a side thereof, said cushion comprising a pair of circular end portions and a pair of substantially straight side portions, the sides of said circular portions being sloped gradually from the surface of said plate to the crest of said ridge, the sides of said side portions having a steeper slope than the sides of said circular portions and the crest of the ridge of said side portions being disposed at a lesser height above said plate than the crest of the ridge of said circular portions.

4. A cushioning pad for a shock cushioning mechanism, comprising a plate having a rubber cushion bonded to a side thereof, said cushion being ring-like in shape and having a pair of oppositely disposed end portions which are of greater width than the adjacent pair of oppositely disposed side portions, the sides of said first-named portions being sloped gradually upwardly from the surface of said plate, the sides of said second-named portions being more steeply sloped than the sides of said first-named portions and the thickness of said second-named portions being less than the thickness of said first-named portions.

5. A cushioning pad as specified in claim 4, having dowel and recess means for maintaining said pad in alignment with a similar pad when assembled therewith.

6. A cushioning paid for a shock cushioning mechanism, comprising a plate having a rubber cushion secured to a side thereof, said cushion being ring-like in shape and having portions which are of greater width than adjacent portions, the sides of said portions of greater width being sloped upwardly from the surface of said plate at an angle no greater than about 23 degrees to permit repeated compression of said pad an amount equal to about 45 per cent of the maximum thickness of the rubber without bond failure, the sides of the narrower portions of said cushion being sloped at an angle of about **32** degrees and the maximum thickness of the rubber of said narrow portions being slightly less than that of said wider portions.

7. A cushioning pad for a shock cushioning mechanism, comprising a plate having a cushion in the form of a ring-like ridge of rubber bonded to a side thereof, portions of said cushion having the crest of said ridge disposed at a lesser height above the surface of said plate than adjacent portions, said first-named portions being of lesser width than the adjacent portions, the sides of said first-named portions being sloped at an angle of about 32 degrees and the sides of said adjacent portions being sloped at an angle of no greater than about 23 degrees.

8. A cushioning pad for a shock cushioning mechanism, comprising a rectangular plate member having a circular central opening therethrough, a rubber cushion bonded to a side of said plate, said cushion being in the form of a ring-like ridge having its inner periphery con-

centric about said opening, portions of the outer periphery of said cushion being concentric about said opening and other portions of said outer periphery being straight, the sides of said first-named portions being sloped at an angle of no greater than about 23 degrees to said plate to permit repeated compression of said pad an amount equal to about 45 per cent of the maximum thickness of the rubber without bond failure, the sides of said other portions being sloped at an angle of about 32 degrees and the maximum thickness of the rubber of said other portions being slightly less than that of said first-named portions.

9. A cushioning pad for shock cushioning mechanism, comprising a metallic plate to the opposite sides of which a rubber cushion is bonded, said cushion being in the form of a ring-like ridge and comprising a pair of circular end portions joined to substantially straight side portions, said circular portions being wider than said side portions and having the sides thereof sloped at an angle of no greater than about 30 degrees to said plate, said side portions having the sides thereof sloped at an angle of no greater than about 32 degrees and the thickness of the cushion at the crest of said side portions being less than at the crest of said circular portions.

10. A cushioning pad as specified in claim 9, having an integral projection on said ridge and a corresponding opening spaced from said projection, said projection and opening being adapted to interlock with the opening and projection of an adjacent similar pad to maintain a group of pads in alignment.

11. A shock cushioning mechanism comprising a group of cushioning pads arranged in face-to-face engagement, certain of said pads comprising a plate having a rubber cushion secured to opposite sides thereof, the end pads of said group comprising a plate having a single rubber cushion secured to a side thereof, each of said cushions

comprising a ring-like ridge having certain portions of greater thickness than adjacent portions, said portions of greater thickness having the sides thereof sloped at an angle of no greater than about 30 degrees to the plate, said adjacent portions having the sides thereof sloped at an angle of no greater than about 32 degrees.

12. A shock cushioning mechanism comprising a group of cushioning pads arranged in face-to-face engagement, certain of said pads comprising a plate having a rubber cushion secured to opposite sides thereof, the end pads of said group comprising a plate having a single rubber cushion secured to one side thereof, each of said cushions being ring-like in shape and having portions which are of lesser width than adjacent portions, the sides of said cushion being sloped gradually upwardly from the surface of said plate, the thickness of said cushion at the crest of said portions of lesser width being less than the thickness at the crest of said adjacent portions.

13. A cushioning pad for a shock cushioning mechanism, comprising a plate having a rubber cushion secured to a side thereof, said cushion comprising a ridge having a side sloped gradually upwardly from the surface of said plate, certain portions of said side of said ridge being more steeply sloped than the adjacent portions, and the thickness at the crest of said ridge at said more steeply sloped portions being lesser than the thickness at the crest of said adjacent portions.

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