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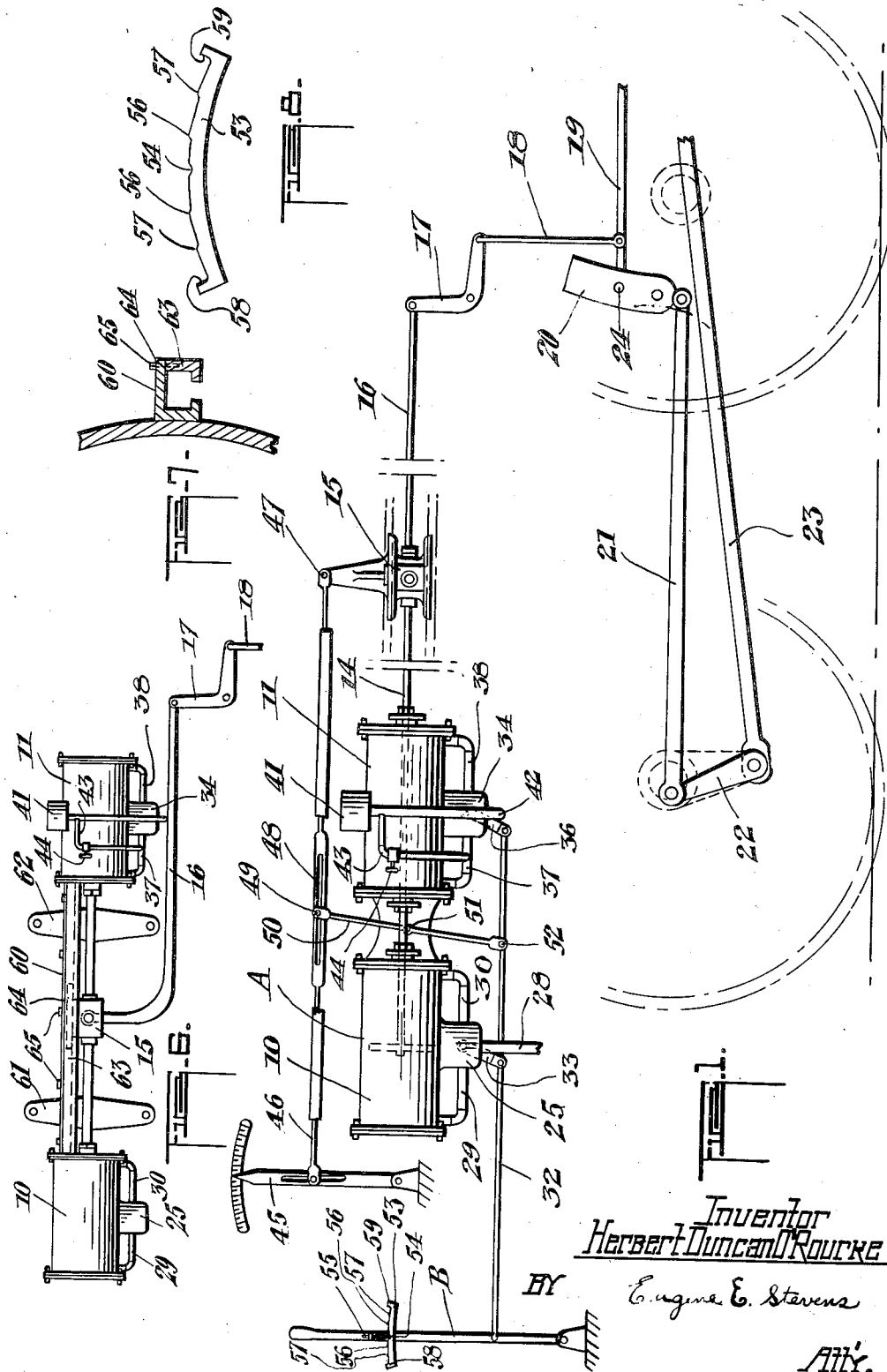
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POWER REVERSING GEAR

Filed June 26, 1937

2 Sheets-Sheet 1



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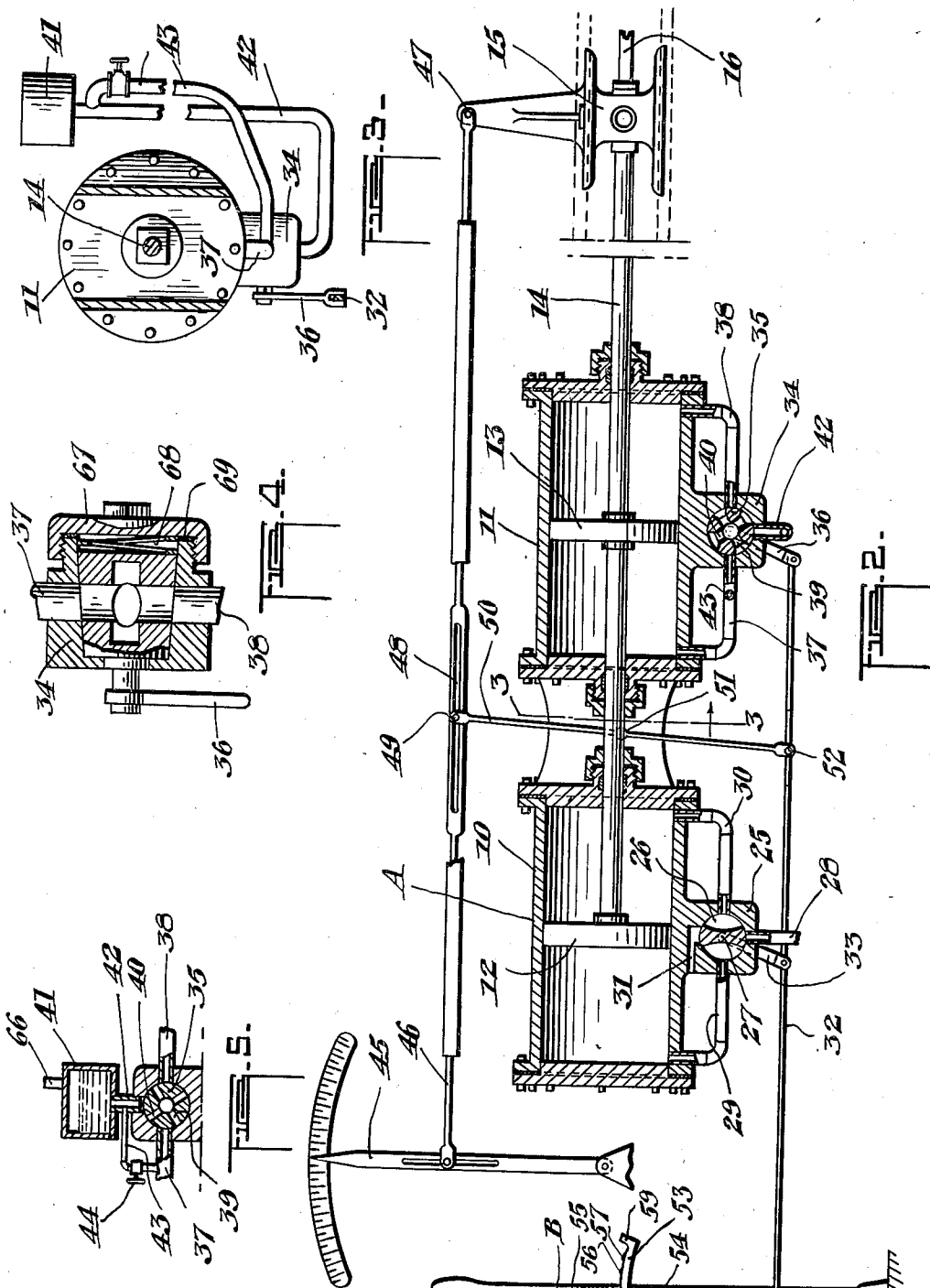
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2,200,562

POWER REVERSING GEAR

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Application June 26, 1937, Serial No. 150,607

1 Claim. (Cl. 121—40)

This invention relates to power reversing gear for locomotives.

An object of the invention is to provide a reversing gear generally simple in construction which will provide for a positive hydraulic lock.

A further object of the invention is to provide a structure of this character which will compensate for expansion or contraction due to climatic changes resulting in pressure or partial vacuum in the cylinder, such as when emerging from a warm roundhouse into an extremely cold atmosphere and vice versa.

A further object of the invention is to provide a structure which can be positioned on the locomotive at a point adjacent to the link block structure, thus avoiding the use of a long reach rod.

A still further object of the invention is to provide a structure which will be quickly responsive to a single control lever and in which the operating lever may be moved to any degree in its normal range to provide for as fine adjustment as desired in the main steam valves for the cylinders.

According to the present invention, a simple and efficient structure is provided avoiding the difficulties of the prior art and answering the main requirements of an efficient power reversing gear. This is accomplished by providing a pair of cylinders, an operating cylinder and a hydraulic cylinder, the pistons of which are connected together to operate in unison, the hydraulic cylinder being filled with liquid, and so constructed either to provide for equal displacement of liquid in the cylinder on each side of its piston or to employ a compensating device for the difference between the displacement in the cylinder on each side of the piston, and in both cases by including means controlling communication between the compensating device and cylinder during operation, a positive lock may be obtained. The construction also includes means preferably embodied in the compensating device acting to maintain the hydraulic cylinder full of liquid at all times and to eliminate the difficulty encountered by the expansion or contraction caused by extreme climatic changes.

The structure employs a minimum of parts and provides for a positive lock of the reversing gear, as well as indicating means to show the exact position of the pistons, and in addition, means for returning the actuating lever to its normal setting, in the case where it might have been inadvertently left in an "on" position.

The invention is described in detail in the fol-

lowing specification and illustrated in the accompanying drawings, in which

Figure 1 is a side elevation of one form of apparatus according to the present invention, showing the manner in which it is connected with the engine link block structure and also illustrating the control means and indicating means.

Figure 2 is an enlarged longitudinal section taken from the apparatus to show the arrangement of the various parts.

Figure 3 is a section taken on the line 3—3 of Figure 2.

Figure 4 is an enlarged longitudinal section of the oil control valve.

Figure 5 is a sectional detail of the oil valve structure showing the auxiliary oil chamber disposed thereabove and communicating therewith in the case where the valves may be disposed on the top of the cylinders.

Figure 6 is a side elevation of an alternative arrangement of the apparatus according to the present invention.

Figure 7 is an enlarged section of the cross head guideway as employed in Figure 6.

Figure 8 is an enlarged detail of a formation of the quadrant guide for the operating lever.

Referring to the drawings A indicates the reversing gear as a whole which essentially includes two cylinders 10 and 11 which may be disposed as shown in alignment with one another but might also be positioned one beside the other or in other arrangement as desired. As shown the cylinders each are provided with pistons 12 and 13 connected by the common piston rod 14. The free end of the piston rod 14 is connected with a cross-head 15, which through the reach rod 16, bell crank lever 17, and link 18 connects with the radius rod 19 connected with the link block structure 20, here shown as a Walschert structure, although any known form of valve motion may be used. The link block structure as shown is operated from the eccentric rod 21 in turn connected to the eccentric crank 22 operated from one of the wheels which are operated by the main driving rod 23. As is well known, the link block structure 20 determines the direction of motion imparted to the wheels of the locomotive, the locomotive being driven in forward or reverse according to whether the radius rod is positioned on one side or the other of the pivoting point 24 of the link block structure and at various degrees of speed according to the distance the radius rod is positioned from the centre point 24 of the link block structure. Thus, through the provision of a simple construction

embodying two cylinders, i. e., an actuating cylinder and a locking cylinder, a reach rod, bell crank lever and a link, the reversing gear of the locomotive is effectively operated.

5 The cylinder 10 constitutes the actuating cylinder designed to receive air under pressure to actuate its piston 12 which functions as the prime mover in the unit. For this purpose cylinder 10 is provided with a valve housing 25 having a cylindrical valve chamber 23 carrying the rotary valve 27 which is concaved on each side to permit the establishment of communication between the various airlines. In Figure 2 the valve is so disposed that the air supplied is cut 10 off from the air supply pipe 28, but depending upon the rotation of the valve, air may be supplied to the air conduit 29 or 30 communicating respectively with opposite ends of the cylinder 10. In each case communication is also established with an exhaust vent 31, whereby the pipe 20 line 29 or 30, as the case might be, which is not being supplied with compressed air, may vent to the atmosphere. For instance, assume that the operating lever B was moved to the right, the 25 corresponding movement of the connecting rod 32 pivotally connected with the operating arm 33 of the valve 27 would cause valve 27 to swing in an anticlockwise direction establishing communication between the airline 28 and line 29 so that air under pressure would be admitted to 30 the left hand side of the cylinder 10, whereas the pipe line 30 would be placed in communication with the exhaust vent 31. The movement of the lever B in the opposite direction would 35 have an opposite effect. In this way the piston rod or prime mover 14 is caused to move back and forward as required.

The locking cylinder 11 which is designed to contain an operating liquid such as oil, or other 40 suitable liquid, is likewise provided with a valve housing 34 having a valve chamber housing the rotary valve 35 provided with an operating arm 36 pivotally connected with the connecting rod 32 so that valve 35 is operated in unison with 45 valve 27 from lever B. Pipe lines 37 and 38 lead from the valve housing 34 to opposite ends of the cylinder 11 and communication is established between these lines by the opposing passageways 39 and 40 disposed at right angles to one another 50 in the valve 35. The cylinder 11 is designed to be filled completely with a liquid which will be caused to flow from one end of the cylinder to the other when the valve 35 establishes communication between the pipe lines 37 and 38 but will 55 function to prevent movement of the piston 13 when the pipe lines 37 and 38 do not communicate with one another. Thus cylinder 11 functions to lock piston 13 and consequently the rod 14 against movement in either direction, when 60 this is required.

In order to provide for a positive hydraulic lock employing apparatus of the general character described, it is necessary to so construct the apparatus as to meet various conditions that ordinarily 65 would operate to prevent its proper functioning. These conditions, such as the balancing of the liquid as between both ends of the control cylinder, and expansion and contraction due to extreme climatic changes, may be overcome in different ways. As shown in Fig. 2 the cylinder 70 containing the locking liquid is disposed forwardly of the air cylinder so that the common piston rod 14 passes completely through the cylinder, and consequently an equal volume of liquid is carried 75 in each end of the cylinder when its piston is at

dead centre, and therefore liquid will pass freely from one end of the cylinder to the other when the control valve 35 is open, whereas when closed, transfer of the liquid from one end of the cylinder is opposed by the valve and the piston and 5 rod are held firmly against movement.

Apart from providing for a general balancing in the oil cylinder as referred to, it is necessary to provide against the creation of additional pressure or the establishment of a partial vacuum 10 in the cylinder caused by expansion and contraction, due to extreme climatic changes, such for instance, as when emerging from the warm roundhouse into extremely cold atmosphere or vice versa. To provide for this a liquid reservoir or 15 expansion tank 41 is disposed above the upper level of the liquid in cylinder 11 and it is preferably connected by a pipe line 42 to the valve housing 34 in a position so that it will communicate with one of the valve passageways 39 or 20 40 when the other is disposed in communication with the pipe lines 37 and 38. Thus the liquid carried in the reservoir 41 is freely in communication with the interior of the cylinder 11 through the pipe lines 37 and 38 when the valve 25 35 is open, and as a result this connection provides a means for maintaining the cylinder 11 full of liquid and provides for discharge of some of the liquid, in the case where pressure is developed due to climatic changes. The liquid level 30 in the reservoir or expansion tank 41 is such that a sufficient extra supply of liquid for the cylinder 11 is carried, with the provision of an air space in the top of the reservoir which will be compressed to permit liquid to be discharged from the cylinder to the reservoir. In this way 35 it will be apparent that as the engineer operates the lever B to vary the link block setting as required continually, having regard to the characteristics of the roadbed such as curves, grades, and the like, the expansion tank 41 is intermittently placed in communication with the control cylinder thus maintaining the control cylinder full of liquid notwithstanding climatic changes.

In order to provide for variation of conditions 45 in the cylinder 11, such for instance when the locomotive is taken to the roundhouse and when the valve 35 is closed, a bypassing line 43 is disposed preferably between the line 42 and one of the pipe lines 37 or 38, the bypassing line being provided with a shut off valve 44. Thus, upon 50 storing the locomotive after operating in zero or below zero temperatures the valve 44 may be opened, permitting liquid to pass to the reservoir or expansion tank 41 from the cylinder and vice versa if necessary, a second line being provided if desired so that the liquid may be fed to the cylinder on each side of the piston. In this way the effects due to climatic changes are overcome, and it will be realized that provision is made for 60 a positive hydraulic lock at all times, due to the fact that the conditions are balanced and the cylinder is maintained full of liquid which cannot be displaced when the control valve 35 is closed and the bypassing line is closed. In the case where the capacity of each end of the cylinder 11 is different, when the piston is at dead centre, 65 for instance, in a structure where the piston rod passes through one end of the cylinder only (as in the case of Figure 6 to be described later), and there exists a difference between the capacity of each end of the cylinder corresponding to the length and width of the piston rod, the expansion tank of the reservoir 41 functions as a compensating means whereby when the valve 35 is open, 70 the excess fluid on one side of the piston would 75

be taken care of through the line 42 and reservoir 41, whereas when moving in the other direction, the reservoir would function to supply the extra liquid required to maintain balanced conditions.

In this way not only does the reservoir and its connections function as a means for maintaining the cylinder full of liquid, but it also functions under certain conditions as a compensating medium to promote balanced conditions within the cylinder 11.

The line 42 from the expansion tank to the cylinder 11 is, as previously indicated, connected through the control valve 35 so that when it is shut there can be no variation of the liquid in the cylinder and consequently a positive hydraulic lock must result. However, it is apparent that the expansion tank could be connected with both ends of the cylinder 11 and provided with valve control means without it being necessary to pass through the valve 35. The preferred form, however, has been illustrated.

To illustrate the operation of the structure described and assuming that it is desired to lower the radius rod 19, the lever B is moved forwardly, causing the arm 33 of the air valve 27 and the arm 36 of the liquid valve 35 to swing in the same direction. In the case of the former, the valve 27 is rotated in an anti-clockwise direction to establish communication between the air line 28 and the pipe line 29, whereas in the case of the latter, communication between the pipe lines 38 and 37 is established. Air entering the left hand end of the cylinder 10 causes the piston to move to the right, while the other side of the cylinder is vented to the atmosphere through the pipe line 30 and exhaust vent 31. When the piston 12 has been caused to move to a desired extent, the lever B is returned to normal position, shutting off the supply of compressed air to the cylinder 10 and at the same time shutting off communication between the pipe lines 37 and 38 of the cylinder 11. At this point the liquid in the cylinder 11 operates to lock piston 13, and consequently the radius rod 19 is locked in its adjusted position through its connections with the piston rod 14.

In order to advise the engineer as to the position at which the piston 13 is locked or in other words, the position at which the valve motion has been set, an indicator 45 may be positioned within the cab connected in any suitable way, such as by a pin and slot connection with an operating rod 46 which is pivotally connected as at 47 to a part disposed on the crosshead 15 whereby movement of the piston rod 14 is registered by the indicator. In this way the engineer is advised at all times as to the setting of the valve motion and he is able to alter the setting with accuracy. Any suitable means for operating the gauge may be employed and while the connections have been shown disposed over the pistons, it will be realized that the connections could be disposed below the pistons or in any suitable desired location, the indicator being arranged so that the pointer preferably moves in the direction of movement of the piston rod 14.

As the operation of lever B involves the moving of it forwardly or rearwardly any desired distance within the range of movement permitted and the return of the lever to normal position immediately a setting required has been obtained, it is desirable to provide a means for returning the lever to normal position, in the case where it might inadvertently be left in a forward or rearward position, which would cause either

one of the pistons to strike the end of its cylinder. To this end the rod 46 may be slotted as at 48 to receive a pin 49 connected with a link 50, the latter being pivoted as at 51 to a suitable mounting between the cylinders 10 and 11 and pivotally connected as at 52 to the operating rod 32. Thus, when the operating lever B is moved forwardly for instance, the link 50 pivots about its pivot point 51 so that the pin 49 carried at its upper end is moved to a corresponding extent in the opposite direction to the pivot pin 52. Thus, if the lever B is left in its forward position the piston rod 14 as it moves forwardly will cause the rod 46 to move likewise and when the end of the slot 48 contacts with the pivot pin 49, this will cause the link 50 to be returned to its normal setting returning lever B to its normal setting and consequently shutting off the valves. The points at which contact takes place between the ends of the slot 48 and the pivot pin 49 may be such as to correspond with a point just short of contact between the pistons 12 and 13 and the end walls of their cylinders, the mechanism operating in the same manner whether the lever B is positioned forwardly or rearwardly of its normal setting.

Preferably the quadrant bar 53 associated with lever B is provided with a shallow centre notch 54 to receive a co-operating spring urged member 55 which may be moved in or out of the notch upon forward or rearward swinging movement of the lever. The quadrant bar also is preferably provided with shoulders 56 and 57 so formed that the member 55 will readily pass over them without obstruction but by providing such shoulders the engineer is immediately aware of the fact that the spring pressed member has reached these predetermined points, the first shoulder 56 indicating the finest possible opening of the valve to the cylinder 12 which permits him to make the finest of adjustments, whereas the shoulder 57 is disposed at such a position as to indicate a substantially half open valve suitable for ordinary reversing and switching movements. The end stops 58 and 59 on the quadrant bar 53 of course indicate a full open valve and lever B may be shifted to its full extent of travel abutting the end stops 58 and 59 to provide a full open valve for a quick operation such as, for instance, emergency stopping, as required in the case where the brakes may have failed to work due, for instance, to ice.

It is apparent that in the range of swinging movement of the lever B there is no restriction as to the extent to which it may be swung as the finest possible adjustment may be made without hindrance, it being only necessary to shift the lever to the desired extent and return it to normal position and after each shift of the lever the piston rod 14 is locked immediately that the lever B is returned to normal position closing the valves 27 and 39.

The foregoing illustrates one complete proposed embodiment of my invention. As has been pointed out, however, the cylinders 10 and 11 may be arranged in various ways, other than shown in Figs. 1 and 2. In Fig. 6, one different form of arrangement is illustrated, wherein the cylinders 10 and 11 are spaced apart from one another to a considerable extent, and the crosshead 15 is connected to the piston rod at a point intermediate its end and intermediate the ends of the cylinders. As shown the pistons are connected together as a unit by means of the crosshead guide 60 disposed above the crosshead and ex-

tending between and connected to each cylinder. The crosshead guide may be conveniently connected to a pair of brackets 61 and 62 which may be disposed to connect with the boiler or a suitable mounting structure formed on the boiler. Thus the structure may be readily mounted and dismantled as a unit. In this form of construction the crosshead guideway 60 is so formed that one side wall 63 is readily detachable and is connected to the top plate 64 by means of a series of bolts 65 so that in dismantling it is only necessary to remove the side wall 63 in order readily to detach the crosshead. The locking piston housed in cylinder 11 in Figure 6 connects with the main piston rod and does not have a rod projecting from its opposite side. Hence the one end of the cylinder has a greater capacity than the other which is compensated for automatically by the tank 41 each time the valve 35 is opened to change the position of the piston in cylinder 11, as has generally been referred to in an earlier part of this specification.

It will be apparent that other modifications are possible throughout the structure. As one instance, it will be realized that the expansion tank or reservoir 41 may be variously positioned. In Fig. 5 the expansion tank has been shown as positioned directly above the valve structure when the latter is positioned on the upper side of the cylinder 10, and a safety valve or shock valve of any well known form has been generally indicated at 66 in this view operable at a given pressure if desired. The expansion tank or reservoir 41 might, of course, be placed at any suitable point on the engine above the level of the hydraulic cylinder and might be conveniently established on top of the locomotive.

Any suitable type of control valve for the cylinders 10 and 11 may be employed, the preferred type having been illustrated in the drawings where both are rotary valves of simple design carried in a housing which may be provided with a screw cap closure 67, compression spring 68 and a sealing gasket 69.

From the foregoing, it will be apparent that I have provided a reversing gear for locomotives which will provide for a positive locking of the structure under all conditions when required. Moreover, it is clear that the structure is of very simple construction employing a minimum of parts which will effect the desired operation efficiently, while including means to indicate to the

engineer the position of the control piston at all times, and a safety device to provide against accident or damage in the case where through inadvertence the operating lever may have been left in other than a normal position after the required operation of the reversing gear.

Various modifications may be made in this invention without departing from the spirit thereof or the scope of the claim, and therefore the exact forms shown are to be taken as illustrative only and not in a limiting sense, and it is desired that only such limitations shall be placed thereon as are set forth in the accompanying claim.

I claim:

Power reversing gear for locomotives comprising in combination with locomotive link block structure an operating cylinder and a control cylinder, pistons in said cylinders having piston rods commonly connected to cause said pistons to operate in unison, control valves for said cylinders and means connected with said control valves for operating them in unison, said control cylinder being filled with liquid, said control valve for said latter cylinder operating to establish and disestablish connection between opposed ends of the control cylinder for transferring the liquid or opposing transfer of the liquid from one end of the cylinder to the other, the control valve for said operating cylinder admitting an operating fluid to the cylinder to actuate its piston and connected piston in the control cylinder when said valves are open, an expansion tank adapted to be connected with said control cylinder and means controlled by the control valve for said cylinder for placing said expansion tank in direct communication with the control cylinder only when its control valve is open, said expansion tank carrying a volume of liquid and functioning to permit passage of liquid to and from the control cylinder, additional means for establishing communication between the control cylinder and expansion tank to compensate for variations in the volume of liquid in the control cylinder caused by extreme climatic changes, and means for connecting the commonly connected piston rods with the link block structure, said operating cylinder functioning to vary the setting of the link block structure, said control cylinder functioning to positively lock the link block structure in a set position.

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