Sept. 20, 1938. B. S. AIKMAN 2,130,608

COMPRESSOR COOLING CONTROL

Filed Oct. 23, 1936

Fig. 2.

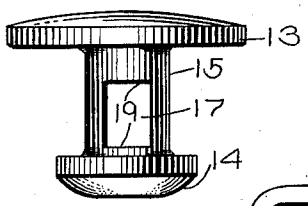


Fig. 1.

INVENTOR
BURTON S. AIKMAN
BY Wm. H. Eady
ATTORNEY

Patented Sept. 20, 1938

2,130,608

UNITED STATES PATENT OFFICE

2,130,608

COMPRESSOR COOLING CONTROL

Burton S. Aikman, Wilkinsburg, Pa., assignor to Westinghouse Air Brake Company, Wilmerding, Pa., a corporation of Pennsylvania

Application October 23, 1936, Serial No. 107,202

4 Claims. (Cl. 230—6)

This invention relates to water cooled air compressors and more particularly to improved means for controlling the operation thereof.

If the supply of water for cooling the cylinder head and/or cylinder walls of an air compressor becomes inadequate or fails, the compressor, if it continues to be operated, is liable to become overheated and damaged, and one object of the invention is to provide improved means for automatically stopping the compressor or for preventing the compressor from being started in case the supply of cooling water therefore becomes inadequate or fails.

Another object of the invention is to provide improved control means for a compressor which depends upon the pressure of the supply of cooling water to effect operation of the compressor and which prevents the compressor from being started, or stops the compressor if it is being operated, in case the pressure of the supply of cooling water is inadequate to provide for proper cooling of the compressor.

Another object of the invention is to provide improved control means of the above type which automatically operates to cut off the supply of cooling water to the compressor when it is not operating so as to thereby prevent waste of water.

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

In the accompanying drawing, Fig. 1 is a diagrammatic view of an electric motor driven air compressor equipment embodying the invention; and Fig. 2 is a view, in side elevation, of a follower member employed in a governor device shown in Fig. 1.

As shown in the drawing, the air compressor equipment comprises an air compressor 1 operative to compress air into an air receiver or reservoir 2 and having a jacketed cylinder head 3 through which water is adapted to circulate from an inlet pipe 4 to an outlet or drain pipe 5 for cooling said head.

The equipment further comprises an electric motor 6 connected to the compressor 1 for operating same, and a governor 7 for controlling the operation of the motor 6.

The governor 7 comprises a casing containing two spaced flexible diaphragms 8 and 9, the diaphragm 8 being of larger area than diaphragm 9 and having at one side a chamber 10. The diaphragm 9 has at the opposite side a chamber 11, while a chamber 12 is formed intermediate said diaphragms.

A diaphragm follower is disposed in chamber 12 and has a head 13 which engages the diaphragm 8, a head 14 which engages the diaphragm 9 and a strut 15 which connects the heads 13 and 14 together.

A switch arm 16 extends throguh chamber 12 and an opening 17 in the strut 15 and is pivotally connected at one end to a fulcrum pin 18' secured in the casing. The switch arm 16 is provided with a cylindrical portion 18 disposed in the opening 17 in strut 15 and engaging opposite end walls 19 of said opening. A movable, plug type, spring switch contact 20 is secured in the other end of the switch arm 16 and is suitably insulated therefrom by means of an insulating bushing 21 and washer 22.

Two spaced fixed contacts 23 are arranged for engagement by the movable contact 20 and are carried by a member 24 made of any suitable insulating material and secured to the governor casing by any suitable means such as a screw 25. One of the contacts 23 is connected to a wire 26 which leads to any suitable source of electrical energy for operating the motor 6, while the other contact 23 is connected to a wire 27 leading to the motor 6, which is also provided with a ground or return wire 28.

A spring 29 is interposed between the governor casing and switch arm 16 for urging said arm in the direction to disengage contact 20 from contacts 23.

The governor casing is provided with a bore, one end of which is closed by a cap nut 30. A shuttle valve 31 is mounted to reciprocate in this bore and is provided with two spaced annular guide ribs 32 which loosely fit said bore and define the side walls of an annular cavity 33 which is in permanent communication with a passage 34 leading to the diaphragm chamber 10.

The valve 31 has on one end an annular seat rib 35 adapted to seal against a gasket 36 which is provided in the cap nut 30 around a restricted vent passage 37, while on the other hand of said valve a seat rib 38 is provided which is adapted to seal against a gasket 39 secured in the casing and surrounding a passage 40 which is at all times in communication with reservoir 2.

A thrust pin 41 is slidably mounted in a suitable bore provided through the cap nut 30 in axial alignment with the valve 31. One end of this pin extends into and engages the bottom of an axial bore provided in the valve 31, while the other end of said pin engages one end of an adjusting screw 42 carried by a lever 43 which is fulcrumed at one end on a pin 44 in the governor casing.

One end of a control spring 45 is hooked over the other end of lever 43 and engages said lever in one of a plurality of notches 48 formed therein, while the other end of said spring is connected to an adjusting screw 46 which slidably extends through a suitable bore in a projecting lug of the casing and upon which there is provided a nut 47 for varying the tension of spring 45 on lever 43.

A water valve 49 is disposed in chamber 11 in engagement with diaphragm 9 and has a fluted stem portion 50 slidably engaging the governor casing within a bore 51. The bore 51 is connected to any suitable source of water under pressure such as may be provided in a pipe 52.

The water valve 49 is provided with a ring like seat 53 adapted to engage and seal upon an annular seat rib 54 surrounding bore 51 for closing communication from said bore to chamber 11 which is connected to the water pipe 4 leading to the air compressor 1. A choke 55 is placed in the communication between chamber 11 and the compressor 1.

In operation, assume that the pressure in the reservoir 2 and consequently that acting in pipe 40 on the left hand face of the shuttle valve 31 is atmospheric pressure and thus lower than the opposing pressure of spring 45 acting through lever 43 and pin 41 on the right hand face of said valve. The valve 31 is then held in its left hand position with seat rib 38 engaging gasket 39. The diaphragm chamber 10 is under this condition vented to the atmosphere through annular cavity 33, the clearance space around the right hand annular guide 32 on the valve 31 and through the vent 37.

With the supply of water cut off to bore 51 and chamber 11 below the diaphragm 9, the pressure in said chamber is substantially that of the atmosphere due to the connection through pipe 4, the compressor cylinder head 3 and drain pipe 5 to the atmosphere, and as a consequence, spring 29 acting on the switch lever 16 holds said lever in the position shown in the drawing in which contact 20 is moved away from contacts 23.

With the equipment conditioned as just described, if it is desired to compress air into the reservoir 2, water under pressure is supplied to pipe 52 and from thence to bore 51 below the valve 49. Assuming that the pressure of the water supply is adequate, such pressure acting on the valve 49 urges aid valve away from the seat rib 54 whereupon water flows into chamber 11 and thence to pipe 4 and through the cylinder head 3 to drain 5.

The choke 55 acts to retard the flow of water from diaphragm chamber 11, so that if the rate at which water is supplied to chamber 11, which in turn is dependent upon the pressure of the water supply, sufficiently exceeds the capacity of choke 55 to permit flow of water out of said chamber, a pressure is built up in said chamber on the diaphragm 9 which is sufficient to deflect said diaphragm upwardly and thereby move the switch arm 16 against the pressure of spring 29 and cause the switch contact 20 to engage the contacts 23 and thereby close the electric circuit through motor 6.

The motor 6 then operates to run the air compressor 1 to compress air into the reservoir 2, and during such operation, water supplied past the valve 49 and through choke 55 to pipe 4 flows through cylinder head 3 to drain 5, and this flow of water through said head prevents said head from becoming overheated.

The pressure of fluid obtained in reservoir 2 acts on the left hand face of the shuttle valve 31 within the seat rib 38 and when this pressure has become increased to a degree sufficient to overcome the opposing pressure of spring 45 acting through lever 43 on the shuttle valve, said valve is moved away from gasket 39.

As soon as the seal between seat rib 38 on the shuttle valve and the gasket 39 is broken as just described, the full area of the left hand face of said valve becomes exposed to the pressure of fluid supplied from reservoir 2 through passage 40, and the force thus developed on the left hand face of said valve promptly overcomes the pressure of spring 45 and moves the shuttle valve to its right hand position in which seat rib 35 engages and seals against gasket 36.

In this right hand position of the shuttle valve, compressed air supplied through passage 40 to the left hand face thereof flows past the loosely fitting annular rib 32 to annular cavity 33 and thence through passage 34 to diaphragm chamber 10.

The pressure of compressed air thus obtained in chamber 10 on diaphragm 8 together with the pressure of spring 29 on lever 16, overcomes the opposing pressure of water in chamber 11 acting on diaphragm 9 and moves the diaphragms 8 and 9, followers 13 and 14 and lever 16 to the position shown in the drawing in which the switch contact 20 is out of engagement with contacts 23 and the valve 49 is seated against the seat rib 54. The electric circuit through the motor 6 is thus opened and said motor and the compressor 1 stopped, while at the same time the seating of valve 49 closes off the supply of cooling water to the cylinder head 3, so that while the compressor 1 is not operating there will be no useless flow of cooling water through the cylinder head 3.

When, due to use of compressed air from reservoir 2, the pressure therein acting on the left hand face of the shuttle valve 31 becomes reduced to a degree which is slightly less than the opposing pressure of spring 45 acting through lever 43, said spring shifts the valve 31 away from the gasket 36 which exposes the full right hand face of said valve to the pressure of fluid leaking past said valve, and since the vent port 37 is of a relatively small size, a pressure builds up on the right hand face of the valve which aids the spring 45 to quickly shift the shuttle valve to its left hand position. In this position of the shuttle valve, the compressed air is vented from diaphragm chamber 10 through port 34, annular cavity 33, through the clearance space around the annular guide rib 32 and thence through vent port 37.

When the compressed air is thus vented from diaphragm chamber 10, the water pressure acting on the valve 49 unseats said valve and flows into chamber 11 and thence through pipe 4 to the compressor cylinder head 3 and due to the action of choke 55, the water pressure builds up in chamber 11 on the diaphragm 9 to a degree sufficient to overcome the pressure of spring 29 on the lever 16, whereupon said lever is operated to move the switch contact 20 into engagement with contacts 23 and thereby start the motor 6 for operating the compressor 1 to replenish the compressed air in reservoir 2. Another cycle of operation is thus initiated, and such cycles will be repeated as required in accordance with the use of compressed air from the reservoir 2.

In the above operation it will be noted that the

pressure in the reservoir 2 will be maintained between limits governed by the adjusted pressure of spring 45 on the shuttle valve 31. When the pressure in reservoir 2 reaches a predetermined high value, the shuttle valve 31 is operated to supply compressed air to diaphragm chamber 10 to effect movement of the switch contact 20 out of engagement with contacts 23 so as to stop the compressor. When the pressure in reservoir 2 becomes reduced to a predetermined degree, the shuttle valve 31 is operated to vent the compressed air from chamber 10, but the subsequent movement of switch contact 20 into engagement with contacts 23 to start the compressor 1 is dependent upon the development of sufficient water pressure in chamber 11 on diaphragm 9 to overcome the pressure of spring 29.

The choke 55 is of such size as to provide an adequate flow of water through the cylinder head 3 for cooling the same when the pressure of water supplied to chamber 11 is at or above a certain degree. The spring 29 is of such value that in case the water pressure in chamber 11 should for any reason become reduced below said certain degree, said spring will operate the lever 16 to move contact 20 away from contacts 23 for opening the circuit through motor 6, or in case said circuit is open, said spring will prevent closure thereof. In other words, if for any reason the pressure of water supplied through pipe 52 should become reduced to a degree where the flow through choke 55 to cylinder head 3 would be inadequate to properly cool said head, the spring 29 will prevent the compressor from operating. In case the compressor is being operated at the time the water supply should fail or becomes inadequate, it will be stopped due to the action of spring 29 to move contact 20 out of engagement with contacts 23, while if the compressor is at rest, said spring will prevent contact 20 from being moved into engagement with contacts 23 to start the compressor, when the supply of water is inadequate.

While one illustrative embodiment of the invention has been described in detail, it is not my intention to limit its scope to that embodiment 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 compressed air receiver, a source of water under pressure, motive means, a water cooled air compressor adapted to be operated by said motive means to compress air into said receiver, valve means for supplying water from said source under pressure to said compressor for cooling same, and a governor device controlled by the pressure of air in said receiver and the pressure of water at its source for controlling the operation of said compressor and valve means, said governor comprising two spaced flexible diaphragms, follower means interposed between and engaging adjacent faces of said diaphragms, means controlled by said diaphragms for effecting the operation of said motive means and for cutting said motive means out of operation, one diaphragm being subject on its outer face to the pressure of water at its source and being operative thereby to operate said means to cut said motive means into operation, valve means controlled by the opposing pressures of air in said receiver and a spring and operative when the air pressure exceeds the pressure of said spring to supply compressed air to the outer face of the other of said diaphragms and operative when the spring pressure exceeds the air pressure to vent the compressed air from said outer face of the other diaphragm, said other diaphragm being adapted to be operated by the compressed air applied thereto to operate said means to cut said motive means out of operation, spring means operative to operate said means to cut said motive means out of operation if the pressure of water on the first diaphragm becomes reduced below a certain degree, and means operative by the first diaphragm upon cutting said motive means out of operation for operating said first named valve means to cut off the supply of cooling water to said compressor.

2. In combination, a fluid pressure receiver, a source of water under pressure, a water cooled air compressor adapted to be cooled by water from said source and operative to compress fluid into said receiver, and a governor device controlled by the pressure of fluid in said receiver and the opposing pressure of water from said source for controlling the operation of said compressor, said governor device comprising valve means operative when the receiver pressure exceeds a predetermined degree to supply fluid under pressure to a chamber and when the receiver pressure is reduced to below a predetermined degree to vent fluid under pressure from said chamber, a flexible diaphragm means subject to the opposing pressures of water from said source and the pressure of fluid in said chamber and movable in one direction by the water pressure when said chamber is vented and movable in the opposite direction when fluid under pressure is supplied to said chamber, means operative by said diaphragm means upon movement thereof by the water pressure to effect operation of said compressor and upon movement in the opposite direction to stop operation of said compressor, and valve means controlled by said diaphragm means for controlling the supply of cooling water from said source to said compressor and operative when said chamber is vented to supply cooling water to said compressor when said chamber is supplied with fluid under pressure to cut off the supply of cooling water to the compressor.

3. In combination, a fluid pressure receiver, a source of water under pressure, a water cooled air compressor adapted to be cooled by water from said source and operative to compress fluid into said receiver, and a governor device controlled by the pressure of fluid in said receiver and the opposing pressure of water from said source for controlling the operation of said compressor, said governor device comprising valve means operative when the receiver pressure exceeds a predetermined degree to supply fluid under pressure to a chamber and when the receiver pressure is reduced to below a predetermined degree to vent fluid under pressure from said chamber, a pair of spaced flexible diaphragms one of which is subject on its outer face to the pressure of fluid in said chamber and the other of which is subject on its outer face to the pressure of water from said source, follower means interposed between and in engagement with the adjacent faces of said diaphragms and movable in one direction by fluid under pressure supplied to said chamber and movable in the opposite direction by the pressure of said water when said chamber is vented, means operative by said follower means upon movement thereof by fluid under pressure supplied to said chamber to stop operation of said compressor and upon movement by the pres-

sure of water when said chamber is vented to effect operation of said compressor, and a valve operative by said diaphragm to cut off the supply of cooling water to said compressor upon operation of said diaphragms to stop said compressor.

4. In combination, a fluid pressure receiver, a source of water under pressure, a water cooled air compressor adapted to be cooled by water from said source and operated to compress fluid into said receiver, and a governor device controlled by the pressure of fluid in said receiver and the opposing pressure of water from said source for controlling the operation of said compressor, said governor device comprising valve means operative when the receiver pressure exceeds a predetermined degree to supply fluid under pressure to a chamber and when the receiver pressure is reduced to below a predetermined degree to vent fluid under pressure from said chamber, a pair of spaced flexible diaphragms one of which is subject on its outer face to the pressure of fluid in said chamber and the other of which is subject on its outer face to the pressure of water from said source, follower means interposed between and in engagement with the adjacent faces of said diaphragms and movable in one direction by fluid under pressure supplied to said chamber and movable in the opposite direction by the pressure of said water when said chamber is vented, a switch for controlling the operation of said compressor, means operative by said follower means upon movement thereof when fluid under pressure is supplied to said chamber to operate said switch to stop said compressor and upon movement of said follower means by water pressure when said chamber is vented to operate said switch to start said compressor, a valve operative by said diaphragm when fluid under pressure is supplied to said chamber to cut off the supply of cooling water to said compressor, and a spring acting on said means operative to operate said switch to stop said compressor and to operate said valve to cut off the supply of cooling water to said compressor if the pressure of water acting on the one diaphragm becomes reduced below a predetermined degree.

BURTON S. AIKMAN.