

## SPECIFICATION

### Brake actuating system

5 This invention relates to vehicle braking systems and more particularly concerns fluid actuated braking systems.

Conventional fluid actuated vehicle braking systems include a source of fluid under pressure such as a compressor driven by the vehicle prime mover and connected to and building pressure in a fluid tank. The tank is connected by a main service line to the brake mechanism, the line including valve means actuated by the vehicle driver such as by operating a vehicle brake pedal. The service line includes means which on release of the pedal cause the line to be exhausted to atmosphere where the fluid is gas e.g. air or into a low pressure zone in the case of the fluid being a liquid e.g. oil.

Many known circuits, especially when incorporated in tractor-trailer combinations, include a second service line known as an emergency line which is supplied with pressurised fluid from the pressure fluid source of the main service line and has its own pressurised fluid tank. Systems involving main and emergency service lines are known as two-line systems and are compulsory in many countries.

Three line systems are sometimes employed and in some countries are obligatory. In such systems a third service line, sometimes called a "dead man line" is included having its own source of pressurised fluid supplying a line with its own valves actuated by action by the vehicle driver as by application of the vehicle hand brake by the driver, and operable if the main and emergency circuits are inactive or fail.

When a driver reverses a vehicle, particularly a large heavily laden goods carrying vehicle, his rear vision is often obstructed and he is unable to see an obstacle behind his vehicle. Rigid obstacles such as a loading bay or a wall may be damaged and also cause damage to the vehicle and where the obstacle is a human or animal body serious injury or death may result.

Detector devices are known which actuate a warning such as a horn or light in the driver's cab to alert the driver to apply the brakes but these suffer from the disadvantage that the driver's reaction time may be too long for a collision to be avoided. Also when the obstacle struck has moved out of contact with the detector it then ceases to activate the warning device.

An object of the present invention is to provide a vehicle braking system in which the aforesaid disadvantages are minimised or eliminated.

According to the present invention we provide a vehicle braking system comprising fluid actuated brakes, at least one source of pres-

surised fluid, at least one service fluid line connecting said source of pressurised fluid to a brake actuating arrangement, said brake actuating arrangement serving to apply the brakes in response to a change in pressure in said service line, and an auxiliary braking system comprising:

(a) an auxiliary fluid circuit including a fluid control valve disposed in said service line between said source of pressurised fluid and said brake actuating arrangement;

(b) a detector mounted at the rear of the vehicle and movable between operative and inoperative positions;

(c) first control means responsive to the position of the detector and providing an open fluid path in said auxiliary fluid circuit when the detector is in its operative position and obstructing said fluid path when the detector is in its inoperative position;

(d) second control means independent of said first control means and responsive to the position a driver-controlled reverse selector on the vehicle, said second control means providing an open fluid path in said auxiliary circuit when said driver-controlled reverse selector is in a vehicle-reversing condition and obstructing said fluid path when the selector is not in a vehicle reversing condition;

(e) said auxiliary circuit fluid control valve being so connected that upon operation of said auxiliary circuit fluid control valve by the first and second control means, the fluid path in the service line between said valve and said source of pressurised fluid is obstructed and the fluid path between said fluid control valve and said brake actuating arrangement is opened, whereby said fluid actuated brakes are applied.

In one embodiment said fluid control valve is a quick release valve connected to an emergency fluid service line, and the first control means is arranged to act on the quick release valve, when the detector is in the operative position, to cause it to apply pressurised fluid to the brakes independently of any change in said emergency fluid service line.

In another embodiment said fluid control valve is a shuttle valve connected in a principal fluid service line controlled by the vehicle driver's foot brake pedal.

In yet another embodiment said fluid control valve is a relay emergency valve connected to a fluid service line and the first control means is arranged to act on the relay emergency valve when the detector is in the operative position, to cause pressurised fluid to be applied to brakes independently of any change in pressure in said fluid service line.

The fluid service line in this embodiment may be the principal fluid service line controlled by the vehicle driver's foot brake pedal or it may be the emergency fluid service line which is connected to the relay emergency

valve.

In this specification the expression "fluid service line" refers to one of the fluid lines present in the conventional braking system, e.g. the principal service brake line operated by the driver's foot brake and the emergency line in a two-line system. In a three-line system it includes the additional emergency line known as the "dead man line".

Reference is now made to the drawings in which:-

Figure 1 is a perspective view showing diagrammatically the rear of a vehicle having a detector bar fitted thereto;

Figure 2 is a simplified circuit diagram of a braking system of an articulated vehicle comprising a tractor unit and trailer unit with auxiliary braking means according to the invention; and

Figure 3 is a simplified circuit diagram of a braking system showing modification to the system shown in Fig. 2.

The diagram shown in Fig. 2 shows the application of the present invention to a conventional three-line vehicle braking system. The diagram in Fig. 2 shows the basic tractor layout to the right of the vertical line X-X and the trailer layout to the left of the line X-X. It will be apparent that these circuits could be modified to a two-line system and that such circuits may be applied to a tractor-trailer, a tractor semi-trailer unit or a single unit.

The systems described, with reference to the drawings, are air-brake systems which operate with air under an elevated pressure but they may also be operated with air under reduced pressure, i.e. a vacuum system. The invention is also applicable to equivalent hydraulic systems.

Fig. 1 of the drawings shows the rear of a vehicle fitted with one form of detector according to the invention. The detector is in the form of a detector bar 10 which is pivoted at 11 and 12 to a bar 13 fixed to the vehicle.

The detector bar 10 may be provided with means such as spring means (not shown) to bias it outwardly from the rear of the vehicle into its inoperative position. Limiting means (not shown) may also be provided to limit the amount of outward movement of the bar 10.

The detector bar 10 can pivot towards the rear of the vehicle about the pivots 11 and 12 from the inoperative position to an operative position in which it opens the control valve 13 which is normally closed and which is mounted on a bracket 14 rigid with the vehicle. The valve 13 shown is a mechanically actuated valve but this may be replaced by an electrical switch which completes an electrical circuit to operate an electrically operated control valve such as a solenoid valve.

The biasing of the bar should be such as to achieve the desired sensitivity so that a relatively small contact pressure will pivot the bar to its operative position and actuate the

control valve 13 or switch.

In Figs. 2 and 3 of the drawings only the trailer brake operation is shown for simplicity, the tractor brakes being operated on a similar principle including where the system is applied to a tractor only.

The system is supplied with air under pressure to an air line from a compressor driven by the tractor's prime mover in a conventional manner. For simplicity many conventional integers such as air dryers, variable load valves responsive to the road on the road wheel axles, and relays are omitted from the drawings but will usually be employed in a conventional manner. Single circuit protection valves may be fitted close to each of the reservoirs so that should one service line fail, the feed to the other line will continue to be maintained to enable the brake system to function.

Conventionally, a tractor unit comprises a main air tank M which can supply pressurised air to a line N under the control of a driver's foot brake pedal T, the line N terminating in a connector whereby it may be connected by a flexible line to a conventional connector N<sub>1</sub> leading to a corresponding line N<sub>2</sub> in the trailer. This line is the principal service line of the tractor-trailer.

The conventional tractor unit also comprises an auxiliary air tank B which is connected via a line P to a flexible line which may be connected to connector P<sub>1</sub> which leads to a corresponding line P<sub>2</sub> in the trailer. This line is the so-called "dead man line". The auxiliary air tank B is also connected via the line R and a flexible connector R<sub>1</sub> which leads to a corresponding line R<sub>2</sub> in the trailer. This is the emergency line.

In preferred brake actuating systems of the invention said auxiliary air tank B is also connected to a valve A which is activated by the driver controlled reverse selector of the vehicle (not shown). This selector will usually be a reverse gear selector in a gear-box of the manual or automatic type. The valve A is arranged so that it is in the open position when the reverse selector is in the vehicle reversing condition, the valve A also being provided with an exhaust to atmosphere which is opened only when the reverse selector is in a condition other than a vehicle reverse condition. The valve A is connected to a line S which can be connected with a flexible line to connector S<sub>1</sub> which leads to an auxiliary air line S<sub>2</sub> on the trailer. This line is part of the auxiliary braking means according to the invention.

The trailer is provided with a brake chamber associated with each wheel G, H, I and J and for normal braking under driver control these are connected to a relay emergency valve F which, in turn, is connected to a trailer air tank K. Thus, when the driver operates the foot brake pedal T, pressure is applied via lines N, N<sub>1</sub> and N<sub>2</sub> to the shuttle valve E and

hence the relay emergency valve F causing the valve to open and pressurised air is then applied from the tank K to the brake chambers G, H, I and J causing the vehicle brakes to be actuated.

The line R, R<sub>1</sub> and R<sub>2</sub> is also connected to the relay emergency valve F and is such that if the pressure of the air in the auxiliary air tank B does not reach a certain predetermined level then the relay emergency valve will be caused to open and permit pressurised air from the tank K to be connected to the brake chambers G, H, I and J.

Another safety feature which is conventionally incorporated in three-line systems is the line P, P<sub>1</sub> and P<sub>2</sub> which connects the quick release valve L to the auxiliary air tank B. This is the conventional "dead man line" and when pressure is applied via the line P, P<sub>1</sub> and P<sub>2</sub> to the quick release valve L, then the pressurised air from the auxiliary air tank B is connected to each of the brake chambers G, H, I and J.

One auxiliary braking system according to the present invention shown in Fig. 2 utilises the relay emergency valve to cause pressurised fluid to be applied to the brakes. In this embodiment the line S, S<sub>1</sub> and S<sub>2</sub> from the valve A is connected to a first control valve C which is actuated by a detector bar D movable between an inoperative position and an operative position when it is deflected by an object. When the detector bar D is in the operative position it causes control valve C to open and thereby connects the line S, S<sub>1</sub> and S<sub>2</sub> to the line S<sub>3</sub> which applies pressure from the auxiliary air tank B to the shuttle valve E, causing the line N, N<sub>1</sub> and N<sub>2</sub> to be shut off and applying pressure to the relay valve F. This pressure causes the relay valve F to operate and apply pressure from the air tank K to the brake chambers G, H, I and J and thus causes actuation of the brakes.

The auxiliary braking system described above is extremely simple to add to the existing braking system as it merely comprises the valve A to be operated by the reverse selector of the vehicle, the lines S, S<sub>1</sub>, S<sub>2</sub> and S<sub>3</sub>, the control valve C and the shuttle valve E. It will be seen that the addition of this auxiliary system in no way affects the existing braking system as it is merely necessary to insert the shuttle valve E in the connection between the line N<sub>2</sub> and the relay emergency valve F.

The operation of the auxiliary braking system will now be described.

When the driver wishes to reverse the vehicle it is necessary for him to select a vehicle reversing condition of the reverse selector. This opens the valve A causing pressure to be applied along the line S, S<sub>1</sub> and S<sub>2</sub> from the air tank B to the control valve C. The driver will then be able to reverse the vehicle normally until the detector bar D strikes an object and is deflected thereby. The detector bar D

will move towards the vehicle as a result of the impact to open the control valve C thereby connecting the pressurised air in line S<sub>2</sub> to line S<sub>3</sub> and the shuttle valve E causing relay emergency valve F to actuate the vehicle brakes. It will then be impossible for the driver to reverse any further, and experience has shown that a fully laden articulated vehicle will stop from normal reversing speed in about three inches. If the driver now selects a condition other than the reverse condition of the selector, the valve A will be closed and the line S connected to atmosphere by the exhaust A<sub>1</sub> so that the pressure applied to the shuttle valve E and relay valve F will be released and the driver can then move the vehicle.

It will be appreciated however, that this will only occur where the detector D has remained in its operative position to maintain the control valve C in the open position, i.e. where the detector has contacted an object immovable under the force applied by the detector D. Where the detector D contacts a movable object such as a person, then it is possible that the person will cease to apply pressure to the detector D, for example, the person may fall and the control valve C will then be closed as the detector moves to its inoperative position.

It will be seen that in this situation, it will not be possible for the driver to move the vehicle in any direction since the brakes will be applied via the relay emergency valve F, but the closing of the control valve C will prevent exhaustion of the pressurised air in the line S<sub>3</sub> to the exhaust A<sub>1</sub>. In consequence, the driver will not be able to move the vehicle either forwards or backwards.

In order for him to move the vehicle it will be necessary for the detector D to be moved again in order to open the control valve C causing the air to exhaust the pressurised air to atmosphere. In normal circumstances this will involve the driver in walking to the rear of the vehicle in order to effect the necessary deflection of the detector D and he will then have the opportunity to inspect the object which has been struck. It is believed that this is a considerable safety factor in that if the detector bar does strike a movable object, the driver must leave his vehicle and go round to the rear to deflect the detector bar before he can move the vehicle either forwards or backwards.

An alternative embodiment of the invention is shown in dashed lines in Fig. 2. This embodiment makes use of the "dead-man" line in a conventional three-line system.

In this embodiment the control valve C is not connected to the shuttle valve E by the line S<sub>3</sub> but is connected to a quick release valve L by a line U which is incorporated in the "dead-man" P, P<sub>1</sub> and P<sub>2</sub>. The operation of the quick release valve L will cause the

pressure from the auxiliary air tank B to be applied to the brakes causing braking of the vehicle. This system has the disadvantage with respect to the system described above, in that it is slower to operate by virtue of the fact that the air line is connected to a remote air tank B and quicker operation can be obtained by connection to the trailer air tank K. The arrangement will still require the opening of the detector control valve C in order to release the brakes by releasing the pressure through the exhaust to atmosphere on valve A.

The exhaust to atmosphere need not be made through the valve A but could be made in a conventional manner, for example through the quick release valve. Such an arrangement would provide for actuation of the brakes when the detector is deflected to its operative position whilst the vehicle is reversing and the brakes would remain applied until the driver selects a condition of the reverse selector other than reverse or the detector moves to its inoperative position. When the exhaust to atmosphere is provided on the side of the control valve C which is connected to the source of pressurised air (e.g. in the line S, S<sub>1</sub>, S<sub>2</sub> or valve A in this embodiment) and there is not provision for exhausting the air line (S<sub>3</sub> in this embodiment) to the valve which causes actuation of the brakes then it will be necessary for control valve C to be open for exhausting to take place and the brakes to be released.

The provision of the exhaust in the valve associated with the reverse selector of the vehicle also ensures that the brakes can be released only when the selector is in a condition other than the vehicle reversing condition, but it will be apparent that if this feature is not required the exhaust could be located in a different part of the circuit.

The embodiment described above can, of course, be modified to utilise another quick release valve in the emergency line if such value is provided.

A further alternative form of the invention is shown in Fig. 3. This arrangement is applicable to both two-line and three-line systems and utilises the emergency line R<sub>2</sub> and the relay emergency valve F of an existing braking system.

Fig. 3 the designation of the relevant components is the same as shown in Fig. 2, with the exception that an additional valve V is inserted in the line R<sub>2</sub> to the relay emergency valve F. The relay emergency valve F is connected to the main service line N<sub>2</sub> and the vehicle brakes G, H, I and J as in Fig. 2.

The emergency line R<sub>2</sub> is normally maintained under pressure and the brakes are operated by means of the relay emergency valve F when there is a drop in pressure in the line R<sub>2</sub>. The valve V is a three-way pilot-operated valve which is connected to the line S<sub>3</sub> from the first control valve C, as shown in

Fig. 2.

When the detector D is moved to its operative position, it causes pressure to be applied via the line S, S<sub>1</sub>, S<sub>2</sub> and S<sub>3</sub> to the three-way pilot-operated valve V and this valve causes the inlet of air at V<sub>1</sub> to be interrupted and the outlet at V<sub>2</sub> to be connected to an exhaust V<sub>3</sub>. Thus the pressure in the line R<sub>2</sub> to the relay emergency valve F is reduced to atmospheric pressure and the relay emergency valve F causes pressurised air to be applied to the brakes.

It will be seen that, as with the arrangements of Fig. 2, the valve V will remain in this condition even if the detector D returns to its inoperative position, as the line S<sub>3</sub> can be exhausted to atmosphere only by way of the lines S<sub>3</sub>, S<sub>2</sub> and S and the valves C and A.

It is, of course, possible to provide more than one detector at the rear of a vehicle and also one or more control valves. It is particularly convenient to use a single detector which extends over the width of the rear of the vehicle as shown in Fig. 1 but two or more such detectors could be used if desired.

A convenient arrangement is to provide one or more additional detectors which is or are forward of a rear detector. This provides an additional safety factor in that, for example, where a human or animal moves beneath the vehicle forward of the detector at the rear of the vehicle then the brakes can be applied by deflection of an additional detector. Such an additional detector or detectors are conveniently associated with flap members disposed to the rear of the vehicle road wheels.

The driver-controlled reverse selector of the vehicle will usually be the reverse gear of a manual or automatic gear-box but it can be any reverse selector mechanism. The operation of the valve may be effected mechanically by the gear lever or a member associated therewith, or it may be effected by a member associated with any part of the mechanism for driving the vehicle in reverse. Alternatively, the member may actuate an electrical switch and the valve may be an electrically operated valve, such as a solenoid valve.

Whilst in the foregoing description the first and second control valves are described as mechanically operated valves it will be apparent that, if desired, either or both valves can be an electrically operated valve, such as a solenoid valve, operated by an electrical circuit actuated by a switch controlled by the detector and the reverse selector of the vehicle respectively.

The provision of an auxiliary braking system in accordance with the present invention is relatively simple and can readily be installed in new vehicles as well as into existing vehicles.

The system has considerable advantage over existing systems in that the operation of the brakes in response to deflection of the

detector occurs independently of any driver action other than placing the reverse selector in the vehicle reversing condition. When the reverse selector is in a condition other than the vehicle reversing condition the detector is inoperative and consequently it will not cause application of the vehicle brakes for example when a following vehicle collides with the detector.

## CLAIMS

1. A vehicle braking system comprising fluid actuated brakes, at least one source of pressurised fluid, at least one service fluid line connected said source of pressurised fluid to a brake actuating arrangement, said brake actuating arrangement serving to apply the brakes in response to a change in pressure in said service line, an auxiliary braking system comprising:

(a) an auxiliary fluid circuit including a fluid control valve disposed in said service line between said source of pressurised fluid and said brake actuating arrangement;

(b) a detector mounted at the rear of the vehicle and movable between operative and inoperative positions;

(c) first control means responsive to the position of the detector and providing an open fluid path in said auxiliary fluid circuit when the detector is in its operative position and obstructing said fluid path when the detector is in its inoperative position;

(d) second control means independent of said first control means and responsive to the position a driver-controlled reverse selector on the vehicle, said second control means providing an open fluid path in said auxiliary circuit when said driver-controlled reverse selector is in a vehicle reversing condition and obstructing said fluid path when the selector is not in a vehicle-reversing condition;

(e) said auxiliary circuit fluid control valve being so connected that upon operation of said auxiliary circuit fluid control valve by the first and second means, the fluid path in the service line between said valve and said source of pressurised fluid is obstructed and the fluid path between said fluid control valve and said brake actuating arrangement is opened, whereby said fluid actuated brakes are applied.

2. A braking system according to Claim 1 in which said fluid control valve is a quick release valve connected in an emergency fluid service line.

3. A braking system according to Claim 1 in which said fluid control valve is a shuttle valve connected in a principle fluid service line controlled by the vehicle driver's foot brake pedal.

4. A braking system according to Claim 1 in which said fluid control valve is a three-way valve connected in an emergency fluid service line and incorporating a fluid path to atmo-

sphere.

5. A braking system according to any of Claims 1 to 4 wherein said auxiliary braking system is arranged to cause operation of the brakes when the detector is deflected from its inoperative position and the driver-controlled reverse selector is in the vehicle-reversing condition, and to release said operated brakes only when the detector is in said deflected operative position and the driver-controlled reverse selector is not in the vehicle-reversing condition.

6. A braking system according to Claim 5 in which exhaust means are provided in the auxiliary fluid line or a valve associated therewith whereby pressurised fluid applied to said auxiliary circuit fluid control valve can be exhausted only when the detector control valve is open due to the detector being in the operative position and the reverse selector is in a non-reversing condition.

7. A braking system according to Claim 6 in which the exhaust means is provided in a second control valve which forms part of the second control means independent of the detector and associated with the driver-controlled reverse selector on the vehicle.

8. A braking system according to any of Claims 1 to 7 in which at least one additional detector is provided and associated with an additional first control means in said auxiliary fluid circuit.

9. A braking system according to Claim 8 in which the additional detector or detectors is or are associated with one or more flap members disposed to the rear of the vehicle road wheels.

10. A braking system according to any of Claims 1 to 9 in which the vehicle comprises a tractor and trailer and each is provided with a separate source of pressurised fluid.

11. A braking system according to Claim 10 in which the detector control means is connected to a source of pressurised fluid carried by the tractor.

12. A vehicle braking system substantially as herein described with reference to and as shown in Figs. 1 and 2 or Figs. 1 and 3 of the accompanying drawings.



detector occurs independently of any driver action other than placing the reverse selector in the vehicle reversing condition. When the reverse selector is in a condition other than the vehicle reversing condition the detector is inoperative and consequently it will not cause application of the vehicle brakes for example when a following vehicle collides with the detector.

#### CLAIMS

1. A vehicle braking system comprising fluid actuated brakes, at least one source of pressurised fluid, at least one service fluid line connected said source of pressurised fluid to a brake actuating arrangement, said brake actuating arrangement serving to apply the brakes in response to a change in pressure in said service line, an auxiliary braking system comprising:

(a) an auxiliary fluid circuit including a fluid control valve disposed in said service line between said source of pressurised fluid and said brake actuating arrangement;

(b) a detector mounted at the rear of the vehicle and movable between operative and inoperative positions;

(c) first control means responsive to the position of the detector and providing an open fluid path in said auxiliary fluid circuit when the detector is in its operative position and obstructing said fluid path when the detector is in its inoperative position;

(d) second control means independent of said first control means and responsive to the position a driver-controlled reverse selector on the vehicle, said second control means providing an open fluid path in said auxiliary circuit when said driver-controlled reverse selector is in a vehicle reversing condition and obstructing said fluid path when the selector is not in a vehicle-reversing condition;

(e) said auxiliary circuit fluid control valve being so connected that upon operation of said auxiliary circuit fluid control valve by the first and second means, the fluid path in the service line between said valve and said source of pressurised fluid is obstructed and the fluid path between said fluid control valve and said brake actuating arrangement is opened, whereby said fluid actuated brakes are applied.

2. A braking system according to Claim 1 in which said fluid control valve is a quick release valve connected in an emergency fluid service line.

3. A braking system according to Claim 1 in which said fluid control valve is a shuttle valve connected in a principle fluid service line controlled by the vehicle driver's foot brake pedal.

4. A braking system according to Claim 1 in which said fluid control valve is a three-way valve connected in an emergency fluid service line and incorporating a fluid path to atmosphere.

sphere.

5. A braking system according to any of Claims 1 to 4 wherein said auxiliary braking system is arranged to cause operation of the brakes when the detector is deflected from its inoperative position and the driver-controlled reverse selector is in the vehicle-reversing condition, and to release said operated brakes only when the detector is in said deflected operative position and the driver-controlled reverse selector is not in the vehicle-reversing condition.

6. A braking system according to Claim 5 in which exhaust means are provided in the auxiliary fluid line or a valve associated therewith whereby pressurised fluid applied to said auxiliary circuit fluid control valve can be exhausted only when the detector control valve is open due to the detector being in the operative position and the reverse selector is in a non-reversing condition.

7. A braking system according to Claim 6 in which the exhaust means is provided in a second control valve which forms part of the second control means independent of the detector and associated with the driver controlled reverse selector on the vehicle.

8. A braking system according to any of Claims 1 to 7 in which at least one additional detector is provided and associated with an additional first control means in said auxiliary fluid circuit.

9. A braking system according to Claim 8 in which the additional detector or detectors is or are associated with one or more flap members disposed to the rear of the vehicle road wheels.

10. A braking system according to any of Claims 1 to 9 in which the vehicle comprises a tractor and trailer and each is provided with a separate source of pressurised fluid.

11. A braking system according to Claim 10 in which the detector control means is connected to a source of pressurised fluid carried by the tractor.

12. A vehicle braking system substantially as herein described with reference to and as shown in Figs. 1 and 2 or Figs. 1 and 3 of the accompanying drawings.

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