March 30, 1965 F. W. SHIREY 3,175,700

HYDRAULIC DRAFT GEAR FOR RAILWAY CARS

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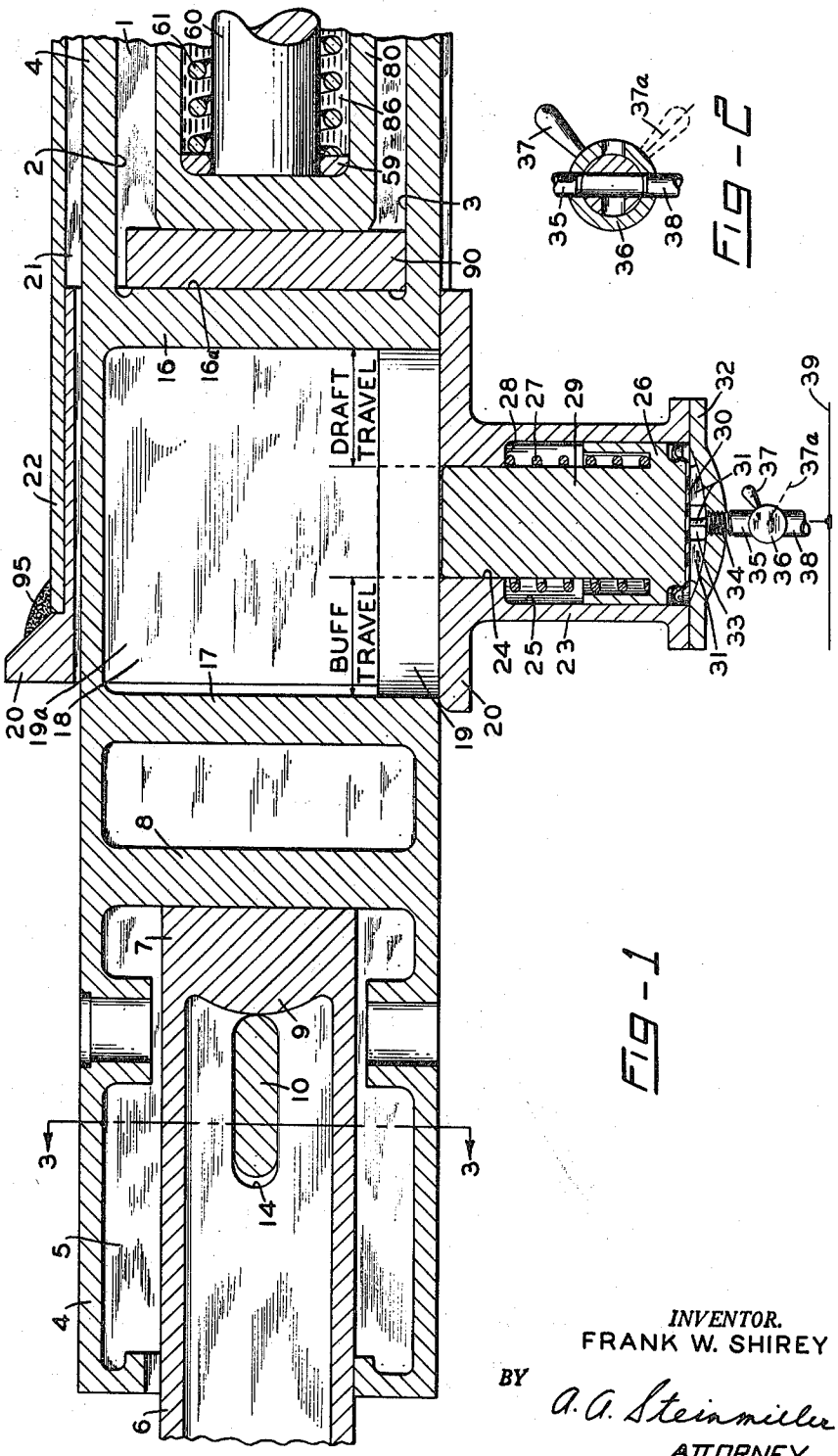


FIG - 1

FIG - 2

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HYDRAULIC DRAFT GEAR FOR RAILWAY CARS

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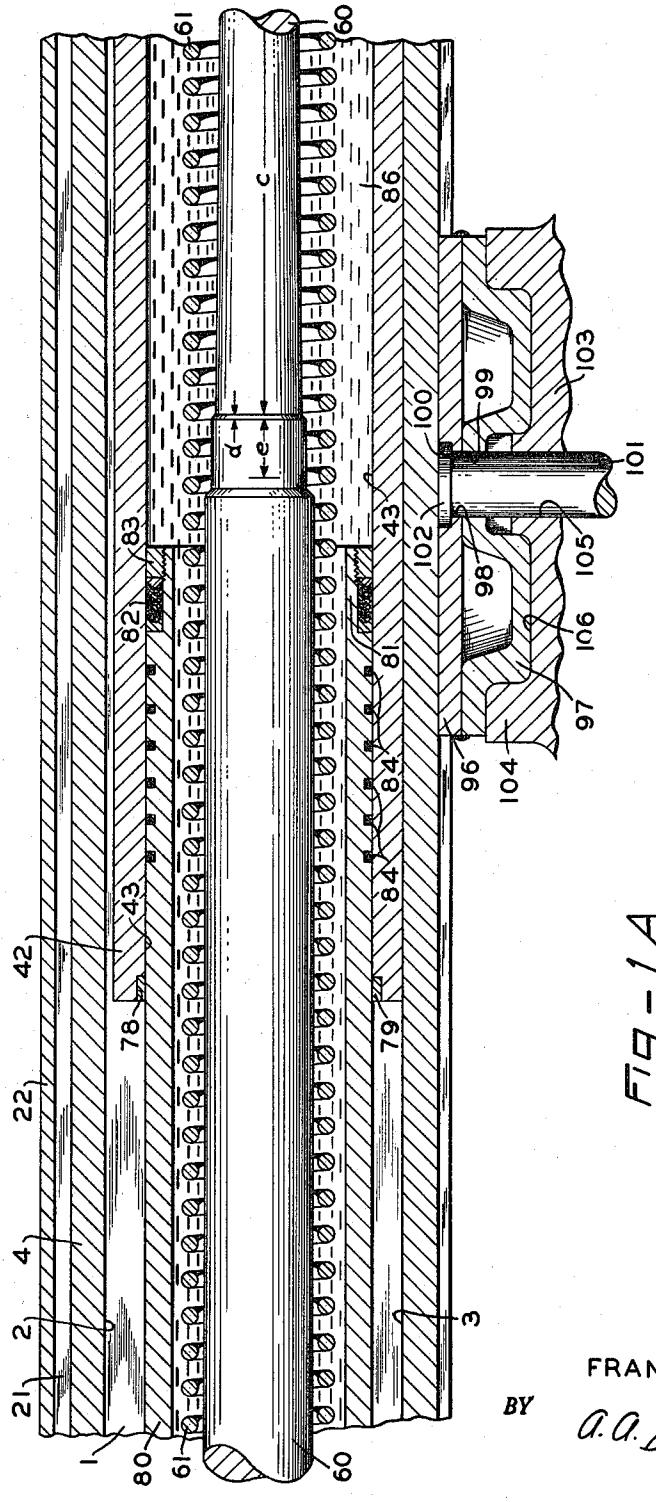


FIG - 1A

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HYDRAULIC DRAFT GEAR FOR RAILWAY CARS

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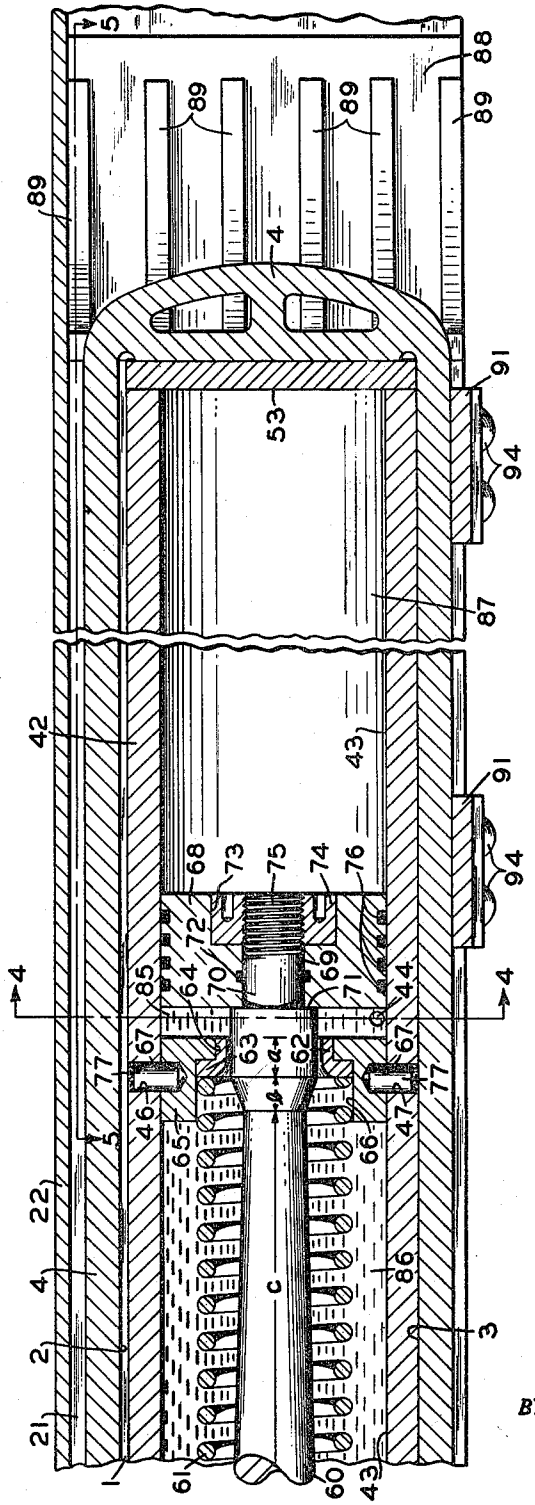


FIG - 1B

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HYDRAULIC DRAFT GEAR FOR RAILWAY CARS

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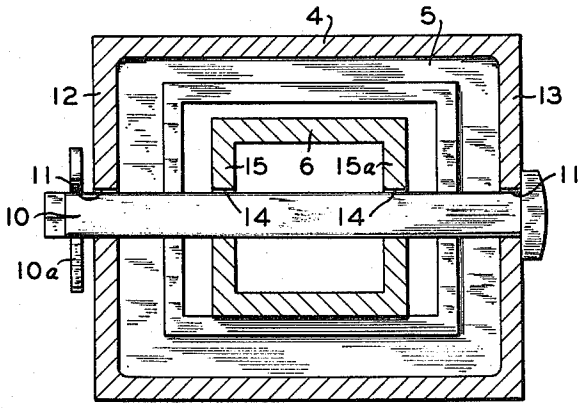


Fig - 3

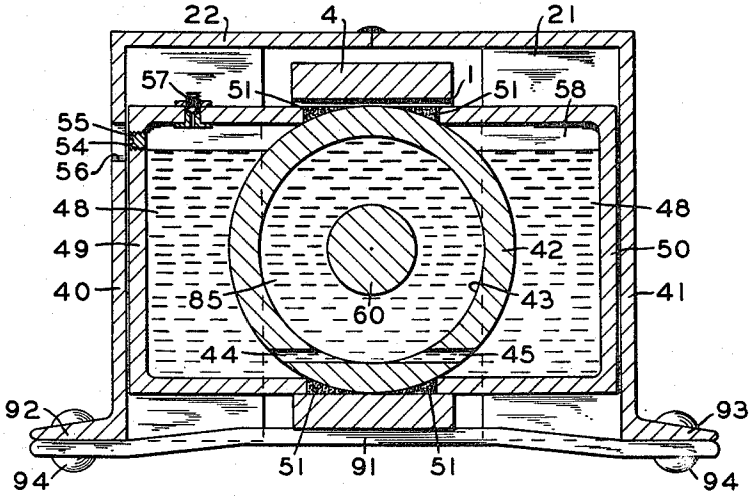


Fig - 4

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HYDRAULIC DRAFT GEAR FOR RAILWAY CARS

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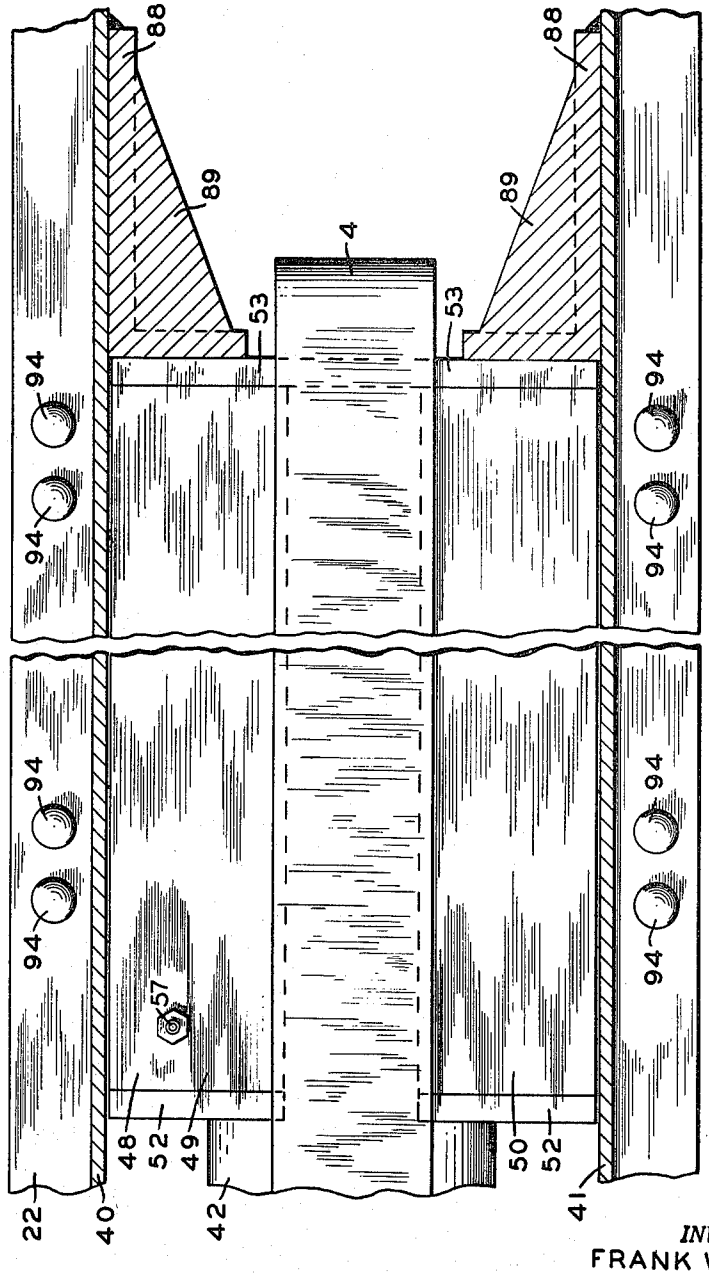


Fig-5

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HYDRAULIC DRAFT GEAR FOR RAILWAY CARS

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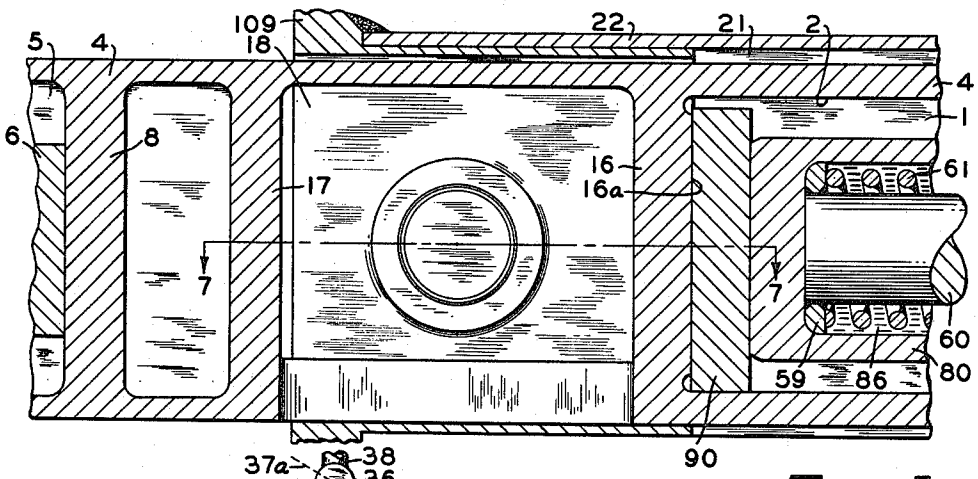


Fig - 6

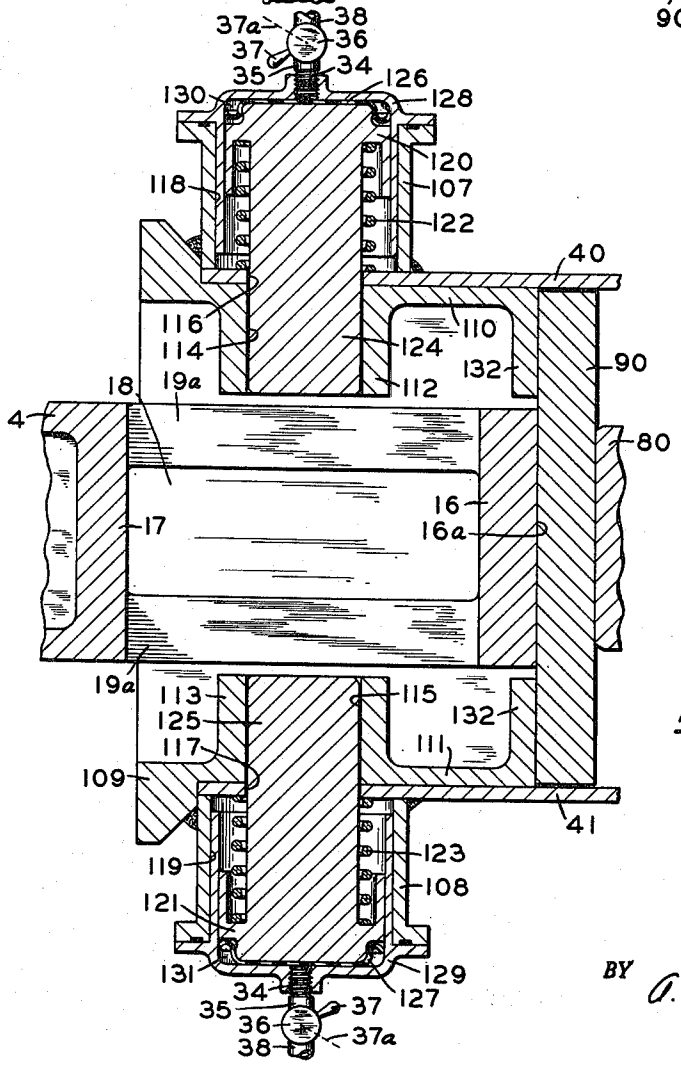


Fig - 7

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HYDRAULIC DRAFT GEAR FOR RAILWAY CARS

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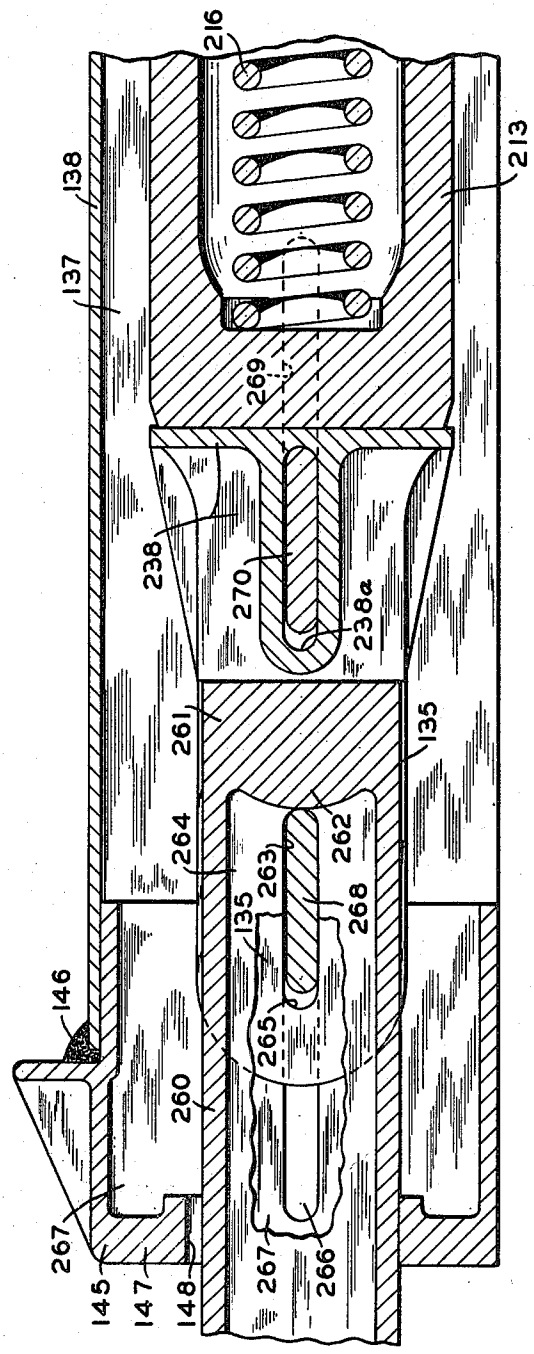


Fig - 8

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HYDRAULIC DRAFT GEAR FOR RAILWAY CARS

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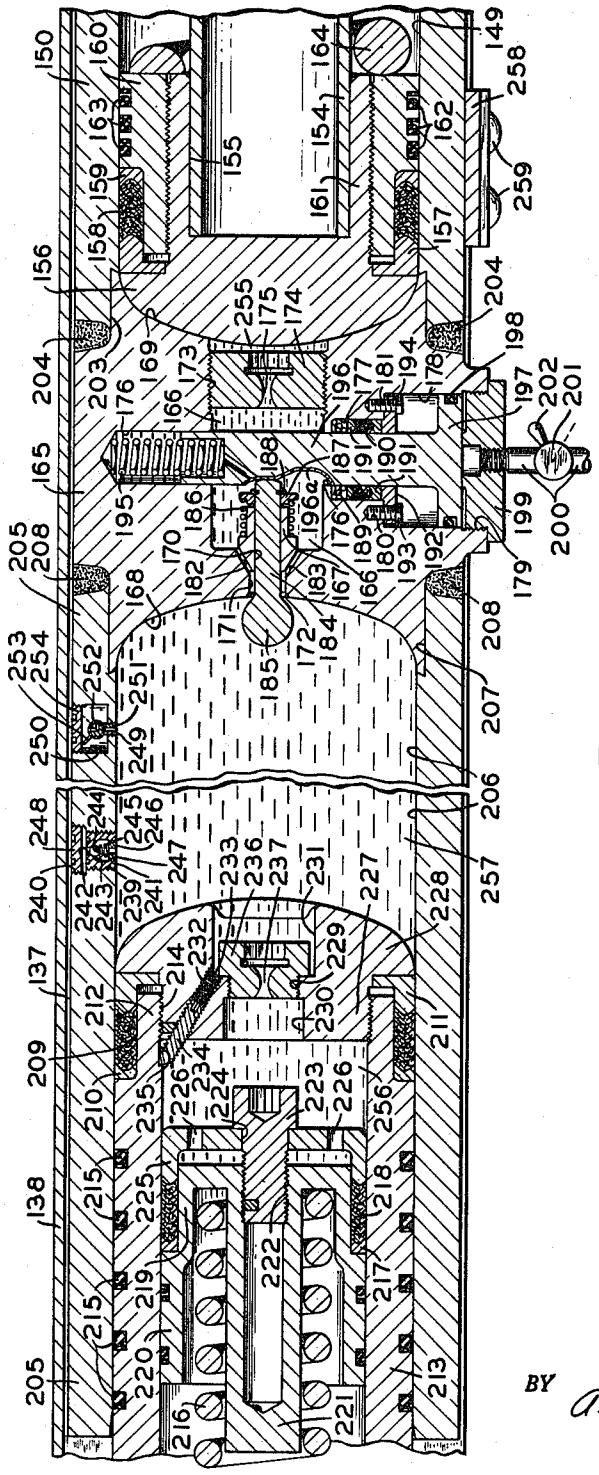


FIG - 8A

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HYDRAULIC DRAFT GEAR FOR RAILWAY CARS

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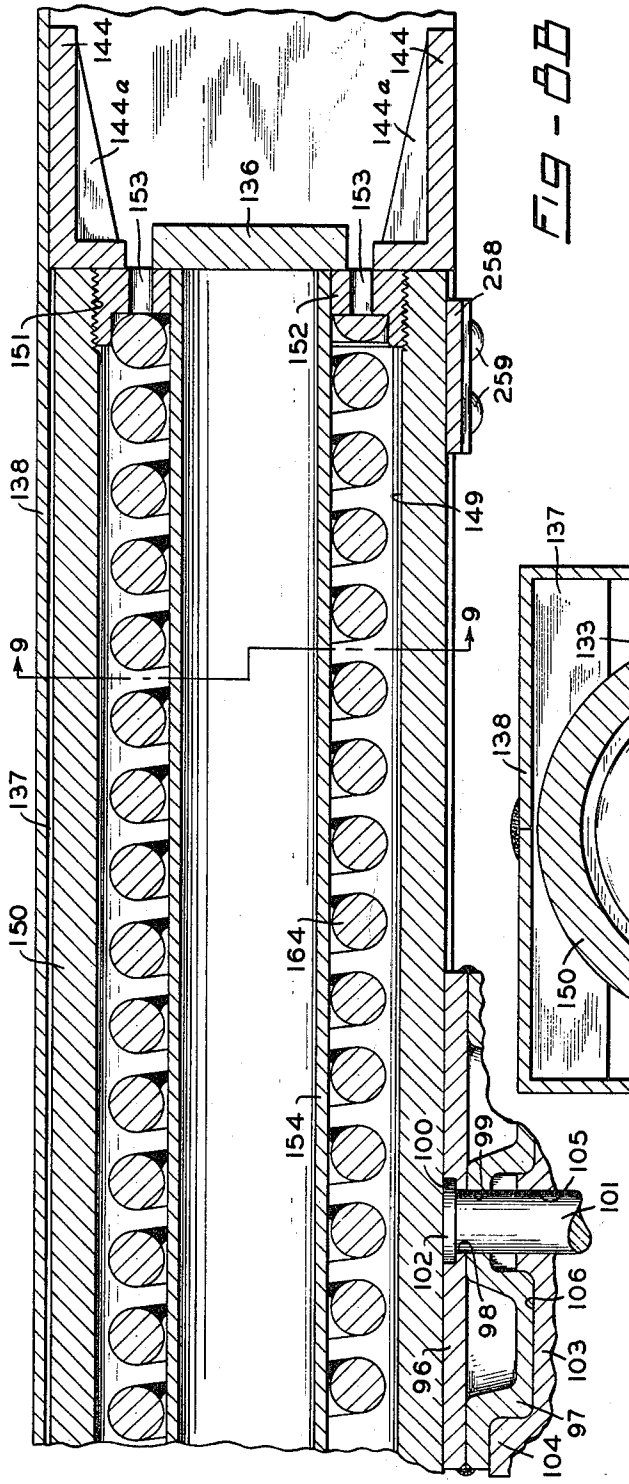
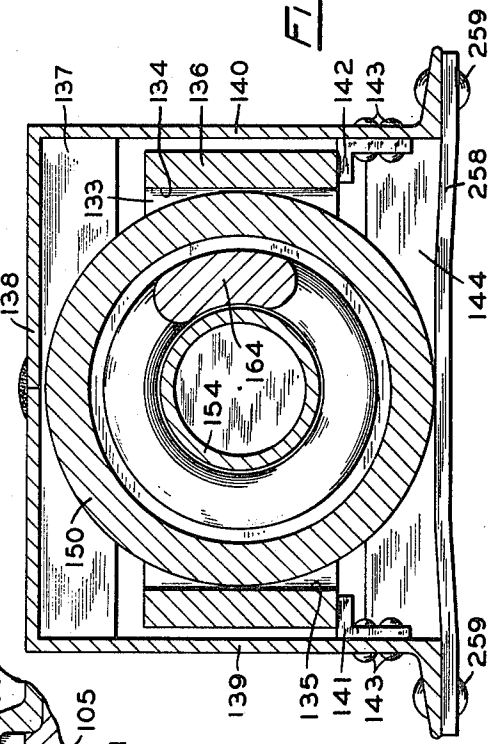


FIG - 8B

FIG - 9



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HYDRAULIC DRAFT GEAR FOR RAILWAY CARS

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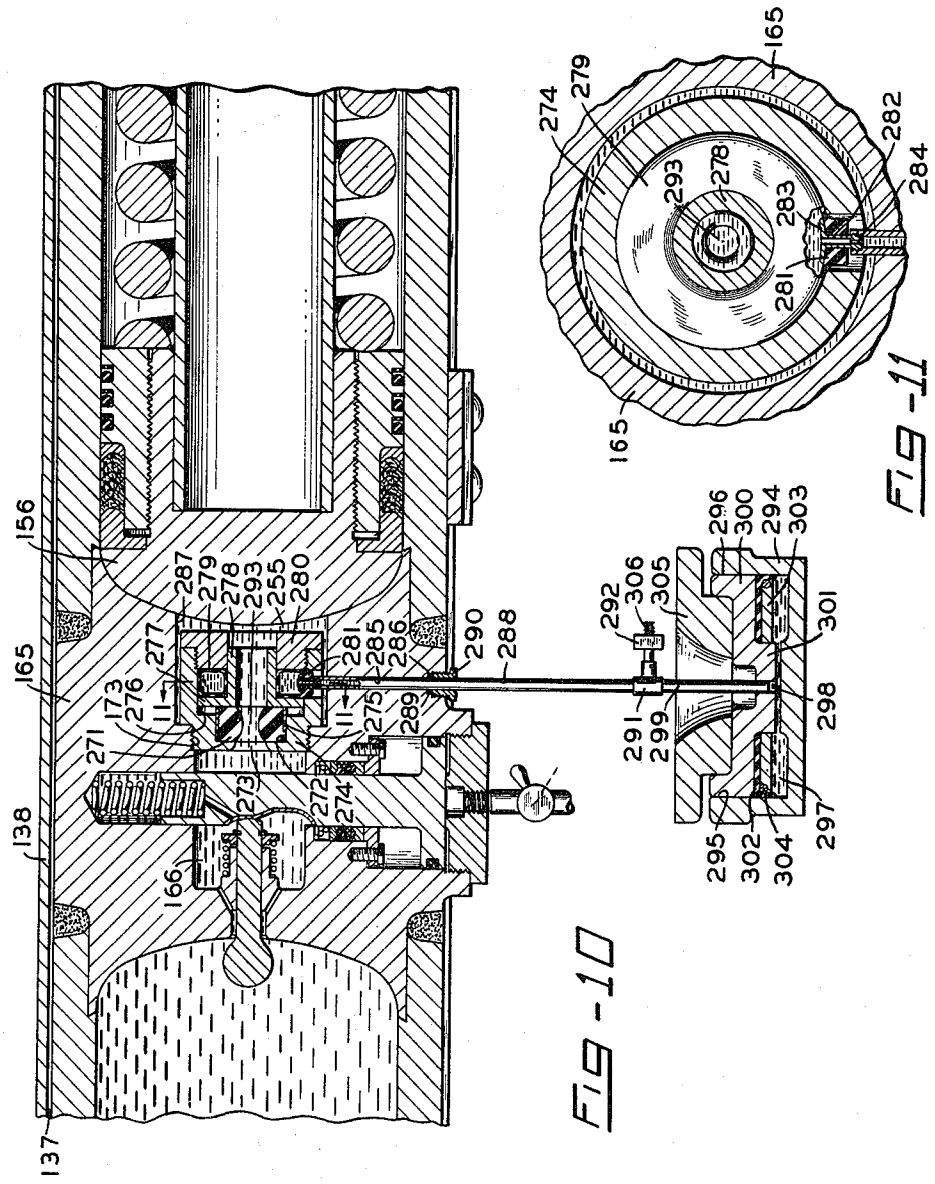


FIG-11

FIG-10

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United States Patent Office 3,175,700 Patented Mar. 30, 1965

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HYDRAULIC DRAFT GEAR FOR RAILWAY CARS

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Filed Dec. 10, 1962, Ser. No. 243,320
14 Claims. (Cl. 213—43)

This invention relates to a combined hydro-pneumatic and spring type of draft gear for a railway freight car, and more particularly to a variable travel cushioned draft gear so selectively controlled automatically that the cushioning travel of the draft gear provided when the car is uncoupled from a train and is being humped in a railway classification yard is substantially greater than when the car is coupled into the train and the train brake pipe charged to the normal fluid pressure.

Experience has shown that a considerable amount of the damage that is inflicted upon fragile lading carried by freight cars occurs, for example, during humping operations when a car, after passing over the hump and traveling at a speed between ten and fourteen miles per hour, strikes a stationary car or a string of coupled stationary cars on the same track on which the humped car is traveling. Furthermore, the shock resulting from the force produced by the moving car striking the stationary car or cars is often of such magnitude as to inflict damage not only to the fragile lading within the car but also to the structure of the car. Such double damage is very expensive and therefore undesirable to the railroad concerned.

Accordingly, it is the general purpose of this invention to provide a novel, small, lightweight and relatively low cost combined hydro-pneumatic and spring type of cushioned freight car draft gear selectively controlled so as to have a substantially longer travel when the car is being humped in a railway classification yard than when it is coupled into a train and traveling between terminals.

According to the present invention, there is provided a variable travel cushioned draft gear employing the combination of a spring, an air compressing piston and a hydraulic snubbing mechanism in which the length of travel of the draft gear is selectively controlled to provide a minimum or a maximum of travel accordingly as the brake pipe of the conventional freight car brake equipment is at its normal fluid pressure or at a reduced pressure such as that which occurs when an emergency brake application is effected.

In the accompanying drawings:

FIG. 1, FIG 1A and FIG. 1B, when taken together such that the right-hand edge of FIG. 1 is matched with the left-hand edge of FIG. 1A and the right-hand edge of FIG. 1A is matched with the left-hand edge of FIG. 1B, constitutes an elevational sectional view of a first embodiment of a novel hydraulic draft gear device for a railway freight car.

FIG. 2 is a horizontal cross-sectional view of a cutout cock shown in FIG. 1 showing the communication established while the cut-out cock is in its open position.

FIG. 3 is an elevational cross-sectional view, taken along the line 3—3 of FIG. 1 and looking in the direction of the arrows, showing how the shank of a freight car coupler is operatively connected to a yoke of a draft gear device.

FIG. 4 is an elevational cross-sectional view, taken along the line 4—4 of FIG. 1B and looking in the direction of the arrows, showing how a hydraulic fluid reservoir is constructed so as to be disposed about the hydraulic draft gear device and between the opposite inside wall surfaces of the vertical sides of the usual center sill of the freight car.

FIG. 5 is a plan view, partly in section, taken along the line 5—5 of FIG. 1B and looking in the direction of the arrows, showing a rear draft lug secured to each of the vertical sides of the usual center sill of the freight car to act as a stop for the hydraulic fluid reservoir and the draft gear cylinder secured thereto upon the application of a buff force to the draft gear device.

FIG. 6, FIG. 1A and FIG. 1B, when taken together such that the right-hand edge of FIG. 6 is matched with the left-hand edge of FIG. 1A and the right-hand edge of FIG. 1A is matched with the left-hand edge of FIG. 1B constitutes an elevational sectional view of a modified form of hydraulic draft gear device constructed in accordance with a second embodiment of the invention.

FIG. 7 is a plan view in section, taken along the line 7—7 of FIG. 6, showing certain details of construction not made apparent in FIG. 6.

FIG. 8, FIG. 8A and FIG. 8B, when taken together such that the right-hand edge of FIG. 8 is matched with the left-hand edge of FIG. 8A and the right-hand edge of FIG. 8A is matched with the left-hand edge of FIG. 8B constitutes an elevational sectional view of a novel hydraulic draft gear device for a railway freight car constructed in accordance with a third embodiment of the invention.

FIG. 9 is an elevational cross-sectional view, taken along the line 9—9 of FIG. 8B and showing how a horizontal type of draft gear yoke is supported for slidable movement on a plurality of angle brackets secured to the opposite inside vertical sides of the usual center sill of a freight car, and how the draft gear cylinder is disposed between the opposite sides of a horizontal type of draft gear yoke and supported on a draft gear carrier that is secured to flanges formed at the lower ends of the vertical sides of the center sill.

FIG. 10 is a partial elevational sectional view of a novel hydraulic draft gear device for a railway freight car showing how the area of an orifice through which hydraulic fluid flows upon operation of the draft gear is varied in accordance with the load on the freight car.

FIG. 11 is an enlarged elevational cross-sectional view, taken along the line 11—11 of FIG. 10 and looking in the direction of the arrows, showing certain details of construction not made apparent in FIG. 10.

Description—FIGS. 1 to 5

In FIGS. 1, 1A, 1B, 2, 3, 4 and 5 of the drawings is shown a variable travel cushioned draft gear device constructed in accordance with one embodiment of the invention. This draft gear device is carried in an elongated yoke pocket or slot 1 formed between parallel and spaced-apart top and bottom horizontal walls 2 and 3 of a draft gear yoke 4. The left-hand end of the draft gear yoke 4 is provided, as shown in FIG. 1, with a substantially rectangular shaped elongated cavity 5, open at its left-hand end, in which is received a hollow shank 6 of a railway freight car coupler, the head of which has been omitted from the drawings since it forms no part of the invention. The right-hand end of the hollow shank 6 is closed by a wall 7 that abuts a shank contact web 8 that is formed integral with the draft gear yoke 4. As shown in FIG. 1, the wall 7 has formed on the left-hand side thereof a boss 9 against which abuts one side of a substantially rectangular-shaped shank pin 10. By referring to FIG. 3, it will be seen that the substantially rectangular-shaped shank pin 10 extends through a pair of aligned substantially rectangular holes 11 formed respectively in a pair of spaced-apart vertical parallel walls 12 and 13 adjacent the left-hand end of the draft gear yoke 4 and through a pair of aligned substantially rectangular holes 14 formed respectively in a pair of spaced-apart vertical parallel walls 15 and 15*a* of the hollow shank 6. The shank pin 10 is retained in place by a cotter pin 10*a*. The shank pin 10 thus provides an operative connection between

the draft gear yoke 4 and the hollow shank 6 of the car coupler through which draft and buff forces are transmitted. It will be noted from FIGS. 1 and 3 that the size of the holes 11 and 14 are slightly greater than the size of the shank pin 10 to conform with standard practice on American railroads since the shank pin 10 is made by the process of forging and the holes 11 and 14 are punched respectively in the draft gear yoke 4 and hollow shank 6.

As shown in FIG. 1 of the drawings, the left-hand end of the top and bottom horizontal walls 2 and 3 of the draft gear yoke 4 are joined by a follower web 16 which has formed on the right-hand side thereof a boss 16*a*. Disposed between the shank contact web 8 and the follower web 16 is a third web 17 which, in cooperation with the follower web 16, forms in the draft gear yoke 4 a cavity 18 from the bottom of which opens an elongated slot 19. Extending through each of the opposite vertical sides of the draft gear yoke 4 and opening into the cavity 18 is a rectangular opening 19*a* for a purpose hereinafter explained, the cavity 18 and opening 19*a* cooperating to form a second slot in the draft gear yoke 4.

After the hollow shank 6 of the car coupler has been secured to the draft gear yoke 4 by the shank pin 10, a hollow box-like striker 20, having extending therethrough a rectangular shaped opening that is slightly larger in cross section than the cross section of the draft gear yoke 4, is slipped over the right-hand end of the draft gear yoke 4 and moved in the direction of the left hand until the left-hand end of the striker is substantially in alignment with the left-hand end of the draft gear yoke 4. The striker 20 is allowed to rest in this position on the draft gear yoke 4 until a draft gear device hereinafter described is assembled and then placed in the yoke pocket 1. Thereafter, the draft gear device and the yoke 4 are placed in a center sill pocket 21 of a center sill 22 also hereinafter described. The striker 20 has formed integral therewith a pair of front draft gear lugs (not shown) which are identical with the front draft lugs hereinafter described in connection with FIG. 6 of the drawings.

Formed integral with the lower side of the striker 20, as shown in FIG. 1 of the drawings, is an interlock cylinder casing 23 that has a vertical axis perpendicular to and intersecting the longitudinal axis of the draft gear yoke 4.

The interlock cylinder casing 23 is provided with a bore 24 and a coaxial counterbore 25 which opens at the lower end of the interlock cylinder casing 23. Slidably operable in the counterbore 25 in the interlock cylinder casing 23 is a fluid pressure actuated piston 26.

A release spring 27 is interposed between the piston 26 and a shoulder 28 formed by the upper end of the counterbore 25. The spring 27 serves to yieldingly bias the piston 26 and a piston rod 29 formed integral therewith to the position in which they are shown in FIG. 1 in which the end of the piston rod 29 is disposed slightly below the elongated slot 19.

A packing cup 30 of the snap-on type is secured to the pressure face of the piston 26. The packing cup 30, when the piston 26 occupies the position in which it is shown in FIG. 1, contacts a plurality of lugs 31 which are formed integral with a pressure head 32 that closes the lower end of the counterbore 25 and is secured to the interlock cylinder casing 23 by any suitable means (not shown). A pressure chamber 33 is thus formed between the pressure head 32 and the packing cup 30 carried by the piston 26 to which chamber fluid under pressure may be supplied through a screw-threaded port 34 and a short piece of pipe or nipple 35 having screw threads at each end thereof, one end being screw threaded into the screw threaded port 34. Screw threaded onto the exterior threaded end of the pipe or nipple 35 is the outlet end of a vented type of cut-out cock 36 having a two-position handle 37. A pipe 38 has one end connected to the inlet end of the cut-out cock 36 and the opposite end connected

to a brake pipe 39 that extends from end to end of the freight car.

While the handle 37 occupies the position in which it is shown in FIGS. 1 and 2, the cut-out cock 36 establishes a communication between the pipe 38 and the short pipe or nipple 35 whereupon the pressure chamber 33 is charged to the same pressure as is present in the brake pipe 39. Whenever the handle 37 is turned from the position in which it is shown in FIGS. 1 and 2 to a position indicated by a broken line 37*a* in FIGS. 1 and 2, communication is closed between the brake pipe 39 and the pressure chamber 33 via the short pipe or nipple 35 and this chamber 33 is vented to atmosphere via the short pipe or nipple 35 and the vented type cut-out cock 36 so that the piston 26 and piston rod 29 will be biased by the spring 27 to the position in which they are shown in FIG. 1.

The hereinbefore-mentioned center sill 22 may be fabricated by welding together, as shown in FIG. 4 of the drawings, two oppositely arranged American Association of Railroads Z-sections 40 and 41 so as to form the hereinbefore-mentioned center sill pocket 21.

The hereinbefore-mentioned draft gear device is constructed and assembled as follows:

First, a hydraulic draft gear cylinder 42 having a bore 43 extending therethrough is provided, as by a drilling operation, with two coaxial passageways 44 and 45 located as indicated in FIGS. 1B and 4. One end of each of these passageways opens at the surface of the bore 43 and the opposite end opens at the peripheral surface of the hydraulic draft gear cylinder 42.

Next, the hydraulic draft gear cylinder 42 is provided, as by a second drilling operation, with a pair of diametrically opposite bores 46 and 47 (FIG. 1B) for receiving therein dowel pins hereinafter described.

After completing the drilling operations, a two-compartment interconnected hydraulic liquid reservoir 48, shown in FIGS. 4 and 5, is welded to the hydraulic draft gear cylinder 42, the two compartments being connected to the interior of the bore 43 of this cylinder by the passageways 44 and 45. From FIG. 4 it can be seen that the hydraulic liquid reservoir 48 is formed by two oppositely arranged standard U-channels 49 and 50 each of which has the outer edge of its upper and its lower flanges welded to the outer periphery of the hydraulic draft gear cylinder 42, as indicated by the numeral 51, along the entire length of these flanges. As shown in FIG. 5, the left-hand end of the hydraulic liquid reservoir 48 is closed by a pair of substantially C-shaped end members 52 welded to the corresponding end of the U-channels 49 and 50 and to the outer periphery of the hydraulic draft gear cylinder 42. The upper ends of the C-shaped end members 52 appear in FIG. 5 of the drawings.

The right-hand end of the hydraulic liquid reservoir 48 is closed by an end plate 53 which is first welded to the right-hand end of the hydraulic draft gear cylinder 42 to close the right-hand end of the bore 43 therein and then welded to the corresponding end of the U-channels 49 and 50. The opposite ends of end plate 53 appear in FIG. 5.

The hydraulic liquid reservoir 48 is provided with a screw-threaded bore 54 (FIG. 4) for receiving a screw-threaded filler plug 55 which, when removed, provides for the insertion therethrough, and through a coaxial opening 56 formed in any suitable manner in the Association of American Railroads Z-section 40 of the spout of an oil can so that the hydraulic liquid reservoir 48 can be filled with liquid, such as a suitable kind of oil.

Furthermore, the hydraulic liquid reservoir 48 is provided with a valve mechanism 57 which may be similar to the well-known air filling valve mechanism used for inflating automobile tires, so that a chamber 58 above the level of the oil in the reservoir, subsequent to the introduction of the oil into the reservoir, may be charged with such as air under pressure to any desired pressure by con-

necting a pump or other source of air under pressure to the valve mechanism 57.

Following construction of the hydraulic liquid reservoir 48 in the manner described above, a washer or spring seat 59, shown in FIG. 1, is welded or otherwise secured to the left-hand end of a metering rod 60 that appears in FIGS. 1, 1A and 1B of the drawings. The design of the metering rod 60 is configured or contoured to provide a bi-directional taper thereon, as shown in FIG. 1B, to produce a substantially rectangular force displacement curve for the draft gear device action. After the spring seat 59 is welded to the metering rod 60, a spring 61 is slipped over the right-hand end of the metering rod 60 and moved in the direction of the left hand until the left-hand end thereof rests against the spring seat 59.

Next, a hydraulic orifice in the form of a bushing 62, shown in FIG. 1B as having at one end a collar 63, is press-fitted into a bore 64 that extends through a cylindrical member 65 that has a counterbore 66 coaxial with the bore 64, the diameter of the counterbore 66 being slightly greater than the diameter of the collar 63 which is disposed within the counterbore so as to rest against the bottom thereof. Two diametrically opposite and coaxial counterbores 67 of the same diameter as the bores 46 and 47 in the hydraulic draft gear cylinder 42 are now drilled in the periphery of the cylindrical member 65.

Subsequent to assembling the bushing 62 to the cylindrical member 65 in the manner described above, the right-hand end of the metering rod 60 is inserted through the collar end of the bushing 62, it being noted from FIG. 1B that the inside diameter of the bushing is greater than the outside diameter of the metering rod thereby providing an orifice for the flow therethrough of a hydraulic liquid in a manner hereinafter described in detail. The size of this orifice can be increased by using a metering rod of smaller diameter or decreased by using a metering rod of larger diameter to provide an orifice size that corresponds to the gross weight of the particular car upon which the draft gear device is used.

After the right-hand end of the metering rod 60 has been inserted through the bushing 62, a force is next applied to the cylindrical member 65 by any suitable means to compress the spring 61 and move the cylindrical member 65 toward the spring seat 59 (FIG. 1) until a piston 68 having a central bore 69 can be slipped onto a portion 70 of reduced diameter formed on the right-hand end of the metering rod 60, as shown in FIG. 1B, and moved in the direction of the left hand until the left-hand face of the piston 68 abuts a shoulder 71 formed on the metering rod 60 at the left-hand end of the portion 70 of reduced diameter, it being understood that an O-ring seal 72 has been previously inserted in an internal groove formed in the wall of the central bore 69. The right-hand face of the piston 68 is provided with a counterbore 73 which is somewhat larger in diameter than a nut 74 that is now screwed onto screw threads 75 formed on the right-hand half of the portion 70 of reduced diameter and tightened by means of a spanner wrench. The force applied to the cylindrical member 65 may now be removed whereupon the spring 61 will be rendered effective to bias the right-hand side of the cylindrical member 65 against the left-hand face of the piston 68.

As shown in FIG. 1B of the drawings, the periphery of the piston 68 is provided with four spaced-apart peripheral annular grooves. Therefore, prior to placing the piston 68 in the bore 43 of the hydraulic draft gear cylinder 42, an O-ring seal 76 is inserted in each of these four peripheral annular grooves in the piston.

Subsequent to securing the piston 68 to the one end of the metering rod 60 and inserting the O-ring seals 76 in the grooves in the piston in the manner just explained, the piston 68 is introduced into the left-hand end of the bore 43 in the hydraulic draft gear cylinder 42. The assembly, which includes the piston 68, spring 61, metering rod 60, spring seat 59, and cylindrical member 65 is then pushed in the direction of the right hand until the cylindrical member 65 reaches the position in which it is shown in FIG. 1B in which the counterbores 67 are in alignment with the bores 46 and 47 in the hydraulic draft gear cylinder 42, it being understood that the assembly may be rotated about the longitudinal axis of the metering rod 60 to obtain this alignment, if necessary.

With the counterbores 67 in the cylindrical member 65 thus in alignment with the bores 46 and 47 in the hydraulic draft gear cylinder 42, a dowel pin 77 is pushed, or driven if necessary, into each of the bores 46 and 47 and the corresponding counterbore 67 after which the outer ends of the dowel pins 77 are welded to the hydraulic gear cylinder 42, it being noted that the length of the dowel pins 77 is less than the combined length of the bore and counterbore in which they are disposed. If desired, the bores and counterbores could be screw threaded and hexagon socket-type set screws used in place of the dowel pins 77.

As shown in FIG. 1A of the drawings, the left-hand end of the hydraulic draft gear cylinder 42 is provided with a counterbore 78 in which is now placed a wiper or scraper element 79 to prevent the entrance of dust and dirt.

Subsequent to placing the wiper or scraper element 79 in the counterbore 78, a cup-shaped plunger 80 is prepared to be slidably mounted in the left-hand end of the bore 43 in the hydraulic draft gear cylinder 42. The plunger 80 is chrome plated to prevent rusting since its left-hand end is exposed to the atmosphere. The right-hand end of the cup-shaped plunger 80 is provided with a portion 81 of reduced diameter, a part of which is provided with external screw threads. A plurality of segments of high pressure packing 82 is first placed on the portion 81 of reduced diameter after which a nut 83 is screwed onto the threaded end of the cup-shaped plunger 80 to retain the high pressure packing thereon.

To the left of the high pressure packing 82 the plunger 80 is provided with six spaced-apart peripheral annular grooves in each of which is now inserted an O-ring seal 84.

The cup-shaped plunger 80 is now slipped over the spring seat 59 (FIG. 1) on the left-hand end of the metering rod 60 and moved in the direction of the right hand so that the right-hand end thereof may be introduced into the bore 43 in the hydraulic draft gear cylinder 42 by pushing it through the wiper or scraper element 79 carried in the counterbore 78 in the left-hand end of the hydraulic draft gear cylinder and thereafter moving the cup-shaped plunger 80 in the direction of the right hand until the bottom thereof abuts the spring seat 59.

The parts so far assembled include the hydraulic draft gear cylinder 42 to which has been welded the hydraulic liquid reservoir 48, the piston 68, the metering rod 60 to the left-hand end of which is welded the spring seat 59, the cylindrical member 65 which carries the bushing 62 and which is anchored to the hydraulic draft gear cylinder 42 by the dowel pins 77, the plunger 80, and the spring 61 that is interposed between the spring seat 59 and the collar 63 on the bushing 62 and which, at this time, is effective to bias the left-hand face of the piston 68 against the right-hand end of the cylindrical member 65 so that the piston 68 is in a position to close that end of the passageways 44 and 45, shown in FIG. 4, that opens at the surface of the bore 43 in the hydraulic draft gear cylinder 42.

In order to move the piston 68 to the position in which it is shown in FIG. 1B of the drawings in which that end of the passageways 44 and 45 that opens at the surface of the bore 53 in the hydraulic draft gear cylinder 42 is uncovered by the piston 68, the parts so far assembled are next placed in a jig. This jig may comprise a flat surface, such as a rectangular platform, having at one end a vertical stop member against which is placed one end of the assembly which, for example, may be the left-

hand end of the cup-shaped plunger 80 shown in FIG. 1. This jig may further comprise a fluid motor secured to the opposite end of the rectangular platform in such a position that the exterior end of a piston rod of the fluid motor will be moved into abutting relationship with the end plate 53 of the hydraulic liquid reservoir 48 upon a small increment of movement of a piston, disposed in the fluid motor and secured to the interior end of the piston rod, in response to the supply of fluid under pressure to the fluid motor. If, after the exterior end of the piston rod of the fluid motor has moved into abutting contact with the end plate 53 of the assembly now in the jig, the supply of fluid under pressure to the fluid motor is continued, this fluid under pressure will be effective on the piston disposed within the fluid motor to move this piston and the piston rod secured thereto in the direction to move the end plate 53 and thereby the hydraulic draft gear cylinder 42, cylindrical member 65 and the hydraulic liquid reservoir 48 in the direction of the left hand, as viewed in FIG. 1B, and relative to the now stationary piston 68, metering rod 60, and cup-shaped plunger 80 (FIGS. 1 and 1A) until the hydraulic draft gear cylinder 42, cylindrical member 65, and the hydraulic liquid reservoir 48 are in a position in which the end of the passageways 44 and 45 that opens at the wall surface of the bore 43 in the hydraulic draft gear cylinder 42 are in a position to the left of the left-hand face of the piston 68, this end of the passageway 44 being shown in this position in FIG. 1B of the drawings. The jig may be provided with a suitable limit stop to prevent further movement of the piston rod of the fluid motor and thereby the hydraulic draft gear cylinder 42 and hydraulic liquid reservoir 48.

With the assembled parts remaining in the jig, the filler plug 55, shown in FIG. 4, is removed from the tapped bore 54 by any suitable means, such as a screw driver or socket wrench. Subsequent to removal of the filler plug 55, the spout of an oil can is inserted through the opening 56 and the tapped bore 54 and a suitable oil poured into the hydraulic liquid reservoir 48. It will be noted that the oil thus introduced into the hydraulic liquid reservoir 48 will flow through the passageways 44 and 45 to a chamber 85 formed by the wall of the bore 43 in the hydraulic draft gear cylinder 42, the left-hand face of the piston 68, and the right-hand face of the cylindrical member 65 which carries the bushing 62. Since the inside diameter of the bushing 62 is greater than the outside diameter of the metering rod 60, the oil supplied to the chamber 85 will flow therefrom through the bushing 62, which constitutes a hydraulic orifice, to a chamber 86 formed by the wall of the bore 43, the left-hand face of the cylindrical member 65, and the interior of the cup-shaped plunger 80. Oil is thus added to the chambers 85 and 86 and the hydraulic liquid reservoir 48 until the oil level in the latter is raised to that shown in FIG. 4, or, in other words, until the oil begins to run out the tapped bore 54.

Subsequent to filling the chambers 85 and 86 and the hydraulic liquid reservoir 48 with oil, the filler plug 55 is replaced in the tapped bore 54 and tightened therein.

Thereafter, an air pump or another suitable source of air under pressure is connected to the valve mechanism 57 and the chamber 58 charged with air under pressure to a chosen pressure that is less than that required to move the piston 68 in the direction of the right hand from the position in which it is shown in FIG. 1B of the drawings, but great enough to insure that chamber 85 is always maintained full of oil and the level of the oil in the hydraulic liquid reservoir 48 does not rise above the level shown in FIG. 4 by flow through the passageways 44 and 45 from the chamber 85 while oil is being forced from chamber 86 to the chamber 85 at a rate controlled by the size of hydraulic orifice 62 while the piston 68 is moving in the direction of the right hand from the position in which it is shown in FIG. 1B in a manner hereinafter described in detail to effect an increase in the pressure of air in an air chamber 87 formed by the wall of the bore 43, the right-hand face of the piston 68, and the end plate 53.

The volume of the air chamber 87 may be such as to provide approximately a ratio of compression of 11 to 1 when the piston 68 makes its maximum stroke in the direction of the right hand from the position in which it is shown in FIG. 1B of the drawings.

The assembly may now be removed from the jig since the oil under pressure in the chambers 85 and 86 will prevent movement of the piston 68 in the direction of the left hand, as viewed in FIG. 1B, by the spring 61.

Next, one of a pair of L-shaped rear draft lugs 88 each having six spaced-apart parallel strengthening ribs 89, as shown in FIG. 1B of the drawings, is welded to the vertical inside face of the respective American Association of Railroads Z-sections 40 and 41 as shown in FIG. 5.

Subsequent to welding the rear draft lugs 88 to the American Association of Railroads Z-sections 40 and 41, a follower 90 (FIG. 1), the length of which is substantially equal to the distance between the vertical inside faces of the American Association of Railroads Z-sections 40 and 41, is placed in the yoke pocket 1 so that the left-hand side thereof abuts the boss 16*a* formed on the right-hand side of the follower web 16 and the opposite ends thereof extend an equal distance beyond the walls 2 and 3 of the draft gear yoke 4.

After the follower 90 has been thus placed in the yoke pocket 1, the draft gear device including the previously assembled hydraulic draft gear cylinder 42 and the cylindrical member 65 secured thereto, the piston 68 therein, the metering rod 60 and spring seat 59 secured thereto, the spring 61, the plunger 80, and the hydraulic liquid reservoir 48 which is welded to the hydraulic draft gear cylinder 42, as has been hereinbefore explained, are positioned in the yoke pocket 1 between the walls 2 and 3 of the draft gear yoke 4 so that the right-hand side of the end plate 53 abuts the end of the yoke 4 at the right-hand end of the yoke pocket 1, as shown in FIG. 1B, and the left-hand end of the plunger 80 abuts the right-hand side of the follower 90, as shown in FIG. 1 of the drawings, it being understood that the draft gear device is so located in the yoke pocket 1 that the longitudinal axis of the hydraulic draft gear cylinder 42 lies in a vertical plane that passes through the yoke 4 midway the width of the walls 2 and 3.

The yoke and draft gear device are now ready to be placed in the center sill pocket 21. To do so, the hydraulic liquid reservoir 48 is introduced into the left-hand end of the center sill pocket 21, it being noted from FIG. 4 that the width of the center sill pocket 21 is slightly greater than the width of the hydraulic liquid reservoir 48. After the yoke and draft gear device are introduced into the left-hand end of the center sill pocket 21, the entire assembly is moved in the direction of the right hand until the end plate 53 abuts the rear draft gear lugs 88 as shown in FIG. 5 of the drawings.

Now, while the assembly is supported by any suitable means, a pair of parallel and identical draft gear carriers 91, which appear in FIGS. 1B and 4, are placed beneath the yoke 4 and riveted at their opposite ends to feet 92 and 93 of the respective Association of American Railroads Z-sections 40 and 41 by rivets 94. After the riveting operation has been completed, the supporting means may be removed from beneath the yoke 4 for the yoke 4 will now be supported by the draft gear carriers 91.

Following removal of the supporting means from beneath the yoke 4, the hereinbefore-mentioned striker 20 is moved from the position in which it was placed, adjacent the left-hand end of the yoke 4 in the direction of the right hand, as viewed in FIG. 1, along the yoke 4 until the right-hand end thereof can be inserted into the left-hand end of the center sill pocket 21, after which the striker 20 is pushed into the center sill pocket 21 until

the striker occupies the position in which it is shown in FIG. 1. With the striker 20 in this position, it is welded to the left-hand end of the center sill 22, as indicated by the reference numeral 95 in FIG. 1. In this position of the striker 20, the right-hand side of the front draft gear lugs that are integral therewith abut the respective left-hand side of the opposite end portions of the follower 90.

It will be understood that the center sill 22 constitutes a part of the body of a railway freight car according to standard methods of freight car construction.

In addition to the pair of draft gear carriers 91 shown in FIG. 1B for supporting the yoke 4 and the draft gear device carried therein, the yoke 4 is also supported by a center plate adapter 96 shown in FIG. 1A. The lower face of the center plate adapter 96 has welded thereto a standard body center plate 97. The center plate adapter 96 is provided with a bore 98 that is coaxial with a bore 99 of equal diameter in the standard body center plate 97 and a coaxial counterbore 100. Subsequent to welding the center plate adapter 96 to the standard body center plate 97, a center pin 101 is inserted into the coaxial bores 98 and 99 so that a cylindrical head 102 formed on the upper end of the center pin 101 is disposed within the counterbore 100, it being understood that the thickness of the head 102 does not exceed the depth of the counterbore 100.

After the center pin 101 has been inserted into the bores 98 and 99, as just explained, the center plate adapter 96 is placed beneath the yoke 4 in the position along the length thereof in which the center plate adapter 96 is shown in FIG. 1A. Thereafter, the opposite ends (not shown) of the center plate adapter 96 are riveted to the feet 92 and 93 of the respective Association of American Railroads Z-sections 40 and 41 by rivets (not shown).

A car truck bolster 103 is provided with a truck center plate 104 that is cast integral with the top side of the bolster and has a central bore 105 in which is received the center pin 101. The truck center plate 104 is further provided with a cylindrical recess or groove 106 concentric with the bore 105 in which groove is received the standard body center plate 97 whereby the car body, of which the center sill 22 is a part, is supported on the car truck bolster 103. This construction allows the car truck to turn freely under the car.

Operation

It should be noted that for the same length of stroke, the capacity of the draft gear device of the present invention to absorb the kinetic energy of a moving railway vehicle, in either buff or draft, is the same. So long as the kinetic energy developed as the result of a buff or a draft impact imparted by each to the other of two adjacent railway car couplers upon the colliding of the two cars carrying these couplers does not exceed the capacity or the amount of kinetic energy for which the draft gear was designed to absorb by more than a certain amount, the stress induced in the couplers and the various parts constituting the bodies of the cars will be limited to a value below or not in excess of the elastic limit of the materials of which the car couplers and car bodies are constructed.

It should be understood that, in draft, kinetic energy is transmitted from the car coupler through the shank pin, the draft gear yoke, the draft gear device and the front dragt lugs to the center sill and car body, and, in buff, kinetic energy is transmitted from the car coupler through the draft gear yoke, the draft gear device and the rear draft lugs to the center sill and car body.

(a) Buff impact—car detached for humping

When a freight car is detached from a train for humping operations in a railway classification yard, fluid under pressure is completely vented from the brake pipe 39 to atmosphere. Consequently, the chamber 33 (FIG. 1) in the interlock cylinder casing 23 is likewise vented to the atmosphere via short pipe or nipple 35, vented type cut-out cock 36, pipe 38, and the brake pipe 39 extending from end to end of the freight car, it being understood that the handle 37 of the cut-out cock 36 occupies the position in which it is shown in FIGS. 1 and 2, in which position a communication is established between the short pipe or nipple 35 and the pipe 38. Upon completely venting the fluid under pressure from the chamber 33, the spring 27 is rendered effective to move the piston 26 and piston rod 29 to the position in which they are shown in FIG. 1, in which the upper end of the piston rod 29 is completely withdrawn from the elongated slot 19 in the draft gear yoke 4.

Now let it be supposed that the detached car, while traveling along a track in the classification yard at some slow speed such as, for example, fourteen miles per hour, collides with a standing car or string of cars on this track. This moving car has a certain amount of kinetic energy. As the couplers on the adjacent ends of the moving car and the standing car come into contact, each coupler imparts an impact to the other, the impact imparted to each coupler by the other being the same. These couplers operate automatically at this time to couple the two cars together.

Let it be assumed that the hollow shank 6 shown in FIG. 1 of the drawings is the shank of the car coupler on a standing car that is struck by the moving car. Therefore, upon collision of the moving car with the standing car some of the kinetic energy of the moving car is transmitted from the coupler on the moving car through the hollow shank 6 and shank contact web 8 shown in FIG. 1 to the draft gear yoke 4, it being understood that the direction of the blow imparted as a result of this impact acts in the direction of the right hand, as viewed in FIGS. 1, 1A and 1B of the drawings. Consequently, the draft gear yoke 4 will be moved in the direction of the right hand relative to the center sill 22 as the result of the moving car striking the standing car.

As shown in FIG. 5 of the drawings, the right-hand side of the opposite end portions of the end plate 53 that extend beyond the opposite sides of the draft gear yoke 4 normally abut the respective rear draft lugs 88 that are welded to the center sill 22, as hereinbefore mentioned. Therefore, the hydraulic draft gear cylinder 42, which has the cylindrical member 65 secured therein by the dowel pins 77, and the hydraulic liquid reservoir 48 are prevented from moving in the direction of the right hand, relative to the center sill 22, upon movement of the draft gear yoke 4 in this direction since the hydraulic draft gear cylinder 42 and the reservoir 48 are welded to the end plate 53, as hereinbefore mentioned.

The movement of the draft gear yoke 4 in the direction of the right hand, as viewed in the drawings, is transmitted through the follower web 16 and boss 16*a* (FIG. 1) which are integral with the yoke 4 to the follower 90 and thence to the plunger 80. The cup-shaped plunger 80 extends telescopically into the left-hand end of the hydraulic draft gear cylinder 42, which is now stationary relative to the center sill 22, and abuts the left-hand end of the metering rod 60 as shown in FIG. 1. Since the piston 68 is secured to the right-hand end of the metering rod 60 as shown in FIG. 1B, it will be apparent that as the draft gear yoke 4 is moved in the direction of the right hand, the follower 90, plunger 80, metering rod 60 and piston 68 are moved therewith against the yielding resistance of the spring 61, and with respect to the now stationary hydraulic draft gear cylinder 42 and the cylindrical member 65 anchored thereto.

This movement of the plunger 80, metering rod 60 and the piston 68 is effective to simultaneously increase the volume of the chamber 85 and decrease the volume of the chambers 86 and 87. As the plunger 80 is thus moved in the direction of the right hand, it is effective to force the oil in the chamber 86 to flow through the orifice con-

stituted by the bushing 62 through which the metering rod 60 extends to the chamber 85.

It is apparent from FIG. 1B that the oil flow initiated by movement of the plunger 80 in the direction of the right hand is from the high pressure chamber 86 through the orifice constituted by the bushing 62 and metering rod 60 and into the chamber 85, the volume of which is increasing at the same rate as the volume of the chamber 86 is decreasing.

The oil flow through the orifice is at a relatively high velocity and creates great turbulence in the chamber 85. This great turbulence is caused at least in part by the high velocity oil impinging directly against the left-hand face of the piston 68, and is responsible for dissipation of much of the kinetic energy of the oil in the form of heat. It will be understood that as the piston 68 moves in the direction of the right hand from the position in which it is shown in FIG. 1B, the effect of the impingement of the oil on this piston decreases.

Movement of the piston 68 in the direction of the right hand, as viewed in FIG. 1B, is effective to decrease the volume of the chamber 87 and increase the pressure of the air in this chamber. As is well known, the compression of air from a lower pressure to a higher pressure by effecting a reduction of the volume of the air requires energy. Consequently, the compression of the air in the chamber 87 absorbs some of the kinetic energy transmitted to the car coupler, shank 6 and yoke 4 by the moving car striking the stationary car, it being understood that this kinetic energy is changed to potential energy and stored in the air under pressure in chamber 87.

Compressing the spring 61 as the plunger 80 moves in the direction of the right hand requires the absorption of some of the kinetic energy transmitted by the moving car, it being understood that this kinetic energy is changed to potential energy and stored in the spring 61.

Furthermore, the friction of the draft gear yoke 4 and the other moving parts is effective to dissipate or absorb some of this kinetic energy. Therefore, all the kinetic energy transmitted to the car coupler and shank 6 on each of the two colliding cars, with the exception of the potential energy stored in the springs 61 and in the air under pressure in the chambers 87, is dissipated in the form of heat by the passing of the oil through the orifices, the turbulence in the chambers 85, and the friction of the various parts of the draft gear devices, or is transferred as kinetic energy via the end plates 53 and rear draft lugs 88 to the center sill 22 of the respective car with its load carried in the body thereof, of which the respective center sill is a part.

The standard coupler used on freight cars is designed to withstand a predetermined buff or compression impact blow without inducing a stress therein that exceeds the elastic limit of the steel, of which the coupler is constructed. In order that the buff stress established by the impact of the two colliding cars is maintained constant during the time required for the plunger 80, metering rod 60 and the piston 68 to travel their maximum length of stroke in the bore 43 of the hydraulic draft gear cylinder 42, the area of the orifice provided by the bushing 62 and metering rod 60 must be varied so as to provide or maintain a constant oil pressure in chamber 86, which constant pressure establishes a corresponding constant force that must not exceed the allowable force that can be transmitted through the hydraulic draft gear cylinder 42 and the hydraulic liquid reservoir 48 to the rear draft gear lugs 88 and thence to the center sill 22 and car body integral therewith without inflicting damage to the lading carried by the car.

As the plunger 80 moves in the direction of the right hand into the bore 43 of the hydraulic draft gear cylinder 42 from the position in which it is shown in FIGS. 1 and 1A at an initial velocity corresponding to the degree of the impact blow on the car coupler as the result of the collision of the moving car with the standing car or cars, the pressure of the oil in the chamber 86 is increased at a rapid rate due to the combined effect of the inertia of the oil in this chamber and the limited area of the orifice provided by the bushing 62 and metering rod 60, through which the oil flows from chamber 86 to chamber 85. In order that the force developed by the increase of the pressure of the oil in the chamber 86 be limited to and thereafter maintained at a value which will not induce a stress in either the coupler or car body in excess of the elastic limit, the orifice area must be rapidly increased subsequent to the metering rod 60 moving in the direction of the right hand the distance *a* indicated in FIG. 1B, in which distance the pressure developed in the chamber 86 is increased to a value somewhat less than that required to induce a stress in either the coupler or car body equal to the elastic limit.

This rapid increase of orifice area is provided, for example, by forming or machining a first taper on the metering rod 60 having the length *b* shown in FIG. 1B. The length *b* is the distance that the metering rod 60 must travel after traveling the distance *a* to reduce the rate of build-up of pressure in chamber 86 to zero and thereby establish that pressure in the chamber 86 which will induce a stress in either the coupler or car body slightly less than the elastic limit.

In order to maintain the pressure thus established in the chamber 86 as the plunger 80, metering rod 60 and piston 68 continue to move in the direction of the right hand a distance *c* shown in FIGS. 1A and 1B, the metering rod 60 must be tapered this distance *c*, the direction of the taper *c* being opposite the direction of the taper *b*. It will be apparent that as the tapered portion *c* of the metering rod 60 passes through the bushing 62, the area of the orifice is decreased at a rate corresponding to the angle of the taper *c*. Furthermore, it will be understood that the initial velocity of the plunger 80, the metering rod 60 and piston 68 has been reduced as they moved in the direction of the right hand, as part of the kinetic energy of the striking car is absorbed in the manner hereinbefore described. Therefore, in order to maintain a constant pressure in the chamber 86 as the plunger 80 and metering rod 60 move in the direction of the right hand with a constantly decreasing velocity, the area of the orifice provided by bushing 62 and the metering rod 60 must be decreased at a certain corresponding constant rate. Consequently, by providing that the direction of the taper *c* is opposite the direction of the taper *b*, this requirement that the orifice area be constantly decreased at this certain constant rate is insured.

The metering rod 60 is provided at the left-hand end of the tapered portion *c* with a portion *d* (FIG. 1A) having an angle of taper greater than the angle of taper of the portion *c* to insure that the pressure in the chamber 86 does not rapidly decrease as this portion *d* of the metering rod 60 begins to move into the orifice bushing 62, since, at this time, the velocity of the metering rod 60 relative to the bushing is approaching zero. Adjacent to the tapered portion *d* is a portion *e* of constant diameter that provides an orifice of minimum area as this portion *e* passes into the left-hand end of the bushing 62. This orifice of minimum area insures that the rate of decrease in the pressure in the chamber 86 is minimized as the plunger 80, metering rod 60 and piston 68 reach the end of their stroke.

The contour of the metering rod 60 provided by the portions *d* and *e* insures that damage to the draft gear device and car body is minimized in the event that the kinetic energy of the striking car is in excess of the capacity of the draft gear device to absorb kinetic energy, for this increase in kinetic energy is effective to increase the pressure of the oil in the chamber 86 to a maximum value as the portion *d* travels through the bushing 62 and then decreases to a certain value as the portion *e* of constant diameter enters the left-hand end of the bushing 62

as the plunger 80, metering rod 60 and piston 68 reach the end of their stroke.

The pressure established in the chamber 86 in response to the plunger 80, metering rod 60 and piston 68 traveling in the direction of the right hand through their full length of stroke constitutes a hydraulic head of oil for forcing the oil from the chamber 86 through the orifice to the chamber 85.

The general equation for the velocity of spouting liquid is $V=\sqrt{2gH}$, where V=theoretical velocity in feet per second, g=acceleration of gravity in feet per second, and H=head of liquid in feet. The discharge from an orifice in cubic feet per second is equal to the product of the actual velocity and the area of the jet. (The above equations are from section 2, page 07 of Eleventh Edition, Volume II, Kent's Mechanical Engineer's Handbook.)

The total quantity Q of oil discharged from the orifice may be expressed by the equation $Q=vt$, where v represents the discharge in cubic feet per second and t the time in seconds that the discharge through the orifice continues.

From the above equations it is apparent that the total quantity of oil discharged from the chamber 86 through the orifice to the chamber 85 is dependent on the pressure in the chamber 86 and the length of time required for the plunger 80, metering rod 60 and piston 68 to travel the full length of their stroke. This time can be greatly increased if the length of stroke of these elements is, for example, 30 inches instead of 2⅝ inches, which is the length of travel of a standard friction draft gear device.

Increasing the length of stroke of the piston correspondingly requires an increase in the length of air chamber 87. It follows, therefore, that as the length of the air chamber 87 and the length of the stroke of the piston 68 are increased, the amount of kinetic energy absorbed or changed into potential energy and stored in the air under pressure in the chamber 87 is accordingly increased.

The amount of kinetic energy absorbed may be expressed mathematically in manner well known to those skilled in the art by use of the general equation for kinetic energy:

$$E=\frac{mv^2}{2}=\frac{m(at)^2}{2}$$

where m=mass=weight÷g; v=velocity in feet per second; a=acceleration in feet per second per second; t=time in seconds.

Reference may be had to The American Society of Mechanical Engineers Paper No. 61–WA–256 covering The Design of Cushioning Gears for Rail-Car Applications by Robert L. Hassenauer and George E. Novak presented at the Winter Annual Meeting in New York, New York, November 26–December 1, 1961, for a fuller explanation of the theory of an air-oil cushioning draft gear and for a method of calculating the relative acceleration between a rail car and its lading occurring as the result of a moving car striking a stationary car or string of cars.

From the above-mentioned equation for kinetic energy,

$$E=\frac{m(at)^2}{2}$$

it will be appreciated that by increasing the length of stroke of the plunger 80, metering rod 60 and piston 68 from, for example, 2⅝ inches to, for example, 30 inches, the time required for the oil to be forced from the chamber 86 through the orifice to the chamber 85 is accordingly increased and this increase in time is effective to increase the kinetic energy dissipated by the flow of the oil through the orifice in accordance with the square of the time required for this flow since

$$E=\frac{m(at)^2}{2}$$

as stated above.

The impact blow delivered to the car coupler and shank 6 of the standing car, as the result of the moving car traveling at a speed of, for example, fourteen miles per hour, colliding with the standing car, is effective to move the shank 6, draft gear yoke 4, follower 90, plunger 80, metering rod 60 and piston 68 in the direction of the right hand, as viewed in the drawings, relative to the hydraulic draft gear cylinder 42, hydraulic liquid reservoir 48 and rear draft gear lugs 88 until the right-hand side of the follower 90 comes into contact with the left-hand end of the hydraulic draft gear cylinder 42. The movement of the plunger 80 into the hydraulic draft gear cylinder 42 is effective to cause absorption of some of the kinetic energy of the moving car by forcing the oil from the chamber 86 through the orifice bushing 62 to the chamber 85 in the manner hereinbefore described. This movement of the plunger 80 is effective to compress the spring 61, which compression also absorbs some of the kinetic energy of the moving car. Furthermore, the friction of the parts of the draft gear device and the compression of the air in the chamber 87 are effective to absorb some of the kinetic energy of the moving car. The remaining kinetic energy of the moving car is transmitted to the rear draft lugs 88 and thence to the center sill 22 to which the rear draft lugs 88 are welded and upon which is supported the body of the freight car and the lading carried in this body. This remaining kinetic energy that is thus transmitted to the center sill 22 and the car body of the standing car is effective to move the standing car or string of standing cars if one or more cars are coupled to the struck car, provided this remaining kinetic energy is great enough to overcome the inertia of the standing car or cars.

From the foregoing, it is apparent that the draft gear device shown in FIGS. 1, 1B, 2, 3 and 4 is effective to dissipate as heat a portion of the kinetic energy of a moving freight car upon the moving car striking a standing car or string of cars by forcing liquid from the chamber 86 through a choke to the chamber 85, that another portion of this kinetic energy is stored as potential energy in the spring 61, that still another portion of this kinetic energy is stored as potential energy in the air under pressure in the chamber 87, and that the remainder of this kinetic energy is transferred via the end plate 53 and rear draft lugs 88 to the center sill 22 of the respective car to impart movement to the standing car or string of standing cars, if one or more cars are coupled to the struck car, provided this remaining kinetic energy is great enough to overcome the inertia of the standing car or cars. If this remainder of kinetic energy is of sufficient magnitude to overcome the inertia of the standing car or cars and impart movement thereo, this movement effects a relative acceleration between each car and the lading in that car.

It is apparent, therefore, that by increasing the amount of kinetic energy absorbed by the draft gear device and stored as potential energy in the draft gear device, the amount of kinetic energy remaining to impart movement to the struck car or string of cars and effect a relative acceleration between each car and the lading in the respective car is correspondingly decreased. It, therefore, follows that a reduction in the amount of kinetic energy imparted to the struck car or string of cars likewise reduces the magnitude of the relative acceleration between each respective car and the lading in the car. Remembering that force is equal to the product of mass (weight÷32.174 feet per second per second) and acceleration, it will be apparent that a reduction in the magnitude of the relative acceleration between the car and the lading in the car correspondingly reduces the force of impact of the lading in a standing car with the end of this car when a moving car strikes the standing car. This reduction in the force of impact of the lading with the end of the car lessens the likelihood of damage to the lading. Accordingly, the purpose of providing a long travel for the piston 68 of the draft gear of the

present invention is to reduce the force of impact on the lading carried in the car equipped with this draft gear, it being understood from the foregoing that, since kinetic energy

$$E=\frac{m(at)^2}{2}$$

an increase in the travel of piston 68 increases the value of t in this equation and therefore the amount of kinetic energy absorbed by the draft gear.

If the amount of kinetic energy transmitted to the struck car or string of cars is great enough to overcome the inertia of the struck car or string of cars, the struck car or string of cars will move, it being understood that the couplers on the striking car and struck car operate at the time of impact to couple these cars. Subsequent to this coupling operation, the potential energy stored in the springs 61 and the air under pressure in the chambers 87 begin to re-expand upon the velocity of the two cars reaching the same value. This re-expansion is effective to restore the various parts of the draft gear devices on the cars to the position they occupied prior to the striking car colliding with the struck car or string of cars.

(*b*) *Draft impact—Car coupled in a train*

When a car is coupled in a train, the brake pipe hose at each end of the car is coupled to the brake pipe hose on the adjacent end of the respective adjacent car in the train. Subsequent to coupling a car in a train, the brake pipe angle cocks at each end of the car are opened so that the entire train brake pipe may be fully charged to the normal pressure carried in the train brake pipe. Assuming that the handle 37 of the cut-out cock 36 on the car that has been coupled in the train occupies the position in which it is shown in FIG. 1 of the drawings, in which position it establishes a communication between the pipe 38 and the short pipe or nipple 35, fluid under pressure will flow from the brake pipe 39 via pipe 38, cut-out cock 36, and the short pipe or nipple 35 to the pressure chamber 33 below the packing cup 30. Fluid under pressure thus supplied to the pressure chamber 33 is effective to move the piston 26 and piston rod 29 upward from the position in which they are shown in FIG. 1 against the yielding resistance of the spring 27 until the upper end of the piston rod 29 is disposed within the elongated slot 19 as indicated by the broken line in FIG. 1.

While the upper end of the piston rod 29 is disposed in the elongated slot 19, the travel of the draft gear yoke 4 and likewise the car coupler in buff and in draft will be retricted or reduced to the distances indicated by the corresponding legends shown in FIG. 1.

Now let it be supposed that the train is standing and the engineer desires to start the train. To do so, he moves the controller handle from idle position to a power position. This effects the supply of power to the driving wheels of the locomotive to start the locomotive from a stopped position. The initial movement of the locomotive is transmitted from the coupler at the train end of the locomotive to the coupler at the locomotive end of the first car in the train. Now let it be further supposed that the hollow shank 6 shown in FIG. 1 of the drawings is the shank of the coupler at the locomotive end of the first car in the train. Therefore, the initial movement of the locomotive is effective to exert a pull or jerk and thereby establish a force that acts in the direction of the left hand on the hollow shank 6 shown in FIG. 1. This force acting on the hollow shank 6 is transmitted through the boss 9 on wall 7 that closes the right-hand end of the hollow shank 6 to the shank pin 10. Since the shank pin 10 extends through the holes 11 (FIG. 3) in the draft gear yoke 4, the shank pin 10 is effective to transmit the force exerted by the locomotive to the draft gear yoke 4. As shown in FIG. 1B, the right-hand end wall of the draft gear yoke pocket 1 abuts the right-hand face of the end plate 53. Therefore, the pull on the draft gear yoke 4 in the direction of the left hand will be transmitted through the end plate 53 to the right-hand end of the hydraulic draft gear cylinder 42 since the end plate 53 is welded to this end of the cylinder.

The left-hand side of the opposite end portions of the follower 90 (FIG. 1) that extend beyond the opposite sides of the draft gear yoke 4 normally abut, respectively, the right-hand side of the front draft gear lugs that are integral with the striker 20, as hereinbefore explained. Furthermore, the right-hand side of the center portion of the follower 90 normally abuts the left-hand end of the plunger 80 as shown in FIG. 1. Therefore, upon movement of the draft gear yoke 4, end plate 53 and hydraulic draft gear cylinder 42 in the direction of the left hand in response to the pull in this direction exerted by the locomotive on the hollow shank 6 of the car coupler, the cup-shaped plunger 80 is prevented from moving in this direction. Since the cup-shaped plunger 80 abuts the left-hand end of the metering rod 60 and the right-hand end of the metering rod 60 has the piston 68 secured thereto, it will be apparent that the metering rod 60 and the piston 68 are likewise prevented from moving in the direction of the left hand. Accordingly, it will be apparent that as the draft gear yoke 4 is moved in the direction of the left hand, the end plate 53, hydraulic draft gear cylinder 42, and the hydraulic liquid reservoir 48 which is welded to the cylinder 42 are moved therewith against the yielding resistance of the spring 61, and with respect to the piston 68, metering rod 60 and cup-shaped plunger 80, to simultaneously increase the volume of the chamber 85 and decrease the volume of the chambers 86 and 87. As this movement continues in the direction of the left hand, it is effective to force the oil in the chamber 86 to flow at a relatively high velocity through the orifice constituted by the bushing 62 through which the metering rod 60 extends to the chamber 85 to dissipate kinetic energy in the manner hereinbefore explained.

Movement of the hydraulic draft gear cylinder 42 in the direction of the left hand relative to the piston 68 is effective to decrease the volume of chamber 87 and increase the pressure of the air in this chamber to absorb a part of the kinetic energy transmitted by the pull or jerk of the locomotive to the car coupler, it being understood that this kinetic energy is changed or converted to potential energy and stored in the air under pressure in the chamber 87.

The compression of the spring 61 as the hydraulic draft gear cylinder 42 moves in the direction of the left hand is effective to change or convert a part of the kinetic energy resulting from the jerk exerted by the locomotive on the car coupler into potential energy and store it in spring 61.

Furthermore, the friction of the draft gear yoke 4 and the other moving parts of the mechanism are effective to dissipate or absorb some of this kinetic energy. Therefore, all of the kinetic energy transmitted to the coupler and its shank on the train end of the locomotive and the coupler and its shank on the locomotive end of the first car in the train, with the exception of the potential energy stored in the springs 61 and the air under pressure in the chambers 87, is dissipated in the form of heat in the manner hereinbefore explained, or is transferred as kinetic energy to the locomotive frame and, via the cup-shaped plunger 80 and follower 90, to the front draft lugs which are integral with the striker 20 that is welded to the center sill 22 of the first car in the train.

The jerk delivered to the car coupler and shank 6 of the first car in the train as the result of the initial movement of the locomotive is effective to move the shank 6, draft gear yoke 4 and hydraulic draft gear cylinder 42 in the direction of the left hand, as viewed in the drawings, relative to the center sill 22, striker 20 and front draft lugs formed integral therewith, follower 90,

cup-shaped plunger 80, metering rod 60 and piston 68 until the left-hand face of the follower web 16, which is an integral part of the draft gear yoke 4, comes into contact with the piston rod 29 which, as hereinbefore stated, is now disposed in the elongated slot 19 (FIG. 1) in the bottom of the chamber 18.

The remaining kinetic energy resulting from the jerk exerted on the hollow shank 6 of the coupler on that end of the first car adjacent the train end of the locomotive is transmitted through the piston rod 29, piston 26, interlock cylinder 23, and the striker 20, which is integral with the interlock cylinder 23, to the center sill 22. This remaining kinetic energy that is not absorbed by, the hydraulic draft gear device but is transmitted to the center sill 22 and car body of the first car in the train is effective to move this car from its standing position in the same direction as the initial movement of the locomotive. This movement of the first car in the train effects a relative acceleration between the body of the first car and the lading therein.

Since the piston rod 29 is now disposed in the elongated slot 19 as hereinbefore explained, the draft gear travel in draft as a result of the initial movement of the locomotive is considerably less (2⅝" instead of 30") than the draft gear travel in buff as the result of a car being humped colliding with a standing car or string of cars. Accordingly, the amount of kinetic energy absorbed by and stored as potential energy in the draft gear device is correspondingly less. However, it must be remembered that the kinetic energy transmitted to the car coupler as a result of the initial movement of the locomotive is considerably less than the kinetic energy transmitted to the car coupler as the result of a moving car in a hump yard colliding with a standing car or string of cars.

When a brake application is effected on a train, the brakes on the cars adjacent the locomotive apply prior to the brakes on the cars farther back in the train, as is well known to those skilled in the art. Therefore, each car farther back in the train than the car adjacent the locomotive tends to overtake or run into the car ahead. This movement of one car relative to the adjacent car ahead causes the car coupler on each respective car to operate in buff. The buff operation of the draft gear device gear associated with the car coupler of each car is the same as has been hereinbefore described in detail in connection with a moving car striking a standing car or string of cars in a humping operation except that the exterior end of the piston rod 29 on each car is now disposed in the corresponding elongated slot 19 to reduce the buff travel from maximum buff travel to an amount indicated by the legend "Buff Travel" in FIG. 1, it being noted that this is the same as the amount of draft travel.

If, for any reason, it is desired that the draft gear device of a car coupled into a train have a buff travel and a draft travel that is the same as the buff travel while the car is detached from a train for humping operation in a railroad classification yard, the handle 37 of the cut-out cock 36 is turned from the position in which it is shown in FIG. 1 to the position indicated by the broken line 37*a* in FIG. 1 to close communication between the brake pipe 38 and the pressure chamber 33 and vent this chamber to atmosphere. When the pressure chamber 33 is thus vented, the spring 27 is rendered effective to move the piston rod 29 and piston 26 to the position shown in FIG. 1. While the piston rod 29 and piston 26 occupy the position shown in FIG. 1, the draft gear device will operate in buff in the manner hereinbefore described in detail in connection with a humping operation.

The draft gear will operate in draft in the manner hereinbefore described, except movement of the draft gear yoke 4 in the direction of the left hand is not limited by the follower web 16 coming into contact with the piston rod 29 but will continue in the direction of the left hand until the left-hand end of the hydraulic draft gear cylinder 42 abuts the right-hand side of the follower 90. This increase in the draft gear travel provides a corresponding increase in the amount of kinetic energy that the draft gear can absorb in draft.

The operation of the draft gear devices associated with the car couplers at the adjacent ends of any two coupled cars in a train is the same as the operation of the draft gear device associated with the coupler at the train end of the locomotive and the draft gear device associated with the coupler at the locomotive end of the first car in the train. Therefore, a detailed description of the operation of the draft gears associated with the car couplers at the respective adjacent ends of two coupled cars is not deemed necessary.

Description—Figs. 6 and 7

According to a second embodiment of the invention, two coaxial and oppositely arranged interlock cylinder casings 107 and 108, which are shown in detail in FIG. 7, replace the single interlock cylinder casing 23 shown in FIG. 1 to provide a draft gear device that functions substantially the same as the draft gear device shown in FIGS. 1, 1A, 1B, 2, 3, 4 and 5, it being understood that FIG. 6, FIG. 1A and FIG. 1B when taken together such that the right-hand edge of FIG. 6 is matched with the left-hand edge of FIG. 1A and the right-hand edge of FIG. 1A is matched with the left-hand edge of FIG. 1B constitutes an elevational sectional view of a hydraulic draft gear device constructed in accordance with this second embodiment of the invention. Accordingly, like reference numerals have been used to designate the structure shown in FIGS. 6 and 7 which is identical with that shown in FIG. 1. Only such features of the structure and operation of the embodiment of FIGS. 6 and 7 which differ from that of the embodiment of FIG. 1, FIG. 1A, FIG. 1B, FIG. 2, FIG. 3, FIG. 4 and FIG. 5 will be hereinafter described.

According to the embodiment of the invention shown in FIGS. 6 and 7, the two interlock cylinder casings 107 and 108 are respectively welded or otherwise secured to the outside vertical faces of the American Association of Railroad Z-sections 40 and 41, adjacent the left-hand end thereof.

In assembling the draft gear device shown in FIGS. 6 and 7, after the hollow shank 6 of the car coupler has been secured to the draft gear yoke 4 by the shank pin 10, as shown in FIGS. 1 and 3, a hollow box-like striker 109 that differs somewhat from the striker 20, shown in FIG. 1, is slipped over the right-hand end of the draft gear yoke 4 and moved in the direction of the left hand until the left-hand end of the striker is substantially in alingment with the left-hand end of the draft gear yoke 4 and allowed to rest in this position until the draft gear device is assembled in the manner hereinbefore explained in connection with the first embodiment of the invention. Subsequent to assembling the draft gear device, the striker 109 is moved from the position in which it was placed in the direction of the right hand, as viewed in FIGS. 6 and 7, along the yoke 4 until the right-hand end thereof can be inserted into the left-hand end of the center sill pocket 21 after which the striker 109 is pushed into the center sill pocket until it occupies the position in which it is shown in FIGS. 6 and 7. With the striker 109 in this position, it is welded to the left-hand end of the center sill 22 and to the interlock cylinder casings 107 and 108, as indicated in FIGS. 6 and 7.

As shown in FIG. 7, the hollow box-like striker 109 is provided with two spaced-apart vertical parallel walls 110 and 111. Formed respectively on the adjacent sides of the walls 110 and 111 are oppositely extending bosses 112 and 113 which are arranged coaxial with the interlock cylinder casings 107 and 108. The bosses 112 and 113 are provided respectively with bores 114 and 115 of equal diameter that are coaxial with bores 116 and 117 of the same diameter provided respectively in the spaced-apart vertical walls of the American Association of Railroads

Z-sections 40 and 41. It will be noted that the centers of the cylinder casings 107 and 108 and the bores 114, 115, 116 and 117 lie on a horizontal axis that is perpendicular to and intersects the horizontal longitudinal axis of the draft gear yoke 4.

The interlock cylinder casings 107 and 108 are provided respectively with bores 118 and 119 in which are respectively slidably mounted fluid pressure actuated pistons 120 and 121.

Release springs 122 and 123 are respectively interposed between the respective pistons 120 and 121 and the outside vertical face of the respective American Association of Railroads Z-sections 40 and 41. These springs serve to yieldingly bias the pistons 120 and 121 and piston rods 124 and 125 respectively formed integral therewith to the position in which they are shown in FIG. 7.

Two packing cups 126 and 127 of the snap-on type are secured to the respective pressure faces of the pistons 120 and 121 and cooperate respectively with pressure heads 128 and 129 secured to the respective interlock cylinder casings 107 and 108 by any suitable means (not shown) to form respectively pressure chambers 130 and 131 to each of which chambers fluid under pressure may be supplied from the brake pipe on the car in the same manner as explained in connection with the pressure chamber 33 shown in FIG. 1 of the drawings.

As shown in FIG. 7, the striker 109 is provided with a pair of front draft gear lugs 132 that are formed integral therewith. While the yoke 4 and the draft gear device carried therein occupy their normal position, the right-hand side of the front draft gear lugs 132 abut the respective left-hand side of the opposite end portions of the follower 90, as shown in FIG. 7.

The draft gear devices shown in FIGS. 1 to 5 inclusive and in FIGS. 6 and 7 are identical in construction, except as pointed out above.

The operation of the draft gear devices shown in FIGS. 1 to 5 inclusive and in FIGS. 6 and 7 is identical, except that when the brake pipe on the car provided with the draft gear device shown in FIGS. 7 and 8 is charged, fluid under pressure is simultaneously supplied to the pressure chambers 130 and 131 whereupon the corresponding pistons 120 and 121 move in opposite directions against the yielding resistance of the respective springs 122 and 123 until the outer ends of the respective piston rods 124 and 125 are disposed within the corresponding parallel spaced-apart rectangular openings 19*a* in the draft gear yoke 4 to limit the movement of the yoke 4 and draft gear device carried therein in either direction from the position in which the yoke 4 is shown in FIGS. 6 and 7.

Description—FIGS. 8, 8A, 8B and 9

In FIGS. 8, 8A, 8B and 9 is shown a variable travel cushioned draft gear device constructed in accordance with a third embodiment of the invention. This draft gear device is suitable for use with a horizontal type of draft gear yoke such as that shown on page 656 of Car Builder's Cyclopedia, 21st edition, published in 1961 by Simmons-Boardman Publishing Corporation.

As shown in FIG. 9 of the drawings and also on the above-mentioned page 656, a draft gear device is carried in an elongated yoke pocket 133 formed between parallel spaced-apart inside surfaces 134 and 135 on the side walls of a horizontal type of draft gear yoke 136 that is disposed in a center sill pocket 137 of a center sill 138 that may be fabricated by welding together two oppositely arranged American Association of Railroads Z-sections 139 and 140. The horizontal type of draft gear yoke 136, as shown in FIG. 9, is supported by two parallel spaced-apart longitudinally extending angle brackets 141 and 142 secured respectively to the inside vertical faces of the American Association of Railroads Z-sections 139 and 140 by means such as a plurality of rivets 143, it being understood that the angle brackets 141 and 142 are not riveted to the respective Z-sections until the draft gear device has been assembled and placed in the draft gear yoke 136 as hereinafter described in detail.

To properly position the draft gear device in the center sill pocket 137, one of a pair of L-shaped rear draft lugs 144 each having a plurality of spaced-apart strengthening ribs 144*a* is welded to the underside of the upper feet of the Association of American Railroads Z-sections 139 and 140 that constitute the center sill 138, as illustrated in FIGS. 8B and 9. The other one of the pair of L-shaped rear draft lugs 144 is disposed between and adjacent the lower end of the inside faces of the vertical spaced-apart parallel walls of the Association of American Railroads Z-sections 139 and 140 and welded thereto.

As shown in FIG. 8, one end of a hollow box-like striker 145 is disposed in the left-hand end of the center sill pocket 137 and welded to the left-hand end of the center sill 138, as indicated by the reference numeral 146. A left-hand end wall 147 of the striker 145 is provided with a substantially square opening 148 the size of which is somewhat in excess of the size of the shank of a railway car coupler.

The hereinbefore-mentioned draft gear device and horizontal type of draft gear yoke 136 are constructed and assembled as follows:

First, the right-hand end of a bore 149 (FIG. 8B) in a cylinder 150 is provided, as by machining, with an internal screw thread portion 151 for receiving the external screw threads formed on a hollow spring seat 152 that has a plurality of arcuately arranged apertures 153, two of which appear in FIG. 8B of the drawings. Subsequent to assembling the spring seat 152 to the right-hand end of the hollow cylinder 150, a piston and spring assembly for insertion into the hollow cylinder 150 is prepared in a manner now to be described.

First, one end of a hollow rod 154, the outside diameter of which is slightly less than the inside diameter of the hollow spring seat 152, is inserted into a counterbore 155 formed in a semi-elliptical-shaped piston 156 and welded thereto. Next, a hollow plastic packing land 157 is placed so as to abut the right-hand side of the piston 156. Thereafter, a plurality of pieces of V-shaped packing 158 arranged in a stack is seated against the right-hand side of the plastic packing land 157. A second plastic packing land 159 is now positioned against the right-hand end of the stack of V-shaped packing 158 after which a packing gland nut 160 is screw threaded onto a threaded portion 161 of the piston 156 to clamp the stack of pieces of V-shaped packing 158 tightly between the plastic packing lands 157 and 159.

The periphery of the packing gland nut 160 is provided with three spaced-apart peripheral annular grooves 162. Therefore, an O-ring seal 163 is now inserted in each of the peripheral annular grooves 162.

Following inserting the three O-ring seals 163 in the corresponding peripheral annular grooves 162, a strong spring 164, constructed of large diameter wire, is slipped over the end of the hollow rod 154 opposite the piston 156 and moved in the direction of the piston 156 until the end of the spring adjacent the piston abuts the right-hand end of the packing gland nut 160.

After completing the operation of assembling the piston 156, hollow rod 154 and spring 164, the end of the hollow rod 154 remote from the piston 156 and the corresponding end of the spring 164 are inserted into the end of the bore 149 in the cylinder 150 remote from the spring seat 152 and then moved in the direction of the spring seat 152 until the packing gland nut 160 can be inserted into the bore 149 in the cylinder 150. Thereafter, the piston and spring assembly are shoved into the cylinder 150 so that the right-hand end of the hollow rod 154 enters the hollow spring seat 152 and is moved to the position shown in FIG. 8B in which the right-hand end of the hollow rod 154 is flush with the right-hand side of the hollow spring seat 152.

Subsequent to placing the piston 156, hollow rod 154

and spring 164 in the bore 149 of the cylinder 150, an interlock piston and valve mechanism is constructed and assembled as follows.

First, an interlock spacer element 165 that may be made from a cylindrical casting having a cylindrical cavity or chamber 166 extending inward from one end thereof and a coaxial stepped boss 167 extending outward from the bottom of the cavity 166. The interlock spacer element 165 has two semi-elliptical recesses 168 and 169 formed, as by machining, in the respective opposite ends thereof, the size of these recesses being substantially the same as that of the semi-elliptical piston 156 so that this piston may be received in the recess 169, as shown in FIG. 8A.

Next, the interlock spacer element 165 is provided, as by a drilling operation, with a bore 170 and a coaxial counterbore 171, the axis of which is coaxial with the axis of the interlock spacer element 165. The end of the bore 170, remote from the coaxial counterbore 171, opens into the cavity 166 and the open end of the counterbore 171 has formed thereon, as by machining, a spherical valve seat 172.

Subsequent to forming the spherical valve seat 172 on the open end of the counterbore 171, an internal screw thread 173 is formed, as by machining, in the open end of the cavity 166 after which a screw-threaded plug 174 having an orifice 175 therein is screw threaded thereinto.

After the plug 174 is screw threaded into the internal screw threaded portion 173, the interlock spacer element 165 is provided, as by a drilling operation, with a bottom bore 176 and two coaxial counterbores 177 and 178, the axis of which intersects at a right angle the axis of the bore 170 and counterbore 171 and passes substantially through the center of the cavity or chamber 166. Following this drilling operation, an internal screw thread 179 is formed, as by machining, in the open end of the counterbore 178.

After the forming of the internal screw thread 179, a pair of diametrically opposite screw-threaded counterbores 180 and 181 are formed, as by a drilling and tapping operation, in the interlock spacer element 165 at the inner end of the counterbore 179 for a purpose hereinafter made apparent.

Finally, the interlock spacer element 165 is placed in a suitable jig after which two bores 182 and 183 are drilled therein to provide two passageways between the bottom of the counterbore 171 and the cavity 166, it being understood that the axes of the two bores 182 and 183 and the axis of the counterbore 171 all lie in the same plane and the axis of each of the bores 182 and 183 form an angle of 45 degrees with the axis of the counterbore 171.

Now, the end of a stem 184 formed integral with a spherical valve element 185 and having an outside diameter such as to form a sliding fit in the bore 170 is introduced into the open end of the counterbore 171 and subsequently inserted into the bore 170 after which the stem 184 and spherical valve element 185 are pushed in the direction to seat the spherical valve element 185 on the spherical valve seat 172.

While the spherical valve element 185 is held seated on the spherical valve seat 172, a spring 186 is slipped over the end of the stem 184 and placed in surrounding relation to the boss 167 after which a hollow spring seat 187 is then pushed onto the stem 184 to compress the spring 186 until the hollow spring seat 187 has been moved far enough for a snap ring 188 to be inserted in a peripheral annular groove formed in the stem 184 adjacent the end thereof.

After the snap ring 188 has been inserted in the peripheral annular groove formed in the stem 184, a cone-shaped spring 189 is placed in the counterbore 177. Thereafter, a plurality of pieces of annular V-shaped packing 190, arranged in a stack and having an annular plastic packing land 191 at each end thereof, is pushed into the counterbore 177. The spring 189, packing 190 and plastic packing lands 191 are now anchored in the counterbore 177 by inserting therein a boss formed on one side of a hollow packing gland 192 that is secured to the interlock spacer element 165 by a pair of cap screws 193 and 194 that have screw-threaded engagement with the respective screw-threaded counterbores 180 and 181 formed in the interlock spacer element 165.

Subsequent to securing the hollow packing gland 192 to the interlock spacer element 165 by means of the cap screws 193 and 194, the interlock spacer element 165 is placed in an inverted position from the position in which it is shown in FIG. 8A of the drawings so that, first, a spring 195 can be dropped through the hollow packing gland 192, annular packing 190 and the cavity 166 into the bottom bore 176. Thereafter, a piston rod 196 that is formed integral with an interlock piston 197 that is provided with a peripheral annular groove in which is disposed an O-ring seal 198 is placed so that the axis thereof is in alignment with the axis of the bottom bore 176. The piston rod 196 is then pushed through the V-shaped packing 190 and into the bottom bore 176 until the interlock piston 197 can be inserted into the open end of the counterbore 178.

After the interlock piston 197 is inserted into the counterbore 178, this piston and the piston rod 196 that has formed thereon a cam surface 196*a* are pushed respectively into the counterbore 178 and the bottom bore 176 against the yielding resistance of the spring 195 until a threaded plug 199 can be screw threaded into the internal screw threads 179 to retain the interlock piston 197 in the counterbore 178 in the position in which it is shown in FIG. 8A of the drawings. It will be noted that while the interlock piston 197 and the piston rod 196 occupy the position in which they are shown in FIG. 8A, the cam surface 196*a* formed on the piston rod 196 is effective through stem 184 to maintain the spherical valve element 185 unseated from the spherical valve seat 172.

The threaded plug 199 is provided with a threaded port to which is connected one end of a pipe 200 having therein a two-position vented type cut-out cock 201 that is provided with an operating handle 202. The other end of the pipe 200 is connected to the brake pipe (not shown) on the car after the draft gear device is completely assembled and placed within the horizontal type draft gear yoke 136.

After the interlock piston and valve assembly has been assembled, as described above, the end of the interlock spacer element 165 having therein the semi-elliptical recess 169 is inserted into a counterbore 203 that is coaxial with the bore 149 in the cylinder 150 and is formed, as by machining, in the left-hand end of this cylinder. The interlock spacer element 165 is then pushed into the counterbore 203 so that the semi-elliptical shaped piston 156 is received in the semi-elliptical recess 169. A force is now applied by any suitable means to the interlock spacer element 165 and piston 156 to push them into the cylinder 150 against the yielding resistance of the spring 164 until the right-hand end of the interlock spacer element 165 abuts the end of the counterbore 203. The interlock spacer element 165 is now welded to the end of the cylinder 150, as indicated by the numeral 204 in FIG. 8A of the drawings.

Subsequent to welding the interlock spacer element 165 to the cylinder 150, a second cylinder 205 having a bore 206 and a coaxial counterbore 207 (FIG. 8A) of the proper diameter to receive the left-hand end of the interlock spacer element 165 that has therein the semi-elliptical recess 168 is pushed onto this end of the interlock spacer element 165 and then welded thereto, as indicated by the numeral 208 in FIG. 8A.

Subsequent to welding the cylinder 205 to the interlock spacer element 165, a plunger assembly for insertion into the open end of the bore 206 in the cylinder 205 is prepared as follows.

First, a plurality of segments of V-shaped high pressure

packing 209 are assembled between two plastic packing lands 210 and 211 after which this assembly is placed in surrounding relation to a portion 212 of reduced diameter formed on the open end of a cup-shaped plunger 213 that is provided with internal screw threads 214 at its open end.

To the left of the high pressure packing 209 the plunger 213 is provided with five spaced-apart peripheral annular grooves, in each of which is now inserted an O-ring seal 215.

Next, a spring 216 is placed within the cup-shaped plunger 213 after which a cup-shaped piston assembly for insertion into the cup-shaped plunger 213 is assembled as follows.

First, a plastic packing land 217 and a plurality of segments of V-shaped high pressure packing 218 are positioned on a portion 219 of reduced diameter formed on the closed end of a cup-shaped piston 220, from the bottom of which extends a hollow boss 221. The open end of the hollow boss 221 is provided with an internal screw thread 222.

Next, a cap screw 223 is inserted through a central aperture 224 formed in a cup-shaped packing retainer 225 that is provided with a plurality of arcuately arranged apertures 226, two of which appear in FIG. 8A of the drawings. Thereafter, the cap screw 223 is screw threaded into the internal screw threads 222 formed in the open end of the hollow boss 221 to force the rim of the cup-shaped packing retainer 225 against the outer segment of the packing 218 and thereby tightly secure the plurality of segments of the packing 218 between the plastic packing land 217 and the packing retainer 225.

The cup-shaped piston assembly is now inserted into the open end of the cup-shaped plunger 213 and pushed in the direction of the spring 216 until the bottom of the cup-shaped piston 220 contacts the end of the spring 216 that was previously placed in the cup-shaped plunger 213.

Following placing the spring 216 and the piston assembly within the cup-shaped plunger 213, an externally threaded boss 227 formed on a semi-elliptical packing retainer 228 is screw threaded into the internal screw threads 214 formed at the open end of the cup-shaped plunger 213 to force the rim of the plastic land 211 against the outer segment of the packing 209 and thereby tightly clamp all the segments of the packing 209 between the packing lands 210 and 211.

The semi-elliptical packing retainer 228 is provided with a central threaded bore 229 and two coaxial counterbores 230 and 231 extending inward from the respective opposite sides thereof. The semi-elliptical packing retainer 228 is also provided with a second threaded bore 232, the axis of which forms an angle of 45 degrees with the axis of the central threaded bore 229 and passes through a point on the periphery of a cylindrical shoulder 233 formed by the inner end of the counterbore 231. Therefore, after the boss 227 on the semi-elliptical packing retainer 228 has been screw threaded into the internal screw threads 214 at the open end of the cup-shaped plunger 213, a dog-point set screw 234 is screw threaded into the screw-threaded bore 232 so that the end of this set screw is disposed in an internal groove 235 that is formed, as by machining, in the cup-shaped plunger 213 adjacent the inner end of the internal threads 214. With the end of the dog-point set screw 234 disposed in the internal groove 235, the semi-elliptical packing retainer 228 cannot work loose from the cup-shaped plunger 213 as a result of vibration or the sudden and severe impact forces which the draft gear device must withstand.

Subsequent to screw threading the dog-point set screw 234 into the threaded bore 232, a screw-threaded plug 236 having an orifice 237 therein is screw threaded into the central threaded bore 229 in the semi-elliptical packing retainer 228.

After the screw-threaded plug 236 has been secured to the semi-elliptical packing retainer 228, the assembly comprising the plunger 213, spring 216, piston 220 and semi-elliptical packing retainer 228 is positioned in the bore 206 in the cylinder 205 by first inserting the semi-elliptical packing retainer 228 into the open end of the bore 206 and then pushing the assembly in the direction of the interlock spacer element 165 until it occupies the position in which it is shown in FIGS. 8 and 8A of the drawings.

Now the parts so far assembled are placed between the front and back walls 134 and 135 of the horizontal type draft gear yoke 136, which it will be understood has not yet been placed in the center sill pocket 137 but which may be suitably supported on a workbench or the top of a table so that the spring seat 152 abuts the closed end of the draft gear yoke.

Next, a follower block 238 (FIG. 8) is placed between the front and back walls 134 and 135 of the draft gear yoke 136 so that its right-hand end abuts the left-hand end of the cup-shaped plunger 213. The follower block 238 is provided with an elongated slot 238*a* which, when the follower block occupies the position in which it abuts the end of the plunger 213, is in alignment with corresponding elongated slots (not shown) formed in the front and back walls 134 and 135 of the draft gear yoke 136, these slots being substantially longer than the slot 238*a*. Therefore, a temporary pin, the length of which is substantially equal to the over-all width of the horizontal type of draft gear yoke 136, is now inserted through the elongated slots in the front and back walls 134 and 135 of the draft gear yoke 136 and the slot 238*a* in the follower block 238 in order that the plunger 213 will not be forced out of the bore 206 in the cylinder 205 when the draft gear device is filled with oil under pressure as will now be described.

To provide for filling the draft gear device with a required quantity of hydraulic fluid, the wall of the cylinder 205 has therein intermediate its ends, as shown in FIG. 8A, a screw-threaded bore 239 and a coaxial screw-threaded counterbore 240. Screw threaded into the bore 239 is a screw-threaded plug 241 that has therein a bore 242 at the lower end of which is a valve seat 243. A ball type of valve 244 is normally biased against the valve seat 243 by a spring 245 that is interposed between the valve 244 and a hollow spring seat 246 that is screw threaded into the screw-threaded end of a bore 247, formed in the plug 241 and coaxial with the bore 242.

A plug 248 is screw threaded into the screw-threaded counterbore 240 to prevent leakage to the exterior of the cylinder 205 of any hydraulic fluid that might leak past the ball valve 244.

In order to vent air from the interior of the draft gear device when filling it with the required quantity of hydraulic fluid, the cylinder 205 is provided with an air vent valve now to be described.

The wall of the cylinder 205 has therein intermediate its ends and on the right-hand side of the screw-threaded bore 239 and counterbore 240 a second screw-threaded bore 249 and coaxial counterbore 250, the outer portion of which is screw threaded.

Screw threaded into the screw-threaded bore 249 is one end of a nipple or short piece of pipe 251 that has mounted on its opposite end a two-position manually operated cut-out cock 252 that is provided with an operating handle 253. The cut-out cock 252 is disposed within the counterbore 250, the outer end of which is closed by a plug 254 to prevent leakage to the exterior of the cylinder 205 of any hydraulic fluid that might leak through the cut-out cock 252 while it is in its closed position.

To fill the draft gear device with hydraulic fluid, the plugs 248 and 254 are removed from the respective screw-threaded bores 240 and 250 by means such as a spanner wrench.

Next, by means of the handle 243, the cut-out cock 252 is moved to its open position to establish an air venting

communication from the interior of the cylinder **205** via the short pipe or nipple **251**, cut-out cock **252** now in its open position, and counterbore **250** to atmosphere.

Subsequent to opening the cut-out cock **252**, the threaded end of a discharge pipe of a suitable pump (not shown) is attached to the screw-threaded counterbore **240**. The pump is then operated to supply the required quantity of hydraulic fluid to the draft gear device.

It will be understood that as the hydraulic fluid is supplied to the interior of the cylinder **205**, it will flow therefrom via counterbore **171** and the bores **182** and **183** in the interlock spacer element **165** to the cavity **166** and thence via the orifice **175** in the plug **174** to a chamber **255** formed between the plug **174** and the semi-elliptical piston **156**. The strength of the spring **164** is such that it is not compressed by the supply of hydraulic fluid under pressure to the chamber **255** while filling the hydraulic draft gear device.

Simultaneously as hydraulic fluid flows from the interior of the cylinder **205** to the cavity **166** and the chamber **255**, hydraulic fluid also flows via the orifice **237** in the plug **236** to a chamber **256** formed between the left-hand side of the boss **227** and the right-hand side of the piston **220**. After the chambers **255** and **256** and a chamber **257** formed by the cooperative relationship between the interlock spacer element **165**, the semi-elliptical packing retainer **228** and the wall of the bore **206** in the cylinder **205** are completely filled with hydraulic fluid under pressure, the continued operation of the pump will cause hydraulic fluid to be discharged through the air vent cut-out cock **252** to atmosphere. Therefore, when hydraulic fluid begins to be discharged through the cut-out cock **252** to atmosphere, the cut-out cock is closed by means of the handle **253**. As the pump continues to operate to supply hydraulic fluid under pressure to the draft gear device, the hydraulic fluid under pressure thus supplied to the chamber **256** is effective to move the piston **220** against the yielding resistance of the spring **216** to increase the volume of the chamber **256**. Therefore, when the required quantity of hydraulic fluid under pressure has been pumped into the draft gear device, the piston **220** will have been moved in the direction away from the boss **227** to the position in which it is shown in FIG. 8A to initially compress the spring **216** a chosen amount.

After the required quantity of hydraulic fluid under pressure has been pumped into the draft gear device, the threaded end of the pump discharge pipe is disconnected from the screw-threaded bore **240**, after which the plugs **248** and **254** are replaced in the respective counterbores **240** and **250**.

The horizontal type draft gear yoke **136** that now has the draft gear device and the follower block **238** disposed between the front and back walls **134** and **135** thereof with the follower block **238** secured thereto by means of the temporary pin that has been inserted in the elongated slot **238***a* in the follower block and the corresponding slots in the front and back walls **134** and **135** of the yoke may now be removed from the work bench or table upon which they have been assembled and then placed in a position below the center sill pocket **137** so that the axes of the cylinders **150** and **205** are parallel to and vertically below the center line of the center sill pocket **137**.

The assembly comprising the yoke **136**, the follower block **238** and the draft gear device is now raised upward by some suitable means, such as jacks, until this assembly is positioned in the center sill pocket **137** as shown in FIGS. 8, 8A, 8B and 9 of the drawings.

Next, the angle brackets **141** and **142** are positioned, as shown in FIG. 9, below the yoke **136** so as to support it, and then secured to the respective American Association of Railroads Z-sections **139** and **140** by the rivets **143**.

After the angle brackets **141** and **142** have been secured to the respective American Association of Railroads Z-sections **139** and **140**, the opposite ends of two parallel spaced-apart draft gear carriers **258**, shown in FIGS. 8A and 8B, are riveted to the bottom feet of the Z-sections **139** and **140** by rivets **259**, as shown in FIG. 9, to support the cylinder **150**.

With the horizontal type draft gear yoke **136** supported by the angle brackets **141** and **142**, and the cylinder **150** supported by the parallel spaced-apart draft gear carriers **258**, the jacks or other means used to raise the draft gear yoke and the draft gear device to the proper position in the center sill pocket **137** may be removed.

Next, a hollow shank **260** (FIG. 8) of a car coupler (not shown) is introduced into the opening **148** in the striker **145** and then pushed in the direction of the right hand, as viewed in FIG. 8 of the drawings, until a wall **261** that closes the right-hand end of the hollow shank **260** abuts the left-hand end of the follower block **238**.

As shown in FIG. 8, the wall **261** has formed on the left-hand side thereof a boss **262** which is disposed at the right-hand end of two aligned parallel spaced-apart elongated slots **263** formed respectively in a pair of spaced-apart vertical parallel walls adjacent the left-hand end of the hollow shank **260**, one of which walls appears in FIG. 8 and is indicated by the reference numeral **264**. While the hollow shank **260** is disposed in the position in which it is shown in FIG. 8, the two aligned parallel spaced-apart elongated slots **263** formed in the parallel spaced-apart walls of the hollow shank **260** are in alignment with corresponding parallel spaced-apart elongated slots **265** formed in the parallel front and back walls **134** and **135** of the horizontal type draft gear yoke **136**, and also in alignment with corresponding parallel spaced-apart elongated slots **266** formed partly in the left-hand ends of the spaced-apart vertical walls of the American Association of Railroads Z-sections **139** and **140** and partly in the right-hand end of two spaced-apart parallel vertical walls **267**, one of which appears in FIG. 8, of the striker **145**, it being noted, however, that the length of the slots **266** is substantially greater than the length of the slots **263**.

With the slots **263**, **265** and **266** in alignment, as shown in FIG. 8 of the drawings, a headed substantially rectangular-shaped shank pin **268**, the length of which is somewhat in excess of the width of the center sill **138**, is inserted through the slots **266**, **265** and **263** and retained in place by a cotter pin (not shown).

After the shank pin **268** has been inserted through the slots **266**, **265** and **263**, it is effective to prevent movement of the shank **260** and follower block **238** in the direction of the left hand from the position in which they are shown in FIG. 8 of the drawings. While the follower block **238** occupies the position shown in FIG. 8, the elongated slot **238***a* therein and the two corresponding elongated parallel spaced-apart slots in the front and back walls **134** and **135** of the horizontal type draft gear yoke **136**, in which slots the hereinbefore-mentioned temporary pin is now disposed, are disposed in alignment with two elongated parallel spaced-apart slots **269** formed in the parallel spaced-apart vertical walls of the American Association of Railroads Z-sections **139** and **140**, it being noted that the slots **269** are substantially longer than the slots **238***a* and are the same in length as the hereinbefore-mentioned slots in yoke **136**. Therefore, the end of a second headed substantially rectangular-shaped shank pin **270** is now inserted in either of the slots **269** such that the end of this shank pin abuts one end of the temporary shank pin. After the end of the shank pin **270** has thus been inserted in one of the slots **269**, it is driven inward by means such as a hammer so that as it advances through the slots in the front and back walls **134** and **135** of the horizontal type draft gear yoke **136** and the slot **238***a* in the follower block **238**, it forces the temporary pin before it so that when the shank pin **270** has substantially passed through all the slots, the temporary pin will be ejected from the other of the slots **269** and fall to the floor.

It will be understood that the center sill **138** constitutes

a part of the body of a railway freight car according to standard methods of freight car construction.

In addition to the pair of draft gear carriers 258 shown in FIGS. 8A and 8B for supporting the cylinder 150 of the draft gear device, this cylinder is also supported on a center plate adapter which, in turn, is pivotally supported on a car truck bolster in the same manner and by a structure that is identical to that shown in FIG. 1A of the drawings.

Since the supporting structures shown in FIGS. 1A and 8B are identical in construction for convenience, corresponding parts of the two supporting structures are identified by the same reference numerals without additional description.

Operation

It should be understood that, in draft, kinetic energy is transmitted from the car coupler through the shank pin 268, horizontal type draft gear yoke 136, the draft gear device, follower block 238, and shank pin 270 to the center still 138 and car body, and, in buff, kinetic energy is transmitted from the car coupler through the follower block 238, the draft gear device and the rear draft lugs 144 to the center sill 138 and car body.

(*a*) *Buff impact—Car detached for humping*

When a freight car is detached from a train for humping operations in a railway classification yard, fluid under pressure is completly vented from the brake pipe to atmosphere. Consequently, fluid under pressure is likewise vented from the lower side of the interlock piston 197 (FIG. 8A) via the pipe 200, cut-out cock 201 and the brake pipe, it being understood that the cut-out cock 201 has been moved to its open position by the handle 202. Upon completely venting fluid under pressure from the lower side of the interlock piston 197, the spring 195 is rendered effective to move the interlock piston 197 and its piston rod 196 to the position in which they are shown in FIG. 8A in which the cam surface 196*a* formed on the piston rod 196 is effective to unseat the spherical valve element 185 from the spherical valve seat 172 to open a communication between the chambers 255 and 257.

Now let it be supposed that the detached car, while traveling along a track in the classification yard at some slow speed such as, for example, fourteen miles per hour, collides with a standing car or string of cars on this track.

Let it be assumed that the hollow shank 260, shown in FIG. 8, is the shank of the car coupler on a standing car that is struck by the moving car. Therefore, upon collision of the moving car with the standing car, some of the kinetic energy of the moving car is transmitted from the coupler on the moving car through the hollow shank 260 and follower block 238 to the plunger 213 to effect movement of the follower block and plunger in the direction of the right hand.

As shown in FIG. 8B of the drawings, the right-hand end of the cylinder 150 of the draft gear device normally abuts the respective rear draft gear lugs 144, as hereinbefore mentioned. Therefore, the cylinder 150 and the spring seat 152 secured thereto, the interlock spacer element 165 and the cylinder 205 are prevented from moving in the direction of the right hand relative to the center sill 138 upon movement of the hollow shank 260, follower block 238 and cup-shaped plunger 213 in this direction. The cup-shaped plunger 213 extends telescopically into the left-hand end of the cylinder 205 which, as aforesaid, is now stationary relative to the center sill 138. Therefore, it is apparent that as the hollow shank 260, follower block 238, plunger 213 and semi-elliptical packing retainer 228 move in the direction of the right hand, they are effective to force the hydraulic fluid in the chamber 257 to flow simultaneously through the orifice 237 in the plug 236 to the chamber 256 and through the counterbore 171, bores 182 and 183, cavity 166 and orifice 175 in the plug 174 to the chamber 255. Movement of the hollow shank 260, follower block 238, plunger 213 and semi-elliptical packing retainer 228 in the direction of the right hand is limited by the right-hand end of the follower block 238 striking the left-hand open end of the cylinder 205.

The hydraulic fluid flow through the orifices 237 and 175 is at a relatively high velocity and creates great turbulence in the chambers 256 and 255 which results in dissipation of much of the kinetic energy of the fluid in the form of heat.

The hydraulic fluid supplied to the chamber 256 is effective on the right-hand end of the piston 220 to move this piston in the direction of the left hand, as viewed in FIG. 8A, against the yielding resistance of the spring 216 to increase the volume of the chamber 256 as the volume of the chamber 257 decreases and to compress the spring 216.

Compressing the spring 216 as the piston 220 moves in the direction of the left hand requires the absorption of some of the kinetic energy transmitted by the moving car, it being understood that this kinetic energy is changed to potential energy and stored in the spring 216.

The hydraulic fluid supplied to the chamber 255 is effective on the left-hand face of the semi-eliiptical-shaped piston 156 to move this piston in the direction of the right hand, as viewed in FIG. 8A, against the yielding resistance of the strong spring 164 to increase the volume of the chamber 255 as the volume of the chamber 257 decreases and to compress the strong spring 164.

Compressing the strong spring 164 as the piston 156 moves in the direction of the right hand requires the absorption of a considerable amount of the kinetic energy transmitted by the moving car, it being understood that this kinetic energy is also changed to potential energy and stored in the spring 164.

Furthermore, the friction of the various moving parts of the draft gear device is effective to dissipate or absorb some of this kinetic energy. Therefore, all the kinetic energy transmitted to the car coupler and shank 260 on each of the two colliding cars, with the exception of the potential energy stored in the springs 216 and 164, is dissipated in the form of heat by the passing of hydraulic fluid through the orifices 237 and 175 and the two small bores 182 and 183 which act as orifices, the turbulence in the chambers 256 and 255, and the friction of the various moving parts of the draft gear device, or is transferred via the spring seat 152, right-hand end of cylinder 150 and rear draft lugs 144 to the center sill 138 of the respective car with its load carried in the body thereof, of which car the respective center sill is a part.

It will be noted that no means are provided for varying the area of the orifices 175 and 237 to provide or maintain a constant fluid pressure in the chamber 257, which constant fluid pressure, if maintained, would establish a corresponding constant force that should not exceed the allowable force that can be transmitted through the draft gear device to the rear draft lugs 144 and thence to the center sill 138 and car body without inflicting damage to the lading carried in the car. Therefore, the buff stress established by the impact of the two colliding cars is not maintained constant during the time required for the plunger 213 and semi-elliptical packing retainer 228 to travel their maximum length of stroke in the bore 206 of the cylinder 205. Therefore, the chokes 175 and 237 must be of such size as to dissipate sufficient kinetic energy as heat, that when the velocity of two colliding cars is not in excess of, for example, ten miles per hour the stress induced in the car couplers of the two colliding cars is not in excess of the elastic limit of the steel or other material from which the two couplers are constructed.

As hereinbefore explained in connection with the first embodiment of the invention shown in FIGS. 1 to 5 inclusive, if the amount of kinetic energy transmitted to the struck car or string of cars is great enough to overcome

the inertia of the struck car or string of cars, the struck car or string of cars will move, it being understood that the couplers on the striking car and struck car operate at the time of impact to couple these cars. Subsequent to this coupling operation, the potential energy stored in the springs 164 and 216 begins to re-expand these springs upon the velocity of the two cars reaching the same value. This re-expansion is effective to restore the various parts of the draft gear devices on the cars to the position they occupied prior to the striking car colliding with the struck car or string of cars.

(b) Draft impact—Car coupled in a train

At the time a car is coupled in a train, the brake pipe hose at each end of the car is coupled to the brake pipe hose on the adjacent end of the respective adjacent car in the train. After the car has been coupled in the train, the brake pipe angle cocks at each end of the car are opened so that the entire train brake pipe may be fully charged to the normal pressure carried in the train brake pipe. Assuming that the handle 202 of the cut-out cock 201 on the car that has been coupled in the train has been moved to the open position, fluid under pressure will flow from the brake pipe through the pipe 200 to the lower face of the interlock piston 197 to move this piston and the piston rod 196 upward from the position in which they are shown in FIG. 8A against the yielding resistance of the spring 195 until the upper face of the interlock piston 197 contacts the heads of the cap screws 193 and 194. The contour of the cam surface 196*a* is such that as the piston rod 196 is thus moved upward, the spring 186 is rendered effective through the spring seat 187 and stem 184 to seat the spherical valve element 185 on the spherical valve seat 172 to close communication between the chamber 257 and the cavity 166. Therefore, in draft operation no fluid flows from the chamber 257 to the cavity 166 and thence through the choke 175 to the chamber 255 to deflect the semi-elliptical piston 156 against the yielding resistance of the strong spring 164.

Now let it be supposed that the train is standing and the engineer desires to start the train. To do so, he moves the controller handle from idle position to a power position. This effects the supply of power to the driving wheels of the locomotive to start the locomotive from a stopped position. The initial movement of the locomotive is transmitted from the coupler at the train end of the locomotive to the coupler at the locomotive end of the first car in the train. Now let it be further supposed that the hollow shank 260, shown in FIG. 8 of the drawings, is the shank of the coupler at the locomotive end of the first car in the train. Therefore, the initial movement of the locomotive is effective to exert a pull or jerk and thereby establish a force that acts in the direction of the left hand on the hollow shank 260, shown in FIG. 8. This force acting on the hollow shank 260 is transmitted through the boss 262 on wall 261 that closes the right-hand end of the hollow shank 260 to the shank pin 268. Since the shank pin 268 extends through the aligned parallel spaced-apart elongated slots 265 formed respectively in the front and back walls 134 and 135 of the horizontal type draft gear yoke 136, the shank pin 268 is effective to transmit the force exerted by the locomotive to the draft gear yoke 136 to move the draft gear yoke in the direction of the left hand, as viewed in FIG. 8, it being noted that the parallel spaced-apart elongated slots 266 formed partly in the left-hand ends of the spaced-apart vertical walls of the American Association of Railroads Z-sections 139 and 140 and partly in the right-hand end of two spaced-apart parallel vertical walls 267 of the striker 145 are substantially longer than the slots 265 in the front and back walls 134 and 135 of the draft gear yoke 136, so that the outer end portions of shank pin 268 can move freely in these slots 266 until the shank pin 268 is moved into contact with the left-hand end of these slots. Thus, the length of the elongated slots 266 limit draft gear travel in draft operations.

The pull in the direction of the left hand will be transmitted through the right-hand end of the yoke 136 (FIG. 8B) to the spring seat 152 which is secured to the right-hand end of the cylinder 150.

The opposite end portions of the shank pin 270 extend through the elongated slots 269 formed in the parallel spaced-apart vertical walls of the American Association of Railroads Z-sections 139 and 140 and rest against the left-hand end of these slots, and the center portion of the shank pin 270 extends through the slot 238*a* in the follower block 238. Therefore, the follower block 238 and plunger 213 are prevented from movement in the direction of the left hand upon movement of the draft gear yoke 136, spring seat 152 and cylinder 150 in response to the pull of the locomotive exerted on the draft gear yoke 136 through the shank 260 of the car coupler. Accordingly, it will be apparent that as the draft gear yoke 136 is moved in the direction of the left hand, the spring seat 152, cylinder 150, interlock spacer element 165 and cylinder 205 are moved therewith relative to the now stationary follower block 238, plunger 213 and semi-elliptical packing retainer 228 that is secured to the right-hand end of the plunger 213. As this movement continues in the direction of the left hand until the left-hand side of the opposite outer ends of the shank pin 268 contacts the left-hand end of the slots 266 in the striker 145, it is effective to force the hydraulic fluid in the chamber 257 to flow at a relatively high velocity through the orifice 237, it being understood that the spherical valve element 185 is now seated to prevent flow through the orifice 175 to the chamber 255, to dissipate kinetic energy in the form of heat in the manner hereinbefore explained.

The hydraulic fluid supplied through the choke 237 to the chamber 256 is effective to move the piston 220 against the yielding resistance of the spring 216 to increase the volume of the chamber 256 and absorb some of the kinetic energy transmitted by the moving car, it being understood that this kinetic energy is changed to potential energy and stored in the spring 216 as hereinbefore explained.

As hereinbefore mentioned, the friction of the various moving parts of the draft gear device is effective to dissipate some of this kinetic energy. Therefore, all the kinetic energy transmitted to each car coupler and its shank 260 by the pull or jerk resulting from the initial movement of the locomotive, with the exception of the potential energy stored in the spring 216, is dissipated in the form of heat by the flow of hydraulic fluid through the single orifice 237, the turbulence in the chamber 256 and the friction of the various moving parts of the draft gear device, or is transmitted via the shank pin 268 and the left-hand end of the slots 266 to the striker 145 which is welded to the center sill 138 that forms a part of a car body of the first car in the train, in which car is a load of some kind of lading.

The jerk delivered to the car coupler and shank 260 of the first car in the train, as the result of the initial movement of the locomotive, is effective to move the shank 260, shank pin 268, draft gear yoke 136 and the draft gear device in the direction of the left hand, as viewed in FIGS. 8, 8A and 8B of the drawings, relative to the center sill 138, striker 145, follower block 238 and plunger 213 until the opposite end portions of the shank pin 268 contact the left-hand end of the respective slots 266 formed in the striker 145.

The remaining kinetic energy resulting from the jerk exerted on the hollow shank 260 of the coupler on that end of the first car adjacent the train end of the locomotive is transmitted through the plunger 213, follower block 238 and shank pin 270 to the center sill 138. This remaining kinetic energy that is not absorbed by the draft gear device but is transmitted to the center sill 138 and car body of the first car in the train is effective to move this car from its standing position in the same direction as the initial movement of the locomotive. This move-

ment of the first car in the train effects a relative acceleration between the body of the first car and the lading therein.

Since movement of the shank 260 of the car coupler and the shank pin 268 is limited to the length of the elongated slots 266 as hereinbefore explained, the draft gear travel, in draft, as a result of the initial movement of the locomotive is considerably less, for example, 3¼" instead of 10", than the draft gear travel, in buff, as the result of a car being humped colliding with a standing car or string of cars. Accordingly, the amount of kinetic energy absorbed by and stored as potential energy in the draft gear device is correspondingly less.

As hereinbefore stated, when a brake application is effected, each car farther back in the train than the car adjacent the locomotive tends to overtake or run into the car ahead. This movement of one car relative to the adjacent car ahead causes the car coupler on each respective car to operate in buff. The buff operation of the draft gear device associated with the car coupler of each car is the same as has been hereinbefore described in connection with a humping operation, except the spherical valve element 185 is seated on the spherical valve seat 172 to cut off flow of hydraulic fluid from the chamber 257 to the chamber 255, which accordingly reduces the amount of kinetic energy absorbed.

If, for any reason, it is desired that the draft gear device of a car coupled into a train have the same energy absorbing capacity as when being "humped" in a railway classification yard, the cut-out cock 201 can be closed by means of the handle 202 to close communication between the brake pipe on the car and the lower face of the interlock piston 197 and vent fluid under pressure from this lower face to atmosphere. The spring 195 will then be effective to maintain the piston 197 and piston rod 196 in the position in which they are shown in FIG. 8A. In this position of the piston rod 196, the cam surface 196*a* thereon is effective through the stem 184 to maintain the spherical valve element 185 unseated so that a communication is established between the chambers 257 and 255. Therefore, the draft gear device will operate in draft in the manner hereinbefore described in detail in connection with a humping operation.

The operation of the draft gear devices associated with the car couplers at the adjacent ends of any two coupled cars in a train is the same as the operation of the draft gear device associated with the coupler at the train end of the locomotive and the draft gear device associated with the coupler at the locomotive end of the first car in the train.

Description—Figs. 10 and 11

According to a fourth embodiment of the invention, a variable area orifice, which is shown in FIG. 10, replaces the constant area orifice shown in FIG. 8A to provide a draft gear device that functions substantially the same as the draft gear device shown in FIGS. 8, 8A, 8B and 9, except the area of an orifice corresponding to the choke 175 shown in FIG. 8A of the drawings is varied in accordance with the load on a car, it being understood that FIG. 8, FIG. 10 and FIG. 8B, when taken together such that the right-hand edge of FIG. 8 is matched with the left-hand edge of FIG. 10 and the right-hand edge of FIG. 10 is matched with the left-hand edge of FIG. 8B, constitutes an elevational sectional view of a hydraulic draft gear device constructed in accordance with this fourth embodiment of the invention. Accordingly, like reference numerals have been used to designate the structure shown in FIGS. 10 and 11 which is identical with that shown in FIG. 8A. Only such features of the structure and operation of the embodiment of FIGS. 10 and 11 which differ from that of the embodiment of FIGS. 8, 8A, 8B and 9 will be hereinafter described.

According to the embodiment of the invention disclosed in FIGS. 10 and 11, a variable area choke comprising a resilient ring 271 that has an arcuate inside surface is disposed in a counterbore 272 that is coaxial with a bore 273 formed in a plug 274 that is provided with external screw threads of substantially the same diameter as the internal screw threads 173 formed in the right-hand end of the cavity 166 in the interlock spacer element 165 in order that the plug 274 can be secured thereto. For a portion of its width, the resilient ring 271 is enclosed in a metallic ring 275 that is disposed in the counterbore 272 with a sliding fit. The left-hand end of the bore 273 in the plug 274 is rounded off to provide somewhat of a streamlined flow of fluid from the cavity 166 through the variable area orifice to the chamber 255.

As shown in FIG. 10, the plug 274 is provided with a second counterbore 276 that is coaxial with the first counterbore 272. Slidably mounted in the counterbore 276 is a collar 277 formed at the left-hand end of a hollow sleeve 278, the inside diameter of which is somewhat in excess of the normal inside diameter of the resilient ring 271. Disposed in surrounding relation to the hollow sleeve 278 and on the right-hand side of the collar 277 is an annular hollow resilient expansion member 279 that is substantially square in cross section and constructed of some suitable flexible material such as rubber. The annular hollow resilient expansion member 279 has an outside diameter that is substantially the same as the diameter of the counterbore 276 in the plug 274 and is retained on the hollow sleeve 278 between the collar 277 and a hollow screw-threaded plug 280 that has screw-threaded engagement with a screw-threaded outer end portion of the counterbore 276, it being understood that the end of the hollow sleeve 278 opposite the collar 277 extends into the hollow plug 280.

As shown in FIG. 11, formed on the outer peripheral surface of the circular hollow resilient expansion member 279 is a boss 281 that has imbedded therein at the time of molding a hollow sleeve 282 having at its inner end a collar 283 that is curved to conform to the curvature of the inside of the outer wall of the annular hollow resilient expansion member 279. The hollow sleeve 282 protrudes somewhat below the end of the boss 281, as shown in FIG. 11. The inside diameter of this protruding portion of the hollow sleeve 282 is less than that of the remaining portion of this sleeve so as to constitute a choke 284. The outside diameter of the protruding portion of the hollow sleeve 282 is larger than the remaining portion of the sleeve and is provided with external screw threads.

The interlock spacer element 165 is provided, as by a drilling and threading operation, with a bore 285 and a coaxial screw-threaded counterbore 286 that are so located that the end of the bore 285 opposite the counterbore 286 opens into a counterbore 287 in the interlock spacer element 165 in alignment with the exterior screw-threaded end of the hollow sleeve 282 so that one end of a pipe or conduit 288 may be inserted through the bore 285 and screw threaded onto the exterior end of the hollow sleeve 282. Subsequent to connecting one end of the pipe 288 to the sleeve 282, an O-ring seal 289 is shoved onto the pipe 288 and into the counterbore 286, after which a hollow plug 290 through which the pipe 288 extends is screw threaded into the screw-threaded end of the counterbore 286 to retain the O-ring seal 289 therein.

The end of the pipe 288 exterior of the interlock spacer element 165 is connected to one end of a pipe T 291 to the side outlet of which is connected a filling mechanism 292 having therein a check valve device (not shown).

In this embodiment of the invention, the size of a choke 293 constituted by the resilient ring 271 is adjusted according to the load on the vehicle by a load measuring mechanism which is operative independent of the springs supporting the vehicle body. This mechanism comprises

a body portion 294 which serves as the center plate of one of the supporting trucks (not shown) of a railway freight car. This body portion 294 has formed therein a centrally located vertical cylinder 295 which is closed at its upper end by a piston assemblage 296, thereby defining in part a chamber 297 which is connected by a passageway 298 in said assemblage and a flexible conduit 299 to the other end of the pipe T 291.

The piston assemblage 296 comprises a piston body 300 which is provided at its lower side, as viewed in FIG. 10, with a downwardly extending hub 301, upon which an annular packing cap 302 is secured by means of a follower 303 attached to the hub 301 by any suitable means (not shown) and expanded radially outward by means of a ring 304. The piston assemblage 296 is arranged to support a follower 305 which serves as a center plate for the car body (not shown).

To fill the chamber 297, flexible conduit 299, pipe 288 and the interior of the annular hollow resilient expansion member 279 with hydraulic fluid, the threaded end of a discharge pipe of a suitable pump (not shown) is attached to a screw-threaded boss 306 formed on the filling mechanism 292. The pump is then operated until the chamber 297, flexible conduit 299, pipe 288 and the interior of the annular hollow resilient expansion member 279 are completely filled with a suitable hydraulic fluid after which the discharge pipe of the pump is disconnected from the screw-threaded boss 306. If desired, a threaded cap (not shown) may be secured to the screw threaded boss 306 to prevent damage to the screw threads thereon, it being understood the check valve device within the filling mechanism 292 prevents backflow of the hydraulic liquid to atmosphere subsequent to disconnecting the pump.

Operation

The piston follower 305 of the load measuring mechanism, as previously stated, serves as a center plate for the car body and therefore carries half the weight of the car body, including the weight of the load. This weight creates a hydraulic pressure in the chamber 297, which pressure is proportional to this weight and is transmitted via the flexible conduit 299 and pipe 288 to the interior of the annular hollow resilient expansion member 279. Since the circular hollow resilient expansion member 279 is restrained from expansion radially inward by the hollow sleeve 278, radially outward by the wall of the counterbore 276 in the plug 274 and sidewise in the direction of the right hand by the hollow plug 280, the pressure transmitted from the chamber 297 via conduit 299 and pipe 288 to the interior of the annular hollow resilient expansion member 279 is effective to expand it sidewise in the direction of the left hand to move the collar 277 in this direction to thereby compress the resilient ring 271 between the collar 277 and the end of the counterbore 272 until the resistance offered by the compression of the resilient material comprising the ring 271 balances the hydraulic pressure acting within the annular hollow resilient expansion member 279. This compression of the resilient material comprising the ring 271 is effective to reduce the cross-sectional area of the choke 293 in accordance with the degree of the compressive force acting on the ring. Therefore, it is apparent that the hydraulic pressure acting in the chamber 297 and within the annular hollow resilient expansion member 279, which pressure varies directly with the load carried on the car, is effective to reduce the cross-sectional area of the choke 293 to a value that is directly proportional to the load on the car. Consequently, as the load on the car is increased or decreased, the cross-sectional area of the choke 293 is correspondingly decreased or increased so that the cross-sectional area of the choke 293 is always in accordance with the load on the car.

Subsequent to adjusting the cross-sectional area of the choke 293 in accordance with the load on the car, the draft gear device disclosed in FIG. 10 and FIG. 11 operates in substantially the manner as the draft gear device disclosed in FIGS. 8, 8A, 8B and 9. Therefore, a complete detailed description of the draft gear device disclosed in FIGS. 10 and 11 is not believed to be necessary.

It should be noted that since a hydraulic fluid is incompressible, it will take a longer period of time to force the same quantity of liquid through a small orifice than through an orifice of larger size. As hereinbefore stated, the general equation for kinetic energy is

$$E=\frac{mv^2}{2}=\frac{m(at)^2}{2}$$

It follows, therefore, that by reason of the fact that the time for the discharge of the hydraulic fluid through the orifice increases as the load on the car increases, the energy absorbing capacity of the draft gear device is correspondingly increased as the load on the car is increased. Consequently, it is apparent that the apparatus shown in FIGS. 9 and 10 provides a draft gear device for a railway freight car, the energy absorbing capacity of which varies in accordance with the load placed in the body of the car.

The choke 284 in the hollow sleeve 282 acts as a time delay choke between the chamber 297 and the interior of the annular hollow resilient expansion member 279 to prevent a change in the pressure within the annular hollow resilient expansion member 279, and thereby a change in the cross-sectional area of the choke 293 as a result of momentary changes in the pressure in the chamber 297 caused by rough track conditions over which the train is traveling or the shock that occurs when two cars collide.

Having now described the invention, what I claim as new and desire to secure by Letters Patent, is:

1. In a railway car having a center sill member affixed to the body of the car and provided with a draft gear pocket, a draft gear assembly disposed in said draft gear pocket and comprising:

(*a*) a draft gear yoke movable up to a certain maximum travel in said draft gear pocket relative to the center sill member responsively to draft and buff forces exerted thereon, said yoke having two spaced-apart elongated slots,

(*b*) a draft gear device disposed in one of said elongated slots and cooperating with the center sill on movement of the yoke to absorb an amount of energy corresponding to the amount of movement of the yoke relative to the center sill, and

(*c*) a fluid pressure controlled means movable into and out of the other of said slots in said draft gear yoke to control the amount of movement of said yoke between a chosen minimum amount and a chosen maximum amount for correspondingly controlling variations in the amount of energy absorbed by said draft gear device.

2. In a railway car having a center sill member affixed to the body of the car and provided with a draft gear pocket, a draft gear assembly disposed in said draft gear pocket and comprising:

(*a*) a draft gear yoke movable up to a certain maximum travel in said draft gear pocket relative to the center sill member responsively to draft and buff forces exerted thereon, said yoke having two spaced-apart elongated slots,

(*b*) a draft gear device disposed in one of said elongated slots and cooperating with the center sill on movement of the yoke to absorb an amount of energy corresponding to the movement of the yoke relative to the center sill,

(*c*) a fluid pressure controlled motor means having a member movable into and out of the other of said elongated slots in said draft gear yoke for controlling to different amounts the travel of said yoke re-

sponsive respectively to draft and buff forces for correspondingly effecting variations in the amount of energy absorbed by said draft gear device, and

(*d*) a brake pipe of a fluid pressure brake system, variations of pressure in which are effective to control operation of said fluid pressure controlled motor means.

3. In a railway car having a center sill member affixed to the body of the car and provided with a draft gear pocket, a draft gear assembly disposed in said draft gear pocket comprising:

(*a*) a draft gear yoke movable up to a certain maximum travel in said draft gear pocket relative to the center sill member responsively to draft and buff forces exerted thereon, said yoke having two spaced-apart elongated slots,

(*b*) a draft gear device disposed in one of said elongated slots and cooperating with the center sill on movement of the yoke to absorb an amount of energy corresponding to the movement of the yoke relative to the center sill, and

(*c*) a fluid pressure controlled motor means operatively associated with said draft gear device and having a member movable into and out of the other of said elongated slots in said draft gear yoke for variously limiting the amount of travel of said draft gear yoke relative to the center sill member between said certain maximum travel and a chosen minimum travel thereby to effect variations in the amount of energy absorbed by said draft gear device.

4. In a railway car having a center sill member affixed to the car body and provided with a draft gear pocket, a draft gear assembly disposed in said draft gear pocket and comprising:

(*a*) a draft gear yoke movable up to certain maximum travel in said draft gear pocket relative to the center sill member responsively to draft and buff forces exerted thereon, said yoke having two spaced-apart elongated slots,

(*b*) a draft gear device disposed in one of said slots and cooperative with the center sill member upon exertion of draft and buff forces on said draft gear yoke to absorb energy, and

(*c*) an interlock cylinder device secured to the center sill member and having a piston and piston rod actuated responsively to a predetermined fluid pressure to a position in which the piston rod projects into the other of said slots in said draft gear yoke to limit travel of said draft gear yoke to a distance less than said certain maximum travel, thereby correspondingly varying the energy absorbed by said draft gear device.

5. In a railway car having a center sill member affixed to the body of the car and provided with a draft gear pocket, a draft gear assembly disposed in said draft gear pocket and comprising:

(*a*) a draft gear yoke movable up to certain maximum travel in said draft gear pocket relative to the center sill member responsively to draft and buff forces exerted thereon, said yoke having two spaced-apart elongated slots,

(*b*) a draft gear device disposed in one of said slots and cooperative with the center sill member upon exertion of draft and buff forces on said draft gear yoke to absorb energy to a degree proportional to the distance of travel of said draft gear yoke,

(*c*) a fluid pressure controlled device secured to the center sill member in a certain aligned position and having a piston and piston rod actuated responsively to a predetermined fluid pressure to a position in which the piston rod projects into the other of said slots in said draft gear yoke whereby the piston rod cooperates with the yoke to control the travel of the yoke between said certain maximum travel and a chosen minimum travel and thereby the energy absorbed by said draft gear device,

(*d*) biasing means effective to normally bias said piston and piston rod to a position in which the piston rod is disposed out of the other of said slots in said draft gear yoke to provide for maximum travel of said draft gear yoke, and

(*e*) a brake pipe of a fluid pressure brake system, an increase in the pressure in which is effective to cause actuation of said piston and piston rod of said fluid pressure controlled device against the biasing force of said biasing means to the position in which the piston rod projects into the other of said slots in said draft gear yoke to provide for minimum travel of said draft gear yoke and a decrease in pressure in which is effective to cause actuation of said piston and piston rod by said biasing means to the position in which the piston rod is disposed out of the other of said slots in said draft gear yoke to provide for maximum travel of said draft gear yoke.

6. In a railway car having a center sill member provided with a draft gear pocket, the combination as claimed in claim 4, further characterized in that said interlock cylinder device is provided with biasing means for biasing said piston and piston rod, with fluid at less than a certain pressure acting on said piston, to a position in which the piston rod is withdrawn from the other of said slots in said draft gear yoke, thereby enabling travel of said yoke up to its said certain maximum travel.

7. In a railway car having a center sill member affixed to the car body and provided with a draft gear pocket, a draft gear assembly disposed in said draft gear pocket and comprising:

(*a*) a draft gear yoke movable up to certain maximum travel in said draft gear pocket relative to the center sill member responsively to draft and buff forces exerted thereon, said yoke having two spaced-apart elongated slots and a cavity for receiving a car coupler shank,

(*b*) a car coupler having a shank disposed in the cavity in said draft gear yoke and operatively connected to said draft gear yoke whereby movement of said car coupler in response to buff and draft forces applied thereto effects movement of said draft gear yoke,

(*c*) a draft gear device disposed in one of said slots and cooperative with the center sill member upon exertion of draft and buff forces on said draft gear yoke to absorb energy, and

(*d*) an interlock cylinder device secured to the center sill member and having a piston and piston rod actuated responsively to a predetermined fluid pressure to a position in which the piston rod projects into the other of said slots in said draft gear yoke to limit travel of said draft gear yoke to a distance less than said certain maximum travel, thereby correspondingly varying the energy absorbed by said draft gear device.

8. In a railway car having a center sill member affixed to the body of the car and provided with a draft gear pocket, in combination:

(*a*) a brake pipe of a fluid pressure brake system normally charged with fluid under pressure variations in which control brake applications and brake releases, and

(*b*) a draft gear assembly disposed in the draft gear pocket, said draft gear assembly comprising:

(i) a draft gear yoke movable in the draft gear pocket up to a certain maximum travel relative to the center sill member responsively to draft and buff forces exerted thereon, said draft gear yoke having two spaced-apart elongated slots,

(ii) a draft gear device disposed in one of said

slots and cooperative with the center sill member upon exertion of draft and buff forces on said draft gear yoke to absorb energy, and

(iii) an interlock cylinder device secured to the center sill member and having a piston and piston rod actuated responsively to a predetermined fluid pressure in said brake pipe to a position in which the piston rod projects into the other of said slots in said draft gear yoke to limit travel of said draft gear yoke to a distance which is a chosen fraction of said certain maximum travel, thereby correspondingly varying the energy absorbed by said draft gear device.

9. In a railway car having a center sill member affixed to the body of the car and provided with a draft gear pocket, in combination:

(*a*) a brake pipe normally charged to a chosen pressure for effecting a brake release and in which a reduction of pressure of a certain amount from said chosen pressure effects a full service brake application, and

(*b*) a draft gear assembly disposed in the draft gear pocket, said draft gear assembly comprising:

(i) a draft gear yoke movable in the draft gear pocket up to a certain maximum travel relative to the center sill member responsively to draft and buff forces exerted thereon, said draft gear yoke having two spaced-apart elongated slots,

(ii) a draft gear device disposed in one of said slots and cooperative with the center sill member upon exertion of draft and buff forces on said draft gear yoke to absorb energy,

(iii) an interlock cylinder device secured to the center sill member and having a piston and piston rod actuated to a position in which the piston rod projects into the other of said slots in said draft gear yoke to limit travel of said draft gear yoke to a distance which is a chosen fraction of said certain maximum travel, responsively to the chosen fluid pressure in said brake pipe, thereby correspondingly varying the energy absorbed by said draft gear device, and

(iv) biasing means effective upon reduction of the pressure in the brake pipe from said chosen pressure by an amount greater than the certain amount required to effect a full service brake application to move said piston and piston rod from the position in which said piston rod projects into the other of said slots in said draft gear yoke to a position in which said piston rod is withdrawn entirely out of the other of said slots in said draft gear yoke, thereby to enable said maximum travel of said yoke.

10. In a railway car having a center sill member affixed to the body of the car and provided with a draft gear pocket, a draft gear assembly disposed in said draft gear pocket and comprising:

(*a*) a draft gear yoke movable up to a certain maximum travel in said draft gear pocket relative to the center sill member responsively to draft and buff forces exerted thereon, said yoke having two spaced-apart elongated slots,

(*b*) a draft gear device disposed in one of said slots and cooperative with the center sill member upon exertion of draft and buff forces on said draft gear yoke to absorb energy, and

(*c*) a pair of oppositely disposed interlock cylinder devices each secured to the center sill in a certain aligned position and each having a piston and piston rod actuated responsively to a predetermined fluid pressure to a position in which the piston rods project into the other of said slots in said draft gear yoke to limit travel of said draft gear yoke to a distance less than said certain maximum travel, thereby correspondingly varying the energy absorbed by said draft gear device.

11. In a railway car having a center sill member affixed to the car body and provided with a draft gear pocket, in combination:

(*a*) a draft gear yoke movable up to a certain maximum travel in said draft gear pocket relative to the center sill member responsively to draft and buff forces exerted theron, said yoke having an elongated slot, and

(*b*) a draft gear device disposed in said slot and comprising:

(i) two coaxial and spaced-apart cylinders,

(ii) a combined interlock cylinder and space element connecting said two coaxial cylinders and having a fluid pressure operated valve means operable from one position in which a communication between said two coaxial cylinders is open to provide a maximum shock absorbing capacity for said draft gear device to another position in which the communication is closed to provide a lesser shock absorbing capacity for said draft gear device,

(iii) fluid disposed in one of said cylinders,

(iv) a hollow piston member reciprocable within one of said cylinders,

(v) a first spring-biased piston slidably mounted in said hollow piston member and cooperating therewith to form a chamber,

(vi) a first choke means carried by said hollow piston member for controlling the rate of flow of fluid between said one cylinder and said chamber,

(vii) a second choke means carried by said combined interlock cylinder and space element for controlling the rate of flow of fluid between said two coaxial and spaced-apart cylinders in response to opening of said communication by said fluid pressure operated valve means, and

(viii) a second spring-biased piston slidably mounted in the other of said cylinders, said hollow piston member being effective to move said fluid from one of said cylinders respectively through said first choke means to said chamber and, upon opening of said communication by said fluid pressure operated valve means, through said communication and said second choke means to the interior of the other of said cylinders whereby said first and second spring-biased pistons are moved by said fluid.

12. In a railway car having a center sill member provided with a draft gear pocket, the combination claimed in claim 10, further characterized by a brake pipe normally charged to a chosen pressure, and in that the fluid pressure operated valve means of said combined interlock cylinder and space element is operated from its one position to its other position in response to the pressure in said brake pipe exceeding a certain low pressure relative to said normally charged brake pipe pressure.

13. In a railway car having a center sill member affixed to the car body and provided with a draft gear pocket, the combination as claimed in claim 10, further characterized by means for varying the orifice area of one of said choke means including means responsive to the load on the car.

14. In a railway car having a center sill member affixed to the car body and provided with a draft gear pocket, the combination claimed in claim 10, further characterized in that said second choke means is constructed of a resilient material and has a bore extending therethrough to constitute an orifice whereby the area of said bore can be varied by compressing said resilient material, and in having means responsive to the load on the railway car to effect variation in the degree of compression of said

resilient material to vary the area of said bore in said second choke means.

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