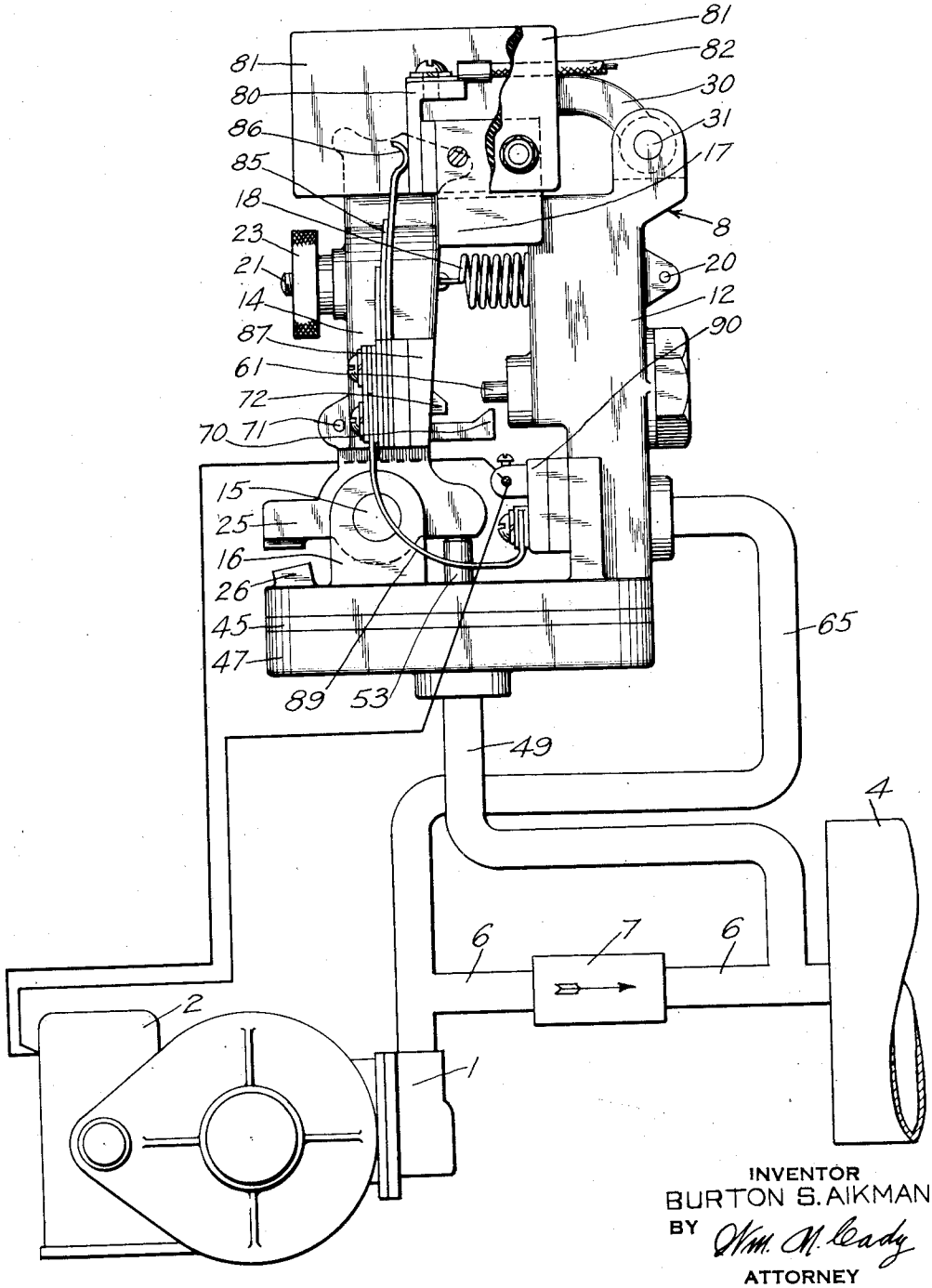
Sept. 20, 1938. B. S. AIKMAN 2,130,607

COMPRESSOR GOVERNOR

Filed June 13, 1935 3 Sheets-Sheet 1

Fig. 1



INVENTOR
BURTON S. AIKMAN
BY Wm. M. Cady
ATTORNEY

Sept. 20, 1938. B. S. AIKMAN 2,130,607

COMPRESSOR GOVERNOR

Filed June 13, 1935 3 Sheets-Sheet 2

Fig. 2

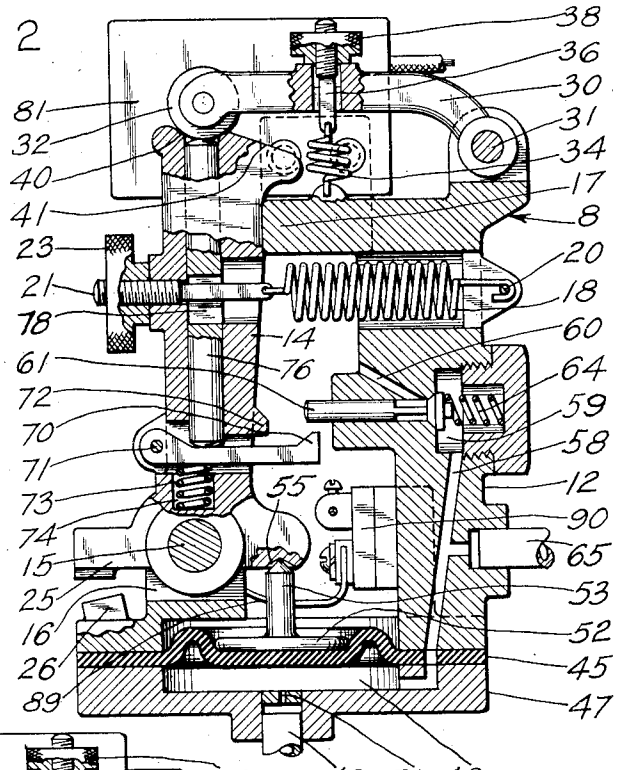
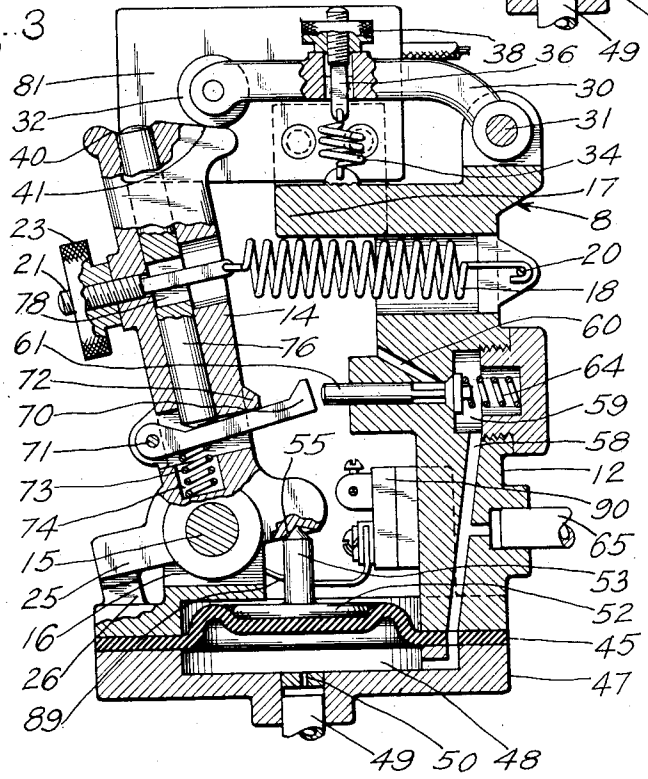


Fig. 3



INVENTOR
BURTON S. AIKMAN
BY Wm. M. Cady
ATTORNEY

Sept. 20, 1938. B. S. AIKMAN 2,130,607

COMPRESSOR GOVERNOR

Filed June 13, 1935 3 Sheets-Sheet 3

Fig. 4

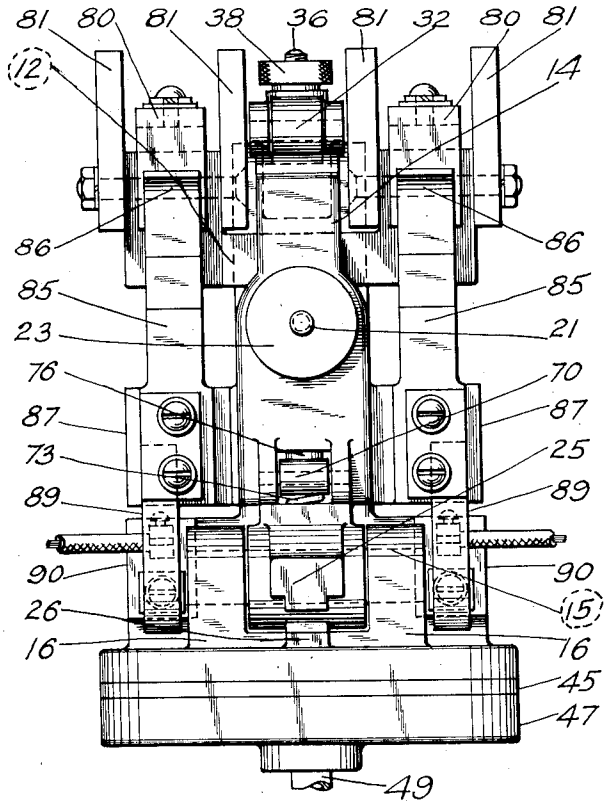
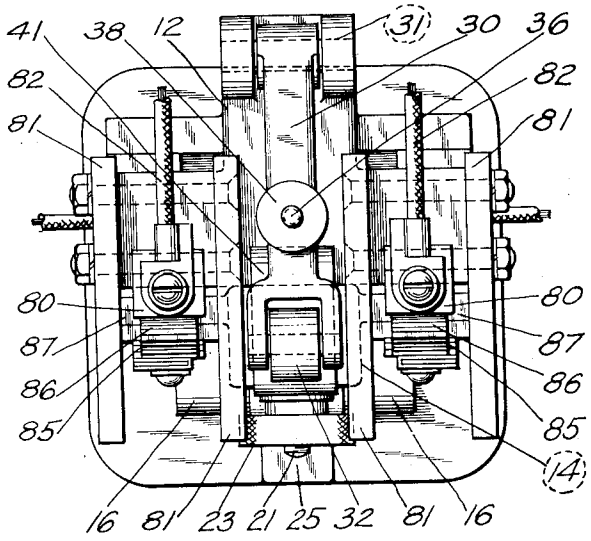


Fig. 5



INVENTOR
BURTON S. AIKMAN
BY Wm. M. Cady
ATTORNEY

Patented Sept. 20, 1938

2,130,607

UNITED STATES PATENT OFFICE

2,130,607

COMPRESSOR GOVERNOR

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

Application June 13, 1935, Serial No. 26,433

20 Claims. (Cl. 200—82)

This invention relates to a fluid pressure switch and also to a compressor governor and particularly to a compressor governor and compressor control system adapted to control the operation of a compressor driving motor in response to variations in the pressure of the fluid compressed by the compressor.

It is the principal object of this invention to provide a fluid pressure switch and a compressor governor of the type described and operable in response to relatively small variations in the pressure of the fluid compressed by the compressor or in the pressure of the fluid supplied to the switch.

It is a further object of the invention to provide a compressor governor controlling a switch in the circuit to the driving motor for the compressor, the governor being constructed so as to be operable in response to relatively small variations in the pressure of the fluid compressed by the compressor and being adapted to exert relatively heavy pressure on the switch contacts when these contacts are in the position to close the circuit to the driving motor, and to move the switch contacts very rapidly when moving from the closed to the open position.

It is a further object of the invention to provide a compressor governor adapted to control the driving means for a compressor in response to variations in the pressure of the fluid compressed, and having means associated therewith and operable to effect unloading of the compressor when the compressor is started.

It is another object of the invention to provide a compressor governor of the type described, and in which the pressures operable to effect opening and closing of the switch controlled by the governor may be adjustably varied, and in which the difference between the opening and closing pressures may be adjustably varied.

It is a further object of the invention to provide an improved compressor governor.

Other objects of the invention and features of novelty will be apparent from the following description taken in connection with the accompanying drawings, in which

Fig. 1 is a diagrammatic view of a compressor control system employing the compressor governor provided by my invention, a side elevational view of the compressor governor being shown, with parts broken away in order to more clearly reveal other parts;

Fig. 2 is a sectional view of the compressor governor provided by my invention showing the relationship of the various parts when the governor is in the switch closed position;

Fig. 3 is a view similar to Fig. 2, and showing the relationship of the various parts when the governor is in the switch open position;

Fig. 4 is a front elevational view of the compressor governor shown in Fig. 1; and

Fig. 5 is a top plan view of the compressor governor shown in Fig. 1.

Referring to the drawings, the control system provided by my invention comprises a fluid compressor 1, driven by an electric motor 2, and supplying fluid under pressure to a reservoir 4 through a pipe 6 having a check valve 7 interposed therein, the operation of the compressor being controlled by means of the governor, indicated generally by the reference numeral 8, and which controls the circuit to the driving motor 2.

The governor 8 comprises a body or support 12 having a switch controlling lever 14 pivotally secured thereon on a pin 15 which extends between ears 16 formed on the body 12, the lever being yieldingly urged to move in a clockwise direction into engagement with a portion 17 of the body or support by means of a spring 18, which extends between a pin 20 secured to the housing and a threaded link 21, which extends through the lever 14 and is adjustably secured relative thereto by a nut 23. The lever 14 has a projecting portion 25 formed thereon and engageable with a stop 26 on the body 12 to limit movement of the lever in a counterclockwise direction.

The governor includes a second lever 30, having one end thereof pivotally secured to the body 12 on a pin 31, and having a roller 32 pivotally secured on the other end thereof and engageable with the free end of the lever 14. The lever 30 is urged to move in a counterclockwise direction by means of a spring 34 having one end thereof secured to the support 12, and having the other end secured to a threaded link 36 which extends through the lever 30 and is adjustably secured relative thereto by means of a nut 38.

When the switch controlling lever 14 is in the position in which it is shown in Fig. 2, the roller 32 on the lever 30 extends into a notch or recess 40 formed in the end of the lever 14, and when the lever 14 is in the position in which it is shown in Fig. 3 of the drawings, the roller 32 rests upon a cam surface 41 on the end of the lever 14.

The governor includes a movable abutment in the form of a diaphragm 45, which is clamped between the body section 12 and a body section 47, and which is subject on one side to the pressure of the fluid in a chamber 48 which communicates

with the reservoir 4 by way of a pipe 49 and a restricted passage 50.

The diaphragm 45 has a follower 52 associated therewith and engaging the exposed face thereof, this follower having a stem 53 formed integral therewith and terminating in a pointed end which extends into a recess 55 in the lever 14, the recess 55 being located adjacent to the pin 15 on which the lever 14 is pivoted, but being spaced therefrom.

The chamber 48 communicates by way of a passage 58 with a chamber 59 formed in the body section 12. Communication between the chamber 59 and the atmosphere by way of a passage 60 is controlled by a valve 61 located in a bore in the casing section 12 and urged into engagement with a seat surrounding the passage 60 by means of a spring 64.

The chamber 48 also communicates by way of the passage 58 and by a pipe 65 with the pipe 6 at a point intermediate the compressor and the check valve 7.

The switch controlling lever 14 has means associated therewith and controlling operation of the valve 61, and this means comprises a latch 70 positioned in an opening extending through the lever 14 and pivotally secured to the lever 14 by a pin 71, and urged to rotate in a counterclockwise direction against a stop 72 by means of a coil spring 73 located in a recess 74 in the lever 14.

The lever 14 has a plunger 76 mounted in a bore therein, the lower end of the plunger engaging the latch 70, and the upper end being engaged by the roller 32. The plunger 76 has an elongated opening 78 adjacent the mid portion thereof through which the link 21 extends.

The body section 12 has a pair of stationary contacts 80 associated therewith, and as is best shown in Figs. 4 and 5 of the drawings, these are located on opposite sides of the switch controlling lever 14 and have arc shields 81 positioned on opposite sides thereof. The stationary contacts 80 are formed of a suitable electrically conducting material and are secured to, but insulated from, the body section 12 and are adapted to have secured thereto wires 82 leading from the source of current supply.

The lever 14 has a pair of movable contacts 85 associated therewith, and, as is best shown in Fig. 4 of the drawings, one contact is located on each side of the lever 14. The construction of the contacts 85 is best shown in Fig. 1 of the drawings, where it will be seen that each contact is constructed of a plurality of laminations of resilient, electrically conducting metal and terminating in a curved end portion 86 adapted to engage a stationary contact 80. The contacts 85 are secured to, but insulated from, ears 87 which project from the lever 14 and they are electrically connected by means of flexible conductors 89 with terminal blocks 90 which are adapted to have secured thereto wires connected to the driving motor 2.

The contacts 85 are arranged so that when the lever 14 is in the position in which it is shown in Fig. 1 of the drawings, they will press firmly upon the contacts 80 so as to establish good contact between the movable contacts 85 and the stationary contacts 80.

In the operation of the governor provided by this invention the switch controlling lever 14 is normally maintained in the position in which it is shown in Figs. 1 and 2 of the drawings by means of the spring 18, and when the lever is in this position the movable contacts 85 are in engagement with the stationary contacts 80 so as to complete a circuit to the driving motor 2 of the compressor 1.

With the lever 14 in this position the roller 32 associated with the lever 30 is positioned in the notch or recess 40 in the end of the lever 14, while the latch 70 is out of engagement with the end of the stem of the valve 61. The latch 70 is also held out of engagement with the stop 72 by the plunger 76, which is urged downwardly by the roller 32 which engages the upper end of the plunger.

As the circuit to the driving motor 2 is complete the compressor 1 will be operated, and will supply fluid under pressure to the reservoir 4, and on an increase in the pressure of the fluid in this reservoir there will be a similar increase in the pressure of the fluid in the chamber 48 which pressure acts upon the movable abutment or diaphragm 45 tending to force it upwardly. The force exerted on the diaphragm 45 is transmitted through the follower 52 and the stem 53 to the lever 14, and urges this lever to rotate in a counterclockwise direction. Movement of the lever 14 at this time is opposed by the spring 18, and by the spring 34 which resists upward movement of the lever 30 which is necessary to lift the roller 32 out of the recess or notch 40 in which it is positioned.

When the pressure of the fluid in the chamber 48 has increased to a sufficient value, however, the force exerted on the lever 14 and tending to move this lever in a counterclockwise direction is sufficient to overcome the forces opposing this movement, and the lever will move, and in moving will cause the arm 30 to rotate in a clockwise direction so that the roller 32 is lifted from the recess in which it is positioned. After a small amount of movement of the lever 14, the roller 32 will engage the cam surface 41, which slopes away from the recess 40, and when the roller 32 is in engagement with this cam surface it tends to assist movement of the lever 14 away from the position in which it is shown in Fig. 2 of the drawings. This insures that the lever 14 will move very rapidly after it starts to move away from the switch closed position.

When the lever 14 moves, the movable contacts 85 are moved with it, and are moved out of engagement with the stationary contacts 80, thus interrupting the circuit to the driving motor of the compressor and interrupting operation of the compressor.

When the switch controlling lever 14 moves to the switch open position, which is the position in which it is shown in Fig. 3 of the drawings, the latch 70 is moved upwardly into engagement with the stop 72 by the spring 73 as the plunger 76 is no longer held by the roller 32.

On a reduction in the pressure of the fluid in the reservoir 4 there will be a similar reduction in the pressure of the fluid in the chamber 48 and a corresponding reduction in the force exerted on the lever 14, and if the reduction in the pressure of the fluid in the chamber 48 is sufficient, the spring 18 will cause the lever 14 to rotate in a clockwise direction. After a small amount of movement of the lever 14 from the switch open position towards switch closed position, the end of the latch 70 engages the end of the stem of the valve 61 and causes this valve to be moved against the spring 64, thereby permitting fluid to escape from the chamber 59 to the atmosphere by way of the passage 60. The chamber 59 is in communication with the chamber 48 by way of the

passage 58 and when the valve 61 is unseated fluid will be released from the chamber 48.

The passage 60 is arranged so the rate at which fluid is released from the chamber 59 and the chamber 48 to the atmosphere through this passage exceeds the rate at which fluid is supplied to the chamber 48 through the restricted passage 50, so that when the valve 61 is unseated there will be a rapid reduction in the pressure of the fluid in the chamber 48.

As a result of the reduction in the pressure of the fluid in the chamber 48 caused by the release of fluid therefrom there will be a rapid reduction in the force exerted by the daphragm on the switch controlling lever 14, and the spring 18 will be able to move the switch controlling lever 14 towards the switch closed position very rapidly.

When the switch controlling lever 14 moves to the switch closed position, which is the position in which it is shown in Fig. 2 of the drawings, the roller 32 is forced into the recess 40 by the spring 34 and it engages the upper end of the plunger 76, forcing the plunger downwardly and moving the latch 70 against the spring 73 and out of engagement with the end of the valve 61. This permits the valve 61 to be moved to its seat by the spring 64 to cut off the release of fluid under pressure from the chamber 48.

When the valve 61 is moved away from its seat so as to release fluid under pressure from the chamber 59 the fluid in the pipe 6 between the compressor 1 and the check valve 7 is released to the atmosphere by way of the pipe 65. Therefore, when the switch controlling lever 14 moves to the closed position and the latch 70 is moved out of engagement with the valve 61 thereby permitting this valve to seat, and current is supplied to the driving motor of the compressor to initiate operation of the compressor there will be little opposition to operation of the compressor 1 as there will be substantially no fluid pressure in the pipe 6 into which the compressor discharges. This reduces the load on the motor 2 in starting the compressor and has the effect of unloading the compressor during the starting period. After a period of operation the pressure of the fluid in the pipe 6 and in the pipe 65 builds up to a value above that in the reservoir 4, and the check valve 7 then operates to permit fluid to flow from the compressor to the reservoir.

The governor provided by this invention may be employed without the unloading feature if desired. When using the compressor without the unloading feature the pipe 65 is omitted, the opening in the housing 12, in which this pipe is connected being closed, and the compressor may be connected directly to the reservoir without a check valve in the conduit extending between these units.

Fluid is supplied to the chamber 48 at all times from the reservoir by way of the pipe 49 and the restricted passage 50, and it flows therefrom by way of the passage 58 to the pipe 65, but the rate of supply of fluid to the chamber 48 through the restricted passage 50 is such that the pressure of the fluid in the chamber 48 and the associated passage will not build up to a substantial value rapidly enough to interfere with the starting of the compressor.

It will be seen that the governor provided by this invention operates to maintain the switch controlling lever in the switch closed position until the pressure of the fluid in the reservoir 4, and in the chamber 48, increases to a value such that the force exerted by the fluid acting on the diaphragm 45 and transmitted therefrom to the lever 14 is sufficient to overcome the force exerted on this lever by the spring 18, and to also overcome the spring 34, which maintains the roller 32 in the notch 40 in the end of the switch controlling lever.

When the pressure in the chamber 48 has built up to a value sufficient to effect a slight amount of movement of the switch controlling lever 14, so that this lever is moved an amount sufficient to move the recess 40 out from under the roller 32, the lever 14 will thereafter move very rapidly, as its movement is no longer resisted by the spring 34, but is assisted by this spring. This insures that the contacts controlled by the switch controlling lever will open very quickly with a minimum of arcing.

The switch controlling lever 14 will remain in the switch open position until the pressure of the fluid in the chamber 48 is reduced to a value such that the force exerted by the fluid under pressure acting on the diaphragm 45 is insufficient to resist movement of the lever 14 by the spring 18. As soon, however, as such a reduction in the pressure of the fluid in the chamber 48 occurs, and there is a limited amount of movement of the switch controlling lever towards the switch closed position, the latch 70 will unseat the valve 61, thus producing a rapid reduction in the pressure of the fluid in the chamber 48, and permitting the spring 18 to quickly return the switch controlling lever 14 to the switch closed position.

Only a relatively small reduction in the pressure of the fluid in the chamber 48 is required to move the switch controlling lever an amount sufficient to cause the latch 70 to unseat the valve 61, and hence the switch controlling lever 14 will be moved to the switch closed position in response to a relatively small reduction in the pressure of the fluid in the reservoir 4 below that at which the lever is caused to moved from the switch closed position to the switch open position.

It will be seen also that the governor operates to effect unloading of the compressor when the switch controlling lever 14 moves from the switch open position to the switch closed position, with the result that the compressor in starting does not have to start under load.

The governor provided by this invention incorporates means by which the opening and closing pressures may be adjustably varied if desired, and in addition means by which the differential between the opening and closing pressures may be adjustably varied.

The pressure which is effective to move the switch controlling lever 14 to the switch open position from the switch closed position may be adjustably varied by varying the tension on the spring 18, which is accomplished by adjusting the nut 23.

The differential between the opening and closing pressures is governed by the spring 34, and may be adjustably varied by varying the tension on this spring, which is accomplished by adjusting the nut 38.

While one embodiment of the compressor governor provided by my invention and a control system incorporating this governor have been illustrated and described in detail, it should be understood that the invention is not limited to these details of construction, and that numerous changes and modifications may be made without departing from the scope of the following claims.

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

1. In combination, a movable abutment subject to the pressure of the fluid in a chamber, a switch, a switch operating element, yielding means urging the switch operating element to a position to maintain the switch in the closed position, means connecting the movable abutment to the switch operating element to effect movement of the switch operating element away from the closed position to the open position on an increase in the pressure of the fluid acting on said abutment, other means yieldingly opposing movement of the switch operating element away from the switch closed position until the pressure of the fluid acting on the movable abutment has increased to a value above that at which the yielding means associated with the switch operating element is operable to move said element from the switch open position to the switch closed position, and means associated with the switch operating element and controlling the pressure of the fluid acting on said abutment.

2. In combination, a switch, a support, a pair of levers pivotally secured to the support, one of the levers controlling the switch and having resilient means connecting the lever to the support and yieldingly urging the lever to a position to effect closing of the switch, the other of the levers being operatively associated with the first lever and having resilient means connecting the lever with the support and yieldingly opposing movement of the first lever away from the switch closed position, a movable abutment subject to the pressure of the fluid in a chamber and urging the first lever to move away from the switch closed position, and means associated with the switch controlling lever and operable on movement of the lever towards the switch closed position to reduce the pressure of the fluid acting on said abutment.

3. In combination, a switch, a support, a pair of levers pivotally secured to the support, one of the levers controlling the switch and having resilient means connecting the lever to the support and yieldingly urging the lever to a position to effect closing of the switch, the other of the levers being operatively associated with the first lever and having resilient means connecting the lever with the support and yieldingly opposing movement of the first lever away from the switch closed position, a movable abutment subject to the pressure of the fluid in a chamber and urging the first lever to move away from the switch closed position, and means associated with one of said levers and operable upon movement of the switch controlling lever towards the switch closed position to reduce the pressure of fluid acting upon said abutment.

4. In combination, a switch, a support, a pair of levers pivotally secured to the support, one of the levers controlling the switch and having resilient means connecting the lever to the support and yieldingly urging the lever to a position to effect closing of the switch, the other of the levers being operatively associated with the first lever and having resilient means connecting the lever with the support and yieldingly opposing movement of the first lever away from the switch closed position, a movable abutment subject to the pressure of the fluid in a chamber and urging the first lever to move away from the switch closed position, and means operable on movement of the switch operating lever from the switch open position toward the switch closed position to reduce the pressure of the fluid acting on said abutment.

5. In combination, a switch, a support, a pair of levers pivotally secured to the support, one of the levers controlling the switch and having resilient means connecting the lever to the support and yieldingly urging the lever to a position to effect closing of the switch, the other of the levers being operatively associated with the first lever and having resilient means connecting the lever with the support and yieldingly opposing movement of the first lever away from the switch closed position and being operable after movement of the first lever away from the switch closed position to assist movement of said lever away from the switch closed position and to oppose movement of the lever to the switch closed position, a movable abutment subject to the pressure of the fluid in a chamber and urging the first lever to move away from the switch closed position, and means associated with one of said levers and operable on movement of the switch controlling lever towards the switch closed position to reduce the pressure of the fluid acting on said abutment.

6. In combination, a switch, a member controlling operation of said switch, means associated with said member and urging said member to a position to effect closing of the switch, a movable abutment subject to the pressure of the fluid in a chamber and urging the switch controlling member to move from the switch closed position to the switch open position, and means operable by the controlling member on movement thereof from the switch open position towards the switch closing position to reduce the pressure of the fluid acting on the abutment.

7. In combination, a switch, a member controlling operation of said switch, means associated with said member and urging said member to a position to effect closing of the switch, a chamber, an abutment subject to the pressure of the fluid in said chamber and urging the switch controlling member to move from the switch closed position to the switch open position, means for supplying fluid under pressure to said chamber at one rate, and means operable on movement of the switch controlling member from the switch open position towards the switch closed position for releasing fluid from said chamber at a more rapid rate than the rate at which fluid is supplied thereto.

8. In combination, a switch, a member controlling operation of said switch, means associated with said member and urging said member to a position to effect closing of the switch, a chamber, an abutment subject to the pressure of the fluid in said chamber and urging the switch controlling member to move from the switch closed position to the switch open position, means for supplying fluid under pressure to said chamber at one rate, and means associated with said switch controlling member and controlling means for releasing fluid from the chamber at a faster rate than the rate at which fluid is supplied thereto.

9. In combination, a switch, a support, a pair of levers pivotally secured to said support, one of said levers controlling operation of said switch, the other lever controlling operation of the first lever, the switch controlling lever being yieldingly urged toward the switch closed position, the other lever yieldingly opposing movement of the switch controlling lever away from the switch closed po-

sition, the support having a chamber associated therewith, a movable abutment subject to the pressure of the fluid in said chamber, the abutment being operable to urge the switch controlling lever away from the switch closed position, means associated with the switch controlling lever and operable by movement of said lever towards the switch closed position to release fluid from said chamber, and means associated with the other lever and operable to actuate the last named means to cut off the release of fluid from said chamber on movement of the controlling lever to the switch closed position.

10. In combination, a switch, a member controlling operation of the switch, means urging said member to a position to effect closing of the switch, a chamber, means for supplying fluid under pressure to said chamber, a movable abutment subject to the pressure of the fluid in said chamber and urging the switch controlling member to move away from the switch closed position, means operable by the switch controlling member on movement thereof toward the switch closed position for reducing the pressure of the fluid acting on the abutment, and means operable upon movement of the switch controlling member to the switch closed position for rendering the last named means ineffective.

11. In combination, a switch, a member controlling the operation of the switch, means urging said member to a position to effect closing of the switch, a chamber, means for supplying at one rate fluid under pressure to said chamber, a movable abutment subject to the pressure of fluid in said chamber, the abutment being operable to urge the switch controlling member to move away from the switch closed position, and means operable on movement of the switch controlling member towards the switch closed position for releasing fluid from the chamber at a more rapid rate than said one rate and operable on movement of the switch controlling member to the switch closed position to cut off the release of fluid from the chamber.

12. In combination, a switch, a member controlling operation of the switch, means urging said member to a position to effect closing of the switch, a chamber, means for supplying at one rate fluid under pressure to said chamber, a movable abutment subject to the pressure of the fluid in said chamber, the abutment being operable to urge the switch controlling member away from the switch closed position, a valve controlling a passage through which fluid is released from the chamber at a rate more rapid than said one rate, and means operable on movemment of the switch controlling member towards the switch closed position to move the valve to a position to open said passage.

13. In combination, a switch, a member controlling operation of the switch, means urging said member to a position to effect closing of the switch, a chamber, means for supplying at one rate fluid under pressure to said chamber, a movable abutment subject to the pressure of the fluid in said chamber, the abutment being operable to urge the switch controlling member away from the switch closed position, a valve controlling a passage through which fluid is released from the chamber at a rate more rapid than said one rate, and means operable on movement of the controlling member towards the switch closed position to move the valve to a position to open said passage, and operable on movement of the switch controlling member to the switch closed position to effect movement of the valve to a position to cut off the flow of fluid through said passage.

14. In a fluid pressure switch, a movable abutment subject to the pressure of fluid in a chamber, an electric switch, switch controlling means operative upon a predetermined increase in the pressure of fluid in said chamber for effecting the movement of said switch to its cut-out position, and upon a predetermined decrease in said pressure for effecting the movement of the switch to its cut-in position, and means operative by said switch upon movement thereof to its cut-in position for venting fluid under pressure from said chamber.

15. In a fluid pressure switch, a movable abutment subject to the pressure of fluid in a chamber, an electric switch, switch controlling means operative by said abutment upon a predetermined increase in the pressure of fluid in said chamber for effecting the movement of said switch to its cut-out position, and upon a predetermined decrease in said pressure for effecting the movement of the switch to its cut-in position, and means operative by said controlling means upon movement of the switch to its cut-in position for reducing the fluid pressure in said chamber.

16. In combination, a switch movable between an open position and a closed position, yielding resistance means associated with the switch and urging the switch to the closed position, a movable abutment subject to and operated on an increase in the pressure of the fluid in a chamber to a predetermined value to move the switch from the closed position to the open position, the switch being moved from the open position towards the closed position on a reduction in the pressure of the fluid in said chamber below said predetermined value, and means operated by said switch on movement thereof from the open position toward the closed position for releasing fluid under pressure from said chamber.

17. In combination, a switch, a movable abutment movable between a switch open position and a switch closed position for operating said switch, yielding resistance means associated with the abutment and urging said abutment to the switch closed position, the abutment being subject to and operated on an increase in the pressure of the fluid in a chamber to a predetermined value to move to the switch open position, the abutment being moved from the switch open position towards the switch closed position on a reduction in the pressure of the fluid in said chamber below said predetermined value, and means operative by said abutment on movement thereof from the switch open position towards the switch closed position for releasing fluid under pressure from said chamber.

18. In combination, a switch, a movable abutment movable between a switch open position and a switch closed position for operating said switch, yielding resistance means associated with the abutment and urging said abutment to the switch closed position, the abutment being subject to and operated on an increase in the pressure of the fluid in a chamber to a predetermined value to move to the switch open position, the abutment being moved from the switch open position towards the switch closed position on a reduction in the pressure of the fluid in said chamber below said predetermined value, means for supplying fluid under pressure to said chamber at a given rate, and means operative on

movement of the abutment from the switch open position towards the switch closed position for releasing fluid under pressure from said chamber at a rate more rapid than said given rate.

19. In combination, a switch, a movable abutment movable between a switch open position and a switch closed position for operating said switch, yielding resistance means associated with the abutment and urging said abutment to the switch closed position, the abutment being subject to and operated on an increase in the pressure of the fluid in a chamber to a predetermined value to move to the switch open position, the abutment being moved from the switch open position towards the switch closed position on a reduction in the pressure of the fluid in said chamber below said predetermined value, and means operated by said abutment on movement thereof from the switch open position towards the switch closed position for releasing fluid from said chamber and operated on movement of the abutment to the switch closed position to cut off the release of fluid from said chamber.

20. In combination, a switch, a movable abutment movable between a switch open position and a switch closed position for operating said switch, yielding resistance means associated with the abutment and urging said abutment to the switch closed position, the abutment being subject to and operated on an increase in the pressure of the fluid in the chamber to a predetermined value to move to the switch open position, the abutment being moved from the switch open position towards the switch closed position on a reduction in the pressure of the fluid in said chamber below said predetermined value, means for supplying fluid under pressure to said chamber at a given rate, and means operated on movement of the abutment from the switch open position towards the switch closed position for releasing fluid from said chamber at a rate more rapid than said given rate and operated on movement of the abutment to the switch closed position to cut off the release of fluid from said chamber.

BURTON S. AIKMAN.