PATENT SPECIFICATION

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COMPLETE SPECIFICATION

Improvements in Compressed Air Vehicle Braking Systems

We, LANCIA & C. FABBRICA AUTOMOBILI TORINO S.P.A., an Italian Joint-Sstock Company, of 99, via Monginevro, Turin, Italy, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to compressed air braking systems for motor vehicles.

Known compressed air braking systems generally comprise a compressor, a pressure regulator and a reservoir, as well as a control valve actuated by the driver's foot pedal for controlling the admission of compressed air to cylinders acting on the wheel brakes.

The compressor, pressure regulator and reservoir together with their connecting pipes form the so-called "automatic" circuit of the system adapted to provide air at the required pressure, the control valve and said cylinders together with their piping forming the "controllable" or "braking" circuit of the system and being adapted to effect vehicle braking by utilising to a controlled extent the stored energy of the compressed air in the automatic circuit. A further circuit, the so-called "service" circuit, is often included in the system, this circuit providing compressed air for the operation of horns, doors, etc. and being equipped with an individual reservoir charged by the compressor.

Where damage or failure liable considerably to reduce or to annul the pressure of air supplied to the cylinders occurs in the system components or piping, the vehicle braking effectiveness is adversely affected or the brakes fail altogether.

While leakage from the braking circuit of the system often directly results in serious effects through failure of the brake when needed and because the braking circuit cannot be constantly checked by the driver, leakage from the automatic circuit reduces the braking action until the brake fails altogether on emptying of the reservoir.

Circuit arrangements are known in which the braking circuit can be divided into two or more sections to avoid a sudden total loss of braking action or to isolate a failed section. However, such arrangements will not enable the vehicle always to be run to a repair shop because, if failure occurs in the automatic circuit, which is not divided, the braking action becomes gradually ineffective and fails altogether when the reservoir is empty, as mentioned above.

It is an object of this invention to provide a compressed air braking system fully avoiding the above drawbacks, more particularly enabling the vehicle to be run as far as may be desired to a repair shop even when failure occurs in an automatic circuit of the system.

A further object of this invention is to provide a braking system in which upon failure in any one of the circuits thereof the driver need not tamper with any component to run the vehicle further till it can be repaired.

The improved compressed air braking system of the present invention comprises two pneumatically independent air compressors adapted to supply compressed air individually to two pneumatically independent reservoirs and independent braking circuits for the front and rear wheels, respectively, each of which includes a control valve controlling the admission of air to the wheel brake cylinders of that circuit, the said control valves being concurrently controlled by the vehicle brake pedal.

The invention will be described with reference to the accompanying drawings given by way of a non-limiting example, wherein:—

Figure 1 shows diagrammatically an improved braking system in accordance with this invention for a trailerless vehicle;

Figures 2 and 3 show a detail of the system of Figure 1 in two different operating positions;

Figure 4 is a diagram of the system as adapted for a vehicle and trailer unit; and

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Figures 5 and 6 show a detail of the system of Figure 4 in two different operating positions.

The braking system illustrated in the drawings comprises a two-cylinder compressor 1 in which the cylinders 2 and 22 are pneumatically separate. If desired, two pneumatically independent single cylinder compressors can be substituted for one two-cylinder compressor.

The air compressed in the cylinders 2 and 22 flows through pipes 3 and 23 to pressure regulators 4 and 24 preceded by safety valves 5 and 25 and followed by non-return valves 6 and 26 respectively. Beyond the regulators, pipes 3 and 23 connect with reservoirs 7 and 27 and control valves 8 and 28 of known type controlled by a brake pedal P through a beam B.

The inlets of valves 8 and 28, which normally are subject to the pressure prevailing in the reservoirs 7, 27 are connected to a three-way delivery cock R delivering air through a calibrated valve V to a service reservoir denoted by S. Thus the reservoir S is fed from a braking circuit at a point upstream of the control valve for such circuit.

The valve V is a spring-loaded non-return valve comprising a valve member 50 connected to a piston 51 movable in a cylinder against the action of a spring 52. As will be clear from the drawing, the opposite sides of valve member 50 are subject to the air pressure upstream of the control valve of a selected braking circuit and of the service reservoir respectively, whilst the piston is urged in the valve-opening direction by the air pressure in the service reservoir. The spring characteristics and the surface areas of the valve member 50 and piston 51 are such that the valve opens to permit air to flow to the reservoir S only whilst the air pressure upstream of the control valve in the braking circuit to which it is connected by the cock R is above a value which gives at least partial braking action in such braking circuit. So long as the pressure in such circuit exceeds said value, the same pressure is established both ahead and past the valve member 50, the valve V closing to isolate reservoir S only on falling of the braking circuit air pressure below said valve-opening value.

On depression of the brake pela P, the air flows through control valves 8 and 28 to the pipes 9 and 29, thence to the front wheel brake cylinders 10 and rear wheel brake cylinders 30, respectively.

A delay valve 11 is interposed in the pipe 9 for causing rear wheel braking in advance of front wheel braking. The valve 11 is such as to initially delay the flow of air through the valve to the cylinders 10 after opening of its associated control valve 8, while affording a quick equalising of the pressure on both sides of the valve 11 at any constant value determined by the setting of the control valves and without affecting the rate of discharge of air on release of the pedal P.

The valve 11 comprises a body enclosing a disc 11*a* urged by a spring 11*b* against a seat 11*c*. The spring 11*b* acts on disc 11*a* in opposition to air pressure from valve 8 and is calibrated to permit displacement of the disc 11*a* away from seat 11*c* only when the pressure has reached a predetermined value such that braking pressure is first established in the brake cylinders 30, whereby the vehicle rear wheels are braked first and its front wheels next, avoiding any instability in drive on braking.

The disc 11*a* is formed with a central opening against which a further disc 11*d* is urged on the side opposite the spring 11*b* by a considerably weaker spring 11*e*, the disc 11*d* moving away from disc 11*a* to permit discharge of pressure air from the cylinders 10 on release of the brake pedal P.

A calibrated orifice is provided in the disc 11*d* or in a by-pass and constantly connects the part of pipe 9 upstream of the valve 11 with the part of pipe 9 downstream of this valve, so as to quickly balance the pressures on the two sides of the valve when the disc 11*a* re-engages its seat 11*c*, thereby to equalise the pressures applied to the front wheel and rear wheel cylinders.

Possible damage on a vehicle equipped with the braking system as described above may occur as follows:—

(1) Air failure occurs in the automatic circuit including components 2 to 4 or in the circuit including components 22 to 24, which may be due to failure of a cylinder of the two-cylinder compressor or either compressor, or damage to one of the safety valves 5, 25, breakage of either pipe 3 or 23 or damage to one of the regulators 4 or 24; in such an event the non-return valve 6 or 26 closes.

In this event the system is at first fully effective but as air is drawn from the reservoir 7 or 27 associated with the failed circuit, available air in that reservoir decreases till a low pressure signalling lamp associated with the damaged circuit is switched on. The other circuit is maintained fully effective whereby the vehicle can be run, though at a reduced speed, to the first repair shop.

Where the damage involves the automatic circuit feeding, in addition to a braking circuit, also the services, and if the latter are to remain effective until repair is effected, supply is maintained by rotating the cock R, for instance from its position shown in Figure 1 to its position shown in Figure 2, that is, to a position such as to feed the services from the effective automatic circuit.

(2) Failure occurs in one of the two auto-

matic circuits downstream of its non-return valve 6 or 26 and upstream of the service feed cock R or one of the two braking circuits.

The only difference over the previously described case resides in a decrease of the initial period in which the whole system is fully effective, one of the two braking circuits failing at once. However, in addition to the other braking circuit remaining fully efficient, if damage occurs in the automatic circuit supplying the services, the latter are maintained effective through the provision of the non-return valve V which prevents the service reservoir from being emptied. In this event also, where the service reservoir should be maintained under pressure till the repair shop is reached, all that need be done is to rotate the cock R so that supply therefor is derived from the effective automatic circuit of the system.

(3) Damage involves the service circuit.

In this event the non-return valve V prevents emptying also of the braking circuit connected through the cock R and above-mentioned valve with the service circuit. The only consequence is that pressure slightly drops in the braking circuit supplying the service circuit, that is, its pressure drops to the value at which valve V closes.

Where before repairing the service circuit it is desired to restore the normal working pressure in the braking circuit connected thereto, it is sufficient to rotate the cock R to the position shown in Figure 3, so that the service circuit is isolated from the automatic circuits.

The modification shown in Figure 4 relates to a braking system for a tractor and trailer unit. Parts similar to those of the system shown in Figure 1 are denoted by the same reference numerals.

In Figure 4, G denotes the joint coupling the circuits on the tractor with the circuits on the trailer. The trailer circuits comprise, similarly to the circuit on the tractor, an automatic circuit which is fed through a conduit 41 from the reservoir 7 and a braking circuit which is controlled by air pressure applied through conduit 42 emanating from between the control valve 8 and valve 11; it will be seen that the circuits on the trailer are fed and controlled in parallel with the circuits for the front wheel brakes of the tractor.

In the system shown in Figure 4, a delay valve 31 is interposed in the rear wheel braking circuit of the tractor, the valve 31 being identical to the valve 11 described with reference to the circuit shown in Figure 1. The valves 11 and 31 are adapted to delay braking of the tractor with respect to the trailer, their action being differential to first brake the trailer, next the rear wheels of the tractor, finally the front wheels of the tractor in order to decelerate the rear masses first in order to maintain as long as possible the possibility of steering the front axle.

Considering the above, the conditions occurring in this system in the event of failure of either an automatic or a braking circuit either on the trailer or tractor will be readily understood.

During normal running with a trailer, air for the service reservoir is drawn from the rear wheel braking circuit of the tractor, inasmuch as the compressor feeding the front wheel braking circuit also supplies the trailer reservoir.

On a tractor vehicle deprived of its trailer, during normal running air for the services is drawn from the compressor serving the front wheel braking circuit inasmuch as the latter requires as a rule less air than the rear wheel braking circuit which serves brakes of greater capacity.

It will be obvious that in a system according to this invention, because of the absence of any connection between the two pairs of automatic and braking circuits for the vehicle (or the tractor of a tractor and trailer unit), any breakage whether in an automatic circuit or a braking circuit leaves it fully possible to brake and run the vehicle further to the first repair station.

It is further noted that the improved system is free of cut-off members operable from the outside or automatically for intercepting the supply of compressed air to the reservoir of a braking circuit, whilst a spring-loaded non-return valve in the preferred arrangement described acts to cut off the service circuit when damaged, as distinct from other known systems, thereby preventing an error in distinguishing the cut-off member associated with the damaged circuit from making braking impossible.

The non-return valve cutting off the services when damaged acts automatically; however, operation of the valve is not essential to maintain the braking action, inasmuch as the valve is connected with one braking circuit only, so that the other braking circuit will in no case become ineffective upon a service circuit failure.

Any incorrect handling of the three-way cock R, whether it involves damaged or effective circuits, leaves braking of the vehicle unaffected. The cock will in no case interconnect the two braking circuits and, when actuated, it merely acts to interchange the braking circuit supplying the service reservoir or cut off supply to the service reservoir when the service circuit is damaged.

It will be understood that, while leaving the principle of this invention unaltered, constructional details and embodiments can be largely varied from the examples described and shown without departing from the scope

of this invention as defined in the appended claims.

WHAT WE CLAIM IS:—

1. A compressed air braking system for motor vehicles, comprising two pneumatically independent air compressors adapted to supply compressed air individually to two pneumatically independent reservoirs and independent braking circuits for the front and rear wheels, respectively, each of which includes a control valve controlling the admission of air to the wheel brake cylinders of that circuit, the said control valves being concurrently operated by the vehicle brake pedal.

2. A system according to Claim 1, including an air reservoir from which pressure air is drawn for operating the vehicle services, the said reservoir being fed through a three-way cock from a braking circuit at a point upstream of the control valve of such circuit and the three-way cock being so arranged as to permit feeding the service reservoir selectively from either of said braking circuits but to prevent interconnection of the braking circuits whatever position is taken by the cock.

3. A system according to Claim 1 or 2, including a delay valve in the braking circuit for the front wheel brake cylinders, said delay valve being downstream of the control valve for such circuit and serving to delay braking of the front wheels with respect to braking of the rear wheels.

4. A system according to Claim 1, 2 or 3, for tractor and trailer units, including a braking circuit for the trailer brake cylinders controlled by ai drawn from the front wheel braking circuit of the tractor downstream of the control valve of such tractor braking circuit, and an automatic trailer circuit fed with air from the same tractor braking circuit upstream of the control valve thereof.

5. A system, for tractor and trailer units, according to Claims 3 and 4, including a delay valve in each of the tractor braking circuits for delaying braking of the tractor with respect to braking of the trailer.

6. A system according to Claim 5, wherein the delay valves are calibrated to cause braking of the trailer followed by braking of the tractor rear wheels and, finally, braking of the tractor front wheels.

7. A system according to Claim 3, 5 or 6, wherein the or each delay valve comprises a main valve member urged by a spring towards its closed position against the action of air pressure from the control valve of its braking circuit, the force of said spring and the valve member area being such that the main valve member moves away from its closed position when the pressure upstream thereof reaches a predetermined value such that braking pressure is first established in the brake cylinders of the circuit which does not include a delay valve.

8. A system according to Claim 7, wherein the or each delay valve further comprises a secondary valve member opening in a reverse direction to the main valve member against a low elastic pressure by the action of the air contained in the brake cylinders of its braking circuit to permit discharge of air from the brake cylinders of such circuit as the control valve is moved to its discharge position by release of the brake pedal.

9. A system according to Claim 7 or 8, wherein the two sides of the or each delay valve are constantly interconnected through a calibrated orifice adapted to equalize the pressures on both sides of the valve directly after closure of the main valve member.

10. A system according to Claim 2 or any claim dependent thereon, wherein the service reservoir is fed through a valve adapted to open and close at a pressure in the braking circuit to which it is connected that gives at least partial braking action in such circuit, thereby to maintain such pressure in said braking circuit upon failure in the service circuit and to isolate the service circuit upon failure in the said braking circuit.

11. A system according to Claim 10, wherein said valve through which the service reservoir is fed comprises a valve member one side of which is acted upon by the pressure in the braking circuit to which the valve is connected and the other side of which is acted upon by the pressure in the service reservoir, the said valve member being connected to a piston which is acted upon by the pressure in the reservoir in opposition to a spring.

12. A compressed air braking system for motor vehicles, substantially as herein described with reference to and as shown in Figures 1 to 3 of the accompanying drawings.

13. A system according to Claim 12, modified substantially as herein described with reference to and as shown in Figures 4 to 6 of the accompanying drawings.

FORRESTER, KETLEY & CO.,
Chartered Patent Agents,
Jessel Chambers, 88/90, Chancery Lane,
London, W.C.2,
and
Central House, 75, New Street,
Birmingham, 2,
Agents for the Applicants.

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Fig. 4

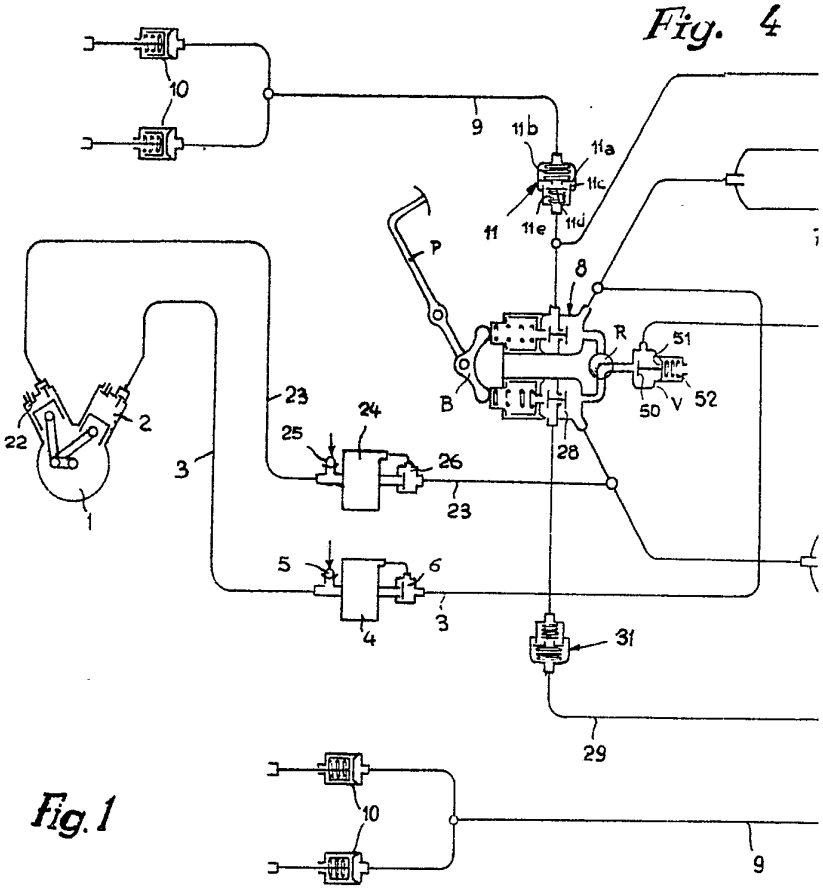

Fig. 1

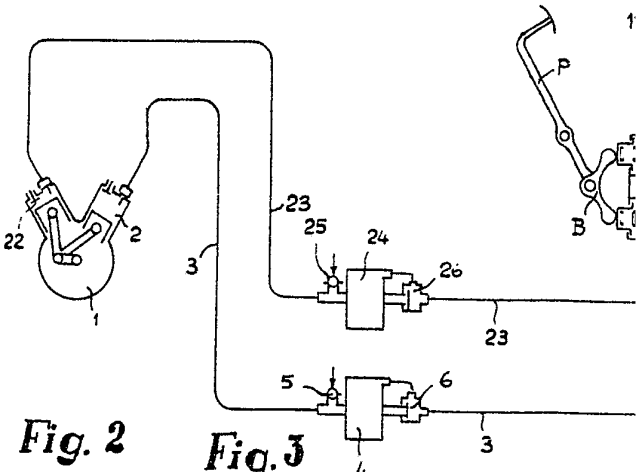

Fig. 2

Fig. 3

817,853 COMPLETE SPECIFICATION
1 SHEET

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Fig. 4

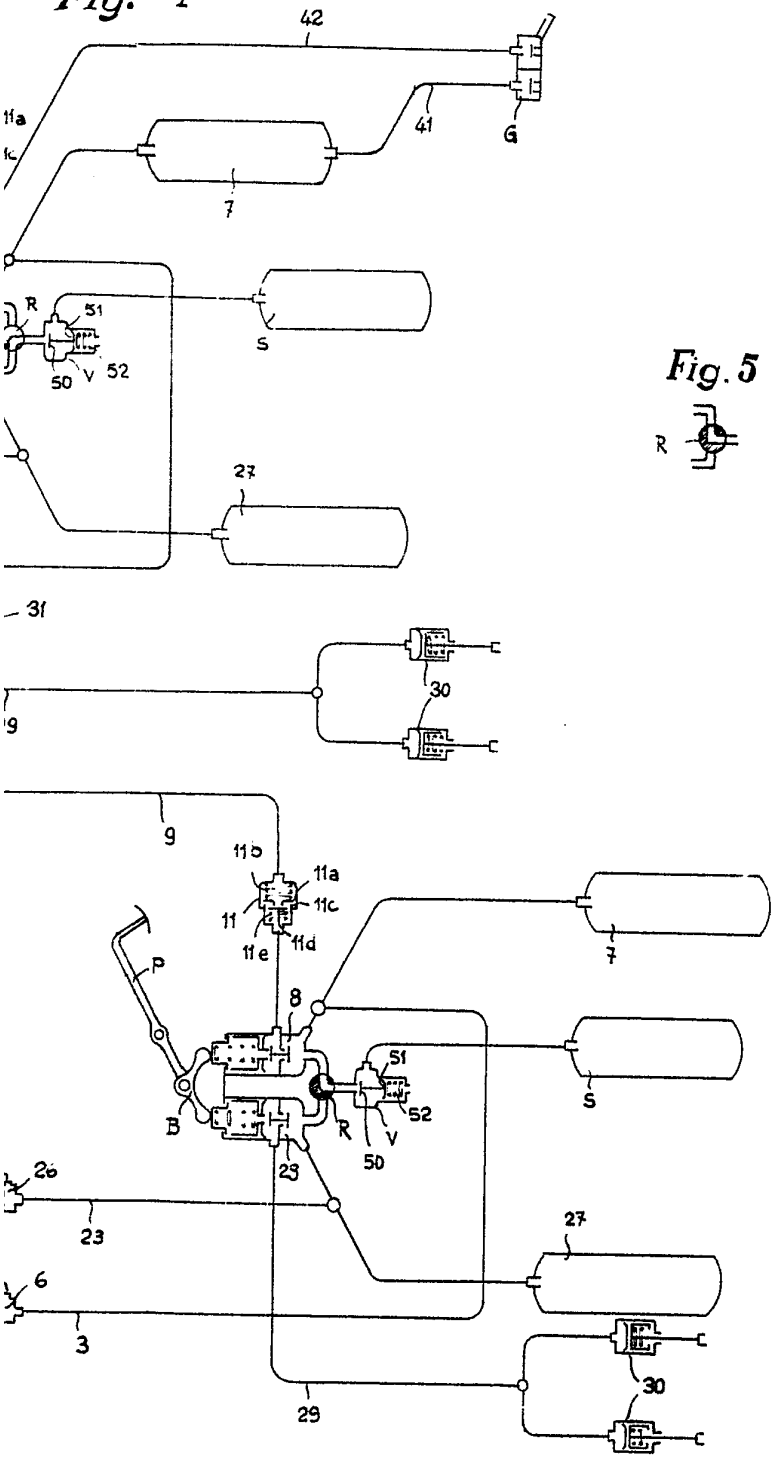

Fig. 5

Fig. 6

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Fig. 4

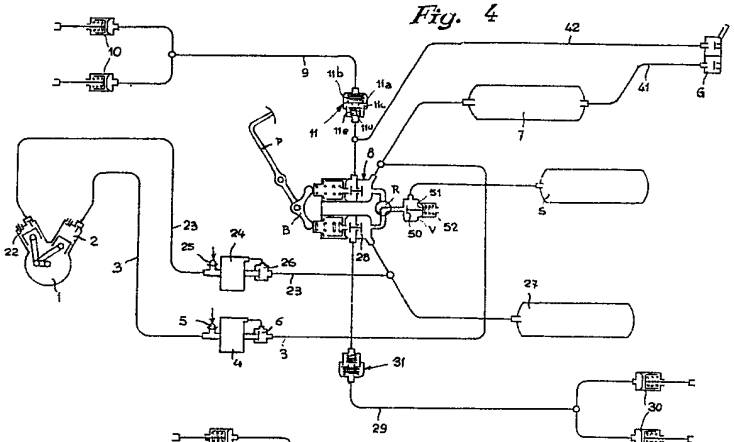

Fig. 1

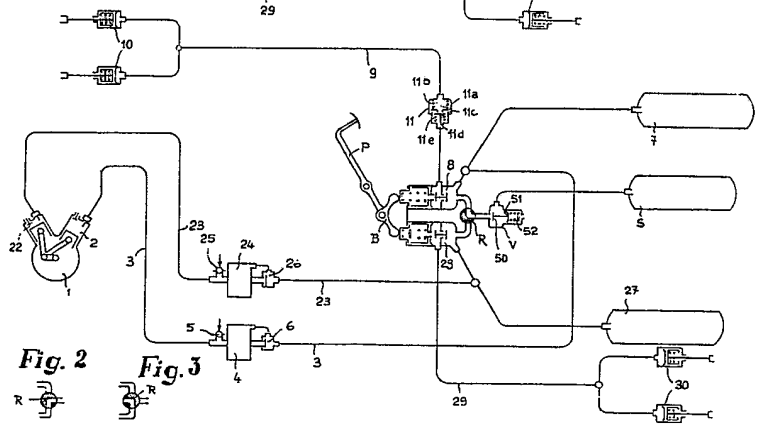

Fig. 2

Fig. 3

Fig. 5

Fig. 6