Jan. 20, 1953 R. McINTYRE 2,626,100

COMPRESSED AIR SUPPLY SYSTEM

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Fig. 1.

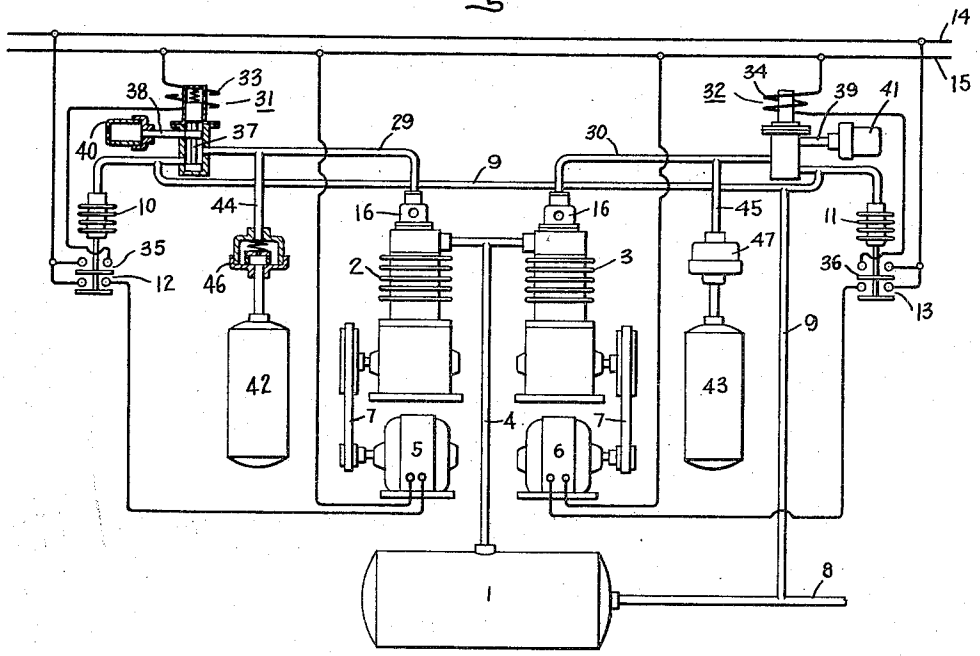
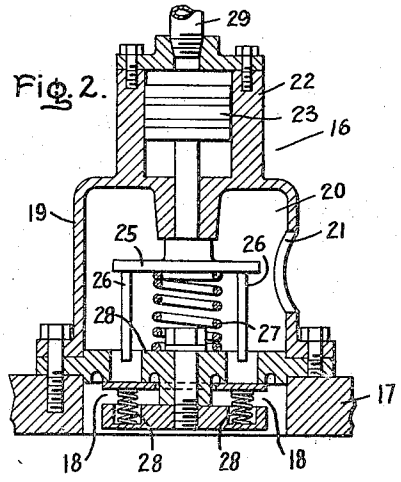


Fig. 2.



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COMPRESSED AIR SUPPLY SYSTEM

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7 Claims. (Cl. 230—31)

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This invention relates to compressed air supply systems, and more particularly to an arrangement for unloading the compressor of such a system for starting.

In the past, it has generally been the design practice on locomotives, for example, diesel-electric and gas turbine-electric locomotives, to direct-connect the main air compressor or compressors to the prime mover. The disadvantage of this arrangement is that an oversize compressor must be utilized to provide at all times sufficient air when the main prime mover is running at idling speed. A further disadvantage is the serious tendency of such a compressor to pass large quantities of oil into the air brake system. It is therefore desirable to utilize motor-driven air compressors in diesel-electric or gas turbine-electric locomotives, and it is further desirable to provide a system having two compressors so that only one need function during normal air demand, with an additional compressor being available for increased demand. There are, however, special problems involved in such an application by virtue of the limited availability of power in such a self-contained motive power unit. It is therefore further desirable to provide a simple arrangement for holding off the compressor load for a short period of time when starting the compressors until the motor torque has had a chance to build up. Without such an arrangement, unduly large size motors would have to be used to start the loaded compressor, with an accompanying heavy drain on the electrical power system.

It is therefore an object of this invention to provide an improved compressed air supply system having an arrangement for unloading the compressor during starting.

A further object of this invention is to provide an improved compressed air supply system having two compressors with means for unloading the compressors during starting and in which only one compressor operates during normal air demand.

Further objects and advantages of this invention will become apparent and the invention will be better understood by reference to the following description and the accompanying drawing, and the features of novelty which characterize this invention will be pointed out with particularity in the claims annexed to and forming a part of this specification.

In accordance with this invention, there is provided a main compressed air reservoir with a motor-driven compressor connected thereto. Means responsive to the air pressure in the main reservoir, such as a pressure responsive switch, is provided for starting the motor when the main reservoir air pressure falls below a predetermined lower level, and for stopping the motor

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when the main reservoir air pressure rises above a predetermined upper level.

The compressor is provided with unloading means, such as an arrangement to hold the inlet valves open, the unloading means being actuated by air pressure. Means, such as a solenoid valve energized through the pressure responsive switch is provided to connect the compressor unloading means to the main reservoir responsive to the predetermined upper pressure, and to connect the unloading means to the atmosphere responsive to the predetermined lower pressure. Throttling means, such as a check valve, is provided on the atmospheric side of the solenoid valve and another air reservoir is connected to the unloading means. A bypass check and choke means is provided arranged to admit air slowly to the second air reservoir from the main reservoir when the compressor unloading means is connected to the main reservoir, and to release air from the second reservoir to the unloading means when the unloading means is connected to the atmosphere. The air throttling means is arranged slowly to discharge the air released from the second reservoir to the atmosphere so that air pressure from the second reservoir is maintained for a short interval of time on the unloading means, so that the compressor is unloaded for starting the motor. If the system includes two compressors, the pressure responsive switch of one of the compressor units is arranged to respectively start and stop its associated motor at lower and upper air pressures respectively lower than the pressures at which the switch of the other compressor unit will start and stop its associated motor, so that only one compressor will operate during normal air demand.

In the drawing, Fig. 1 is a schematic illustration of the improved compressed air supply system of this invention; and Fig. 2 is a view in cross-section of the compressor unloading device utilized in this system.

Referring now to the drawing, there is shown a main compressed air reservoir 1 which is fed by compressors 2 and 3 through line 4. The compressors 2 and 3 are respectively driven by electric motors 5 and 6 in any suitable manner, as by belt drives 7. A compressed air supply line 8 discharges from the main reservoir 1, and another line 9 branching off therefrom feeds air from the main reservoir 1 to pressure responsive switches 10 and 11. The pressure switches 10 and 11 are respectively provided with first contacts 12 and 13 arranged to respectively connect motors 5 and 6 for energization from lines 14 and 15, which in turn are connected to a suitable external source of power (not shown).

Each of the compressors 2 and 3 is respectively provided with an unloading device 16 as shown

in detail in Fig. 2. Referring now to Fig. 2, there is shown the end wall 17 of the compressor cylinder, with air inlet valves 18 arranged therein. A casing 19 is arranged over the air inlet valves 18, defining a cavity 20 communicating with the air inlet valves and an air inlet opening 21 is formed in the wall of the casing 19 for admitting air to the cavity 20 and thence to the compressor through the air inlet valves 18. A cylinder 22 is formed on the upper surface of the casing 19 with a piston 23 arranged therein. Line 29 communicates with the cylinder 22 and piston 23 is connected to a diaphragm member 25 having fingers 26 depending therefrom. A spring 27 is arranged between the diaphragm member 25 and a seat 28 to bias the piston 23 and member 25 away from the inlet valves 18. It will be readily seen that when compresed air is admitted to cylinder 22 through the inlet pipe 24, the piston 23 will move downwardly against the spring 27, causing the fingers 26 to hold open the inlet valves 18, which are normally biased closed by means of suitable springs 28.

Referring again to Fig. 1, the compressor unloading devices 16 are connected to the line 9 by means of unloading lines 29 and 30 respectively. Solenoid valves 31 and 32 are respectively arranged in the lines 29 and 30 and are respectively provided with operating coils 33 and 34, the operating coils 33 and 34 being respectively connected for energization from the power lines 14 and 15 through contacts 35 and 36 of pressure responsive switches 10 and 11. Each of the solenoid switches 31 and 32 is provided with a spool 37, only the solenoid switch 31 being here shown in cross-section, it being understood that switch 32 is identical in construction. When the operating coils 33 and 34 are not energized, the spools 37 respectively open the lines 29 and 30 and when the solenoid switch operating coils are energized, the spools 37 are shifted, closing the lines 29 and 30 so they no longer communicate with line 9, and connecting the lines 29 and 30 to discharge lines 38 and 39 respectively. Adjustable choke valves 40 and 41 are arranged on the ends of the discharge lines 38 and 39, the choke valve 40 being shown in cross-section. Volume reservoirs 42 and 43 are provided connected to the lines 29 and 30 by lines 44 and 45, in which bypass check and choke valves 46 and 47 are arranged; valve 46 being shown in cross-section.

In operation, considering only the system associated with compressor 2 and assuming that the main air reservoir 1 is fully charged to the required pressure, for example, 140 lb., the pressure responsive switch 10 will have opened the contacts 12 and the motor 5 will therefore be shut off. Since the contacts 35 of switch 10 will also be open, the operating coil 33 of solenoid valve 31 will not be energized and the spool 37 will not be picked up. The unloading device 16 of the compressor 2 will therefore be connected to the main reservoir 1 through lines 8, 9 and 29, and the main reservoir air acting on the piston 23 will cause the member 25 and fingers 26 to open the air inlet valves 18, thus preparing the compressor for the next starting cycle. During this period, the volume reservoir 42 has been relatively slowly charged from the main reservoir 1 through the restricted bypass check and choke valve 46.

As the pressure in the main reservoir 1 drops due to normal usage, such as applying and releasing the air brakes, blowing the horn, etc., a predetermined lower pressure will be reached, for example, 130 lb., which will cause the pressure responsive switch 10 to close the contacts 12 and 35. Closing the contacts 12 will start the motor 5 and compressor 2, and since the air inlet valves 18 were held open by reason of main air pressure being applied to the unloading device 16, the compressor will start sucking air in through the entrance 21 and the valves 18, and discharging it back through the same valves and opening. Consequently, the compressor does no work except for the friction and windage losses during this period. The closing of the contacts 35 energizes the operating coil 33 of solenoid valve 31, picking up spool 37. This closes off the main reservoir air from the compressor unloading device 16 and connects the line 29 to discharge line 38. The air pressure in the volume reservoir 42 now exerts pressure on the unloading device 16 to hold the inlet valves 18 open. In the meantime, the air from the volume reservoir 42 is exhausted to the atmosphere through discharge line 38 and choke valve 40 at a controlled slow rate. After a certain period of time, for example, 3 to 4 seconds, sufficient to allow the motor 5 to start, sufficient air will have been vented out of the line 29 through discharge line 38 and choke valve 40 to permit the piston 23 and diaphragm 25 of the unloading device 16 to raise, permitting the inlet valves 18 to close. The valves then function normally so that the compressor will pump air in the normal manner.

The compressor is now functioning normally to again charge up the main air reservoir 1. As the pressure in the reservoir 1 builds up to the top setting of 140 lb., the pressure responsive switch 10 will again operate, opening the contacts 35 and 12, shutting off the motor 5, and de-energizing the operating coil 35 of solenoid valve 31. When de-energized, the spool 37 of solenoid valve 31 returns to its normal position as shown in Fig. 1, disconnecting the line 29 from discharge line 38 and connecting it again to line 9 so that the main reservoir air again passes into the unloading device 16 to open the inlet valves 18. The compressor is then prepared for another time delay starting cycle, and the volume reservoir 42 is again slowly charged with main reservoir air through the bypass check and choke valve 46.

It will be readily understood that the operation of the system and components connected to compressor 3 is identical to that described above in connection with compressor 2. In order to have one compressor only operate during normal demand, it is merely necessary to set the drop-out and pick-up ranges of one of the pressure responsive switches 10 and 11 lower than the corresponding ranges of the other switch. For example, the switch 10 of compressor 2 may be set to drop out at a high pressure of 140 lb. and to pick up at a low pressure of 130 lb., and the switch 11 of compressor 3 may be set to drop out at a high pressure of 135 lb. and to pick up at a low pressure of 125 lb. Thus, during normal air demand on the locomotive air system, only compressor 2 will function. For example, with normal air demand, if the pressure falls slightly below 130 lb., but not to 125 lb., only compressor 2 will start. However, assuming greatly increased air demand, as for example when all brakes are applied, the air pressure in the reservoir 1 may rapidly fall below 125 lb., so that both compressors are started. Compressor 3 will then cut out when 135 lb. pressure is reached, and compressor 2 will cut out when the upper level of 140 lb. is reached.

It will now be readily apparent that this invention provides an improved compressed air supply system and in particular an improved arrangement for unloading the compressors for

starting. In addition, this system provides a simple arrangement to utilize only one compressor during normal air demand.

While I have shown and described a particular embodiment of this invention, further modifications and improvements will occur to those skilled in the art. I desire it to be understood, therefore, that this invention is not limited to the form shown, and I intend in the appended claims to cover all modifications which do not depart from the spirit and scope of this invention.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. A compressed air supply system comprising a main compressed air reservoir adapted to have a compressed air supply line connected thereto, a compressor connected to supply compressed air to said main reservoir, an electric motor connected to drive said compressor, means responsive to the air pressure in said main reservoir for starting said motor when said main reservoir air pressure falls below a predetermined lower level and for stopping said motor when said main reservoir pressure rises above a predetermined upper level, means responsive to air pressure for holding open the inlet valve of said compressor to unload said compressor, means for connecting said holding means to said main reservoir responsive to said predetermined upper pressure and to the atmosphere responsive to said predetermined lower pressure, means for throttling air on the atmospheric side of said connecting means, another air reservoir connected to said holding means, and means arranged to admit air slowly to said other air reservoir from said main reservoir when said holding means is connected to said main air reservoir and to release air from said other reservoir to said holding means when said holding means is connected to the atmosphere, said air throttling means being arranged slowly to discharge the air released from said other reservoir to the atmosphere whereby air pressure from said other reservoir is maintained for a short interval on said holding means to unload said compressor for starting said motor.

2. A compressed air supply system comprising a main compressed air reservoir adapted to have a compressed air supply line connected thereto, a compressor connected to supply compressed air to said main reservoir, an electric motor connected to drive said compressor, switch means operable responsive to the air pressure in said main reservoir and connected in circuit with said motor for starting said motor when said main reservoir air pressure falls below a predetermined lower level and for stopping said motor when said main reservoir air pressure rises above a predetermined upper level, unloading means on said compressor operable in response to air pressure arranged to hold open the inlet valve of said compressor, valve means arranged to connect said unloading means to said main reservoir responsive to said predetermined upper pressure and to a discharge line responsive to said predetermined lower pressure, air choking means in said discharge line, another air reservoir connected to said unloading means, and bypass checking and choking means connected between said other air reservoir and said unloading means and arranged slowly to admit air to said other reservoir from said main reservoir when said unloading means is connected to said main reservoir and to release air from said other air reservoir to said unloading means when said unloading means is connected to said discharge line, said air choking means being arranged slowly to discharge to the atmosphere the air released from said other reservoir whereby air pressure from said other reservoir is maintained on said unloading means for a short interval to unload said compressor for starting said motor.

3. A compressed air supply system comprising a main compressed air reservoir adapted to have a compressed air supply line connected thereto, a compressor connected to supply compressed air to said main reservoir, an electric motor connected to drive said compressor, switch means operable responsive to the air pressure in said main reservoir and connected in circuit with said motor for starting said motor when said main reservoir air pressure falls below a predetermined lower level and for stopping said motor when said main reservoir air pressure rises above a predetermined upper level, unloading means on said compressor operable in response to air pressure arranged to hold open the inlet valve of said compressor, valve means operable responsive to operation of said switch means and arranged to connect said unloading means to said main reservoir responsive to said predetermined upper pressure and to a discharge line responsive to said predetermined lower pressure, air choking means in said discharge line, another air reservoir connected to said unloading means, and bypass checking and choking means connected between said other air reservoir and said unloading means and arranged slowly to admit air to said other air reservoir from said main reservoir when said unloading means is connected to said main reservoir and to release air from said other air reservoir to said unloading means when said unloading means is connected to said discharge line, said air choking means being arranged slowly to discharge to the atmosphere the air released from said other air reservoir whereby air pressure from said other reservoir is maintained on said unloading means for a short interval to unload said compressor for starting said motor.

4. A compressed air supply system comprising a main compressed air reservoir adapted to have a compressed air supply line connected thereto, a compressor connected to supply compressed air to said main reservoir, an electric motor connected to drive said compressor, a pressure responsive switch connected to said main reservoir and operable responsive to the air pressure therein, said switch being connected in circuit with said motor and arranged to start said motor when said main reservoir air pressure falls below a predetermined lower level and to stop said motor when said main reservoir air pressure rises above a predetermined upper level, said compressor having an unloading device operable in response to air pressure and arranged to hold open the air inlet valve of said compressor to unload the same, an unloading line connecting said main reservoir to said device for supplying air thereto, a two-way solenoid valve having its operating coil connected for energization through said switch, said valve being connected in said line and arranged to open the same responsive to said predetermined upper pressure and to close said line and connect said unloading device to a discharge line responsive to said predetermined lower pressure, a choke valve in said discharge line, another air reservoir connected to said unloading device by a third line, and a bypass check and choke valve in said third line arranged slowly to admit air to said other reservoir from said main reservoir when said unloading line is open, and to re-

lease air from said other reservoir to said unloading device when said unloading device is connected to said discharge line, said choke valve being arranged slowly to discharge to the atmosphere the air released from said other reservoir whereby air pressure from said other reservoir is maintained on said unloading device for a short interval to unload said compressor for starting said motor.

5. A compressed air supply system comprising a compresed air reservoir adapted to have a compressed air supply line connected thereto, and a pair of compressor units each comprising a compressor connected to supply compressed air to said main reservoir, an electric motor connected to drive said compressor, means responsive to the air pressure in said main reservoir for starting said motor when said main reservoir air pressure falls below a predetermined lower level and for stopping said motor when said main reservoir air pressure rises above a predetermined upper level, means responsive to air pressure for holding open the inlet valve of said compressor to unload said compressor, means for connecting said holding means to said main reservoir responsive to said predetermined upper pressure and to the atmosphere responsive to said predetermined lower pressure, means for throttling air on the atmospheric side of said connecting means, another air reservoir connected to said holding means, and means arranged to admit air slowly to said other air reservoir from said main reservoir when said holding means is connected to said main air reservoir and to release air from said other reservoir to said holding means when said holding means is connected to the atmosphere, said air throttling means being arranged slowly to discharge the air released from said other reservoir to the atmosphere whereby air pressure from said other reservoir is maintained for a short interval on said holding means to unload said compressor for starting said motor, said starting means of one of said units being arranged respectively to start and stop its associated motor at upper and lower air pressure levels respectively lower than the pressure levels at which the starting means of the other of said units respectively starts and stops its associated motor so that only one compressor unit operates during normal air demand.

6. A compressed air supply system comprising a compressed air reservoir adapted to have a compressed air supply line connected thereto, and a pair of compressor units each comprising a compressor connected to supply compressed air to said main reservoir, an electric motor connected to drive said compressor, a pressure responsive switch connected to said main reservoir and operable responsive to the air pressure therein, said switch being connected in circuit with said motor and arranged to start said motor when said main reservoir air pressure falls below a predetermined lower level and to stop said motor when said main reservoir air pressure rises above a predetermined upper level, said compressor having an unloading device operable in response to air pressure and arranged to hold open the air inlet valve of said compressor to unload the same, an unloading line connecting said main reservoir to said device for supplying air thereto, a two-way solenoid valve having its operating coil connected for energization through said switch, said valve being connected in said line and arranged to open the same responsive to said predetermined upper pressure and to close said line and connect said unloading device to a discharge line responsive to said predetermined lower pressure, a choke valve in said discharge line, another air reservoir connected to said unloading device by a third line, and a bypass check and choke valve in said third line arranged slowly to admit air to said other reservoir from said main reservoir when said unloading line is open and to release air from said other reservoir to said unloading device when said unloading device is connected to said discharge line, said choke valve being arranged slowly to discharge to the atmosphere the air released from said other reservoir whereby air pressure from said other reservoir is maintained on said unloading device for a short interval to unload said compressor for starting said motor, said pressure responsive switch of one of said units being arranged respectively to start and stop its associated motor at upper and lower air pressure levels respectively lower than the air pressure levels at which the pressure responsive switch of the other of said units respectively starts and stops its associated motor so that only one compressor unit operates during normal air demand.

7. A compressed air supply system comprising a main compressed air reservoir, a compressor connected to supply compressed air to said main reservoir, an electric motor connected to drive said compressor, means responsive to the air pressure in said main reservoir for starting said motor when said main reservoir air pressure falls below a predetermined lower level and for stopping said motor when said main reservoir air pressure rises above a predetermined upper level, means operable in response to air pressure for unloading said compressor, means for connecting said unloading means to said main reservoir responsive to said predetermined upper pressure and to the atmosphere responsive to said predetermined lower pressure, means for throttling air on the atmosphere side of said connecting means, another air reservoir connected to said unloading means, and means arranged to admit air slowly to said other air reservoir from said main reservoir when said unloading means is connected to said main air reservoir and to release air from said other reservoir to said unloading means when said unloading means is connected to the atmosphere, said air throttling means being arranged slowly to discharge the air released from said other reservoir to the atmosphere whereby air pressure from said other reservoir is maintained for a short interval on said unloading means to unload said compressor for starting said motor.

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