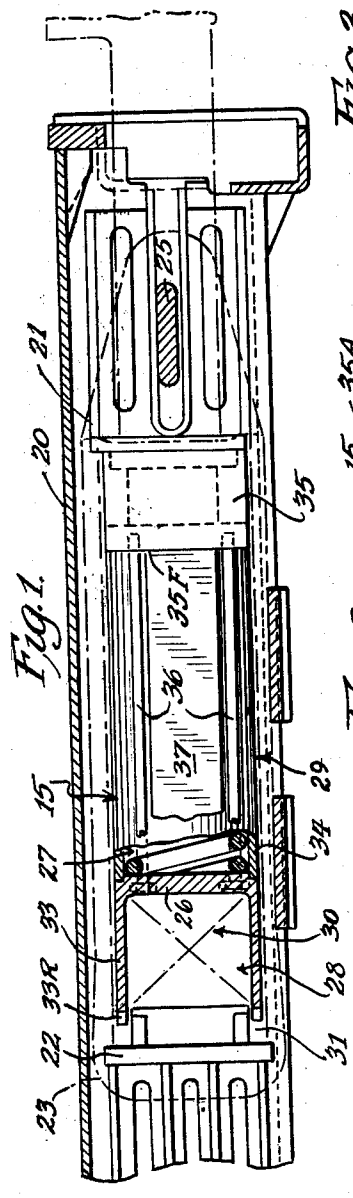
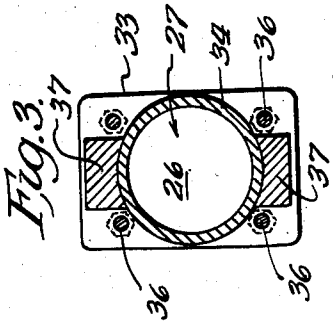
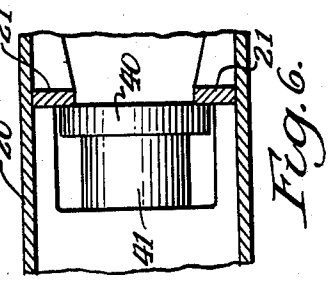
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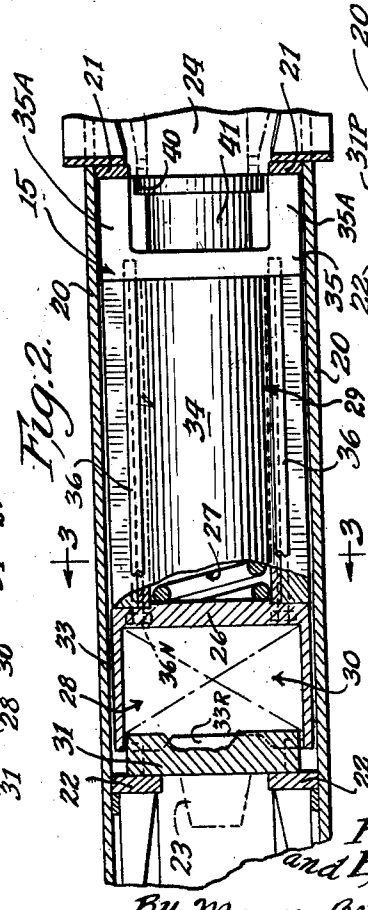
HIGH CAPACITY DRAFT GEAR

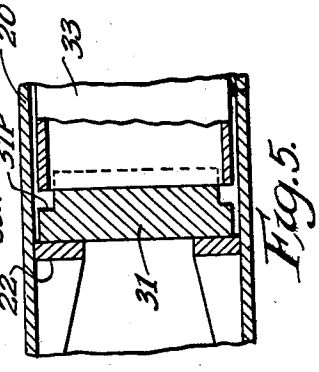
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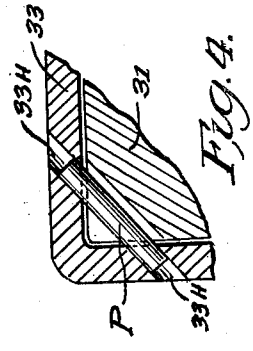












Richard J. Housman
and Eldred H. Natschke
By Mann, Brown & McWilliams
Attys

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HIGH CAPACITY DRAFT GEAR

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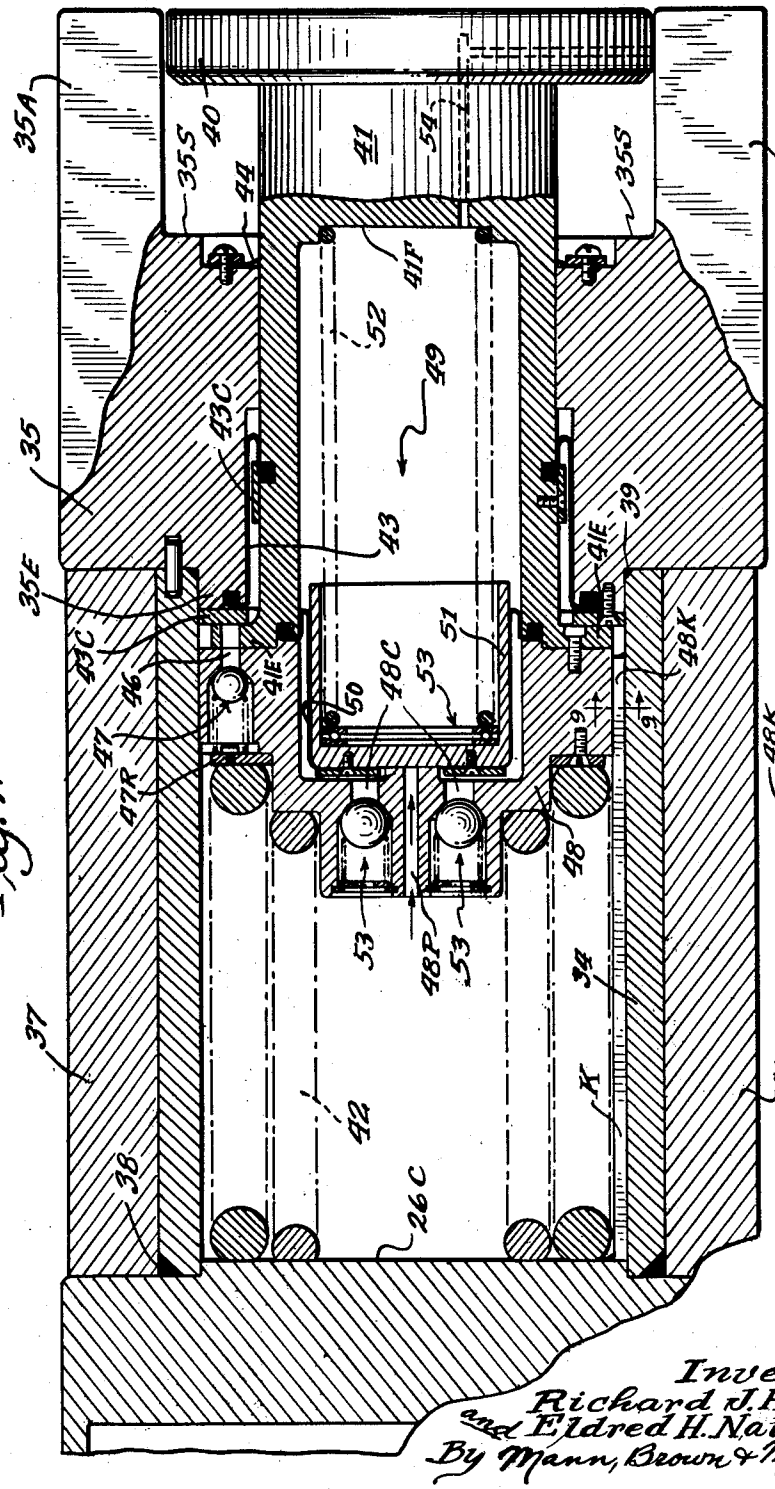


Fig. 7.

Fig. 9.

Inventors
Richard J. Housman
and Eldred H. Natschke
By Mann, Brown & McWilliams
Attys.

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HIGH CAPACITY DRAFT GEAR

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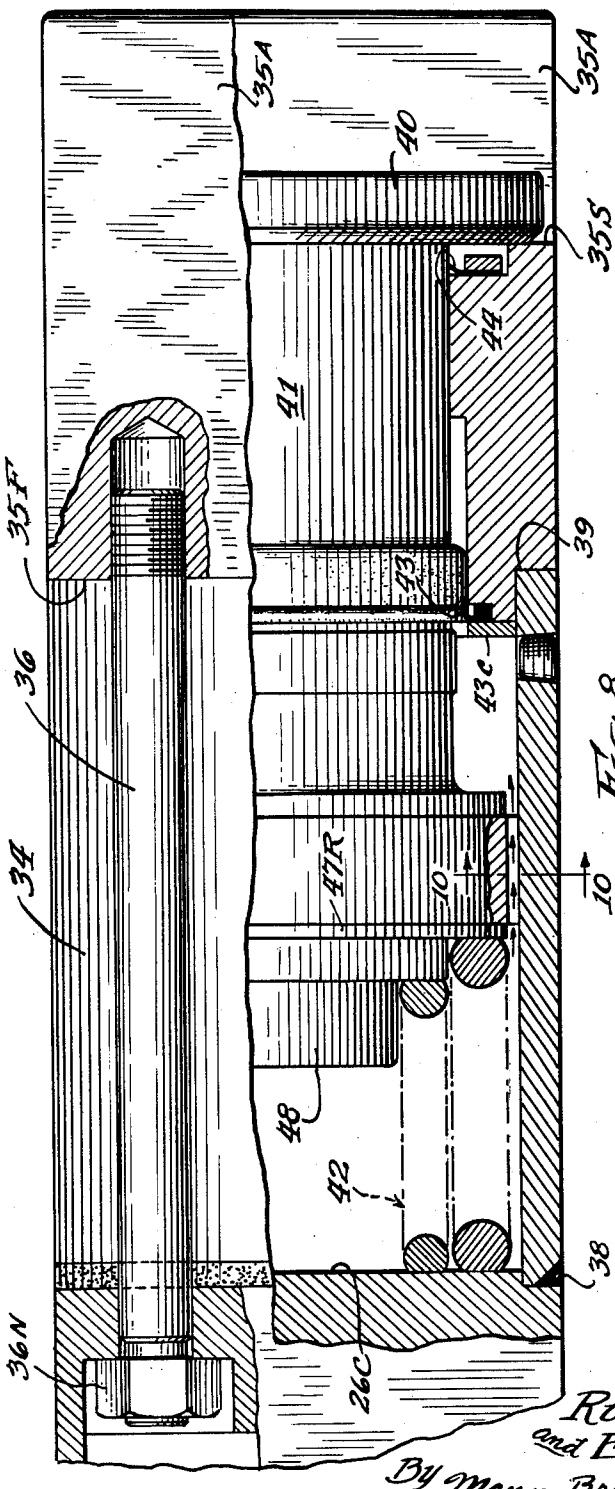


Fig. 8.

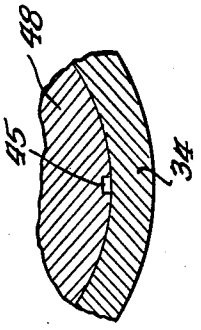


Fig. 10.

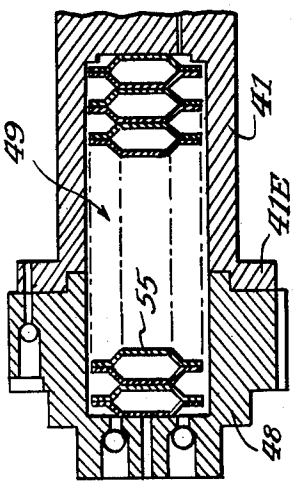


Fig. 11.

Inventors
Richard J. Housman
and Eldred H. Natschke
By Mann, Brown & McWilliams
Attys

Fig. 12.

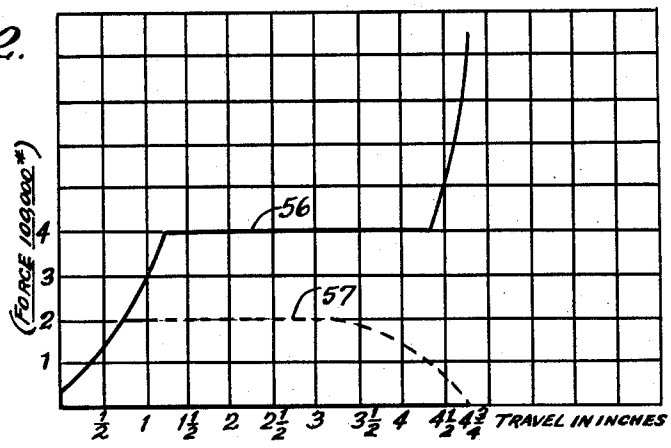
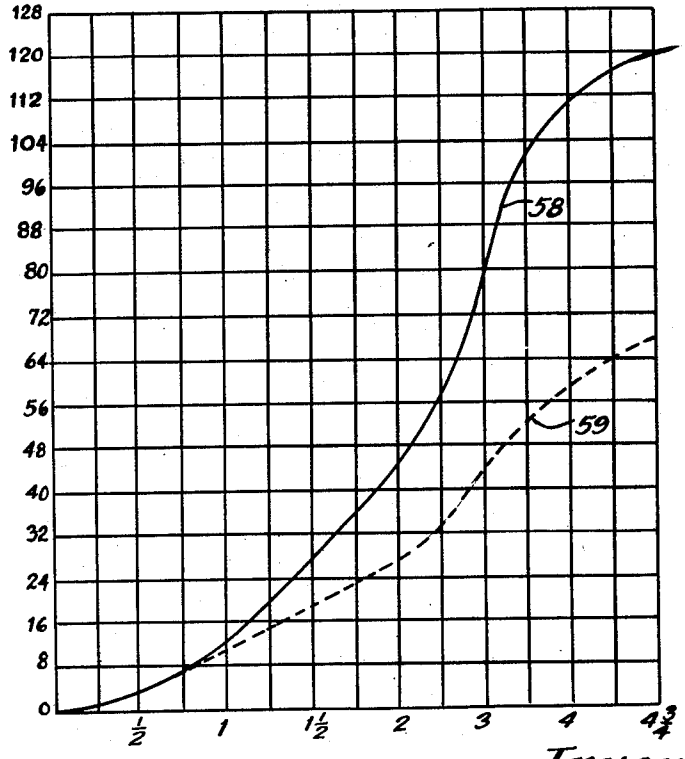


Fig. 13.



Inventors
Richard J. Housman
and Eldred H. Natschke
By Mann, Brown & McWilliams.
Attys.

United States Patent Office 3,150,781 Patented Sept. 29, 1964

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HIGH CAPACITY DRAFT GEAR

Richard J. Housman, Dolton, and Eldred H. Natschke, Bourbonnais, Ill., assignors to Cardwell Westinghouse Company, a corporation of Delaware

Filed Dec. 27, 1960, Ser. No. 78,367
5 Claims. (Cl. 213—23)

This invention relates to high capacity draft gears for application in the draft pockets of railroad car frames and has for its principal object the provision of a draft gear arrangement having a positive resistance type of spring cushioning unit that is operable to cushion draft loads which are relatively light and a hydraulic fluid throttling type cushioning unit that is operable in conjunction with the first unit to jointly resist buff loads which are relatively stronger, with the first unit operating during initial buff travel to limit shock effects during set up of the hydraulic unit.

There have been many arrangements devised for utilizing hydraulic cushioning units in draft gear applications. For such applications, hydraulic units have advantageous features which are highly desirable, such as, offering high capacity and offering increasing resistance and absorption as the speed of load application increases. However, hydraulic units have certain disadvantages which make them undesirable for draft gear application. Some amount of initial cushioned travel must be provided during which the hydraulic unit may set up and condition itself for yieldably resisting closure.

An object of the invention, therefore, is to provide an arrangement wherein a positive resistance type of spring cushioning unit acts in series with a hydraulic unit to handle the light loads and the initial shock effects of the heavy loads to which the hydraulic unit may be subjected.

Still another problem that is inherent in the use of hydraulic units for draft gear applications relates to the possibility of the development of destructive internal pressures when extremely high energy impact loads are encountered.

A further object of the invention is the provision of an arrangement wherein the maximum loading on the hydraulic unit is positively limited to an acceptable range and wherein a spring cushioning unit acts to resist loads in excess of the maximum capacity of the hydraulic unit.

Another difficulty with hydraulic units arises from the fact that they normally will undergo thier full closure travel if they are subjected to a light but steady force. Under a constant force or pull, the hydraulic oil bleeds through the flow restricting orifice. Draft loads of this nature are commonly encountered during train operation and objectionable train run-in and run-out can result when hydraulic units are applied for handling draft loads. It may also be noted that where a hydraulic gear which has a relatively slow recovery characteristic is permitted to operate, even partially during draft, a situation can occur wherein a sudden reversal of forces from draft to buff would leave the hydraulic unit partially closed and hence incapable of providing its full closure travel for resisting the buff loading.

Accordingly, another object of the present invention is to provide a draft gear arrangement incorporating a hydraulic unit in a fashion such that the hydraulic unit is precluded from operating under draft loading.

Briefly, in a preferred embodiment of the invention, the high capacity draft gear arrangement is constructed for mounting in a 36" draft pocket of a railway car frame to act between the usual front and rear stops of the pocket and provide a total buff travel on the order of 4¾" with a nominal capacity of 130,000 foot pounds, and a total

draft travel on the order of 1½". The arrangement includes a housing structure having an intermediate abutment wall separating oppositely opening front and rear chambers with a hydraulic cushioning unit mounted in the front chamber and with a rubber spring unit mounted in the rear chamber to bias the housing against the front stops for disabling the hydraulic unit from reacting during draft loading. The rubber spring unit which is operable during both buff and draft may have a travel of 1½" and the hydraulic cushioning unit which is operable only during buff may have a travel of 3¼".

The force-closure characteristics of the two units are correlated so that under buff loading, the rubber unit initially undergoes limited closure travel while the hydraulic unit is setting up for providing a substantially constant reaction force throughout its entire closure travel. A positive stop arrangement is provided to relieve the hydraulic unit of excessive internal pressure at the end of its travel whereupon the rubber unit undergoes further closure to handle those impacts that exceed the capacity of the hydraulic unit.

Other objects and advantages will become apparent during the course of the following description.

In the accompanying drawings forming a part of this specification and in which like numerals are employed to designate like parts throughout the same;

FIG. 1 is a vertical sectional view through a railway car frame and illustrating the draft gear of this invention mounted in place therein with parts of the draft gear being broken away and sectioned to facilitate the disclosure;

FIG. 2 is a horizontal sectional view illustrating the draft gear in mounted position within the draft pocket of the railway car frame;

FIG. 3 is a transverse cross-sectional view through the gear and is taken on the line 3—3 of FIG. 2;

FIG. 4 is an enlarged fragmentary sectional view as taken at the rear end of the gear and illustrates a follower-lock pin arrangement;

FIG. 5 is a fragmentary horizontal sectional view illustrating an alternative rear follower arrangement;

FIG. 6 is a fragmentary horizontal sectional view illustrating an alternative front follower arrangement;

FIG. 7 is an enlarged lengthwise sectional view through the hydraulic unit to illustrate its details of construction;

FIG. 8 is a side elevational view of the hydraulic unit, with parts thereof broken away and sectioned, and illustrates the unit in a closed position;

FIG. 9 is a fragmentary transverse cross-sectional view through the hydraulic unit and is taken on the line 9—9 of FIG. 7 to illustrate a piston guide rib arrangement;

FIG. 10 is a fragmentary transverse cross-sectional view through the hydraulic unit and is taken on the line 10—10 of FIG. 8 to illustrate the orifice passage configuration;

FIG. 11 is a diagrammatic lengthwise sectional view illustrating an alternative compression chamber construction for use in the hydraulic unit of the draft gear;

FIG. 12 is a force-closure diagram illustrating the high and low speed buff closure characteristics of the combined action of the rubber and hydraulic units; and

FIG. 13 is a capacity-closure diagram illustrating the high and low speed buff closure characteristics of the combined action of the rubber and hydraulic units.

For purposes of disclosure, in FIGS. 1 and 2 the draft gear of this invention is designated generally at 15 and is shown mounted in a draft gear pocket provided within a railway car frame having the usual center sills 20 equipped with front and rear draft gear lugs or stops 21 and 22, respectively, with a vertical yoke 23 shown encircling the gear and connected to a coupler shank 24 by a draft key 25. The draft gear has a housing struc-

ture of a length substantially less than the distance between the front and rear stops to accommodate its lengthwise shifting movement within the pocket. The housing structure includes an intermediate abutment wall **26** that separates a forwardly opening chamber **27** of generally circular cross-sectional configuration and a rearwardly opening rear chamber **28** of generally rectangular cross-sectional configuration.

A self-restoring cushioning unit **29** of the hydraulic fluid throttling type is located in the front chamber for cushioning inward or buff movement of the coupler shank. A separate self-restoring type of cushioning unit **30** of the positive resistance spring type is shown mounted in the rear chamber and equipped with a rear follower **31** to react through the rear follower **31** and the rear lugs **22** to bias the housing structure towards the front lugs **21** when the gear is in its normal release position.

Under buff loads, the coupler shank **24** moves inwardly to transmit forces serially through the hydraulic unit **29** and the spring unit **30** with the housing structure moving rearwardly through the pocket a distance determined by the travel of the spring unit **30**. Preferably, the cushioning characteristics of the spring unit are selected to prevent the housing structure from going solid against the rear stops.

Under draft loads the yoke **23** moves forwardly against the rear follower **31** to transmit draft forces into the spring cushioning unit **30** which reacts directly against the front stops **21** through intermediate portions of the housing structure.

The housing structure, illustrated in FIGS. 1–3 for the purpose of disclosure, is comprised of an assembly of elements and includes a hollow box-shaped casting **33** generally of rectangular cross-sectional configuration for housing a rubber mat type of spring unit and closed at one end to form the intermediate abutment wall **26**, a cylinder **34** for the hydraulic unit and composed of a length of seamless tubing of adequate wall thickness to withstand the internal fluid pressures developed in the hydraulic unit, an end cap **35** seated in the front end of the cylinder, a set of four mounting bolts **36** external of and extending lengthwise alongside the cylinder to secure it in tightly sealed relation between the end cap **35** and the casting **33**, and a pair of thrust bars **37** interposed between opposing external surfaces on the rectangular casting and the end cap to transmit forces therebetween and thereby relieve the seamless tubing of excessive buckling loads.

As is best shown in FIGS. 1 and 2 the rear face of the intermediate abutment wall **26** is formed with a set of recesses to receive the nuts **36N** of the mounting bolts in counter-sunk relation.

As is best shown in FIGS. 7 and 8, the seamless tubing that forms the cylinder **35** of the hydraulic unit is snugly seated on a circular embossment **26C** provided on the front face of the casting wall **26** and it is sealed in place by a peripheral weld line **38** at its rear end and an O-ring **39** at its front end. The other ends of the mounting bolts **36** are threaded into suitably tapped sockets provided in a rearwardly directed face **35F** of the end cap. At the rear end of the casting horizontally extending recesses **33R** are formed along the rear edges of the top and bottom walls to accommodate full clearance travel for the rear end of the yoke **23**.

It will be apparent that the elements **33**, **34**, and **37** may be cast integrally to provide a one-piece housing structure having an intermediate abutment wall separating front and rear chambers thereof.

The end cap is generally rectangularly shaped to provide the abutment face **35F** for the thrust bars and mounting bolts and includes a circular inner end **35E** for tight fitting engagement in the front of the cylinder **34** and it also includes forwardly projecting lateral arms **35A** for abutment against the front stops **21** to disable the hydraulic unit from any response during draft loading. The end cap is also arranged to provide forwardly facing internal abutment shoulders **35S** for solid engagement with a front follower **40** which may, as illustrated herein, be formed integrally with the piston **41** of the hydraulic unit, there being adequate clearance for free movement of this front follower in the space between the lateral arms of the end casting.

The spring unit **30** for the rear chamber preferably consists of an aligned stack of rubber mats intercalated with metal spacer plates, a preferred construction of this type being shown in copending application, Serial No. 6,305, filed February 2, 1960, in the name of Bertil E. Peterson.

For use in the draft gear application of this disclosure, however, a locking arrangement such as is shown in FIG. 4 may be employed wherein the outermost corner regions of the rear follower **31** are cut out and aligned holes **33H** are provided in the adjacent edges of the side walls of the casting. When the gear is initially assembled the rubber spring unit is compressed until these holes come into registry with the cut out regions of the corners and lock pins P are inserted to hold the parts under initial compression. It will be apparent that other locking arrangements known to the art may also be employed as desired.

While the characteristics of a rubber spring unit of the foregoing type are preferred for use in combination with a fluid throttling type of hydraulic unit, it will be apparent to those skilled in this art that coil springs might be employed in place of the rubber or in conjunction with the rubber, and it is also contemplated that coil springs or rubber might be employed in combination with a friction clutch meachanism within the rear chamber. All such types of cushioning units are defined herein under the generic phrase "a positive resistance type of spring cushioning unit," and it will be apparent that each of these is also self-restoring in that it returns to its initial configuration upon removal of the load.

The details of a preferred form of hydraulic cushioning unit, which is illustrated herein for purposes of disclosure, are best shown in FIG. 7 wherein the piston **41** is shown with its integral front follower portions **40** spaced 3¼ inches from the abutment shoulder **35S** provided internally and facing forwardly on the end cap **35**. These portions engage in solid abutment, as illustrated in FIG. 8, to limit the maximum travel of the hydraulic unit to 3¼" and, in addition, to positively limit the internal fluid pressures at full closure of the hydraulic unit. The positive stop arrangement prevents the hydraulic unit from going solid on the oil, a condition which, under the severe impacts that must be taken into account in draft gear practice, could readily lead to rupture of the cylinder **34**.

The piston **41** has an enlarged inner end flange **41E** within the cylinder **34** and the piston works against a double coil helical type compression spring **42** housed within the cylinder to restore the hydraulic unit after release of the applied loads.

In the normal release position of the hydraulic unit the enlarged inner end of the piston is urged forwardly by the action of the compression spring **42**. The circular outer end of the piston is of a diameter to nest in fluid tight sealing relation within the outer end of the circular bore of the end cap and an annular rolling diaphragm type seal **43** is provided in the end cap and clamp rings **43C** mount it in sealed relation against both the piston **41** and the inner end **35E** of the end cap for preventing leakage from the cylinder of hydraulic fluid and for preventing entrance to the cylinder of dust and dirt. A seal scraper or wiper ring **44** is clamped to the end cap **35** in recessed relation to the abutment shoulder **35S** thereof to exclude dust, dirt, or other foreign matter from entering between the slideably engaging surfaces of the piston and end cap.

During inward movement of the piston the hydraulic fluid is displaced from the rear of the cylinder to occupy an annular space created at the front side of the enlarged inner end flange of the piston. It will be apparent that this annular space increases in volume at a subtantially lower rate than the decrease in volume at the rear of the chamber due to the fact that the entrance of the piston into the cylinder progressively subtracts from the initial volume of the cylinder chamber. To accommodate the loss of volume within the cylinder the piston **41** is provided with a rearwardly opening axial pocket that registers with a pocket provided in a hat-shaped orifice cap **48** that is anchored across the inner end of the piston. These internal pockets in the piston and orifice cap cooperably define an accumulator chamber **49** for receiving the excess hydraulic fluid displaced by the piston during its inward stroke.

The accumulator chamber **49** is provided with a rolling diaphragm **50** of rubber or other suitable material trained about a sleeve piston **51** and urged rearwardly towards the orifice cap by a helical coil type compression spring **52** one end of which seats against an internal face **41F** on the piston and the other end of which seats against a ball bearing type thrust bearing assembly **53** that is fitted within the sleeve piston **51**. A vent passage **54** is shown extending axially and then transversely to open through the follower portions **40** of the piston. These vent passages accommodate the required free flow of air out of and into the accumulator chamber during closure and release movements, respectively, of the assembly of the diaphragm **50** and sleeve piston **51**. The compression spring **52** within the pocket determines the resistance to closure characteristic of the diaphragm.

It is preferred that the gear's characteristic be independent of an entrapped air pocket since the pressures involved make it substantially impossible from a practical standpoint to assure that the entrapped quantity of air will not undergo some significant leakage over a period of time.

The hat shaped orifice cap **48** is formed with uniformly peripherally spaced full-length orifice passages **45** which are preferably of uniform cross sectional configuration throughout their length and of the shape shown in FIG. 10. A set of three such passages are provided to act as flow restricting orifices through which the hydraulic fluid is throttled during closure of the gear. Essentially it is desired that the fluid pressure existing in the cylinder will be substantially constant throughout a given closure stroke of the gear. For high speed closures the fluid pressure will be substantially greater than for low speed closures. From the standpoint of the gear design as well as from the standpoint of the structural members of the car framing, a constant fluid pressure relationship within the hydraulic gear is important, as it assures a maximum utilization of the energy absorbing characteristics and a maximum utilization of the closure travel and thereby protects against rupture of the parts which are subjected to load under buff impacts.

In order to prepare the hydraulic unit for subsequent cushioning action it is desirable that the piston be restored as swiftly as possible. For this purpose a set of six substantially uniformly peripherally spaced fluid return passages **46** (see FIG. 7) are provided in the orifice cap **48** and are normally held closed by suitable ball check assemblies **47** which respond to internal fluid pressure at the inner end of the cylinder to become tightly seated and block fluid flow during the cushioning stroke of the piston. These ball check assemblies **47** unseat to accommodate a relatively rapid return stroke under the action of the double coil compression spring **42**. An annular mounting ring **47R** retains the ball check assemblies **47** in their mounted position and the return passages open rearwardly through under cut regions of the orifice cap to accommodate the desired free flow around the edge of the ring **47R**.

In the arrangement illustrated the orifice cap **48** has a central flow throttling orifice passageway **48P** for restricting the flow of hydraulic fluid into the accumulator chamber during gear closure. This cap has a set of return flow channels **48C** controlled by one-way ball check assemblies **53** to assure rapid return of fluid from the accumulator chamber to the cylinder during the release stroke of the gear.

During the closure stroke the hydraulic fluid in the main cylinder of the hydraulic unit is throttled through the set of three orifice passages **45** in the enlarged inner end of the cylinder and through the axial orifice passage **48P** in the orifice cap to generate energy absorption in the hydraulic unit. The amount of absorption varies with the speed and energy of the impact as these factors determine the pressure within the main cylinder and hence the flow through the throttling orifices. The pressure within the main cylinder chamber also depends upon the design of the compression spring **52** of the accumulator chamber and the size of the throttling orifices.

Upon release of the load, fluid is returned to the main cylinder through the various return flow passages **46** and **48C** under the control of the ball check assemblies **47** and **53**, respectively, and through the throttling passages of both the orifice cap and the inner end of the piston.

To lock the piston **41** against rotation within the cylinder sleeve **34**, the keying arrangement, as is illustrated in FIGS. 7 and 9, is employed. An elongated key K is fixed to extend lengthwise within the cylinder **34** and it engages in a lengthwise keyway **48K** along the edge of the cap **48**.

The rolling diaphragm **50** and the spring **52** assembly shown in the accumulater chamber **49** for the arrangement of FIG. 7 may be replaced with an aligned stack of metal type bellows element **55** such as is illustrated in FIG. 11. Each bellows element is resiliently collapsible under pressure to create increased volume for receiving the excess hydraulic fluid and upon the release of the load each bellows element restores automatically to its original shape to return the hydraulic fluid to the main reservoir. Where bellows are used the vent passage **54** is utilized to permit of bleeding all of the air from the accumulator chamber during the initial assembly of the gear. The vent passage is then sealed off by removable plugs (not shown) to make the closure characteristics of the gear dependent upon the resiliently collapsible nature of the bellows and not upon entrapped air pockets.

The gear performance under buff loading is depicted in FIGS. 12 and 13. The curve **56** in FIG. 12 illustrates the force closure characteristic for high velocity buff impacts and the curve **57** illustrates the force closure characteristic for low velocity buff impacts.

As is apparent from a consideration of curve **56**, during the first inch or more of closure travel the rubber cushioning unit acts to resist closure and during this time the hydraulic unit is becoming set up and conditioned to permit a continuous and smooth fluid throttling flow through the orifices of the piston and orifice cap. The hydraulic unit then undergoes its full closure travel at a reaction force of 400,000 pounds and at the end of this travel when the front follower portions **40** abut the shoulders **35S** on the end cap (see FIG. 8) the cushioning characteristics of the hydraulic unit are fully exhausted. The solid stops prevent buff impacts from going solid on the oil of the hydraulic unit and this is important for avoiding internal pressures of rupturing magnitude. The final ½ inch of closure travel is then resisted by the rubber unit which is preferably arranged so that the housing structure is not actually permitted to go solid.

The low velocity impact curve **57** illustrates that the rubber gear again operates first but due to the slower closure rate and lower capacity impact involved, the hydraulic unit comes into play after less than one inch of initial travel. Thereafter the hydraulic unit undergoes closure at a constant reaction force value of 200,000

pounds which for the illustrated condition is sufficient to handle the full energy of the impact.

The capacity-closure characteristics are shown in the curves 58 and 59 of FIG. 13 to illustrate conditions for high velocity and low velocity impacts, respectively.

In FIG. 5 an alternative rear follower arrangement is illustrated wherein a rear follower 31' is shown as having corner portions 31P overlapping the end face of the side walls of the casting 33 for engaging in solid abutment therewith. Where such an arrangement is utilized, the casting will be shorter by the amount of the thickness of the corner portions 31P in order to maintain the same length closure travel as is provided in the preferred embodiment.

While in the preferred embodiment, the piston 41 and its integral follower portions 40 are locked in the cylinder at all times by the inner end construction of the end cap the invention contemplates other end cap structures that need not include such a locking feature. For this purpose, the front follower 40 is of sufficient lateral extent to overlap with the front lugs 21 and create solid abutment therewith in establishing the release position of the gear in the pocket.

It should be understood that the description of the preferred form of the invention is for the purpose of complying with Section 112, Title 35, of the U.S. Code and that the claims should be construed as broadly as prior art will permit.

We claim:

1. A draft gear for mounting in the draft pocket of a railway car frame, said pocket having front and rear stops, said gear including housing structure of a length substantially less than the distance between said stops disposed in said pocket for movement lengthwise therein, said structure having an intermediate abutment wall and endwise opening front and rear chambers on opposite sides of said abutment wall, a first self-restoring cushioning unit of a hydraulic fluid throttling type mounted in said front chamber to react against said abutment wall and a second self-restoring cushioning unit of a positive resistance type mounted in said rear chamber under predetermined compression to react between said abutment wall and said rear stops and normally bias said housing structure against said front stops for confining draft loads to said second cushioning unit.

2. The draft gear of claim 1 wherein said first cushioning unit incorporates means providing such unit with a substantially constant reaction force characteristic throughout its closure travel and said second cushioning unit incorporates means providing such unit with a reaction force characteristic that rises progressively throughout its closure travel from a value substantially beneath that of said first cushioning unit to a value substantially above it.

3. In a draft gear for mounting in the draft pocket of a railway car frame, the combination of a first self-restoring cushioning unit of a hydraulic fluid throttling type, a second self-restoring cushioning unit of a positive resistance type, means for transmitting loads serially through said first and second units to close the same simultaneously during application of buff forces to said gear and means for loading only said second unit during application of draft forces to said gear.

4. In a draft gear for mounting in the draft pocket of a railway car frame, the combination with a first self-restoring cushioning unit of a hydraulic fluid throttling type, said first unit incorporating means providing such unit with a substantially constant reaction force characteristic throughout its closure travel, a second self-restoring cushioning unit of a positive resistance type, said second unit incorporating means providing such unit a reaction force characteristic that rises progressively throughout its closure travel from an initial value that is substantially beneath the constant reaction force of said first unit to an ultimate value that substantially exceeds the reaction force of said first unit, means for transmitting loads serially through said first and second units to close the same simultaneously during application of buff forces to said gear with said second unit undergoing initial closure travel during which said first unit sets up for resisting subsequent closure travel, and means for loading only said second unit during application of draft forces to said gear.

5. In a draft gear rigging that includes a draft gear mounted in the draft pocket of a railway car, said pocket having front and rear stops and said rigging having a coupler yoke assembly encircling the gear, said gear comprising a housing unit of a length appreciably less than the distance between said stop disposed in lengthwise movable relation in said pocket, said housing unit having endwise opening front and rear chambers separated by fixed intermediate abutment structure, a first self-restoring cushioning unit of the positive resistance type under predetermined compression in said rear chamber and engaging said abutment structure to react between said front and rear stops through said housing unit and through rear follower means respectively, to bias said housing against said front stops for confining draft loads to said first cushioning unit, a second self-restoring cushioning unit of the hydraulic fluid throttling type mounted in said front chamber and engaging said abutment structure to transmit forces serially through said second and first units under buff loading applied through said coupler yoke assembly, and means for applying draft forces from said coupler yoke assembly forwardly through said first cushioning unit and said housing unit, said second cushioning unit incorporating means providing such unit with a substantially constant reaction force characteristic throughout its closure travel and said first cushioning unit incorporating means providing such unit with a reaction force characteristic that rises progressively throughout its travel closure from a value substantially beneath that of said second cushioning unit to a value substantially above it, such that during application of buff loads said first unit undergoes initial closure travel during which said second unit sets up for resisting subsequent closure travel.

References Cited in the file of this patent

UNITED STATES PATENTS

2,208,338	Munro et al.	July 16, 1940
2,816,670	Edwards et al.	Dec. 17, 1957
2,825,472	Peterson	Mar. 4, 1958
2,915,198	Spencer	Dec. 1, 1959

FOREIGN PATENTS

303,141	Great Britain	July 18, 1929
384,642	Great Britain	Mar. 2, 1931
695,109	Great Britain	Aug. 5, 1953