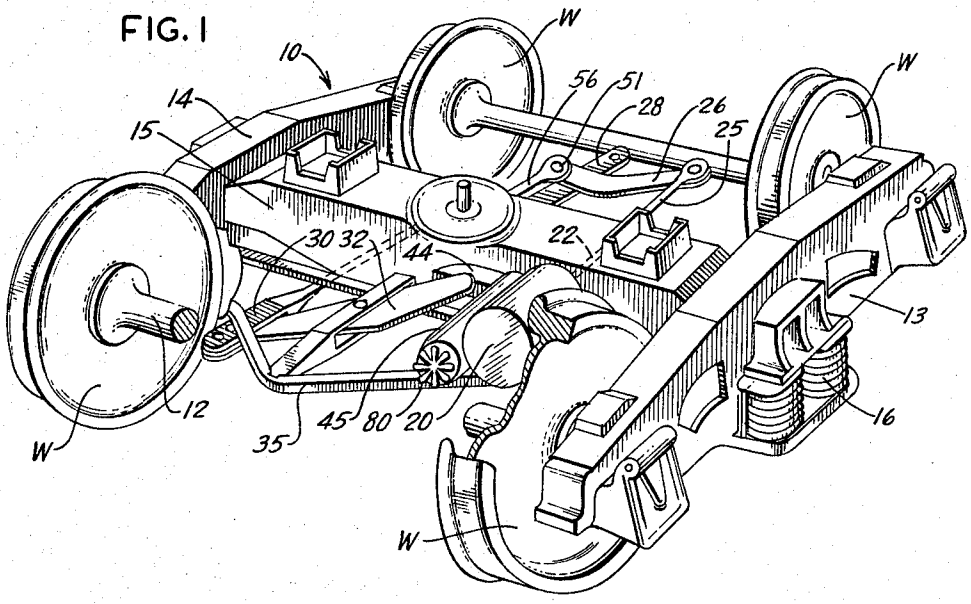
Aug. 16, 1966 T. S. TAYLOR 3,266,601

RAILWAY BRAKE

Filed Dec. 12, 1963 4 Sheets-Sheet 1

FIG. 1



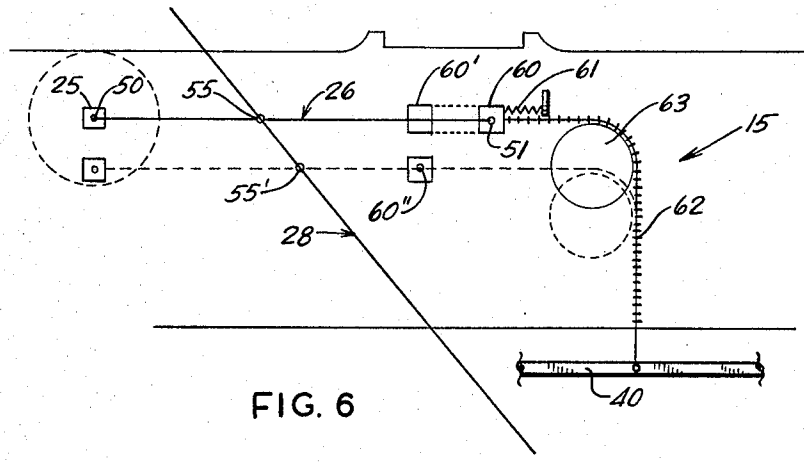


FIG. 6

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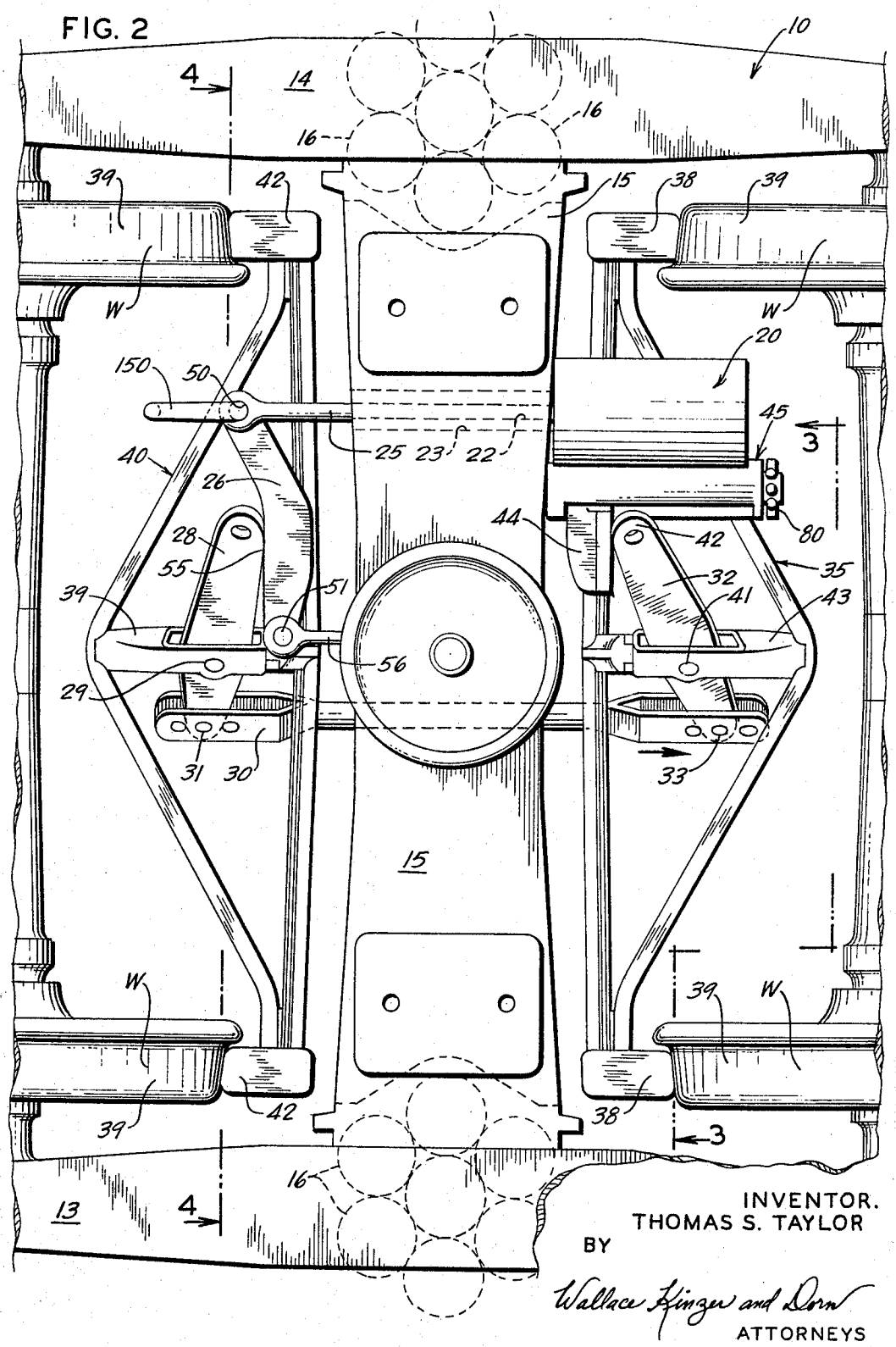
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RAILWAY BRAKE

Filed Dec. 12, 1963 4 Sheets-Sheet 2

FIG. 2



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RAILWAY BRAKE

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FIG. 3

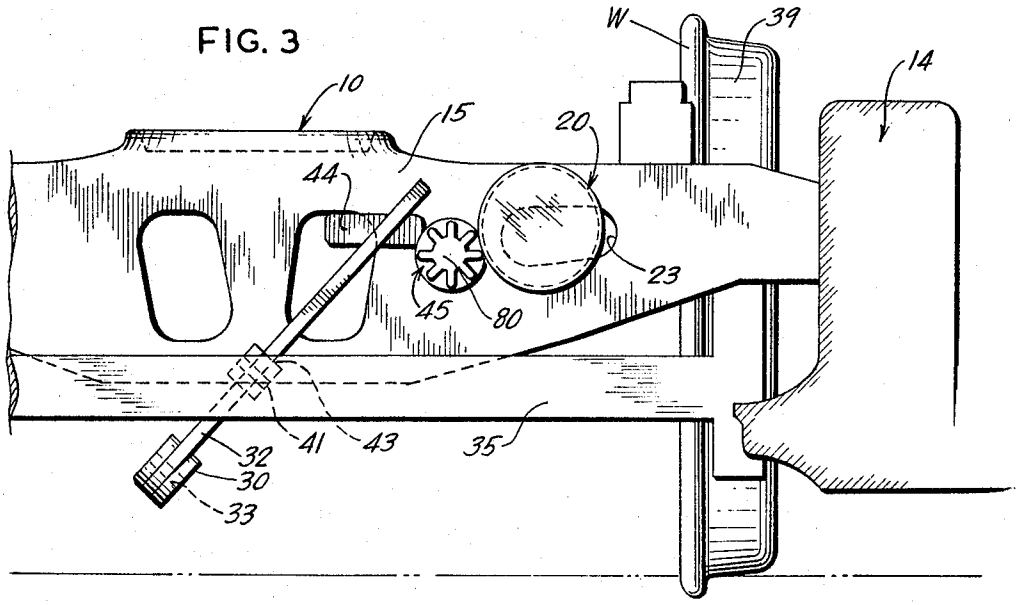
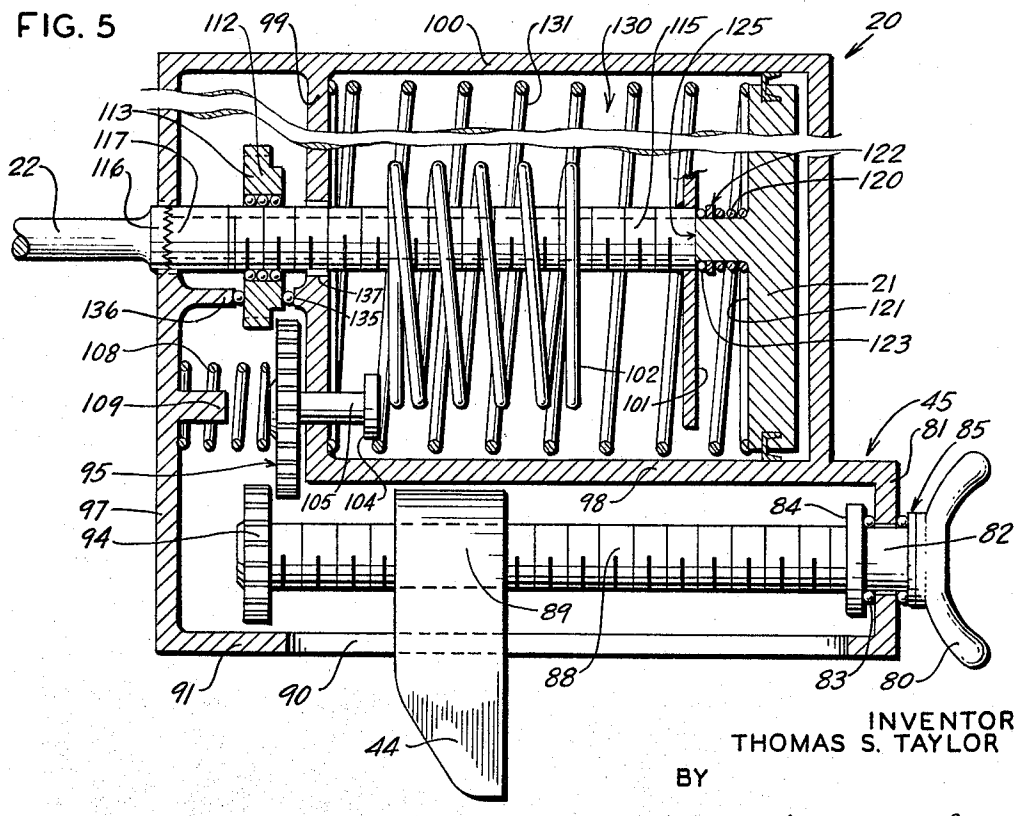


FIG. 5



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RAILWAY BRAKE

Filed Dec. 12, 1963 4 Sheets-Sheet 4

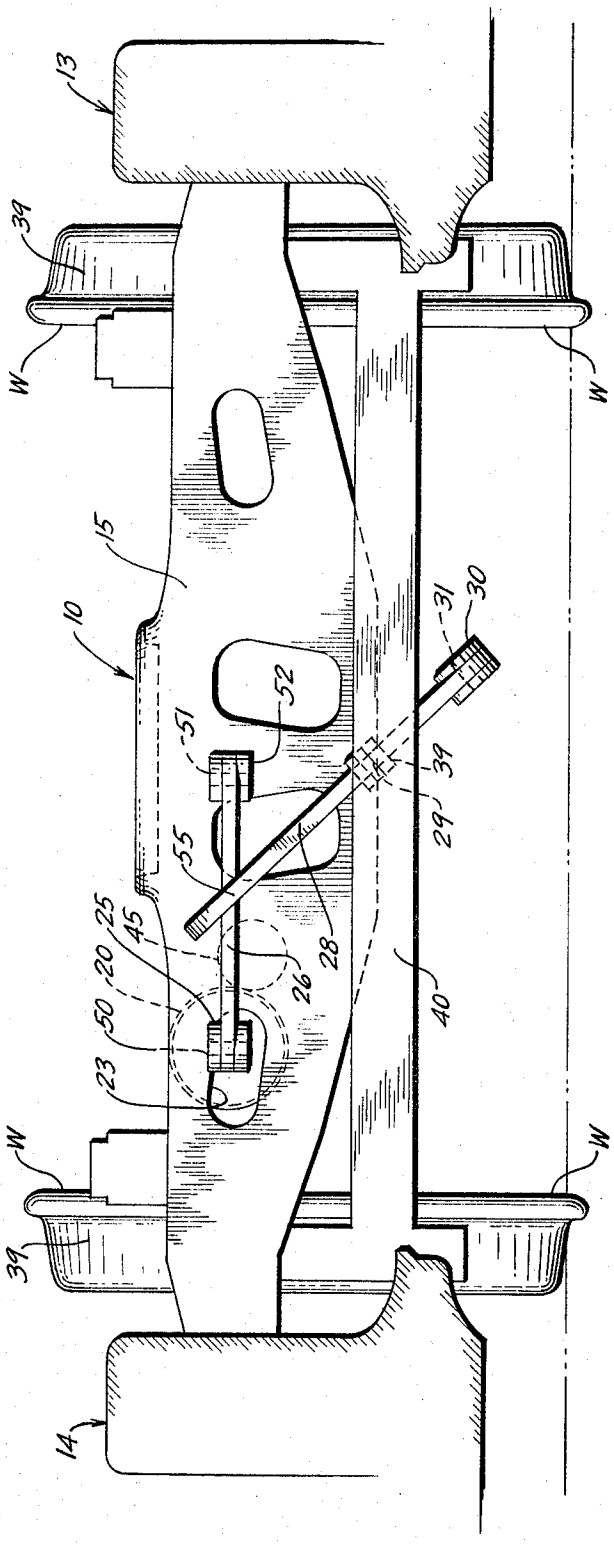


FIG. 4

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United States Patent Office 3,266,601 Patented August 16, 1966

3,266,601

RAILWAY BRAKE

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Filed Dec. 12, 1963, Ser. No. 330,192
20 Claims. (Cl. 188—52)

This invention relates to a brake unit for a railroad car, and more particularly, to a brake unit to be mounted on a truck of a railway car.

The present invention relates to a so-called package brake unit which is characterized by an individual air cylinder or cylinders carried by each truck of a railroad car. Preferably, the brake unit is mounted on a spring supported bolster so as not to be subject to direct rail shock, although some package brake units have been supported upon the truck side frames and thus have been unsprung masses subject to direct rail shock.

Preferably, the package brake unit is mounted below the top surface of the bolster so as not to interfere with the various types of car designs, which are to be mounted on the bolster. While it has been heretofore proposed to mount a plurality of cylinders on the truck, these cylinders were not controlled by suitable adjusters to adjust for slack in order to maintain the piston stroke and thereby the air pressure. Accordingly, the present device has for its principal object a novel package brake unit mounted completely beneath the top surface of the bolster and employing a cylinder with its air pressure and stroke maintained by a suitable adjuster and as a further object a single cylinder with a comparatively long stroke operable through the bolster unit to actuate each of brake beams on opposite sides of the truck.

The package brake of the present invention increases the braking force with increase in car loading by reason of its unique geometric construction wherein its force multiplying characteristics are changed with increases and decreases in bolster movement due to weight. More specifically, and in accordance with a further object of the invention, a single force multiplying lever changes its point of intersection with respect to a live lever of a conventional brake beam upon vertical movement of the bolster so that the braking force becomes proportional to the loading of the bolster. According to a further object of the invention, an increase or decrease in weight on the bolster causes a proportional change in the braking force, and in the stroke of the fluid operated piston of the cylinder, the stroke of the fluid operated piston being controlled by an automatic slack adjuster.

While the construction of the package brake unit permits a limited amount of proportional braking force change with a corresponding change in freight car loading, the package brake unit can advantageously be provided with, according to a further object of the invention, an automatic mechanism for changing the force multiplying characteristics of the force multiplying lever so that the package brake unit can afford an empty brake force as well as a full brake force without the incorporation of a costly additional empty load brake unit, which has heretofore been necessary to achieve complete compensation for an empty load condition. Under a further object of the invention, an automatic slack adjuster compensates for changes in the stroke of the cylinder as the automatic force multiplying mechanism is employed.

Another object of the invention is to enable the package brake unit to employ the same standard, unmodified brake beams and brake struts of AAR standards in different weights of railroad cars, for example, seventy or ninety ton railroad cars. Thus, under this object of the

invention, a brake unit can be assembled with standard elements and employed in trucks for varying weights of railroad cars by changing the fulcrum point of the force multiplying lever to increase correspondingly the braking force for larger cars and to decrease correspondingly the braking force for lighter cars.

The present invention has as a further object the capability of employing either high friction shoes, typically of the composition type, or lower friction shoes typically exemplified by iron brake shoes without a decrease in efficiency of the brake unit. A problem with a capability of employing both of these types of shoes has been that the iron brake shoe may be a much thicker brake shoe than composition brake shoe so that an iron brake shoe undergoes a larger change in size with wear than a composition shoe which was thinner in the first instance. Thus, an object of the invention is a brake unit having the capability of adjusting its operating movements to provide a relatively constant braking even though there has been a wearing away of iron brake shoes or of a composition type of brake shoe. Another object of the present invention is providing in a package brake unit the capability of being able to employ either a low friction brake shoe or for a higher friction brake shoe.

Another object of the invention is the utilization of the package brake unit in conjunction with a conventional hand brake mechanism whereby its hand brake pull rod can be directly employed to actuate the package brake to employ the needed braking force while causing the appropriate movement of the piston of the cylinder. Under this object, the piston rod of the air cylinder is protected from the weather elements by nature of its extending through the bolster and hence can remain extended for long periods of time without deleterious effect on the piston rod.

An additional object of the invention is an automatic slack adjuster which is effected to cause movement of the piston both in pay out and take up directions, and be operable with a brake operation.

According to the preferred embodiment of the invention, the cylinder-adjuster unit is mounted on one side of the bolster and has a piston whose piston rod goes through the bolster to actuate a force multiplying lever secured in a substantially horizontal manner on the opposite side of the bolster. A live lever for actuating a brake beam is disposed at an angle to instersect and to engage the horizontal lever while permitting relative vertical movement between the levers, due to changes in load on the spring mounted bolster. As the bolster moves in response to weight changes, the effective length of the lever arm is changed correspondingly to vary the multiplying effect of the lever arm and thus the braking force. The live lever is connected by a rod which passes under the bolster to a dead lever mounted on the opposite brake beam. The dead lever is adapted to contact a movable lug on a slack adjuster which moves to compensate for changes in brake shoe thickness due to wear or for changes in piston stroke resulting from changes in the effective lever ratio as cargo is added to or removed from the car. The slack adjuster, if automatic, is interconnected with the piston of the cylinder or with its directly driven members so as to change its position correspondingly with changes in force and the piston stroke as a result of force changing characteristics of the system.

Other and further objects of the present invention will be apparent from the following description and claims and are illustrated in the accompanying drawings which, by way of illustration show a preferred embodiment of the present invention and the principles thereof and what is now considered to be the best mode contemplated for applying these principles. Other embodiments of the invention embodying the same or structural changes may

be made as desired by those skilled in the art without departing from the present invention and the purview of the appended claims.

In the drawings:

FIG. 1 is a perspective view of the truck of a railroad car equipped with a brake unit of the present invention;

FIG. 2 is an enlarged plan view of a brake unit installed upon a conventional truck;

FIG. 3 is an end elevational view taken along the lines 3—3 of FIG. 2 in the direction of the arrows;

FIG. 4 is an end elevational view showing the brake unit on a truck along the line 4—4, FIG. 2 in the direction of the arrows;

FIG. 5 is an enlarged sectional view of the automatic slack adjuster and cylinder, according to the preferred embodiment of the invention; and

FIG. 6 is a diagrammatic view of an automatic mechanism for causing a proportional braking force for variances in car weight, according to the preferred embodiment of the invention.

Referring now to the drawings, and more particularly to FIG. 1, there is shown a conventional railroad truck **10** for a railroad car, in which is mounted the brake unit of the present invention. The truck **10** includes a set of four wheels W mounted on a pair of spaced axles **11** and **12**, the ends of the axles being journaled in an opposed pair of side frames **13** and **14**. A centrally disposed bolster **15** spans the side frames **13** and **14**. The bolster element **15** has its opposite ends mounted on springs **16** carried by the side frames **13** and **14** and thereby the bolster **15** is isolated from the direct rail shock encountered by the wheels and directly transmitted to the side frames **13** and **14**. Two of such trucks **10** support a railroad car, and each of the trucks **10** is supplied with an individual brake system confined to an associated truck to constitute a so-called package brake unit.

The brake unit of the present invention includes a brake cylinder **20**, which, upon admission of fluid under pressure, causes an internal piston **21**, FIG. 5, to move a piston rod **22**, FIG. 2, through an internal opening or bore **23** in the bolster **15** to move an outer end **25** of the piston rod **22** to apply a braking force to a force multiplying lever **26** pivotally connected to the end **25** of the piston rod **22**. The force multiplying lever **26** is in contact with the upper portion of a live lever **28** and applies the brake force thereto. This application of a braking force to the upper end of live lever **28** by the force multiplying lever **26** causes the live lever **28** to pivot about a central pivot pin **29** and thereby to thrust rearwardly a bottom-under rod **30**. The bottom-under rod is articulated by a pin **31** to the live lever **28** and is articulated by a pin **33** to a dead lever **32**. Thus, rightward movement of the bottom-under rod **30**, FIG. 2, pivots the dead lever **32** in a counterclockwise direction, as viewed in FIG. 2; and moves the brake beam **35** rightwardly, FIG. 2, to engage its brake shoes **38** with treads **39** on the rear wheels W.

The live lever **28** has its pivot pin **29** supported in a central strut **39** of the front brake beam **40** to that the counterclockwise pivoting of the live lever **28** to cause applying of the rear brakes is simultaneously accompanied by movement of the front brake beam **40** leftwardly, as viewed in FIG. 2, to bring the front brake shoes **42** into engagement with the threads **39** of the front wheels W. The brake beams **35** and **40** are conventional brake beams of AAR standards as are the live lever **28**, bottom rod **30**, and dead lever **32**, which, together with the brake beams **35** and **40** constitute a standard bottom-rod-under truck linkage system.

When the bottom rod **30** moves rightwardly, as viewed in FIG. 2, in response to a braking force, and once the shoes **38** are applied against the wheel treads **39**, the upper free end **42** of the dead lever **32** is prevented from rotating further about a pivot pin **41** in a strut **43** of the brake beam **35** by a lug **44** on a slack adjuster **45**. In this manner, the rightward thrust of bottom rod **30** causes the brake beam **35** to translate rightwardly as viewed in FIG. 2 to apply the brake shoes **38** against the wheel treads.

The slack adjuster **45** is secured to the side of the cylinder **20** and/or the bolster **15**. Both the cylinder **20** and slack adjuster **45** are disposed beneath the upper surface of the bolster **15**, as seen in FIGS. 1, 3 and 4. Thus, the cylinder **20** will not preclude mounting of a car body on the bolster **15** which fits relatively close to the top of the bolster **15**. The mounting of the cylinder **20** on the side of the bolster **15** opposite the live lever **28** is advantageous in affording a long piston stroke. Because of the availability of a long piston stroke, the cylinder can be of smaller diameter than a comparable cylinder having a shorter stroke.

The brake beams **35** and **40** are supported in the usual manner by the side frames **13** and **14** at spaced points outwardly near the wheels W to guide the brake beams **35** and **40** to slide so as to carry the brake shoes into engagement with the wheel. Inasmuch as the bolster **15** is spring supported, the bolster **15** is subject to moving vertically relative to the side frames **13** and **14** and relative to the brake beams **35** and **40**, particularly as the weight of the railroad car supported by the bolster **15** is being varied due to increases or decreases in the loading of the railroad car. Since the cylinder **20** and adjuster **45** are directly mounted on the bolster **15**, as are the connecting rod **25** and the force multiplying lever **26**, these elements also partake of relative movement with respect to the live lever **28** and the brake beam **40**. As the bolster **15** moves relative to the side frames **15**, the horizontal lever **26** and adjuster lug **44** move relative to the upper ends of the dead and live levers **28** and **32** respectively.

Normally, a brake unit delivers a predetermined amount of brake shoe load irrespective of the loading in the railroad car. However, the AAR standards for brake shoe loads call for a maximum brake shoe load not to exceed a certain percentage of the car weight empty and a minimum brake shoe load not less than another percentage of the total car weight loaded. With the advent of special types of cars and the employment of lightweight, high strength steels and aluminum in car bodies, the brake shoe load needed for a fully loaded car, will in many cases, exceed the maximum permissible brake shoe load for an empty car. Thus, resort is made to the provision, in many instances, of an additional empty load brake mechanism. Manifestly, the requirement for a special empty load brake mechanism is an expensive addition to the braking system for the railroad car.

The present invention compensates for changes in loading of the railroad car by changing the multiplying effect of the force multiplying lever **26**, so that the amount of braking force applied by the force multiplying lever **26**, to the live lever **28** increases as the weight of the railroad car increases and decreases as the weight of the railroad car decreases. More specifically, the force multiplying lever **26** is disposed in a generally horizontal plane, as best seen in FIG. 4 with one end pivotally connected by a pin **50** to the piston rod **22**, and with the opposite end pivoted by a pin **51** to a fulcrum post **52** secured in a suitable manner to the bolster **15**. As best seen in FIG. 4, the live lever **28** extends upwardly and leftwardly in front of the horizontal lever **26**, and intersects the horizontal lever **26** at a contact or reaction point **55**. The live lever **28** of a conventional brake beam is disposed at nominally 40° to the vertical, FIG. 4, so that as the lever **26** moves up and down relative to the end of the live lever **28**, the contact or intersection point **55** between these levers moves horizontally. Thus, as the bolster **15**, air cylinder **20** and force multiplying lever **26** move upwardly and downwardly relative to the relatively stationary live lever **28**, brake beam **40**, and the side frames **13** and **14**, in response to changes in weight of the railroad car supported on the truck

10, the intersection point 55 between the horizontal lever 26 and live lever 28 also moves transversely to vary the effective length of the force multiplying lever arm between the point 55 and the fulcrum point 51 of the lever 26.

From a force standpoint, the total moment of force of the cylinder force about pivot point 51 remains constant since the force applied to the end of the force multiplying lever 26 by the piston rod 22 is unchanged. That is, the piston force is operative over the length of the lever arm from pin 50 to the fulcrum pin 51. Hence, the moment of force remains the same. However, because of the shorter distance or effective lever arm between the reaction point 55 and pin 51, the force at the reaction point 55 increases in order to maintain the two opposing moments of force in balance. However, this increase in force applied to the live lever 28 at the reaction point 55 is offset to some extent because the effective length of live lever arm 28 is shortened as the reaction point 55 moves toward the pivot pin 29, thereby decreasing the moment of force or braking load, from that which would be available, if the effective lever arm of the live lever 28 were not shortened as a result of the bolster 15 moving downwardly.

Thus, the brake load varies automatically with changes in freight car loading due to the geometrical relationship between the force multiplying lever 26 and live lever 28. The change in braking force or load experienced is approximately in the range of 10%, which will not be a sufficient change in brake load to assure that all cars employing the present invention need not have an auxiliary empty load brake unit. Nonetheless, the present invention will, in many cases, eliminate the necessity for empty load brake equipment in addition to the regular brake package.

Because of the unique construction of the present package brake, it can be readily adapted for employment in various sizes and weights of railroad cars. For example, in the embodiment of the invention illustrated herein, the brake unit is shown employed in a 90 ton railroad car, whereas to adapt the same package brake unit for a 70 ton railroad car, requires only the lengthening of the force multiplying lever arm about two inches. To accomplish this, for example, the lever arm 26 could be provided with a series of spaced holes therein in which the pivot pin 51 could be placed so as to employ the same lever 26 when changing the effective distance between the fulcrum pin 51 and the pivotal connection 50 with the connecting rod 25. The compression or fulcrum rod 56 secured to the bolster 15 may likewise be moved between a series of positions when changing the effective length of the force multiplying lever 26. Thus, it will be appreciated that an important aspect of the present invention is its ready applicability to varying sizes and weights of railroad cars merely by providing separate and varying lengths of force multiplying levers 26, or by changing the fulcrum point for a single force multiplying lever by moving a pivot pin between a series of pivot pin holes therefor.

Since the brake beams 35 and 40, as well as the live lever 28, bottom rod 30, and dead lever 32 are standard AAR bottom-under brake beam equipment, the package brake of the present invention advantageously can be repaired with normally inventoried brake beams and components thereof. Also, a railroad car having a rod-under brake system can be readily fitted with the present cylinder 20, adjuster 45 and lever 26.

As hereinbefore explained, the brake force applied to the live lever 28 can be varied either by changing the length of the force multiplying arm 26, and/or an automatic adjustment in the distance between the reaction point 55 and the fulcrum 51 as the lever 26 moves vertically relative to live lever 28. Advantage is taken of both of these concepts to provide a simple mechanical arrangement whereby the amount of braking force can be varied automatically; and, more significantly, to approximate more closely an empty load brake force for most railroad cars, while still providing the maximum brake shoe load for these cars in the loaded condition.

Referring now to FIG. 6, the bolster 15 is shown in the full line position corresponding to an empty car condition, at which position, the reaction point 55 marks the intersection between the horizontal, force multiplying arm 26 and the intersecting live lever arm 28. The piston rod 22 is connected to the live lever 26 by the pin 50 at its left end and is fulcrumed at its right end by a pin 51 on a sliding block 60. The sliding block 60 is employed in lieu of the fixed compression rod 56 and serves as a fulcrum for the force multiplying lever 26. The sliding block 60 is adapted to slide horizontally along the bolster 15 to the position 60' under influence of a compression spring 61 as the bolster moves downwardly the full extent under a heavy load condition. That is, the slide 60 is biased by a compression spring 61 to move leftwardly to the position 60' as the bolster 15 moves downwardly to the phantom line position under the weight of a full load.

The end of the sliding block 60 has secured thereto a chain 62 or the like which extends from the block 60, around a pulley 63 and to the brake beam 40.

Since the brake beam 40 remains stationary, upward movement of the bolster 15, for example, in response to decrease in load of the railroad car exerts a force on the cable 12 to cause the pulley 63 to rotate in a clockwise direction, as viewed in FIG. 6, as the cable 62 pulls the sliding block 60 rightwardly against the resistance of the spring 61 thereby lengthening the effective lever arm between the reactance point 55 and the block 60. Thus, with the longer effective lever arm, the brake force applied to live lever 28 is decreased considerably from the brake force applied for a full load, wherein the effective length of the lever arm is between the point 55' and the sliding block position 60'. It will be understood that the sliding block 60 is limited to horizontal sliding movement only along the bolster 15; but because the bolster 15 partakes of a simultaneous vertical movement as block slides horizontally, the block 60 achieve the vertically displaced position 60' at full load condition of the railroad car.

The amount of sliding movement of the block 60 is equal to the amount of vertical movement of the bolster 15, as shown in FIG. 6. However, by employing a suitable lever or an equivalent, the amount of horizontal sliding movement of the block 60 can be multiplied so as to be greater than the amount of vertical movement of the bolster. Thus, an even greater change in force can be readily accomplished between an empty and full load condition of the railroad car.

It is to be noted that when the force multiplying lever 26 moves vertically with respect to the live lever 28, the amount of movement of rotation of the live lever 28 will be changed for a fixed piston stroke and accordingly the amount of movement of the bottom rod 30 also will be changed. The slack adjuster 45 advantageously compensates for changes in amounts of rotation of the live lever and assures that live lever 28 and bottom rod 30 move to apply the brake shoes 38 and 42. Also, the slack adjuster 45 performs the function of compensating for brake shoe wear.

The slack adjuster 45 can be manually adjusted to compensate for changes such as brake shoe wear or shoe replacement by turning an exterior handle 80, FIG. 5, extending outwardly of an adjuster housing wall 81 of the adjuster 45. The handle 80 is fixedly secured to a threaded shaft 82, which has one end rotatably supported in a bearing 83 carried in the housing wall 81.

The threaded shaft 82 is permitted to rotate within the bearing 83, but is prevented from moving axially by a thrust collar 84 secured to the shaft 82 interior of the housing wall 81 and by a thrust collar 85 on the handle 80

exterior of the housing wall 81. Turning of the handle 80 rotates the threaded shaft 82, and turns its threads 83 in an interiorally threaded collar 89 from which extends adjuster lug 44 through a slotted opening 90 in an adjuster housing wall 91. The lug 44 thus is held against rotation with the threaded shaft 82 while permitted to move axially as the threaded shaft 82 turns. Secured to the interior end of the threaded shaft 82 is a drive gear 94 which is adapted to mate with an idler gear 95 in a manner hereinafter explained.

As will be understood from a comparison of FIGS. 2 and 5, rightward movement of the adjuster lug 44 causes the dead lever 32 and the brake beam 35 to move the brake beam 35 and brake shoe 38 closer to the wheels W and take up looseness or slack. Thus, even with worn shoes or a smaller amount of rotation of the live lever 28, the adjuster lug 44 has taken up the slack and assured movement of the brake beam 40 leftwardly to bring the brake shoes 42 against the wheels W. In this manner, by turning the handle 80 and the threaded portion 88 of the shaft 82 the adjuster lug 44 may be moved rightwardly, as viewed in FIGS. 2 and 5 to take up slack. Manifestly, if new shoes are being employed, the handle 80 can be rotated in the opposite direction to rotate the adjacent lug 44 leftwardly to accommodate such increased thickness in shoe size, this direction being called the "pay out" direction, therefore the live lever 28 and bottom rod 30 can still partake of their normal movements.

In the interior of the adjuster 45 is a longitudinally extending wall 98 terminating a housing wall 99 to constitute with an exterior housing wall 100, the fluid receiving cylinder in which reciprocates the piston 21.

The wall 99 has an aperture therein in which is disposed a slideable shaft 105. On the leftward end of shaft 105 is journaled an idler gear 95 for free rotation about its supporting shaft 105. As the piston 21 move s leftwardly under fluid pressure through a distance corresponding to its nominal stroke, the piston 21 moves a disk 101 into engagement with the top of a compression spring 102, which is operative to engage a collar 104 on shaft 105 and to move the gear 95 leftwardly against the resistance of a second compression spring 108. The spring rates of springs 102 and 108 are balanced so that when the piston 21 moves through its nominal stroke, the idler gear 95 is in meshing egagement with gears 94 and 112. Leftward movement of shaft 105 and gear 95 is limited by a projecting stop 109 secured to the housing wall 97. The spring 102 is secured to the housing wall 99 in a suitable manner and is preferably guided by a cylindrical tube (not shown) coaxial with the spring 102.

The gear 112 is formed on the outer peripheral surface of a ball-nut 113, which is disposed for rotation on a threaded sleeve 115. The threaded sleeve 115 has a central bore, through which extends the piston rod 22. The sleeve 115 is limited against axial movement leftwardly by a toothed collar 116 formed on the outer end of the piston rod 22. The toothed collar 116 is adapted for tooth engagement with a complementary toothed collar or end portion 117 on the threaded sleeve 115. The tooth portion 117 of the sleeve 115 is biased into engagement with the teeth 116 of the piston rod 22 by a compression spring 120 disposed between the interior surface 121 of the piston 21 and a slideable collar 122, which is in engagement with a bearing 123 disposed against the end wall 125 of the threaded sleeve 115. Thus, the compression spring 120 forces the slidable collar 122, bearing 123 and sleeve 115 to urge the teeth 117 of sleeve 115 into the teeth 116 of the piston rod 22. The bearing 123 serves to permit the sleeve 115 to rotate more freely against the end of spring 120 than would be the case if the spring 120 were directly abutted against the end surface 125 of the sleeve 115.

When the piston 21 begins to move under fluid pressure, the piston rod 22 carrying sleeve 115 moves the disk 101 on the sleeve 115 against the spring 102. As the piston 21 and piston rod 22 move further leftwardly, the spring 102 begins to move the shaft 105 leftwardly against the resistance of spring 108. When the piston 21 moves through its nominal stroke, idler gear 95 on shaft 105 is moved to mesh with the gears 94 and 112. At this position, the reaction load on lug 44 is balanced by the fluid pressure force on the piston 21. Thus, the gear 94 is locked against rotation by the gears 95 and 112 since the gear 112 cannot rotate the threaded shaft 115, which shaft is locked by its toothed collar 117 engaging the teeth 116 of the non-rotatable piston rod 22.

If the brake shoe load appears before the normal stroke of the piston 21 is obtained, the reaction load acts on the adjuster lug 44 to cause the threaded screw 88 to turn, thereby permitting the adjuster lug 44 to move in the pay out direction, leftwardly. Thus, further movement of piston rod 22 does not increase the brake shoe load as further movement of the piston 22 is compensated by leftward movement of the adjuster lug 44. When the piston rod 22 moves a sufficient distance to move idler gear 95 into meshing engagement with the gear 94, the threaded shaft 82 is locked against being turned by the leftward movement of the lug 44. Hence, the adjuster lug 44 is locked from further movement, the proper brake shoe load is being applied with the piston 21 moving through its nominal stroke.

Upon releasing the brakes, the fluid pressure leaves the cylinder cavity 130, and an internal return spring 131 acting on the inner face 121 of the piston 21 moves the piston 21 rightwardly, and the disk 101 moving therewith permits the compression spring 108 to disengage the idler gear 95 from the drive gear 94 on the adjuster shaft 82. Thus, the adjuster lug 44 will retain this new pay out position.

If the brake shoe load is not obtained by the time the piston 21 has moved through its nominal stroke and has caused the idler gear 95 to be in meshing engagement with the driver gear 94 and the gear 112, further movement of the piston 21 leftwardly compresses the spring 120. Since the gear 112 is locked against rotation by meshed idler gear 95, gear 112 holds sleeve 115 stationary as the piston shaft 22 moves leftwardly and separates the toothed collars 116 and 117. When the tooth elements 116 and 117 are disengaged, further leftward movement of the piston 22 and the brake shoe load acting through the lug 44 and the threaded shaft 88 rotate idler gear 95 and the gear 112 on the ball-nut 113. The ball-nut 113 is limited by bearings 135 on casting walls 136 and 137 from axial movement. Thus, rotation of the gear 112 causes the threaded sleeve 115 to move leftwardly toward the collar 116 on the shaft 22 and to engage the clutch collars 116 and 117 to stop the piston stroke.

When the air pressure on the piston 21 is released, the compression spring 131 moves the piston 21 rightwardly, and the threaded sleeve 115 moving through the ball-nut 113 rotates the gears 95 and 94 to move the adjusting lug 44 leftwardly, there being no braking force, that is, no reaction force opposing this leftward movement of the adjusting lug 44. Thus on the return or retraction stroke of the piston 20, the adjusting lug 44 moves to take up any existing slack. When the piston rod 22 moves rightwardly a sufficient distance, the disk 101 on the sleeve 115 will release compression spring 102 and the spring 108 is operative to disengage the idler gear 95 so that the remainder of movement of the piston in rightward direction is accompanied merely by rotation of the ball-nut 113 without accompanying rotation of the drive gear 94 and adjuster lug 44.

The package brake unit of the present invention is readily adapted for operation by a hand brake since it is only necessary to attach a hand brake pull rod 150, FIG. 2, to the pin 50, so that the pull rod 150 actuates the force multiplying lever 26. Upon application of the hand brake, the piston rod 22 can be retained outwardly of the cylinder 20 for considerable periods of time without adverse effects on the piston rod 22, since the piston rod is disposed

in a cavity within a bolster **15**, and thereby protected from the weather. Generally speaking, it is not desirable to move the piston rod with the hand brake, since the piston rod would be exposed to the weather elements, and, for instance, could become iced and frozen in position to maintain the brake applying position upon release of the hand brake. A bushing or seal can be provided to guide the piston rod **22** as well as to seal the bore **23** in the bolster **15** against the elements. With the present invention, release of the hand brake permits the return spring **131** to return the piston **21** to its proper position. Also, the automatic slack adjuster **45** will automatically limit the hand brake stroke to a predetermined proper amount. Inasmuch as the conventional hand brake generates twice the output forces of the cylinder **20**, a hand brake pull rod **150** need be connected to only one truck of a railroad car, thus saving the necessity of providing a second hand brake mechanism for the second truck of the railroad car.

From the foregoing, it will be seen that the package brake unit is so constructed as to be disposed completely below the level of the bolster, and is so designed to provide changing braking forces between empty load and full load conditions of the car, thereby eliminating the need, in many instances, for a costly empty load brake equipment. Where additional adjustment or compensation is required for empty load condition, the present invention is provided with a movable fulcrum which varies the length of the force multiplying lever so as to afford a greater compensation than that available due to the geometry of the linkage employed.

Also, it will be seen that an automatic slack adjuster can be provided to compensate for changes in piston stroke due to the change in lever ratios and to assure the proper brake shoe load, as applied to the car wheels, irrespective whether or not, relatively thick or relatively thin brake shoes are applied.

Moreover, the package brake is readily actuatable by a hand brake mechanism, which need merely be attached to the end of the force multiplying lever to cause the proper piston stroke, and the piston rod is permitted to move with the application of the hand brake, inasmuch as it is protected by the bolster.

Hence, while preferred embodiments of the invention have been described and illustrated, it is to be understood that they are capable of variation and modification, and I therefore do not wish to be limited to the precise details set forth, but desire to avail myself of such changes and alterations as fall within the purview of the following claims.

I claim:

1. In a brake unit adapted to be secured to the truck of a railroad car, wherein a bolster of the truck is spring mounted for vertical movement relative to side frames of the truck; a pair of brake beams disposed on opposite sides of the bolster, each of said brake means being movable on said side frames; brake beam operating means including a beam operating lever extending upwardly from one of said brake beams at an angle to the vertical; cylinder means secured to said bolster for vertical movement therewith, said cylinder means having a piston means movable in response to fluid pressure within said cylinder to generate a braking force; a force multiplying lever means operated by said piston means of said cylinder means, said force multiplying lever means being mounted on said bolster, and partaking of vertical movement with the bolster with respect to said beam operating lever, said force multiplying lever means engageable with said beam operating lever at a point of engagement, said force multiplying lever means movable vertically relative to said beam operating lever to change the point of engagement with said beam operating lever and said force multiplying lever means as said force multiplying lever means moves with said bolster.

2. In a brake unit adapted to be secured to the truck of a railroad car wherein a bolster in the truck is spring mounted for vertical movement relative to side frames of a truck, live lever and dead lever brake beams disposed on opposite sides of the truck and movable with respect to said side frames; a cylinder means secured to one side of the bolster having said dead lever brake beam and having a piston means with an operative stroke through said bolster to supply the brake operating force for said live lever brake beam, slack adjuster means secured to said bolster on said one side of said bolster and engageable by said dead lever brake beam, and a lever means engageable with said piston means to operate said brake beams, said lever means being disposed on the other side of the bolster opposite said cylinder means and said slack adjuster.

3. The brake unit of claim **1** wherein said cylinder means is disposed beneath the upper top surface of said bolster so that said cylinder means does not engage the body of a railroad car mounted on said bolster.

4. The brake unit of claim **2** wherein said bolster has an interior cored area, a hand brake operating means attached to said lever means for operating said lever means to apply a brake force to said braking beams, said piston means being movable by said lever means and being protected from the weather elements by being disposed at least partially in said cored area in said bolster.

5. In a brake unit adapted to be secured to the truck of a railroad car wherein the bolster in the truck is spring mounted for vertical movement relative to side frames of the truck: a pair of brake beams disposed on opposite sides of the truck and supported for movement by said side frames, one of said brake beams having a beam operating lever extending vertically at an inclination to the normal; a power operated cylinder means mounted on said bolster and adapted to generate the braking force for said brake beams; a horizontal lever means having one end secured to said cylinder means for rotational movement by said cylinder means about a pivotable connection of the opposite end of the lever means with the bolster; said lever means engageable with said beam operating lever at a point of contact and actuating said beam operating lever in response to being pivoted by said cylinder means, vertical movement of said bolster and said horizontal lever means thereon changing the point of contact between said horizontal lever means and said beam operting lever and changing the braking force applied to the beam operating lever with loading of the railroad car.

6. The brake unit of claim **5** including another horizontal lever means, to adapt the brake unit for a railroad car of lower rated capacity for weight, said another horizontal lever means of longer effective length so as to increase the distance between the fulcrum point and the connection of said horizontal lever means with the cylinder means.

7. In a brake unit adapted to be secured to the truck of a railroad car, wherein a bolster of the truck is spring mounted for vertical movement relative to side frames of the truck: a pair of brake beams disposed on opposite sides of the bolster, each of said brake beams being movable on said side frames; beam operating means including a beam operating lever extending upwardly from one of said brake beams at an angle to the vertical; cylinder means secured to said bolster for vertical movement therewith, said cylinder means having a piston means movable in response to fluid pressure within said cylinder to generate a braking force; a force multiplying lever means operated by the piston means of said cylinder means, said force multiplying lever means being pivotally mounted on said bolster and partaking of vertical movement with the bolster with respect to said beam operating lever, said force multiplying lever means movable vertically relative to said beam operating lever, said force multiplying lever means engaging said beam operating lever at a contact point and said contact point changing between said beam operating lever and said force multiplying lever

means as said force multiplying lever means moves with said bolster; and means movable in response to vertical movement of the bolster to change the point of pivotally mounting of said force multiplying lever means on said bolster so that said braking force varies with changes with vertical movement of the bolster.

8. In a brake unit adapted to be secured to the truck of a railroad car wherein a bolster in the truck is spring mounted for vertical movement relative to side frames of a truck: brake beams disposed on opposite sides of the truck and movable with respect to said side frames; a cylinder means secured to one side of the bolster and having a piston with an operative stroke through a bore in said bolster and adapted to supply the brake operating force for said brake beams, lever means operable by said piston to operate said brake means, said lever means being disposed on the side of the bolster opposite said cylinder means; a movable block mounted on said bolster; said lever means having a pivotal connection with said movable block; biasing means biasing said block in one direction; and connecting means extending between said movable block and said brake beam means to move said block in response to vertical movement of said bolster in an opposite direction to said one direction against the force of said baising means.

9. In a brake unit adapted to be secured to the truck of a railroad car wherein a bolster of the truck is spring mounted for vertical movement relative to side frames of the truck: a pair of brake beams disposed on opposite sides of the bolster, each of said brake beams being movable on said side frames; a live, beam operating lever extending vertically from one of said brake beams at an inclination to the normal; a dead lever on said other of said brake beams; cylinder means secured to said bolster for vertical movement therewith, said cylinder means having a piston movable in response to fluid pressure within said cylinder means to generate a braking force; a force multiplying lever means operated by the piston of said cylinder means, said force multiplying lever means being mounted on said bolster, and partaking of vertical movement with the bolster with respect to said beam operating lever, said force multiplying lever means adapted to move vertically relative to said beam operating lever and to change an intersecting contact point between said beam operating lever and said force multiplying lever means as said force multiplying lever means with said bolster; and an automatic slack adjuster means mounted on said bolster and having a portion for engagement with said dead lever.

10. In a brake unit for a railroad car having a truck with a bolster and having one brake beam operated by a live lever and another brake beam operated by a dead lever and with a bottom rod joining the live lever and dead lever, a power cylinder means disposed on one side of the bolster with said dead lever; a piston rod means operable through a bore in the bolster; a horizontal force multiplying lever having one end in pivotal connection with said piston rod means and having its opposite end fulcrumed on said bolster, said horizontal lever being positioned adjacent said live lever to engage said live lever at a contact point and to rotate said live lever in response to operation of said power cylinder means, said horizontal force multiplying lever moving vertically with said bolster and changing the ratio of distances between the pivotal connection and the contact point, and the contact point and the fulcrum point.

11. In a brake unit for a railroad car having a truck with a bolster and having one brake beam operated by a live lever and another brake beam operated by a dead lever and with a bottom rod joining the live lever and dead lever; a power cylinder means disposed on the side of the bolster with said dead lever; a piston rod means operable through a bore in the bolster; a force multiplying lever disposed horizontally and having one end in pivotal connection with said piston rod means and having its opposite end fulcrumed on said bolster, said horizontal lever being positioned adjacent said live lever and engageable with said live lever at a contact point and rotating said live lever in response to operation of said power cylinder means, said horizontal force multiplying lever moving vertically with said bolster and changing the ratio of distances between the pivotal connection and the contact point and the contact point and the fulcrum point; and an automatic slack adjuster means mounted on said bolster for regulating the piston stroke of said piston rod means with changes in position of said contact point between said horizontal force multiplying lever and said brake beam lever that cause change in the amount of rotation of said live lever by said force multiplying lever.

12. In a brake unit for a railroad car having a truck with a bolster and having one brake beam operated by a live lever and another brake beam operated by a dead lever and with a bottom rod joining the live lever and dead lever: a power cylinder means disposed on one side of the bolster with said dead lever; a piston rod means operable through a bore in the bolster; a horizontal force multiplying lever having one end in pivotal connection with said piston rod means and having its opposite end fulcrumed on said bolster, said horizontal lever being positioned adjacent said live lever and adapted to engage said live lever at a contact point and adapted to rotate said live lever in response to operation of said power cylinder means, said horizontal force multiplying lever moving vertically with said bolster and changing the ratio of distances between the pivotal connection and the contact point, and the contact point and the fulcrum point; and an automatic slack adjuster means mounted on said bolster, said slack adjuster having a movable lug in sliding contact with a free end of said dead lever.

13. In a brake unit for a railroad car having a truck with a bolster and having one brake beam operated by a live lever and another brake beam operated by a dead lever and with a bottom rod joining the live lever and dead lever, a power cylinder means disposed on one side of the bolster with said dead lever and disposed beneath the upper surface of said bolster to be clear of interference with the railroad car; a piston rod means operable through a bore in the bolster; a horizontal force multiplying lever having one end in pivotal connection with said piston rod means and having its opposite end fulcrumed on said bolster, said horizontal lever being positioned adjacent said live lever engageable with said live lever at a constant point and rotating said live lever in response to operation of said power cylinder means, said horizontal force multipying lever moving vertically with said bolster and changing the ratio of distances between the pivotal connection and the contact point, and the contact point and the fulcrum point; and an automatic slack adjuster means mounted on said bolster beneath the upper surface of said bolster and associated with said piston rod means to compensate for a change in the amount of rotation of said live lever by said force multiplying lever.

14. In a brake unit for a railroad car having a truck with a movable bolster and having one brake beam operated by a live lever and another brake beam operated by a dead lever and with a bottom rod joining the live lever and dead lever, a power cylinder means disposed on one side of the bolster with said dead lever; a piston rod means operable through a bore in the bolster; a horizontal force multiplying lever having one end in pivotal connection with said piston rod means, mounting means at a fulcrum point mounting the opposite end of said horizontal lever on said bolster; said horizontal lever being positioned adjacent said live lever to engage said live lever at a contact point and adapted to rotate said live lever in response to operation of said power cylinder means, said horizontal force multiplying lever moving vertically with said bolster and changing the ratio of distances between the pivotal connection and the contact

point, and the contact point and the fulcrum point; and operating means on said movable bolster and connected to the truck and said mounting means, vertical movement of the bolster to relative to said brake beams actuating said operating means to move said mounting means and thereby the point of pivotally mounting of said force multiplying lever on said bolster so that the braking force applied to said live lever changes with vertical movement of the bolster.

15. In a brake unit for a railroad car having a truck with a bolster and having one brake beam operated by a live lever and another brake beam operated by a dead lever and with a bottom rod joining the live lever and dead lever: a power cylinder means disposed on the side of the bolster with said dead lever; a piston rod means operable through a bore in the bolster; a horizontal force multiplying lever having one end in pivotal connection with said piston rod means, mounting means mounting the opposite end of said horizontal lever on said bolster; said horizontal lever having its opposite end fulcrumed on said mounting means, said horizontal lever being positioned adjacent said live lever and engageable said live lever at a contact point and rotating said live lever in response to operation of said power cylinder means, said horizontal force multiplying lever moving vertically with said bolster and changing the ratio of distances between the pivotal connection and the contact point and between the contact point and the fulcrum point; an automtaic slack adjuster means mounted on said bolster for controlling the piston stroke of said piston rod means with changes in position of said contact point between said horizontal force multiplying lever and said live lever and compensating for a change in the amount of rotation of said live lever by said force multiplying lever; operating means operable for changing the point of pivoting of said horizontal lever on said bolster with changes in vertical movement of said bolster, said mounting means including a block mounted on said bolster for horizontal sliding movement, said operating means including spring means biasing said sliding block to a first predetermined position, and means interconnecting said sliding block and one of said brake beams to move said sliding block against the bias of said spring means in response to vertical movement of said bolster relative to said one of the brake beams.

16. In a brake unit for a railroad car having a truck with a bolster and having one brake beam operated by a live lever and another brake beam operated by a dead lever and with a bottom rod joining the live lever and dead lever: a power cylinder means disposed on the side of the bolster with said dead lever; a piston rod means operable through a bore in the bolster; a horizontal force multiplying lever having one end in pivotal connection with said piston rod means and having its opposite end fulcrumed on said bolster, said horizontal lever being positioned adjacent said live lever and adapted to contact said live lever at a contact point and to rotate said live lever in response to operation of said power cylinder means, said horizontal force multiplying lever moving vertically with said bolster and changing the ratio of distances between the pivotal connection and the contact point, and the contact point and the fulcrum point; and an automatic slack adjuster means mounted on said bolster for controlling the stroke of said piston rod means as changes in position of said contact point between said horizontal force multiplying lever and said live lever cause a change in the amount of rotation of said live lever by said force multiplying lever; said slack adjuster means including a lug movable against an upper and free end of said dead lever, a threaded shaft carrying said lug for movement in response to rotation of said shaft, to move said lug and said dead lever and thereby said brake beams to take up slack or to pay out slack, a drive gear secured on said threaded shaft and operable to turn with said threaded shaft, an idler gear movable into engagement with said drive gear in response to movement of said piston rod means through a predetermined stroke, said piston rod means including a piston and a piston rod, means biasing said idler gear from meshing engagement with said driving gear when said piston has returned a predetermined distance on its return stroke, a third gear adapted to be in meshing engagement with said idler gear when said idler gear is in position to mesh with said drive gear, a screw thread operable for turning said third gear with movement of said piston, said screw thread operable to lock said third gear against rotation when said piston has moved through its nominal stroke and thereby lock said drive gear, threaded shaft and lug against pay out or adjust slack movement.

17. The brake unit of claim **16** wherein said piston rod has a tooth surface thereon, and wherein an axially movable sleeve is carried on said piston rod and has said threaded screw thereon, said threaded sleeve having a tooth end for engagement with said tooth surface on said piston rod to lock said sleeve and said screw thread against rotation by said third gear, spring means biasing said threaded sleeve to engage its tooth surface with said tooth surface on said piston rod, movement of said piston rod when said gears are meshed causing said spring to be compressed and said piston rod to move to separate its tooth surface from the tooth surface on said threaded sleeve.

18. A brake slack adjuster adapted to be employed with a movable piston of a brake cylinder, comprising a housing; a threaded shaft journaled in said housing for rotational movement; an adjuster lug axially movable along said threaded shaft in response to rotation of said threaded shaft; a drive gear secured to said threaded shaft and rotatable with said threaded shaft; an idler gear biased to a position out of meshing engagement with said gear and movable by said piston into meshing engagement with said gear and movable by said piston into meshing engagement with said driving gear; a third gear adapted to be driven by said idler gear when said idler gear is in meshing engagement with said drive gear; and a screw thread for driving said third gear, idler gear, and drive gear so as to move said lug to take up slack when the brakes are released, said third gear being locked against rotation during the application stroke of said piston.

19. A brake slack adjuster adapted to be employed with a movable piston and piston rod of a brake cylinder comprising a housing; a threaded shaft journaled in said housing for rotational movement; an adjuster lug axially movable along said threaded shaft in response to rotation of said threaded shaft; a drive gear secured to said threaded shaft and rotatable with said threaded shaft; an idler gear biased to a position out of meshing engagement with said drive gear and movable by said piston into meshing engagement with said drive gear; a third gear aligned for meshing engagement with said idler gear; a threaded sleeve axially slideable on the piston rod of said piston, said threaded sleeve adapted to turn said third gear in response to movement of a piston in a cylinder with which said slack adjuster is associated, said piston rod having a first end with a tooth surface; a complementary toothed surface on the end of said sleeve for tooth engagement with said tooth surface on said piston rod, spring means biasing said threaded sleeve to engage its tooth surface with said tooth surface on said piston rod; movement of said piston rod when said idler gear is in meshing engagement with said drive gear and said third gear, causing said spring to compress and said tooth surfaces to separate, whereby retraction of said piston rod causes said threaded sleeve to rotate said gears and to move said lug in an adjusting direction.

20. In a brake unit adapted to be secured to the truck of a railroad car, wherein a bolster of the truck is spring mounted for vertical movement relative to side frames of the truck: a pair of brake beams disposed on opposite

sides of the bolster, each of said brake beams being movable on said side frames; brake beam operating means including a live lever, a dead lever, and a connecting rod between said live lever and said dead lever, said live lever extending upwardly from one of said brake beams at an angle to the vertical; cylinder means secured to said bolster for vertical movement therewith, said cylinder means having a piston means movable in response to fluid pressure within said cylinder to generate a braking force; and a camming means on said bolster and connected to said piston means and engageable with said live lever to rotate said live lever of said brake beam operating lever, said camming means adapted to contact said live lever at different points thereon as said camming means moves vertically with said bolster and with the piston means relative to said live lever so that the braking force applied to the live lever changes with loading of the railroad car.

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