

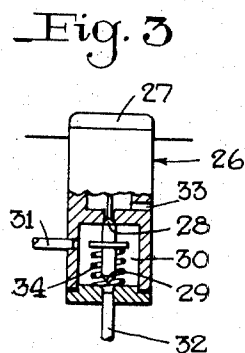
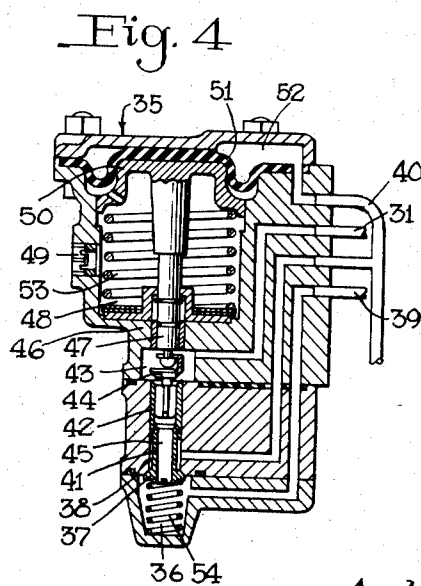
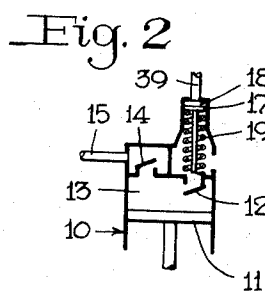
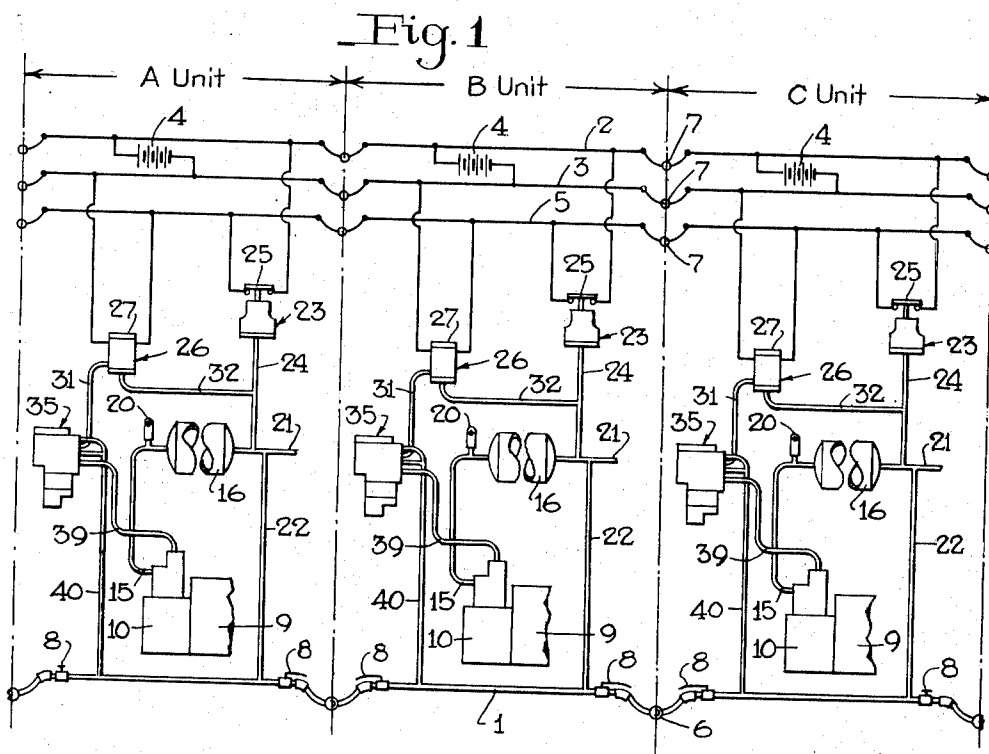
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CONTROL APPARATUS FOR FLUID COMPRESSORS

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CONTROL APPARATUS FOR FLUID
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1 Claim. (Cl. 230—7)

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This invention relates to apparatus for controlling fluid compressors and more particularly to apparatus for synchronizing the operation of a plurality of fluid compressors.

A diesel locomotive for railway service usually comprises two or more power units coupled together and each power unit may comprise one or more diesel engines and a fluid or air compressor is usually connected to each of the engines for compressing air into a main reservoir on the unit, the several main reservoirs on the locomotive being usually connected to a common reservoir pipe extending through the units from one end of the locomotive to the opposite end and from which fluid under pressure is taken for controlling or operating various devices on the locomotive and for also controlling brakes on the locomotive and cars of a train. Each compressor usually operates continuously with the driving engine. An unloader piston at the compressor is provided for operation by fluid under pressure to open and hold open the compressor inlet valve or valves to terminate its compressing of air, or to unload the compressor as it is commonly referred to. Upon release of fluid under pressure from the unloader piston the compressor inlet valve or valves are permitted to function, or to load the compressor, so that operation of the compressor will restore the pressure in the main reservoir. Fluid under pressure is thus supplied to the unloader piston of each compressor upon energization of a magnet valve device and released from the piston upon deenergization of said magnet valve device. Also on each unit there is provided a compressor governor responsive to pressure of fluid in the respective reservoir for a purpose to be presently brought out, and a safety valve is connected to the discharge line of each compressor to limit the pressure in the main reservoir to some safe degree, such as 165 pounds, in case the compressor fails to be unloaded as intended.

Since all of the main reservoirs on the locomotive are connected to the common main reservoir pipe extending from end to end of the locomotive it is desirable that each of the compressors operate to provide its share of compressed air on the locomotive in order to minimize wear and maintenance of the compressors. To this end a synchronizing arrangement is therefor usually provided whereby all of the magnet valve devices will be energized to load the respective compressors upon response of the first governor on the locomotive to a chosen reduced pressure of fluid (125 pounds) in the main reservoir to which it is con-

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nected and all of the compressors will then keep on compressing air, and not be unloaded, until the last one of the governors on the locomotive operates, in response to an upper limit of pressure (140 pounds) in the reservoir to which it is connected, to effect deenergization of the magnet valve devices.

In spite of this synchronizing arrangement, however, it has been found that when the pressure in the main reservoir on the leading unit of certain diesel locomotives becomes reduced to a degree at which the respective governor operates to start all the compressors on the locomotive to compress air, and particularly where a large amount of compressed air is being used from the main reservoir on the leading unit, that the compressor or compressors on the other units may build up pressure in their main reservoirs to a degree in excess of that in the main reservoir in the leading unit and also in excess of that at which their governors are adjusted to operate to stop the compressors from compressing air, since under this condition none of the compressors can stop compressing air until the pressure in the main reservoir on the leading unit has built up to the degree required to operate the governor on that unit. In certain instances such excess has been so great as to cause the safety valves on the main reservoirs to the rear of the leading unit to operate and keep on operating to relieve their reservoirs of excess pressure until the governor operates on the leading unit to unload all compressors, with the result that the compressors to the rear of the leading unit have to unnecessarily operate against excess load with excessive heating and shortening of their life and increased maintenance and also the safety valves on such units become damaged and their life shortened.

It will be seen that if, through the main reservoir pipe, the pressures in all of the main reservoirs on the locomotive could increase in unison the above described over loading of any one or more compressors would not occur, but under certain conditions, such as the condition above mentioned, this uniform increase in pressure in all of the main reservoirs cannot occur due to the resistance to air flow through the long main reservoir pipe extending from one end of the locomotive to the other and through hose couplings in the connections in said pipe between the coupled locomotive units, and through the branch pipes connecting the main reservoirs to the main reservoir pipe, with respect to the air compressing capacity of the compressors on the different units. In other words, while the

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compressors on the units to the rear of the leading unit will be operating to compress air through the main reservoir pipe to the leading unit to increase or help increase the pressure in the main reservoir thereon to the degree for operating the respective governor to unload all compressors, the pressure in the main reservoir or reservoirs on the units to the rear of the leading unit will increase to the setting of the safety valves thereon and cause said safety valves to operate until the governor on the leading unit operates to unload all of the compressors on the locomotive. Moreover on certain locomotives a main reservoir cut-off valve device of the general type disclosed in Patent No. 2,407,890, issued to G. T. McClure, on September 27, 1946, is employed between each main reservoir and the main reservoir pipe to hold sufficient pressure in said reservoir, in case of rupture of the main reservoir pipe, to insure integrity of the brake system on the unit, and said valve device only tends to accentuate the above difficulty by providing a further restriction to air flow. The condition is still further aggravated if a compressor on a unit should fail to compress air and where two diesel engines and two compressors with corresponding greater air compressing capacity are employed on a single unit of a locomotive.

The principal object of the invention is therefore the provision of means for overcoming the above difficulty, and this object is obtained by the provision of an auxiliary valve device on each unit for unloading the respective compressor or compressors whenever the pressure in the respective main reservoir is increased to a degree just slightly in excess (at 145 pounds) of the pressure at which its governor is set (140 pounds) to unload the compressors. When the pressure in this main reservoir then becomes reduced sufficiently by flow to the main reservoir on, for example, the leading unit, the auxiliary valve device will operate to restore the control of the compressor unloader to the governor on the leading unit whereupon the compressor will again be loaded until the pressure in its reservoir is again increased to the pressure where the auxiliary valve device operates. In this way the compressors on the units to the rear of the leading unit will be alternately loaded and unloaded to aid to a maximum degree the recharging of the main reservoir on the leading unit, without however, materially overloading of such compressors and without undue work and wear on their part or on the connected safety valves.

Other objects and advantages will become apparent from the following more detailed description of the invention.

In the accompanying drawing; Fig. 1 is a diagrammatic representation of an air supply system including a plurality of air compressors and control means therefore embodying the invention, for a multiple unit diesel locomotive; Fig. 2 is a diagrammatic representation of a portion of an air compressor carried by each of said units; Fig. 3 is a longitudinal sectional view of a magnet valve device associated with each of said units; and Fig. 4 is a longitudinal sectional view of an auxiliary control valve device associated with each of said units.

Description

As shown in Fig. 1 of the drawing, the air supply system embodying the invention is shown, for the purpose of illustration only, for three units of a diesel locomotive, said units being

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designated in the drawing as "A unit," "B unit" and "C unit," and through all of these units, from one end of the locomotive to the other there extends a main reservoir pipe 1, battery supply and return wires 2 and 3, respectively, connected on each unit to opposite terminals of a battery 4, and a compressor synchronizing wire 5, said pipe and wires being connected between the units by the usual couplings 6 and 7, respectively. A cut-off cock 8 is provided in the main reservoir pipe at each end of each unit of the locomotive, the cocks at the outer ends of the two end units being closed and all others open.

On each unit of the locomotive reference numeral 9 designates a portion of a diesel propulsion engine for the unit, and reference numeral 10 designates an air compressor adapted to constantly operate with said engine, that is, whenever the engine is operating, the compressor will be operating in accordance with conventional practice.

Each compressor 10 may, for illustrative purposes only, comprise (Fig. 2) a reciprocating piston 11 adapted to draw air past an inlet valve 12 into an air compressing chamber 13 and to compress such air in said chamber out past a discharge valve 14 into a pipe 15 leading to a main reservoir 16, the inlet valve 12 closing to permit such compression, as well known. The numeral 17 designates an unloader piston adapted to be operated by fluid under pressure, when present in a chamber 18, to hold the inlet valve 12 open to unload the compressor or, in other words, to permit air drawn into chamber 13 past valve 12 upon the intake stroke of piston 11 to be discharged back past said valve upon the air compressing stroke of said piston in order to prevent compressing such air past the discharge valve 14. When chamber 18 is void of fluid under pressure a spring 19 will elevate the piston 17 to permit closure of valve 12 whereby the compressor will be loaded to compress air past valve 14, as above mentioned.

A safety valve 20, set for example to open at 165 pounds, is connected to pipe 15 to limit pressure of fluid obtained therein by operation of the respective compressor 10.

The main reservoir 16 is shown as having an outlet pipe 21 for conveying fluid under pressure to a point of use, while a branch 22 connects said pipe to the main reservoir pipe 1 whereby all of the main reservoirs on the locomotive are open to each other through said main reservoir pipe.

Reference numeral 23 on each unit of the locomotive designates a compressor governor connected by a pipe 24 to a main reservoir outlet pipe 21 and which is adapted to operate in response to a pressure, such as 140 pounds, in the respective main reservoir 16 to open a switch 25 for disconnecting the synchronizing wire 5 from the battery supply wire 2. When the pressure in the main reservoir outlet pipe 21 is reduced to a lower degree, such as 125 pounds, the compressor governor 23 is adapted to respond thereto to close switch 25 for connecting the synchronizing wire 5 to the battery supply wire 2. This governor device may be like that disclosed in Patent No. 1,615,365 issued to C. C. Farmer on January 25, 1927, in view of which and the fact that governors of this type are so well known that a further disclosure and description thereof in the present application is not deemed essential to a clear understanding of the invention.

Reference numeral 26 designates a magnet valve device comprising a magnet 27 the oppo-

site terminals of which are connected, respectively, to the synchronizing wire 5 and the battery return wire 3. The valve device further comprises two valves 28 and 29 contained in a chamber 30 which is open to a pipe 31, the valve 29 being provided for controlling communication between the pipe 31 and a pipe 32 connected through pipe 24 to the main reservoir outlet pipe 21, and the valve 28 being arranged to control communication between pipe 31 and an atmospheric exhaust passage 32. Energization of magnet 27 is adapted to open the valve 28 and close the valve 29, while upon deenergization of said magnet a spring 34 is adapted to open valve 29 and close valve 28.

Heretofore on each locomotive unit the pipe 31 has been connected directly to the unloader piston chamber 18 in the respective air compressor 10 but in accordance with the invention this connection is now controlled by a valve device 35.

The valve device 35 (Fig. 4) comprises a casing having a chamber 36 containing a valve 37 for controlling communication between said chamber and a chamber 38, said chambers being open, respectively, to a pipe 39 leading to the unloader piston chamber 18 of the respective compressor and to a pipe 40 connected to the main reservoir pipe 1. The valve 37 is formed on one end of a stem 41 extending through chamber 38 and connected at the opposite end to a plunger 42 slidably mounted in the casing and separating chamber 38 from a chamber 43 which is open to pipe 31 leading to the magnet valve device 27 on the unit. A valve 44 contained in chamber 43 is arranged to cooperate with a seat provided on the adjacent end of plunger 42 for controlling communication between said chamber and an axial bore 45 extending through said plunger, the valve stem 41 and the valve 37 to the chamber 36. The valve 44 is connected to one end of a stem 47 for movement therewith, said stem slidably extending through a bore provided in a partition wall 46 which separates chamber 43 from a chamber 48 which latter chamber is open to atmosphere through a breather passage 49. In chamber 43 a follower 50 provided on the end of stem 47 engages one side of a flexible diaphragm 51 separating chamber 48 from a pressure control chamber 52 at the opposite side of said diaphragm. Chamber 52 is open to pipe 40 and thereby the main reservoir pipe 1. A spring 53 in chamber 48 acts on the follower 50 for actuating same and the diaphragm 51, when chamber 52 is void of fluid under pressure, to pull the valve 44 out of seating engagement with the plunger 42 whereupon a spring 54 contained in chamber 36 is adapted to close the valve 37. When fluid at sufficient pressure is supplied to chamber 52, as will be later described, the diaphragm 51 will deflect against spring 53 and actuate the stem 47 to seat valve 44 against plunger 42 and then actuate said plunger to unseat valve 37 against spring 54.

Operation

In operation, let it be assumed that, due to use, the pressure of fluid in the main reservoir 16 on one of the locomotive units becomes reduced to a degree at which the respective governor device 23 operates to close its switch 25 for connecting the battery supply wire 2 to the synchronizing wire 5. Current will then be supplied from one side of the battery 4 on the respective unit to the synchronizing wire 5 and

thence to magnet 27 of the magnet valve device 26 on each of the locomotive units, the opposite terminal of the several magnets 27 being connected to the battery return wire 3 and thus to the opposite terminal of said battery. The magnets 27 of all of the magnet valve devices 26 on the locomotive will therefore be simultaneously energized to disconnect the respective pipes 32 and 31 and open pipe 31 to atmosphere. With the pressure of fluid in all main reservoirs 16, and therefore in the main reservoir pipe 1, below the pressure of spring 53 on diaphragm 51 in the several valve devices 35, the valve 44 will be open and the valve 37 closed in each of said valve devices whereby on each locomotive unit, the pipe 39 will be open through bore 45 in plunger 42 and past the unseated valve 44 of the respective valve device to the now vented pipe 31. On each locomotive unit the unloader piston chamber 18 will thus be open to atmosphere through the respective valve device 35 and the energized magnet valve device 26 and the compressor 10 will as a consequence be loaded and operative to compress air through the pipe 15 to the respective main reservoir 16.

Now let it be assumed that the "A unit" is the leading or control unit of the locomotive and that fluid under pressure is being taken from the reservoir 16 thereon for the control of brakes or other uses and that through the medium of the main reservoir pipe 1 extending throughout the length of the locomotive that the compressors 10 on the other locomotive units are trying to aid the compressor 10 on the leading unit to restore and build up the pressure in the main reservoir 16 on the leading unit. Further let it be assumed that the restriction to flow of fluid under pressure from the main reservoirs 16 on the trailing units to the main reservoir 16 on the leading unit is such that the pressure in the main reservoirs 16 on the trailing units will increase above that in the main reservoir on the leading unit and finally to a pressure where the respective governor devices 23 will operate the switches 25 to locally disconnect the battery supply wire 2 from the synchronizing wire 5. This will have no effect upon delivery of air by the compressors 10 on the trailing units however since the magnet valve devices 26 thereon will be retained energized by current supplied to the synchronizing wire 5 through operation of the governor device 23 on the leading unit, the switch 25 of which will be still closed. As a result, the compressor 10 on each trailing unit will continue to compress fluid into its main reservoir and hence in the portions of the main reservoir pipe on said unit until such pressure acting in diaphragm chamber 52 of the respective valve device 35 becomes increased to a degree (145 pounds) sufficient to actuate said valve device to close its valve 44 and open its valve 37, whereupon, fluid under pressure from the main reservoir pipe 1 will flow past the valve 37 to the unloader piston chamber 18 and unload the respective air compressor. The air compressor 10 on one or more of the trailing units will thereby be unloaded to terminate compressing of air into the respective main reservoir 16 while compressor 10 on the leading unit of the locomotive remains loaded and continues to compress air into its reservoir 16. After the compressor or compressors on the trailing unit or units, are thus unloaded, the pressure of fluid in their main reservoirs 16 will reduce by flow through the main reservoir pipe 1 to the main reservoir 16 on the

leading unit to aid the compressor 10 thereon to increase the pressure in the respective reservoir, and when the pressure in the main reservoirs on the trailing unit or units becomes reduced by such flow to a pressure slightly below 145 pounds, spring 53 in each valve device 35 will actuate said valve device to reopen the valve 44 and close the valve 37 therein, whereupon, the respective unloading piston chamber 18 will again be vented to atmosphere by way of the respective magnet valve device 26 and the compressor on the respective trailing unit will be again loaded to compress further air into the respective main reservoir 16. The compressor on the trailing unit or units will thus be alternately unloaded and loaded at a limited pressure of substantially 145 pounds in the respective main reservoir to aid the compressor 10 on the leading unit to build up the pressure in its reservoir 16 until the pressure in the latter reservoir becomes increased to the degree required for operating the governor device 23 on the leading unit to open its switch 25 for deenergizing magnets 27 of the magnet valve devices 25 on all of the locomotive units, whereupon, on each unit fluid under pressure from the respective main reservoir 16 will be supplied through pipes 32 and 31 to the valve device 35 thereon. On the leading locomotive unit the valve 44 will be open and the valve 37 closed in the valve device 35 so that such fluid supplied to pipe 31 will flow to pipe 39 and unload the respective compressor 10. The same will promptly occur on all other units of the locomotive if the valve device 35 thereon is conditioned with the valve 44 open and the valve 37 closed, but if the valve device 35 on said other units is operated to close valve 44 and open valve 37 at the instant the governor device 23 on the leading locomotive unit opens its switch 25 the compressors 10 on said other units will already be unloaded by fluid under pressure from the main reservoir pipe 1 as above described. When the pressure of fluid in the main reservoir pipe on the trailing units becomes subsequently reduced to the point where the spring 53 in the valve devices 35 will operate to open valve 44 and permit closure of valve 37 the compressors on said units will be maintained unloaded by fluid under pressure from pipe 31 the same as on the leading unit.

It will be noted that the valve device 35 on the leading unit will remain in the condition connecting pipe 31 to pipe 39 for restoring pressure of fluid in the respective main reservoir 16, but since either end of the locomotive may be the leading end said valve device is required at both end units of the locomotive as well as on all intermediate units. It is also required on both end units of the locomotive for the purpose of limiting operation of the compressors thereon to for example restore pressure of fluid in the main reservoir 16 on an intermediate unit in case the compressor therein has for any reason failed and is not compressing air.

From the above description it will now be seen that the valve device 35 will operate on each unit of a diesel locomotive, or the like, to permit maximum use of the air compressor thereon in restoring pressure in the main reservoir 16 on another unit without however abnormal loading and operation of such compressor and undue damaging operation of the associated safety valve device.

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

A fluid pressure supply system comprising, in combination, a pipe, a plurality of reservoirs connected, respectively, to spaced apart portions of said pipe, a plurality of air compressors, the pressure outlets of which are connected, one each, to said reservoirs, each compressor comprising unloading means operable by fluid under pressure to render the respective compressor ineffective to compress air and upon release of such fluid under pressure to render the respective compressor effective to compress air, a source of electrical energy, a first wire connected to one pole of said source, a second wire connected to the opposite pole of said source, a control wire, and a plurality of control means, one for controlling supply of fluid under pressure to and its release from the said unloading means of each of said compressors, each of said control means comprising a governor connected and subject to pressure of fluid in the respective reservoir, said governor including switch means responsive to a chosen pressure of fluid in its respective reservoir to electrically connect said first wire to said control wire and responsive to a lower pressure therein to break electrical connection between said first wire and said control wire for thereby energizing and deenergizing, respectively, said control wire, each of said control means further comprising a conduit and a first control device connected to said conduit, said first control device comprising movable abutment means connected and constantly subject to pressure of fluid in the respective reservoir, valve means controlled by said abutment means controlling one communication between the respective said unloading means and reservoir and another communication between the respective said unloading means and said conduit, said abutment means being operative in response to a pressure of fluid in the respective reservoir, which is greater than said chosen pressure, to actuate said valve means to open said one communication and close said other communication, and means acting on said valve means and abutment means operative in response to a pressure in the respective reservoir acting on said abutment means, which pressure is lower than said greater pressure, to actuate said valve means to close said one communication and open said other communication, each of said control means further comprising a second control device connected to said second wire and controlled from said control wire and also connected to said conduit and the respective reservoir and operative upon energization of said control wire to connect said conduit to atmosphere and upon deenergization of said control wire to connect said conduit to the respective reservoir.

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