March 1, 1966 H. M. VALENTINE Re. 25,969

COMBINED CONTROL AND TRACTOR PROTECTION VALVE

Original Filed June 28, 1961 2 Sheets-Sheet 1

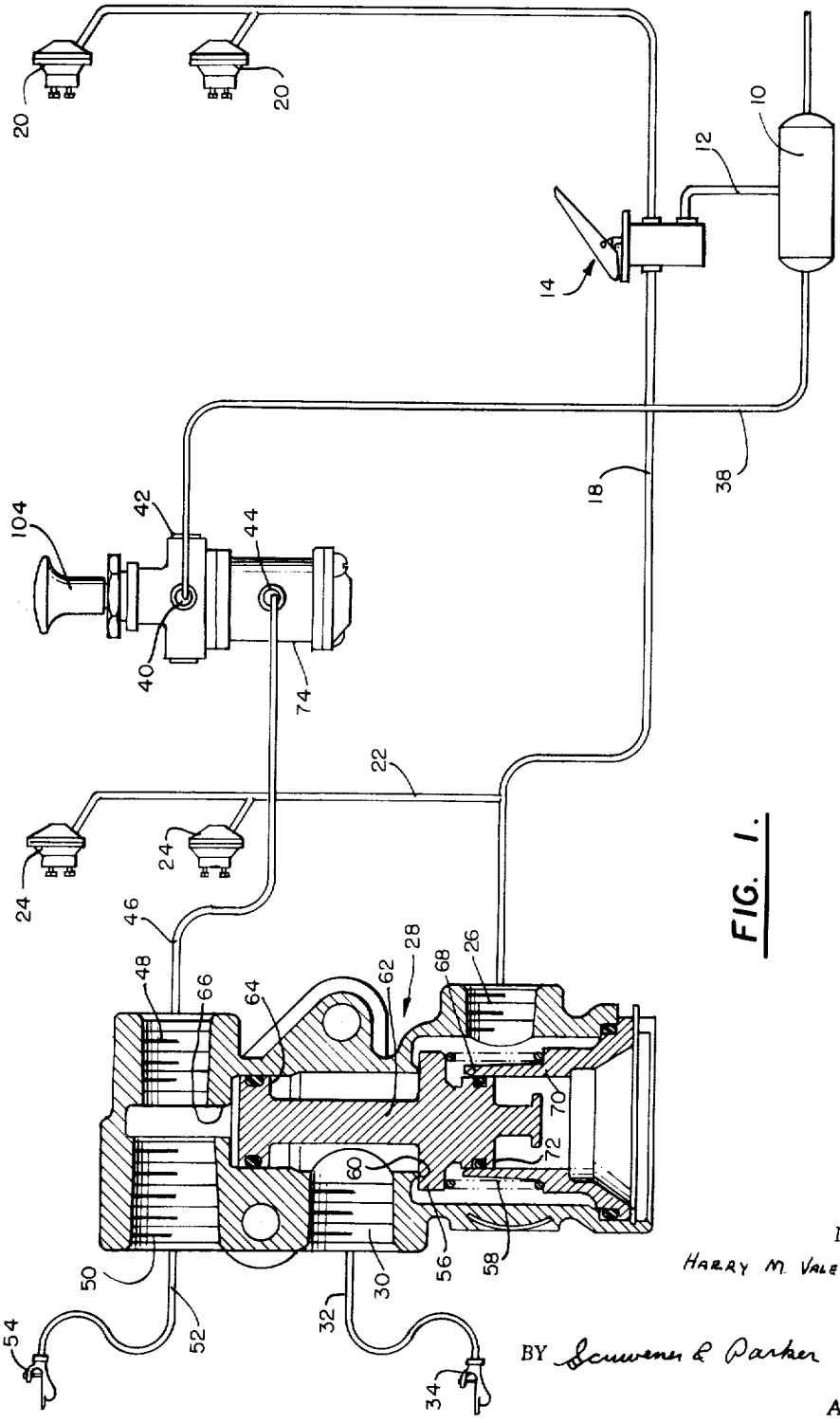


FIG. 1.

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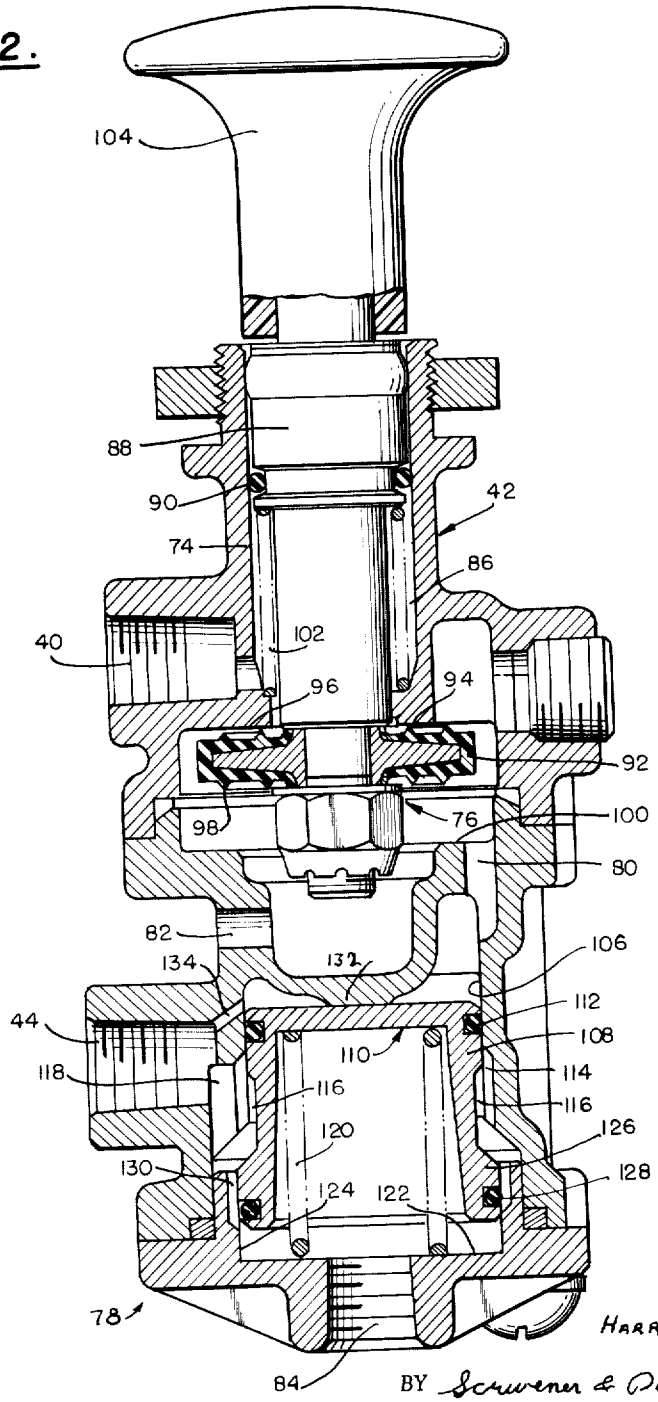
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COMBINED CONTROL AND TRACTOR PROTECTION VALVE

Original Filed June 28, 1961 2 Sheets-Sheet 2

FIG. 2.



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COMBINED CONTROL AND TRACTOR PROTECTION VALVE

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8 Claims. (Cl. 303—29)

Matter enclosed in heavy brackets [ ] appears in the original patent but forms no part of this reissue specification; matter printed in italics indicates the additions made by reissue.

This invention relates to braking systems for use in tractor-trailer combinations and, more particularly, to an improved system, including a control valve therefor, for conserving air pressure on a tractor vehicle in the event of tractor-trailer break-in-two.

The present invention is concerned with braking systems of a well-known type having a service conduit, under the control of a manually operable brake-valve, and an emergency conduit which is normally charged with tractor reservoir pressure and so long as this pressure is above a predetermined safe value the emergency portion of a trailer relay-emergency valve is retained by this pressure in an inactivated position but whenever the pressure in the emergency conduit falls below the predetermined safe value, as might be caused for example, by tractor-trailer break-in-two, the emergency portion of the trailer relay emergency valve shifts automatically to its emergency position thereby directly connecting a trailer pressure reservoir with the trailer brakes so that these are automatically applied entirely independently of the brake valve carried on the tractor. To prevent the loss of pressure in the tractor system, particularly in the event of tractor-trailer break-in-two, substantially all connected vehicles carry on the tractor some sort of tractor protection valve means which is normally retained open by pressure in the tractor system which is above a predetermined safe value and this valve automatically moves to closed position to conserve sufficient pressure on the tractor for braking purposes whenever the pressure in the emergency conduit falls below the predetermined safe value.

In addition to a pressure responsive tractor protection valve, conventional fluid pressure brake systems also include a second manually operable valve which can be moved to a position for connecting the trailer emergency conduit to atmosphere while simultaneously disconnecting said conduit from the tractor system, thereby producing an automatic setting of the trailer brakes exactly as if the emergency conduit was broken, and it is an object of the present invention to provide an improved valve of the foregoing nature.

More particularly, it is an object of the present invention to provide a manually operable control valve which can be utilized to exhaust the trailer emergency conduit at the will of the operator while at the same time it closes off that portion of the emergency conduit carried on the tractor so as to conserve fluid pressure existing in the tractor system.

Another object of the invention is to provide a manually operable control valve which accomplishes the foregoing and yet is automatically responsive to the fall of pressure in the emergency conduit below a predetermined safe value so as to conserve pressure in the tractor system while simultaneously connecting the trailer emergency conduit to atmosphere.

It is yet another object of the invention to provide a valve which accomplishes the foregoing object yet is so constructed and arranged that when the pressure in the emergency conduit has fallen below a safe value, no

amount of manual manipulation of the valve handle can prevent the automatic portion of the valve from moving to its emergency position nor, once the emergency portion has moved to its emergency position, can it be moved out of its emergency position by manipulation of the valve handle until such time as pressure in the tractor reservoir has been restored to a value above the predetermined safe value.

Still another object of the invention is to provide in a single casing manually operable valve means for controlling the flow of fluid pressure to and from the trailer emergency conduit and an automatically movable valve means which performs the function of a tractor protection valve to conserve fluid pressure on the tractor whenever this pressure falls below a predetermined safe value, the second valve means being movable only in response to fluid pressure and entirely independently of the manual movement of the first valve means.

Still another object of the invention is to provide control valve means of the foregoing nature wherein the manually operable valve portion is also responsive to the fall of pressure in the emergency conduit and is movable automatically to a position positively disconnecting the tractor system from the trailer emergency conduit.

Other objects and their attendant advantages will become apparent as the following description is read in conjunction with the accompanying drawings wherein:

FIG. 1 is a schematic view of a braking system for use with tractor-trailer combinations and incorporating the present invention; and

FIG. 2 is an axial sectional view of a valve constructed in accordance with the present invention.

Referring to FIG. 1, a brake system arranged in accordance with the present invention is there illustrated as comprising a main tractor reservoir **10** which is connected by a conduit **12** to a conventional manually operated, self-lapping brake valve **14** having outlet service conduits **16, 18**, the former of which leads to the forward brake actuators **20** of the tractor and the latter of which has connected thereto a branch conduit **22** leading to the rear brake actuators **24** of the tractor. The conduit **18** leads rearwardly of the tractor and is connected to an inlet port **26** of a tractor-carried, pressure responsive check valve means **28** having an outlet port **30** which has connected thereto a flexible conduit **32** carrying the usual "glad hand" **34** for connection to the corresponding member on the trailer (not shown).

Leading from the tractor reservoir is a second conduit **38** which is connected to the inlet port **40** of control valve means **42** constructed in accordance with the invention and hereinafter described in detail. The valve **42** has an outlet **44** to which there is connected one end of an emergency conduit **46** whose opposite end is connected to an inlet port **48** of the valve **28**. The port **48** is in open communication with an outlet port **50** which has connected thereto an end of a flexible conduit **52** carrying at its opposite end a "glad hand" **54** adapted to be connected to the corresponding part of the trailer emergency conduit (not shown).

The valve **28** is of substantially conventional construction and includes a check valve element **56** which is normally urged by a spring **58** against a valve seat **60** to cut off communication between the inlet and outlet ports **26, 30**. The check valve **56** has connected thereto a plunger **62** whose upper end carries a piston **64** having an upper surface which is exposed at all times through a port **66** with the pressure existing in the emergency conduit by way of aligned ports **48, 50**. When the pressure in the emergency conduit is above a predetermined safe value of, say, 40 p.s.i., the upward force of the spring **58** is overcome by the pressure acting downwardly on the piston **64** so that

the check valve **60** is moved from its normally closed position of FIG. 1 to a position wherein the lower side of the element **60** engages the upper annular edge **68** of a hollow part **70** thereby effecting a connection between the service ports **26, 30**. In order that pressure in the service conduit will not thereafter retain valve element **60** in its open position independently of the pressure existing at the emergency ports **48, 50**, a balancing piston **72** is provided to slide in hollow member **70**. The diameters of pistons **64, 72** are equal so that pressures acting upwardly and downwardly on valve element **56** are equalized and can have no effect on the valve in its movement between its open and closed positions. It will, of course, be apparent that whenever the pressure in the emergency conduit falls below a safe value, the valve element **56** moves to its closed position to disconnect ports **26, 30** so that when the brake valve on the tractor is moved to its open position, service pressure admitted to conduit **18** cannot flow out of the trailer service line which might previously have been broken by tractor-trailer break-in-two.

Referring now to FIG. 2 which illustrates the control valve **42** of the present invention, it will be noted that said valve comprises a casing **74** containing the aforementioned inlet and outlet ports **40, 44**. The connection between the ports **40, 44** is controlled by two valve elements **76, 78**, which may be considered as separate serially arranged valves in the emergency conduit with the valves being communicated with each other by way of a port or passage **80** in the casing **74**. The passage **80** is, in effect, an extension of the emergency conduit carried on the tractor and it is the purpose of the upper valve element **76** to connect passage **80** either to the inlet port **40** leading to the tractor reservoir or to an exhaust port **82**. As will become fully apparent hereinafter, when valve **76** is moved to a position connecting port **80** with port **40**, fluid pressure is admitted to the second valve member **78** by way of passage **80** and if this pressure is above the predetermined safe value, the valve **78** is moved by this pressure to a position connecting passage **80** with outlet port **44** and thereby admitting emergency pressure through the upper end of check valve **28** to the trailer relay-emergency valve to move and retain the emergency portion thereof to its inactive position in a manner well known in the art; at the same time, the service check valve element **56** of valve **28** is moved to open position as above explained.

When the valve member **76** is moved from the last mentioned position back to the position of FIG. 2, passage **80**, and hence valve member **78** are connected to atmosphere through exhaust port **82** thereby causing valve member **78** to return to the position of the drawing and effect a connection between outlet port **44** and a second exhaust port **84** in the bottom of the casing **74**. Upon this occurrence, pressure in the emergency conduit **46** is exhausted to atmosphere to cause the service check valve element **56** to move to its closed position of FIG. 1 while simultaneously the emergency portion of the trailer relay emergency valve moves to its emergency position to cause an automatic application of the trailer brakes.

Referring more particularly to the valve member **76** of the control valve **42**, it will be observed that the casing **74** includes a bore **86** communicating with inlet port **40** and slidably receiving a valve plunger **88** having an O-ring seal **90**. The lower end of the plunger **88** carries a valve element **92** of rubbery material having an inlet valve on its upper face and an exhaust valve on its lower face. The inlet valve is constituted by an annular bead **94** adapted to contact a face **96** of the casing **74** while the exhaust valve is formed by an annular bead **98** adapted to contact a face **100**. A spring **102** is confined between a portion of the casing **74** and the plunger **88** and constantly tends to urge the plunger upwardly to maintain the inlet valve **94** closed. When closed, the area of the annular bead **94** is less than the area of the O-ring so that when the valve member **92** is in the closed or emergency position of FIG. 2, the valve will remain in such position even though the pressure at the inlet port **40** rises to full reservoir pressure. The valve may, however, be manually moved by means of a handle **104** from the position of FIG. 2 to a position wherein bead **98** engages face **100**, in which event the valve element **92** will remain in such position provided the pressure acting on the upper side of the element **92** is above the minimum safe pressure of 40 p.s.i. This is due to the area of the exhaust valve bead **98** which is considerably larger than the bore **86**. Hence, the valve element **92** is pressure responsive by reason of the pressure acting on the upper surface thereof over the area of the lower bead **98** to maintain the valve down against the force effective on the ring **90** and the force of the spring **102** until the fluid pressure at the inlet port **40** drops to or below the minimum safe value, whereupon the spring **102** moves the valve to the position of FIG. 2.

Referring now to the valve **78**, this includes a bore or chamber **106** which slidably receives the upper end **108** of an inverted-cup-shaped, piston-like valve element **110** having an O-ring **112** which, in the position of FIG. 2, serves to effect a seal between the upperside of the member **110**, which is at all times in open communication with the aforementioned passage **80**, and a series of vertical grooves **114** in the wall of bore **106**. The grooves **114** serve to retain the O-ring **112** within its annular groove about the upper end of member **110** while simultaneously connecting the space above the member **110** to the outlet conduit **44** when the element **110** is moved by pressure from the position of FIG. 2 to a depressed position wherein the O-ring **112** is below the upper ends of the grooves **114** so that fluid pressure acting on member **110** can flow to outlet port **44** by way of grooves **114** and an annular recessed portion **116** about the exterior of member **110**, which recessed portion is at all times in communication with the outlet port **44** by way of an opening **118** in the casing **74** as shown.

The element **110** is normally retained in the position of FIG. 2 by means of a spring **120** interposed between an abutment **122** and the lower surface of the member **110** as shown.

The bore **106** has an enlarged lower part **124** which slidably receives an enlarged part **126** of the piston-like element **110**, the enlarged part **126** having an O-ring **128** which is adapted to slide past a series of vertical grooves **130** in the bore part **124**, the grooves having a length such that when the element **110** is in the position of FIG. 2, the grooves communicate the space beneath element **110**, which space is at all times in open communication with the aforementioned exhaust bore **84**, which the outlet port **44** by way of annular recess **116** and opening **118**. It will be understood that when element **110** is moved to its second position by pressure acting on the upper side thereof, the O-ring **128** will be first moved below the grooves **130** to disconnect the exhaust bore **84** from the outlet port **44** and immediately thereafter or simultaneously therewith the O-ring **112** will be moved below the upper end of the grooves **114** so as to connect the pressure in passage **80** with the outlet port **44**. As pressure flows from passage **80** to port **44** it also acts downwardly on O-ring **128** which, being larger than O-ring **112**, causes the element **110** to be moved fully into its second position with a snap action. After element **110** has been moved to its second position, it is retained in this position by pressure above the minimum safe value acting on the entire area of element **110** defined by the circumference of the larger O-ring **128** and the enlarged bore part **124**. When the pressure in passage **80** *and bore 106* falls below the minimum safe value of 40 p.s.i., spring **120** acts on element **110** to move it to the position of FIG. 2 where its upward movement is adapted to be limited by a stop member **132** integral with casing **74**. As element **110** approaches its upper position, the O-ring **128** is first moved above the lower ends of groove **130** and immediately thereafter the O-ring **112** is moved above the upper ends of the grooves **114** so

that element **110** moves fully into its position of FIG. 2 with a snap action. Upon this occurrence, [pasage **80** is disconnected from] outlet port **44** [while the latter] is connected with the exhaust port **84**. To positively insure against the possibility of both O-rings **112** and **128** partaking of a lap position wherein each is in sealing engagement with its respective bore part beyond the grooves thereof, a small bleed passage **134** is provided which at all times interconnects the space on the upper side of element **110** *as well as passage 80* with the outlet port **44**. This arrangement prevents the trapping of pressure in the emergency conduit downstream of outlet port **44** to the extent where an emergency brake application is long delayed, depending on the location and magnitude of a possible leak in the emergency conduit The bleed hole **134** is of such size that it does not exceed the capacity of the vehicle's compressor (not shown) to build up the system pressure in the event the handle **104** of valve member **76** is held in manually during pressure build-up from a no air condition to a pressure above the predetermined safe value whereupon valve element **92** is retained by pressure in its depressed condition as previously mentioned.

In operation, assume a condition wherein the pressure in the main reservoir is substantially above the minimum safe value of 40 p.s.i. and assume further that the control valve of FIG. 2 and the checkvalve of FIG. 1 are in the positions illustrated. Under these circumstances, the emergency conduit **46** is connected with atmosphere by way of outlet port **44** and exhaust port **84** of valve **42** so that the trailer brakes are set and the tractor and trailer service conduits are disconnected from each other as a result of the closed condition of the service check valve element **56** of valve member **28**. Should the operator now desire to release the trailer brakes, he merely pushes inwardly on the handle **104** of valve **42** to compress spring **102** while moving inlet valve bead **94** to its open position and exhaust valve bead **98** to its closed position. Because the pressure is assumed to be above the predetermined safe value, element **92** is retained in the second position by the pressure at inlet port **40**. This pressure then flows by way of passage **80** to the upper end of bore **106** of the lower valve means **78** and acts on the upper surface of valve member **110** to move this downwardly against the upward force of spring **120** thereby connecting the pressure in passage **80** to the outlet port **44** by way of vertical grooves **114**, recess **116** and opening **118**, the pressure thus admitted to outlet port **44** flowing through emergency conduit **46** and the upper end of valve **28** to the trailer relay emergency valve so that this now moves to its inactive position thereby releasing the trailer brakes. The pressure in the emergency conduit also acts on piston **64** of valve member **28** to move the service checkvalve element **56** to its open position thereby interconnecting the tractor and trailer service systems so that all of the brakes on the connected vehicles may be service applied under control of the brake valve **14** on the tractor.

Assume now, that for some reason the operator desires an application of the trailer brakes independently of the tractor brakes, as might be desirable in parking the vehicles. Under these conditions, the operator merely pulls the valve handle **104** outwardly which has the effect of disconnecting inlet port **40** from passage **80** in valve casing **74** while simultaneously connecting passage **80** to exhaust port **82**. Upon this occurrence, downwardly acting pressure on the top of element **110** of valve part **78** is immediately relieved and the spring **120** returns element **110** to the position of FIG. 2 thereby connecting the emergency conduit **46** to atmosphere by way of ports **44**, **84** so that the emergency conduit is exhausted to effect an application of the trailer brakes as previously explained.

Assume now, that the operator is driving the vehicles and a slow leak takes place somewhere in the brake system so that the pressure in the tractor reservoir **10** falls below the safe value but this fact is unknown to the operator. As soon as the pressure reaches a level slightly less than 40 p.s.i., spring **102** of the manually controlled valve member **76** moves plunger **88** to the position of FIG. 2 thereby disconnecting port **40** from passage **80** while connecting the latter to atmosphere. Upon this occurrence, valve element **110** promptly moves to the position of FIG. 2 to effect an emergency application of the trailer brakes. Should, at this stage, the operator wish to release the trailer brakes even though he is aware that braking pressure is below a safe value, he may endeavor to effect such a release by pushing inwardly on the handle **104** of the valve member **76**. He is, of course, capable of doing this and when this has been accomplished he can, by continued manual pressure, maintain the valve element **92** in its second position so as to connect tractor reservoir pressure with the upper surface of valve element **110** by way of port **40** and passage **80**. However, because tractor reservoir pressure is below the safe value which is required to depress spring **120** acting on valve element **110**, the latter remains in the position of FIG. 2 and the trailer brakes remain applied and no amount of manipulation of handle **104** will effect a release of the trailer brakes and these can only be released by restoration of tractor reservoir pressure to a level above the minimum safe value.

Assume again that the tractor-trailer combination is moving normally and that the trailer unexpectedly breaks away from the tractor thus breaking the service and emergency conduit at a point between the vehicles. Upon this occurrence, the trailer emergency conduit is, of course, immediately exhausted to atmosphere and the trailer brakes are automatically applied. Because that part of the emergency conduit carried on the tractor is also connected to atmosphere through the broken end of the conduit, the emergency conduit **46** is immediately exhausted though this has no immediate effect if it is assumed that tractor reservoir pressure was substantially above the predetermined safe level at the moment of break-in-two. So long as tractor reservoir pressure is above the safe value both valve **76** and valve **78** remain in their down position and pressure flows from the tractor reservoir through the port **40**, passage **80**, outlet port **44** through the broken emergency conduit to atmosphere and this flow continues until the pressure in the tractor reservoir has fallen to just below the minimum safe operating value whereupon manually controlled valve element **92** is moved automatically by its spring **102** to the position of FIG. 2 thereby immediately disconnecting the broken conduit from the tractor reservoir so that sufficient pressure is retained in the tractor reservoir to permit the tractor to be brought to a stop by a regular service application of the tractor brakes. Naturally, as soon as the manually operable valve element **92** had moved to the position of FIG. 2, the passage **80** was connected to atmosphere through exhaust port **82** and the valve element **110** of the valve part **78** moved to the position of FIG. 2 from whence it cannot be moved merely by the manual operation of the valve element **92**. Thus, the operator is prevented from involuntarily connecting the tractor reservoir to atmosphere through the broken emergency conduit by unwittingly pushing inwardly on the handle **104**.

In none of the foregoing examples can the operation of the valve device **78** be prevented by a balanced pressure condition acting on element **110** to retain this in a lap position. As previously explained, such action is obviated by the small bleed hole **134**.

It should be apparent from the foregoing description, that the present invention has provided an improved combined trailer brake control valve and a tractor protection valve which positively prevents the loss of tractor braking pressure in the event of leakage or tractor trailer break-in-two. Furthermore, the valve of the invention affords

means whereby the operator is prevented from overriding the automatic operation of the safety features of the invention. Though the valve of the invention has been described in connection with its use in a tractor-trailer braking system, it will be apparent that the valve has equal applicability in any fluid pressure system where it may be desirable to have both manual and non-overridable automatic control of the pressure in the system.

It will be apparent that the invention is susceptible of a variety of modifications and changes without, however, departing from the scope of the appended claims.

What is claimed is:

1. Fluid pressure control valve means comprising a casing having an inlet port connected at all times to a source of fluid pressure and an outlet port connected at all times to a pressure actuated device, first and second valve chambers in said casing respectively connected to said inlet and outlet ports, a pair of independently movable valve elements each respectively occupying one of said chambers, a pair of exhaust ports each connected respectively to one of said chambers, passage means interconnecting said chambers, manual means for moving said first valve element between a first position wherein said inlet port is disconnected from said passage means and the latter is connected to said first exhaust port and a second position wherein said inlet port is connected to said passage means and the latter is disconnected from said exhaust port, and means responsive to the pressure in said passage means for effecting movement of said second valve element between a first position wherein [said passage means is disconnected from] said outlet port [and the latter] is connected to said second exhaust port and a second position wherein [said passage means is connected to] said outlet port [and the latter] is disconnected from said second exhaust port.

2. The fluid pressure control valve means of claim 1 wherein resilient means normally urge each of said valve elements towards its first position.

3. The fluid pressure control valve means of claim 2 including fluid pressure responsive means for retaining said first valve element in its second position against said resilient means so long as the pressure at said inlet port is above a predetermined value.

4. The fluid pressure control valve means of claim 2 wherein said resilient means acting on said second valve element retains said element in its first position until the pressure in said passage means is above a predetermined value.

5. Fluid pressure control valve means comprising a casing having inlet and outlet ports respectively connected to a source of fluid pressure and to a fluid pressure receiver, manually operable valve means in said casing movable between first and second positions for [permitting or preventing] *preventing or permitting* the flow of fluid pressure from said inlet port towards said outlet port, [means independent of said manually operable valve means for preventing the flow of fluid pressure from said inlet port to said outlet port unless said pressure at said inlet port is above a predetermined value, said last named means comprising] second valve means in said casing between said inlet and outlet ports, *said casing having an exhaust port,* resilient means urging said second valve means to a position [preventing the flow of fluid pressure from said inlet to] *normally connecting* said outlet port, *and exhaust port,* fluid pressure responsive means responsive to pressure above [said] *a* predetermined value for moving said second valve means to a position [connecting] *disconnecting* said [inlet and] outlet *and exhaust* ports when said manually movable valve means is moved to its second position, and means for subjecting said fluid pressure responsive means to the pressure at said inlet port only when said manually operable valve means is moved to its second position.

[6. The fluid pressure control valve means of claim 5 including an exhaust port in said casing controlled by said second valve means, said valve means including means connecting said exhaust port to said outlet port when said valve means is in its first position and disconnecting said outlet port from said exhaust port when said valve means is in its second position.]

7. The fluid pressure control valve means of claim 5 including [an] *a second* exhaust port in said casing controlled by said manually operable valve means, means connecting said *second* exhaust port and said pressure responsive means when said manually operable valve means is in its first position, and means disconnecting said pressure responsive means from said *second* exhaust port when said manually operable valve means is in its second position.

8. The fluid pressure control valve means of claim 5 including a [bleed] passage at all times connecting said outlet port with said fluid pressure responsive means.

[9. The fluid pressure control valve means of claim 5 including a pair of exhaust ports in said casing, means for connecting or disconnecting said outlet port to one of said exhaust ports depending upon whether said second valve means is in its first or second position, and means for connecting or disconnecting said pressure responsive means to said second exhaust port depending upon whether said manually operable valve means is in its first or second position.]

10. The fluid pressure control valve means of claim [9] 7 wherein said fluid pressure responsive means is integral with said second valve means and includes a pair of differential areas, one of which is alternatively connectable to said outlet port or said first exhaust port and the other of which is alternatively connectable to said inlet port or said second exhaust port depending upon whether said valve means are in their first or second positions.

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EUGENE G. BOTZ, *Primary Examiner.*