

May 24, 1938.

B. S. AIKMAN

2,118,130

COMPRESSOR CONTROL DEVICE

Filed July 16, 1937

2 Sheets-Sheet 1

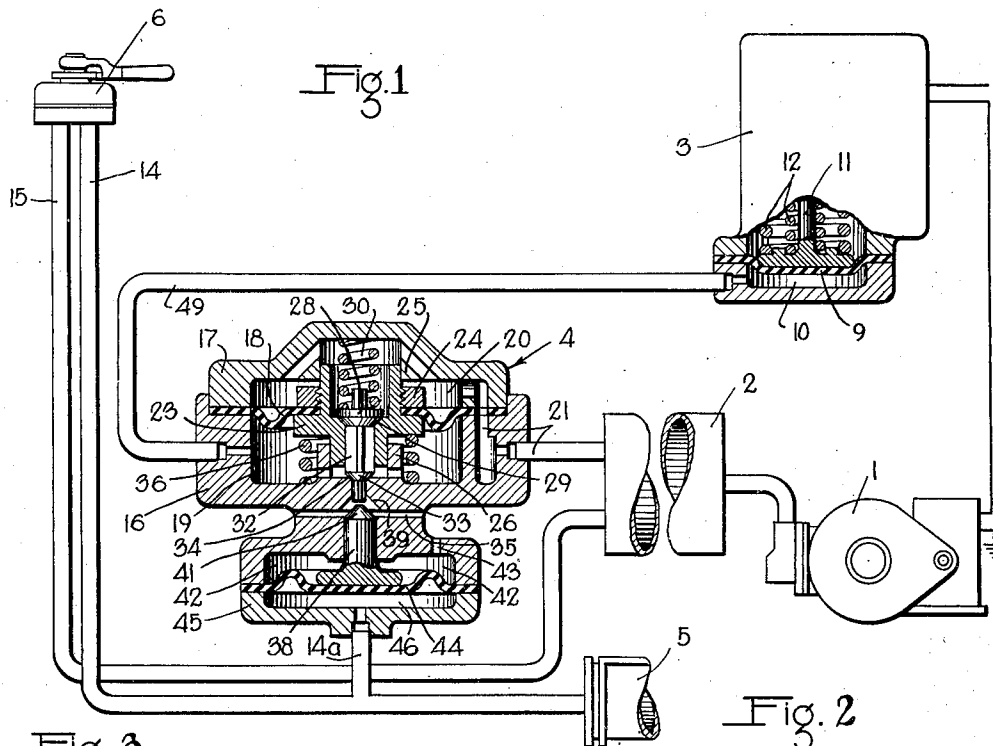
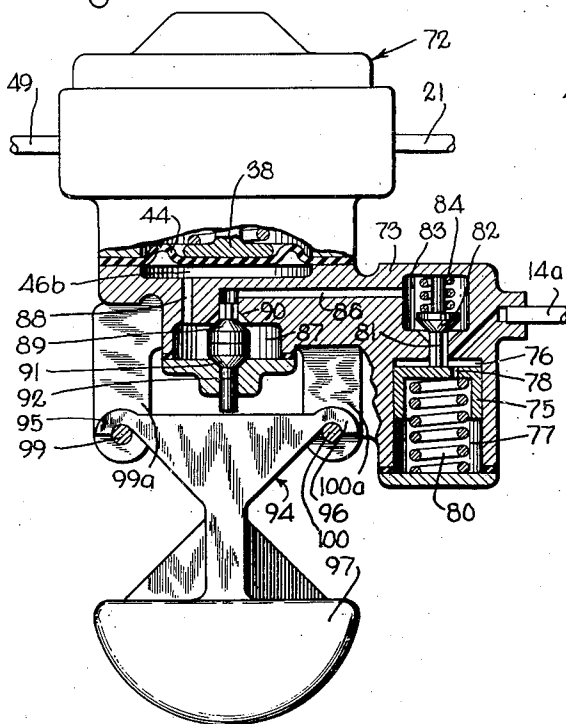
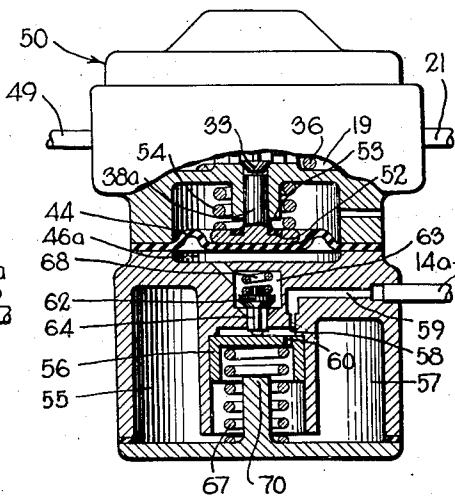


Fig. 3



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2 Sheets-Sheet 2

Fig. 4

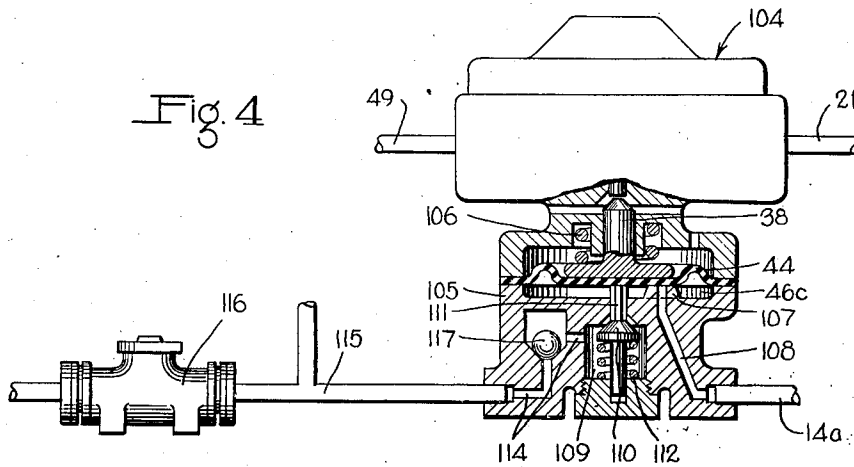


Fig. 5

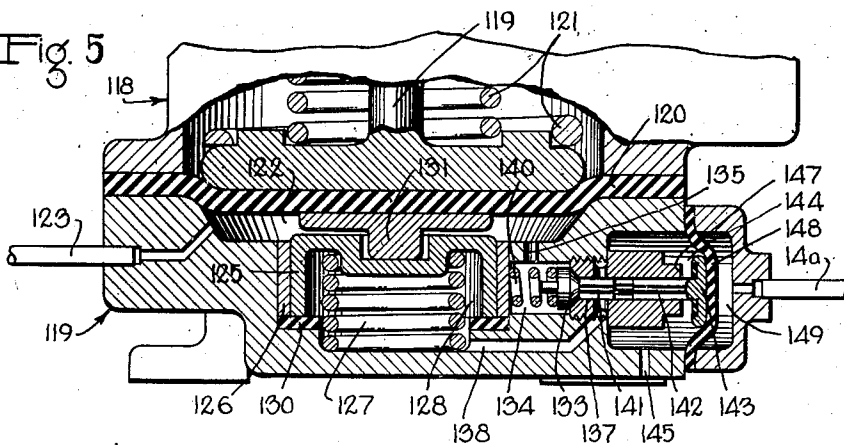
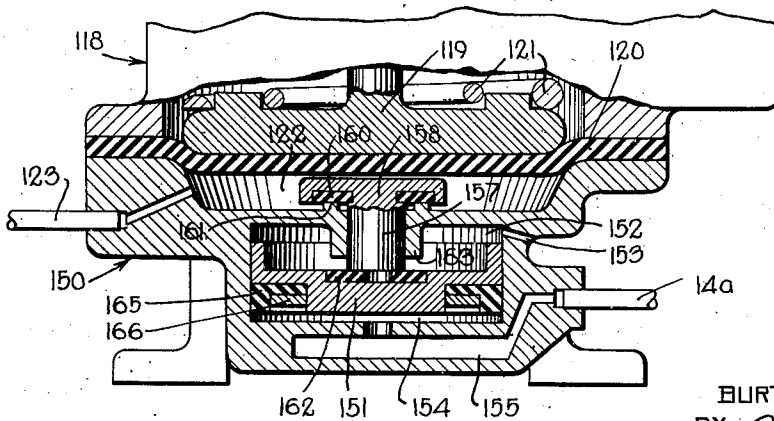


Fig. 6



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COMPRESSOR CONTROL DEVICE

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Application July 16, 1937, Serial No. 153,895

22 Claims. (Cl. 303-1)

This invention relates to compressor governor devices for controlling the starting and stopping of fluid compressors, and more particularly to improved means cooperative with a compressor governor for controlling a compressor in accordance with different ranges of pressure variation in a receiving reservoir.

The noise of operation of a fluid compressor carried on a vehicle in street railway or subway service, although usually not noticeable while the vehicle is in motion, becomes annoying and undesirable when the vehicle is brought to a stop, and in order to avoid this condition, control means have heretofore been proposed for preventing the compressor from operating while a vehicle is standing still, or unless the main reservoir pressure has been reduced to a very low degree. The control means referred to have generally necessitated considerable alteration in the design of the compressor governor apparatus, thus involving expense.

One object of my invention is to provide improved automatic means for preventing a vehicle carried compressor from operating while the vehicle is at a standstill, unless the reservoir pressure is reduced to a very low degree, which means is embodied in a mechanism of simple and inexpensive design.

Another object of my invention is to provide automatic means of the above type which is adapted to be employed with a compressor governor of the well known type responsive to a predetermined reduction in fluid pressure to start the compressor and to a predetermined increase in fluid pressure to effect the stopping of the compressor.

A further object of my invention is to provide means associated with a compressor governor upon a vehicle equipped with a fluid pressure brake apparatus, which means is responsive to operation of the brakes for causing the governor to start and stop the compressor in accordance with variations in fluid pressure in the reservoir within a certain range at one time, and within a different range at another time.

Other objects and advantages will appear in the following description of the invention, taken with reference to the accompanying drawings, in which:

Fig. 1 is a diagrammatic view, partly in section, of a fluid compressing apparatus embodying my invention, and having associated therewith a simplified form of fluid pressure brake;

Fig. 2 is a diagrammatic sectional view of a compressor control device similar to that shown

in Fig. 1 but embodying my invention in a different form;

Figs. 3 and 4 are diagrammatic sectional views illustrating further modifications of the compressor control device; and

Figs. 5 and 6 are fragmentary sectional views of compressor governors embodying still other forms of my invention.

The apparatus shown in Fig. 1 of the drawings comprises a fluid compressor 1, a reservoir 2 for receiving fluid compressed thereby, a compressor governor 3 for controlling the supply of current to the compressor driving motor, an auxiliary control device 4, and fluid pressure braking means comprising a brake cylinder 5 and a brake valve device 6. The compressor governor 3 is preferably of the well known pressure range type such as that disclosed in the Patent 1,615,365 issued to Clyde C. Farmer on January 25, 1927, and is adapted to close the compressor motor circuit in response to a predetermined minimum fluid pressure and to break the circuit in response to a predetermined maximum fluid pressure. In Fig. 1 the governor 3 is illustrated diagrammatically, as comprising a flexible diaphragm 9 subject to the pressure of fluid in a chamber 10 and adapted to operate a switch mechanism, not shown, through the medium of a switch operating member 11 which is urged downwardly toward a circuit closing position by a pair of springs 12. When the pressure of fluid in the chamber 10 is below a predetermined value the springs 12 are adapted to maintain the governor 3 in circuit closing position for effecting supply of current to the electric driving motor of the compressor 1 and upon a predetermined increase in the pressure of fluid in the chamber 10 the diaphragm 9 is adapted to be operated to move the switch mechanism of the governor into another position for cutting off the supply of current to the compressor driving motor.

The brake valve device 6 may be of any well known type adapted when moved to release position to establish communication from the brake cylinder 5 by way of a pipe 14 to the atmosphere and when moved to a brake application position to supply fluid under pressure from the reservoir 2 through a pipe 15 and the pipe 14 to the brake cylinder for effecting an application of the brakes.

According to the invention the auxiliary control device 4 comprises a main casing section 16 and a cover section 17 containing a pressure reducing mechanism including a flexible diaphragm 18, which is clamped between said sections and has on the lower side thereof a cham-

ber 19 and on the upper side a chamber 20, the chamber 20 being connected through a passage and pipe 21 with the reservoir 2. Fitted within a central opening in the diaphragm 18 is a valve seat member 23, which is secured to the diaphragm by means of a screw-threaded nut 24 and has one portion in sliding engagement within a bore formed by an annular shoulder 25 provided in the cover section 17 and another portion in sliding engagement within an apertured sleeve portion 26 of the main casing 16. A valve 28 is carried within the seat member 23 and is adapted to be urged into engagement with a seat 29, formed on said member, by the pressure of a spring 30 that is interposed between the valve and the cover section 17. The valve 28 has a fluted stem 32 extending through a suitable bore in the seat member 23, the stem having on the lower end thereof a valve 33 which is adapted for engagement with a seat 34 formed on the casing section 16 for controlling communication between the chamber 19 and an atmospheric exhaust passage 35. A coil spring 36 is interposed between the lower wall of the chamber 19 and the seat member 23 for biasing the seat member and the diaphragm 18 upwardly.

Operatively aligned with the lower end of the valve 33 is a plunger element 38, which has a valve portion 41 aligned for seating engagement with a seat 39 formed on the casing section 16. The element 38 is slidably mounted in a suitable bore in the casing section 16 and extends into a chamber 42, which is open to the atmosphere by way of a port 43, the valve portion 41 being normally held away from the seat 39 by the weight of the plunger 38. Clamped between the casing section 16 and a cover plate 45 is a flexible diaphragm 44, which is subject to the pressure of fluid in a chamber 46 communicating through a branch pipe 14a with the brake cylinder 5, the diaphragm being operative on an increase in fluid pressure in said chamber for moving the element 38 upwardly.

When the compressor 1 is operated to supply fluid under pressure to the reservoir 2, fluid under pressure flows therefrom through the pipe and passage 21 to the chamber 20 within the auxiliary control device 4 and acts against the diaphragm 18 so as to force the diaphragm and the seat member 23 downwardly. With the valve 33 held in engagement with the seat 34 due to the pressure of the spring 30, downward movement of the seat member 23 causes the seat 29 to move away from the valve 28, and fluid under pressure is then supplied from the chamber 20 past the fluted stem 32 and through the apertures in the sleeve portion 26 to the chamber 19 and thence through a pipe 49 to the chamber 10 in the compressor governor 3.

The supply of fluid under pressure from the reservoir 2 by way of the chamber 20 in the auxiliary control device to the chamber 19 therein and thence to the chamber 10 in the compressor governor 3 will continue until the combined forces of fluid under pressure in the chamber 19 acting against the diaphragm 18 and of the spring 36 acting against the seat member 23 become slightly greater than the pressure of fluid in the chamber 20 acting on the diaphragm, at which time the diaphragm will be operated to move the seat member upwardly until the seat 29 engages the valve 28.

It will thus be apparent that the pressure reducing mechanism in the auxiliary control device 4 is operative to maintain the pressure of

fluid in the chamber 10 of the compressor governor 3 a predetermined degree less than the pressure of fluid in the reservoir 2, as determined by the force of the spring 36. Assuming, for example, that it is desired to maintain the pressure of fluid in the reservoir 2 within a normal operating pressure range of 60 to 70 pounds per square inch, or in other words that the compressor 1 is to be cut into operation when the fluid pressure in the reservoir 2 falls below 60 pounds and cut out of operation when said reservoir pressure exceeds 70 pounds, and assuming also that a force of 10 pounds is required to compress the spring 36 in the auxiliary control device, the compressor governor 3 should then be adjusted to close the circuit to the compressor driving motor when the fluid pressure in the chamber 10 falls below 50 pounds and to respond to an increase in fluid pressure in said chamber to approximately 60 pounds for breaking the circuit to the driving motor. Consequently, while the auxiliary control device 4 is in the normal position shown in Fig. 1 of the drawings, said device and the compressor governor 3 are cooperative to control operation of the compressor 1 for maintaining the fluid pressure within the reservoir 2 within a 60 to 70 pound range.

It will be understood that if the pressure of fluid in the reservoir 2 should for any reason be reduced below the combined pressures of the spring 36 and of the fluid under pressure in chamber 19, the pressures of the fluid in the chamber 19 and of the spring 36 will then move the diaphragm 18 and the seat member 23 upwardly together with the valve 28 so as to unseat the valve 33, thereby venting fluid under pressure from the chamber 19 and consequently from the chamber 10 in the governor 3 past the valve 33 and through the passage 35 to the atmosphere. When the pressure of fluid in the chamber 19 has been thus reduced sufficiently to permit the fluid pressure in the chamber 20 acting against the diaphragm 18 to overcome the fluid pressure in the chamber 19 and the force of the spring 36, the valve 33 is again moved into engagement with the seat 34. If the fluid pressure in the chamber 19 and the governor pipe 49 is thereby reduced to a degree below the minimum pressure for which the governor 3 is adjusted, the governor will then start the compressor.

If the brake valve device 6 is now operated to effect the supply of fluid under pressure from the reservoir 2 to the brake cylinder 5 for causing an application of the brakes and for thereby bringing the vehicle to a stop, fluid under pressure is at the same time supplied by way of the branch pipe 14a to the chamber 46 in the auxiliary control device 4 and operates the diaphragm 44 to move the plunger element 38 and the valve portion 41 into engagement with the seat 39. As the element 38 is thus moved upwardly, the upper end thereof engages the projection on the end of the valve 33 and shifts the valves 33 and 28 to their uppermost positions against the pressure of the spring 30, the valve 28 being then positioned beyond the range of movement of the seat member 23, upward movement of which is checked on engagement of the ring 24 with the annular shoulder 25.

With the valve 28 in the auxiliary control device 4 thus maintained unseated, fluid at the pressure of that in the reservoir 2 is then supplied to the chamber 10 in the governor device 3, and since the governor device is adjusted to control operation of the compressor 1 in response

to variations in pressure in the chamber 10 within a range a predetermined degree less than the range of pressures normally maintained in the reservoir 2, the compressor 1 will be cut out of operation while the vehicle is at a standstill. It will be understood, of course, that in case the pressure of fluid in the reservoir 2 is reduced below the minimum pressure for which the governor 3 is adjusted, the compressor will be cut into operation to supply sufficient fluid under pressure to the reservoir to restore the fluid pressure therein to the predetermined value below the normal pressure, but under usual operating conditions it is to be expected that when the vehicle is stopped the fluid pressure in the reservoir will remain high enough to prevent operation of the compressor.

When the brakes are released in order to permit the vehicle to proceed, fluid under pressure is vented from the brake cylinder 5 and the connected chamber 46 in the usual manner, and the operative elements in the auxiliary control device 4 again assume the position shown in Fig. 1 for supplying fluid at reduced pressure to the governor device 3 and thereby effecting operation of the compressor to build up the fluid pressure in the reservoir 2 to that normally carried.

According to the modified form of my invention illustrated in Fig. 2 of the drawings, there is provided an auxiliary control device 50, the principle of operation of which is similar to that of the control device 4 shown in Fig. 1, and which includes, in addition, means for delaying the supply of fluid at brake cylinder pressure to the control device for a predetermined interval after an application of the brakes has been effected, so as to avoid undesired stopping of the compressor when the brakes are applied only for reducing the speed of the vehicle. The upper portion of the auxiliary control device 50 containing the pressure reducing mechanism is not shown in detail in Fig. 2 of the drawings as the structural features thereof are substantially the same as those of the corresponding portion of the device 4 shown in Fig. 1, it being noted that the diaphragm 44 in the mechanism shown in Fig. 2 is adapted to operate the valve 33 through the medium of a plunger element 38a, which is somewhat different from the element 38 shown in Fig. 1 in that the element 38a is provided with a gasket 52 adapted for seating engagement with an annular portion 53 of the casing surrounding the bore in which said element is mounted. A spring 54 is provided for biasing the element 38a and the diaphragm 34 shown in Fig. 2 toward a normal position.

The auxiliary control device 50 is provided with a timing portion comprising a casing section 55 having slidably mounted therein a timing piston 56, which is subject on one side to the pressure of fluid in a volume chamber 57 and on the other side to the pressure of fluid in a chamber 58 connected through a passage 59 in the casing with the branch pipe 14a leading to the brake cylinder. The piston 56 has a restricted port 60 through which fluid under pressure may flow at a slow rate from one of the chambers 58 and 57 to the other. A valve 62 is contained in a valve chamber 63 formed in the casing section 55 for controlling communication from the chamber 58 through the valve chamber to the chamber 46a at the lower side of the diaphragm 44. The valve 62 has a fluted stem 64, the lower end of which operatively engages the timing piston 56, which is urged upwardly by the force of spring

67 disposed in the chamber 57, so that the valve 62 is normally maintained unseated as shown in Fig. 2 of the drawings. A spring 68 is interposed between the valve 62 and the upper wall of the chamber 63 for urging the valve downwardly toward seated position.

While the fluid pressure brakes are released, the volume chamber 57 and the chamber 58 are connected to the atmosphere by way of the passage 59 and the brake cylinder pipe 14a, and the spring 67 is thus permitted to act through the medium of the piston 56 and the valve stem 64 to maintain the valve 62 unseated so that the diaphragm chamber 46a is also connected to the atmosphere through the valve chamber 63 and the other communications already mentioned. With the plunger element 38a maintained in the position shown in the drawings by the force of the spring 54, the pressure reducing mechanism in the auxiliary control device 50 is operative to supply fluid under pressure through the pipe 49 to the compressor governor at a pressure a predetermined degree less than that of the fluid supplied through the pipe 21 from the reservoir, as already explained in connection with the apparatus shown in Fig. 1.

When an application of the brakes is effected, fluid at the pressure of that in the brake cylinder is supplied through the pipe 14a and the passage 59 to the piston chamber 58 at a faster rate than that of flow of fluid from the chamber 58 through the restricted port 60 in the timing piston 56, which is thereby moved downwardly against the pressure of the spring 67 and into engagement with a stop member 70 provided on the casing within the chamber 57. As the piston 56 thus moves downwardly, the spring 68 becomes effective to move the valve 62 into seated position so as to cut off communication between the chamber 58 and the valve chamber 63. Meanwhile, fluid under pressure continues to flow from the chamber 58 through the restricted port 60 to the volume chamber 57, and after a predetermined interval the fluid pressure in the chamber 57 acting on the piston 56 as aided by the spring 67 becomes sufficient to move the piston upwardly into engagement with the valve stem 64, the valve 62 being then unseated.

With the valve 62 unseated, fluid at brake cylinder pressure is supplied through the chamber 63 to the diaphragm chamber 42a and acts on the diaphragm 44 to effect operation of the auxiliary control device 50 to permit fluid to flow from the reservoir to the compressor governor without reduction in pressure. As a result, the compressor on the vehicle is not operated while the vehicle is standing, unless the reservoir pressure should fall to the low degree at which the compressor governor is adjusted to operate as hereinbefore explained.

Referring to Fig. 3 of the drawings, the invention is shown in another form comprising an auxiliary control device 72 which is associated with means for preventing the device from functioning to cause the compressor governor to cut the compressor out of operation before the vehicle is brought to a stop by an application of the brakes. The auxiliary control device 72 comprises pressure reducing valve means, which although not shown in detail in Fig. 3, will be understood to be similar to that shown in the device 4 in Fig. 1 of the drawings, and in addition the control device 72 is provided with a portion 73 containing valve means controlling the supply of fluid at brake cylinder pressure to a dia-

phragm chamber 46b at the lower side of the diaphragm 44. Mounted in the portion 73 is a timing piston 75 having on one side a chamber 76 communicating with the brake cylinder pipe 14a and on the other side a volume chamber 77, which communicates through a restricted port 78 formed in the piston 75 with the chamber 76. A spring 80 is disposed in the chamber 77 for urging the piston 75 upwardly and into engagement with the stem 81 of a valve 82 contained in a valve chamber 83, the valve being thereby normally maintained in unseated position for permitting communication between the chamber 76 and valve chamber 83. A spring 84 is provided for urging the valve 82 toward seated position.

The valve chamber 83 is adapted to communicate through a passage 86 with a valve chamber 87, which is open through a passage 88 to the diaphragm 46b and which contains a valve 89 operatively aligned with a valve seat 90 and adapted to control communication from the passage 86 to the chamber 87. The valve 89 is normally held unseated by the force of gravity and as shown in Fig. 3 is adapted to engage the upper end of a sealing element 91 having a stem 92 slidably mounted in a suitable bore in the casing and extending outwardly thereof.

The valve 89 is adapted to be operated through the medium of the stem 92 by a vehicle retardation responsive device, which comprises an inertia controlled element 94 having oppositely extending lugs 95 and 96 and a centrally depending weight portion 97, the lugs 95 and 96 being supported on pins 99 and 100, respectively, which are carried by trunnion portions 99a and 100a of the casing. The arrangement of the member 94 is such that the lugs 95 and 96 are in line with the path of movement of the vehicle, so that when the speed of the vehicle is reduced, the inertia of the weight portion 97 causes the member 94 to tilt about one of the pins 99 and 100, depending upon the direction of movement of the vehicle, thereby bringing the portion of the member between the lugs into operative engagement with the stem 92, which is thus moved upwardly to effect engagement of the valve 89 with the seat 90.

Assuming that the auxiliary control device 72 is associated with a vehicle braking and fluid compressor apparatus such as that shown in Fig. 1 of the drawings, if while the vehicle is in motion an application of the brakes is effected, fluid under pressure is supplied from the usual brake cylinder through the pipe 14a to the chamber 76 and forces the piston 75 downwardly against the pressure of the spring 80 to permit the spring 84 to seat the valve 82 for temporarily cutting off communication from the chamber 76 to the chamber 83. When the pressure of fluid in the chamber 77 has been built up to a predetermined value by flow of fluid through the port 78 in the piston, the spring 80 becomes effective to move the piston 75 upwardly, again unseating the valve 82 and allowing fluid under pressure to flow from the chamber 76 to the chamber 83 and the passage 86. So long as the rate of deceleration of the vehicle exceeds a predetermined degree, however, the member 94 is effective to maintain the valve 89 seated, in the manner already explained, and since fluid under pressure is thus prevented from flowing into the chamber 87 and the connected diaphragm chamber 46b, the auxiliary control device 72 continues

to function to permit the usual operation of the compressor.

If the application of the brakes is sufficient to bring the vehicle to a stop, the inertia controlled member 94 again assumes the normal position shown in Fig. 3, thereby permitting the valve 89 to move downwardly from the seat 90. With the valve 89 unseated, fluid at brake cylinder pressure is supplied from the passage 86 through the chamber 87 to the diaphragm chamber 46b and operates the diaphragm 44 to render the reducing valve mechanism ineffective as hereinbefore described, with the result that operation of the compressor is prevented unless the fluid pressure in the reservoir should fall below the minimum value for which the compressor governor is adjusted.

Referring to Fig. 4 of the drawings, a modified form of my invention is shown comprising an auxiliary control device 104, which includes the features of the auxiliary control device 4 shown in Fig. 1, including the diaphragm 44, and is further provided with means for preventing supply of fluid under pressure from the vehicle brake cylinder for operating the diaphragm 44 until the vehicle doors have been opened.

The diaphragm 44, which operates the plunger element 38 as already explained, is subject to the pressure of fluid in a diaphragm chamber 46c formed in a casing section 105, and is normally urged by a spring 106 into seating engagement with a seat rib 107 for controlling communication from the brake cylinder pipe 14a through a passage 108 to the chamber 46c. Disposed in a valve chamber 109 is a valve 110 having a fluted stem 111 extending through the chamber 46c into operative engagement with the diaphragm 44, which in the normal position thereof holds the valve 110 unseated against the biasing force of a spring 112 that is interposed between the valve and the lower wall of the chamber 109. The valve chamber 109 communicates by way of a passage 114 with a door engine pipe 115, which is adapted to be supplied with fluid under pressure for operating the usual door engine 116 in the well known manner for opening the vehicle doors. A ball check valve 117 is interposed in the passage 114 for preventing back flow of fluid from the chamber 109 to the pipe 115.

In operation, when the brake cylinder on the vehicle is supplied with fluid under pressure for effecting an application of the brakes, the brake cylinder pipe 14a becomes charged with fluid under pressure as already explained. With the diaphragm 44 in seating engagement with the seat rib 107, however, fluid at the pressure of that of the brake cylinder is prevented from flowing into the chamber 46c, so that the auxiliary control device 104 continues to cooperate with the usual compressor governor to permit the compressor to maintain the reservoir charged at the normal operating pressure. After the vehicle has been brought to a stop for taking on or discharging passengers, fluid under pressure is supplied in the usual manner through the pipe 115 for operating the door engine 116 to open the door, and at the same time fluid under pressure is supplied from the pipe 115 through the passage 114, past the check valve 117, through the valve chamber 109 and past the unseated valve 112 to the diaphragm chamber 46c. The diaphragm 44 is thereby moved upwardly to establish communication from the passage 108 to the chamber 46c, at the same time permitting the spring 112 to move the valve

110 into seated position. Fluid under pressure is then supplied from the brake cylinder by way of the pipe 14a and passage 108 to the diaphragm chamber 45c, so that the auxiliary control device 104 is conditioned to permit operation of the compressor governor to cut the compressor out of action while the vehicle is standing.

In Fig. 5 of the drawings, my invention is shown embodied in a unitary compressor governor device which comprises a governor portion 118 and an auxiliary control portion 119 which may be secured to the governor portion by any suitable means such as bolts, not shown. The governor portion 118 is of a usual construction and is not shown in detail, it being understood that this portion comprises a switch mechanism, not shown, which is adapted to be operated through the medium of a switch operating member 119 by a flexible diaphragm 120 subject to the opposing pressures of spring 121 and of fluid in a chamber 122 which is connected by way of a pipe 123 with the reservoir receiving fluid compressed by the compressor. When the pressure of fluid in the chamber 122 is below a predetermined value the spring 121 is adapted to maintain the member 119 and the associated switch mechanism in circuit closing position for effecting supply of power to the driving motor of the compressor, and upon a predetermined increase in the pressure of fluid in the chamber 122, the diaphragm 120 is adapted to be operated to move the switch mechanism into another position for cutting off further supply of power to the driving motor.

The auxiliary control portion 119 comprises a booster piston 125 slidably mounted in a bushing 126, the piston being subject on one side to the pressure of fluid in the chamber 122 and on the other side to the force of a spring 127 which is disposed in a chamber 128 formed in the portion 119. The piston 125 is adapted normally to be forced downwardly into sealing engagement with a gasket 130 by the fluid pressure in the chamber 122, but when the fluid pressures in the chambers 122 and 128 are equalized in the manner herein-after explained, the spring 127 is adapted to act through the medium of the piston 125 and a follower member 131 in engagement therewith to apply a force against the diaphragm 120 in addition to the pressure of fluid in the chamber 122.

Communication between the chamber 122 and the chamber 128 is controlled by a valve 133 which is contained in a valve chamber 134 connected through a passage 135 with the chamber 122 and by way of a bore 137 and a passage 138 with the chamber 128. A spring 140 is provided in the valve chamber 144 for normally maintaining the valve 133 in seated position, as shown in the drawings.

The valve 133 has a fluted stem 141 slidably mounted in the bore 137, which stem operatively engages a similar fluted stem 142 that terminates in a valve portion 143. The valve portion 143 is disposed in a chamber 144 which is open to the atmosphere through a passage 145, and is adapted to be moved into seating engagement with a seat 147 by operation of a flexible diaphragm 148 which is adapted to be subjected to fluid at brake cylinder pressure supplied to a chamber 149 through the brake cylinder pipe 14a.

In operation, with the brakes released and the chamber 149 consequently at atmospheric pressure, the spring 140 is effective to maintain the valve 133 seated and the valve 143 unseated, so that the chamber 128 beneath the booster piston 125 is connected to the atmosphere through the

passage 138, the bore 137, and the vented chamber 144. Fluid under pressure supplied from the reservoir by way of the pipe 123 to the chamber 122 is thus effective to maintain the booster piston 125 in its lowermost position as shown in the drawings, and at the same time the fluid in the chamber 122 acts through the medium of the diaphragm 120 to effect operation of the governor portion 118 in the usual manner for controlling operation of the compressor.

It should be understood that the governor portion 118 shown in Fig. 5 is adjusted to respond to variations in pressure within the normal range of pressures at which the reservoir is to be maintained charged, so that with the brakes released and the governor diaphragm 120 subject only to the pressure of fluid supplied from the reservoir, as just described, the compressor is permitted to operate to supply fluid to the reservoir at full operating pressure.

When an application of the brakes is effected, fluid under pressure supplied from the brake cylinder by way of the pipe 14a to the chamber 149 operates the diaphragm 148 to seat the valve portion 143 while unseating the valve 133. With the valve 133 unseated, fluid under pressure is permitted to flow from the diaphragm chamber 122 through the passage 135, the chamber 134, the bore 137 and passage 138 to the chamber 128, thereby equalizing the fluid pressures on opposite sides of the booster piston 125, so that the spring 127 becomes effective to apply additional force against the diaphragm 120 through the medium of the piston and the follower member 131. It will be apparent that by reason of the additional force applied to the diaphragm 120 by the spring 127, the governor portion 118 will be rendered effective to cut the compressor out of action while the vehicle is at a standstill, unless the reservoir pressure in the chamber 122 should fall a predetermined degree lower than the normal minimum pressure for which the governor is adjusted.

As shown in Fig. 6 of the drawings, the invention may be embodied in a structure that is somewhat similar to that shown in Fig. 5, except that an auxiliary control portion 150 is substituted for the portion 119 shown in Fig. 5. The auxiliary control portion 150 comprises a booster piston 151 having on one side a chamber 152 connected with the atmosphere through an opening 153, and subject on its lower side to the pressure of fluid in a chamber 154 which communicates through a passage 155 with the brake cylinder pipe 14a. The piston 151 is provided with a stem 157 slidably mounted in a suitable bore in the casing, which stem extends into the chamber 122 and terminates in a head portion 158 in operative alignment with the diaphragm 120. An annular gasket 160 is inserted in the lower face of the head portion 158 and is adapted for sealing engagement with an annular seat 161 formed on the lower wall of the chamber 122, and a similar gasket 162 is inserted in the upper portion of the piston 161 for sealing against an annular portion 163 of the casing surrounding the bore in which the stem 157 is mounted. For minimizing leakage of fluid from the chamber 154 to the chamber 152 an annular packing 165 is secured to the piston 151 by means of a clamping ring 166.

While the brakes of the vehicle are released, the chamber 154 below the booster piston 151 is connected to the atmosphere by way of the brake cylinder 14a and the pressure of fluid at reservoir pressure in the chamber 122 acting on the head portion 158, as aided by the weight of the

head portion and associated piston 151, is effective to maintain said element in the normal position shown in Fig. 6 of the drawings, the gasket 160 being in sealing engagement with the annular rib 161. The diaphragm 120 of the governor portion is accordingly subject only to the pressure of fluid in the chamber 122, so that the compressor is permitted to operate in the usual manner to maintain the reservoir charged with fluid at full operating pressure. If the vehicle brakes are applied, however, fluid under pressure is supplied from the brake cylinder through the pipe 14a and the passage 155 to the chamber 154, and acts through the medium of the piston 151 and the head portion 158 to apply additional force to the diaphragm 120, thereby causing the governor to prevent normal operation of the compressor while the vehicle is not in motion.

While several illustrative embodiments of the invention have been described in detail, it is not my intention to limit its scope to those embodiments or otherwise than by the terms of the appended claims.

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

1. In combination, a motor driven compressor, a reservoir into which fluid compressed by said compressor is supplied, regulatory means operative by variations in fluid pressure for causing said compressor to start and stop when the pressure in the reservoir reaches given minimum and maximum pressures, respectively, control means operated by variations in fluid pressure for causing said regulatory means to effect the starting and stopping of the compressor when the pressure in the reservoir reaches minimum and maximum pressures different from said given pressures, and braking means including a brake cylinder communicating with said control means, whereby the fluid pressure on said control means is varied in accordance with operation of the braking means.

2. In combination, a compressor, means for driving the compressor, a reservoir into which fluid compressed by said compressor is supplied, a fluid pressure responsive governor operative at a predetermined maximum degree of pressure to stop operation of said compressor and at a predetermined minimum degree of pressure to start operation of said compressor, auxiliary valve means for at one time supplying fluid to said governor at the pressure of fluid in the reservoir and at another time supplying fluid to said governor at a lower pressure than that in said reservoir, fluid pressure responsive means for controlling said auxiliary valve means, and means for supplying and releasing fluid under pressure to and from said fluid pressure responsive means.

3. The combination with an electric motor driven compressor, a reservoir for receiving fluid compressed thereby, and a compressor governor for controlling the opening and closing of the compressor motor circuit in accordance with variations in fluid pressure within a certain zone, of a control device normally effective to supply fluid from the reservoir to said governor at a pressure a predetermined degree less than the pressure prevailing in said reservoir, said control device being adapted to be actuated for supplying fluid at full reservoir pressure to said governor, fluid pressure braking apparatus including a normally vented chamber, means operative to supply fluid under pressure to said chamber in effecting an application of the brakes, and means subject to the pressure of fluid in said chamber

and operative upon a predetermined increase therein to actuate said control device for supplying fluid at full reservoir pressure to said governor.

4. The combination with a vehicle carried compressor, an electric driving motor therefor, and governor means including a movable abutment responsive to the pressure of fluid compressed by the compressor for controlling the circuit to said motor, of fluid pressure braking apparatus including a normally vented chamber, means for supplying fluid under pressure to said chamber in applying the brakes, and auxiliary control means operative upon a predetermined increase in the pressure of fluid in said chamber for applying additional force to said movable abutment to augment the pressure thereon of fluid supplied by the compressor.

5. The combination with a vehicle braking apparatus including a brake cylinder, a compressor, a reservoir into which fluid compressed by said compressor is supplied, and a governor adjusted to operate at a predetermined maximum degree of fluid pressure in said reservoir for cutting the compressor out of action and at a predetermined minimum degree of reservoir pressure for cutting the compressor into action, of control means normally effective for causing the governor to cut the compressor into and out of action when the minimum and maximum pressures of fluid in the reservoir are higher than said predetermined pressures for which the governor is adjusted, means responsive to an increase in fluid pressure for rendering said control means ineffective to control said governor, and an always open communication connecting said fluid pressure operated means to said brake cylinder.

6. The combination with a vehicle braking apparatus including a brake cylinder, a compressor, a reservoir into which fluid compressed by said compressor is supplied, and a governor adjusted to operate at a predetermined maximum degree of fluid pressure in said reservoir for cutting the compressor out of action and at a predetermined minimum degree of reservoir pressure for cutting the compressor into action, of control means normally effective for causing the governor to cut the compressor into and out of action when the minimum and maximum pressures of fluid in the reservoir are higher than said predetermined pressures for which the governor is adjusted, means responsive to an increase in fluid pressure for rendering said control means ineffective to control said governor, and mechanism controlling communication between said brake cylinder and said fluid pressure responsive means, said mechanism consisting of a normally open valve and means operative on an increase in fluid pressure in said brake cylinder for temporarily closing said valve.

7. The combination with a vehicle braking apparatus including a brake cylinder, a compressor, a reservoir into which fluid compressed by said compressor is supplied, and a governor adjusted to operate at a predetermined maximum degree of fluid pressure in said reservoir for cutting the compressor out of action and at a predetermined minimum degree of reservoir pressure for cutting the compressor into action, of control means normally operative for causing the governor to cut the compressor into and out of action when the minimum and maximum pressures of fluid in the reservoir are higher than said predetermined pressures for which the governor is adjusted, means responsive to an increase in fluid pressure

for rendering said control means ineffective to control said governor, a normally open valve controlling communication between said brake cylinder and said fluid pressure responsive means, and inertia controlled means responsive to retardation of the vehicle for closing said valve.

8. The combination with a vehicle braking apparatus including a brake cylinder, a compressor, a reservoir into which fluid compressed by said compressor is supplied, and a governor adjusted to operate at a predetermined maximum degree of fluid pressure in said reservoir for cutting the compressor out of action and at a predetermined minimum degree of reservoir pressure for cutting the compressor into action, of control means normally operative for causing the governor to cut the compressor into and out of action when the minimum and maximum pressures of fluid in the reservoir are higher than said predetermined pressures for which the governor is adjusted, means responsive to an increase in fluid pressure for rendering said control means ineffective to control said governor, a door engine operative by fluid under pressure, and means operative by fluid supplied to said door engine for controlling communication from said brake cylinder to said fluid pressure responsive means.

9. The combination with a vehicle carried fluid compressor, an electric driving motor therefor, and governor means including a movable abutment responsive to the pressure of fluid compressed by the compressor for controlling the circuit to said motor, of fluid pressure brake apparatus including a normally vented chamber, means for supplying fluid under pressure to said chamber in effecting an application of the brakes, and auxiliary control means comprising a spring and means operative upon a predetermined increase in the pressure of fluid in said chamber for effecting application of the force of said spring to said movable abutment to augment the pressure thereon of fluid supplied by the compressor.

10. The combination with a vehicle carried fluid compressor, an electric driving motor therefor, and governor means including a movable abutment responsive to the pressure of fluid compressed by the compressor for controlling the circuit to said motor, of fluid pressure braking apparatus including a normally vented chamber and means for supplying fluid under pressure to said chamber in effecting an application of the brakes, and means for applying additional force to said movable abutment in the governor comprising a piston subject to the pressure of fluid in said chamber.

11. In combination, a fluid compressor, a reservoir into which fluid is compressed by said compressor, a compressor governor operated by variations in fluid pressure in a chamber for controlling the operation of the compressor, a valve device for controlling the fluid pressure in said chamber comprising a spring, a movable abutment subject on one side to the pressure of said spring and the fluid pressure in said chamber and on the opposite side to the pressure of fluid compressed by the compressor into said reservoir, a valve operated upon an increase in reservoir pressure on said abutment for supplying fluid under pressure to said chamber, and a valve operated upon a reduction in reservoir pressure on said abutment for venting fluid under pressure from said chamber.

12. In combination, a fluid compressor, a reservoir into which fluid is compressed by said compressor, a compressor governor operated by varia-

tions in fluid pressure in a chamber for controlling the operation of the compressor, a valve device for controlling the fluid pressure in said chamber comprising a spring, a movable abutment subject on one side to the pressure of said spring and the fluid pressure in said chamber and on the opposite side to the pressure of fluid compressed by the compressor into said reservoir, a valve operated upon an increase in reservoir pressure on said abutment for supplying fluid under pressure to said chamber, a valve operated upon a reduction in reservoir pressure on said abutment for venting fluid under pressure from said chamber, and additional means operated by fluid under pressure for opening said supply valve.

13. In combination, a fluid compressor, a reservoir into which fluid is compressed by said compressor, a compressor governor operated by variations in fluid pressure in a chamber for controlling the operation of the compressor, a valve device for controlling the fluid pressure in said chamber comprising a spring, a movable abutment subject on one side to the pressure of said spring and the fluid pressure in said chamber and on the opposite side to the pressure of fluid compressed by the compressor into said reservoir, a valve operated upon an increase in reservoir pressure on said abutment for supplying fluid under pressure to said chamber, a valve operated upon a reduction in reservoir pressure on said abutment for venting fluid under pressure from said chamber, and additional means operated by fluid under pressure for opening said supply valve and for closing communication through which said vent valve vents fluid from said chamber.

14. The combination with a vehicle braking equipment, a fluid compressor, a reservoir into which fluid compressed by the compressor is supplied, driving means for said compressor, and a fluid pressure responsive governor operative at a predetermined minimum degree of fluid pressure to start said driving means and at a predetermined maximum degree of fluid pressure to stop said driving means, of fluid pressure controlled means subject to the pressure of fluid compressed by the compressor for controlling the supply of fluid under pressure to said governor and normally operative to limit the maximum degree of pressure of fluid supplied to said governor to a degree less than the pressure of fluid compressed by the compressor, and means operative by an increase in fluid pressure in effecting an application of the brakes to effect the supply of fluid at the same pressure as that in said reservoir to said governor.

15. In combination, a fluid compressor, a reservoir into which fluid compressed by said compressor is supplied, regulatory means operative to effect the starting and stopping of the compressor when subjected to predetermined minimum and maximum pressures, respectively, a fluid pressure operated control device operative to control the pressure to which said regulatory means is subjected, said control device having a normal position wherein said regulatory means is subjected to pressure bearing one ratio to the fluid pressure in said reservoir, said control device being movable to another position on an increase in fluid pressure for subjecting said regulatory means to pressure bearing a different ratio to said reservoir pressure, and means for varying the fluid pressure on said control device.

16. In combination with a vehicle brake equip-

ment, a fluid compressor, a reservoir into which fluid compressed by said compressor is supplied, regulatory means operative to effect the starting and stopping of the compressor when subjected to predetermined minimum and maximum pressures, respectively, a fluid pressure operated control device adapted to control the pressure to which said regulatory means is subjected, said control device having a normal position wherein said regulatory means is subjected to pressure bearing one ratio to the fluid pressure in said reservoir, said control device being movable to another position on an increase in fluid pressure for subjecting said regulatory means to pressure bearing a different ratio to said reservoir pressure, and means operative upon application of the brakes for varying the fluid pressure on said control device.

17. In combination, a fluid compressor, a reservoir into which fluid compressed by said compressor is supplied, a single compressor governor adapted to start and stop the compressor when subjected to predetermined minimum and maximum pressures, respectively, a fluid pressure operated control device adapted to control the pressure to which said governor is subjected, said control device having a normal position wherein said governor is subjected to pressure bearing one ratio to the fluid pressure in said reservoir, said control device being movable to another position upon an increase in fluid pressure for subjecting said governor to pressure bearing a different ratio to said reservoir pressure, and means for varying the fluid pressure on said control device.

18. In combination, a fluid compressor, a reservoir for receiving fluid compressed thereby, a compressor governor operated by variations in fluid pressure for effecting the starting and stopping of the compressor, and a control valve device comprising a casing having a reservoir chamber communicating with said reservoir and a governor chamber communicating with said governor, a movable abutment interposed between said chambers and carrying a valve seat, a movable valve element normally positioned to be engageable by said seat for controlling communication from the one chamber to the other, a spring biasing said abutment toward said valve element in opposition to the pressure of fluid in said governor chamber, and means operative for at times positioning said valve element beyond the range of movement of the valve seat on said abutment.

19. In combination, a fluid compressor, a reservoir for receiving fluid compressed thereby, a compressor governor operated by variations in fluid pressure for effecting the starting and stopping of the compressor, and a control valve device comprising a casing having a reservoir chamber communicating with said reservoir and a governor chamber communicating with said governor, a movable abutment interposed between said chambers and carrying a valve seat, a valve element normally engageable by the seat on said abutment for controlling communication from the one chamber to the other and also from said governor

chamber to the atmosphere, a spring acting on said abutment to oppose the pressure of fluid in said reservoir chamber, and means operative at times to prevent engagement of said valve seat with said valve element.

20. In combination, a fluid compressor, a reservoir for receiving fluid compressed thereby, a compressor governor operated by variations in fluid pressure for effecting the starting and stopping of the compressor, and a control valve device comprising a casing having a reservoir chamber communicating with said reservoir and a governor chamber communicating with said governor, a movable abutment interposed between said chambers and carrying a valve seat, a valve element normally engageable by the seat on said abutment for controlling communication from the one chamber to the other and also from said governor chamber to the atmosphere, a spring acting on said abutment to oppose the pressure of fluid in said reservoir chamber, and means operative to condition said valve element to prevent engagement thereof by said valve seat while preventing escape of fluid under pressure from the governor chamber to the atmosphere.

21. In combination, a fluid compressor, a reservoir for receiving fluid compressed thereby, a compressor governor operated by variations in fluid pressure for effecting the starting and stopping of the compressor, and a control valve device comprising a casing having a reservoir chamber communicating with said reservoir and a governor chamber communicating with said governor, a movable abutment interposed between said chambers and carrying a valve seat, a valve element normally engageable by the seat on said abutment for controlling communication from the one chamber to the other and also from said governor chamber to the atmosphere, a spring acting on said abutment to oppose the pressure of fluid in said reservoir chamber, and means automatically operative when the vehicle is stopped to seal said governor chamber from the atmosphere and to prevent engagement of said seat with said valve element for cutting off communication between said reservoir and governor chambers.

22. In combination with a vehicle carried fluid compressor, a reservoir for receiving fluid compressed thereby, and a compressor governor operated according to variations in fluid pressure for effecting the starting and stopping of the compressor, an auxiliary control device comprising valve means operative to control the supply of fluid under pressure from said reservoir to said governor, a spring, a movable abutment subject on one side to the pressure of fluid in said reservoir and on the opposite side to the pressures of said spring and of the fluid in said governor, said abutment being adapted normally to control seating and unseating of said valve means, and means automatically rendered effective when the vehicle is stopped to actuate said valve means independently of the abutment for permitting uninterrupted supply of fluid under pressure from said reservoir to said governor.

BURTON S. AIKMAN.