Sept. 9, 1941. C. S. BAKER ET AL 2,255,095

CONTROLLING DEVICE

Filed Sept. 6, 1940 2 Sheets-Sheet 1

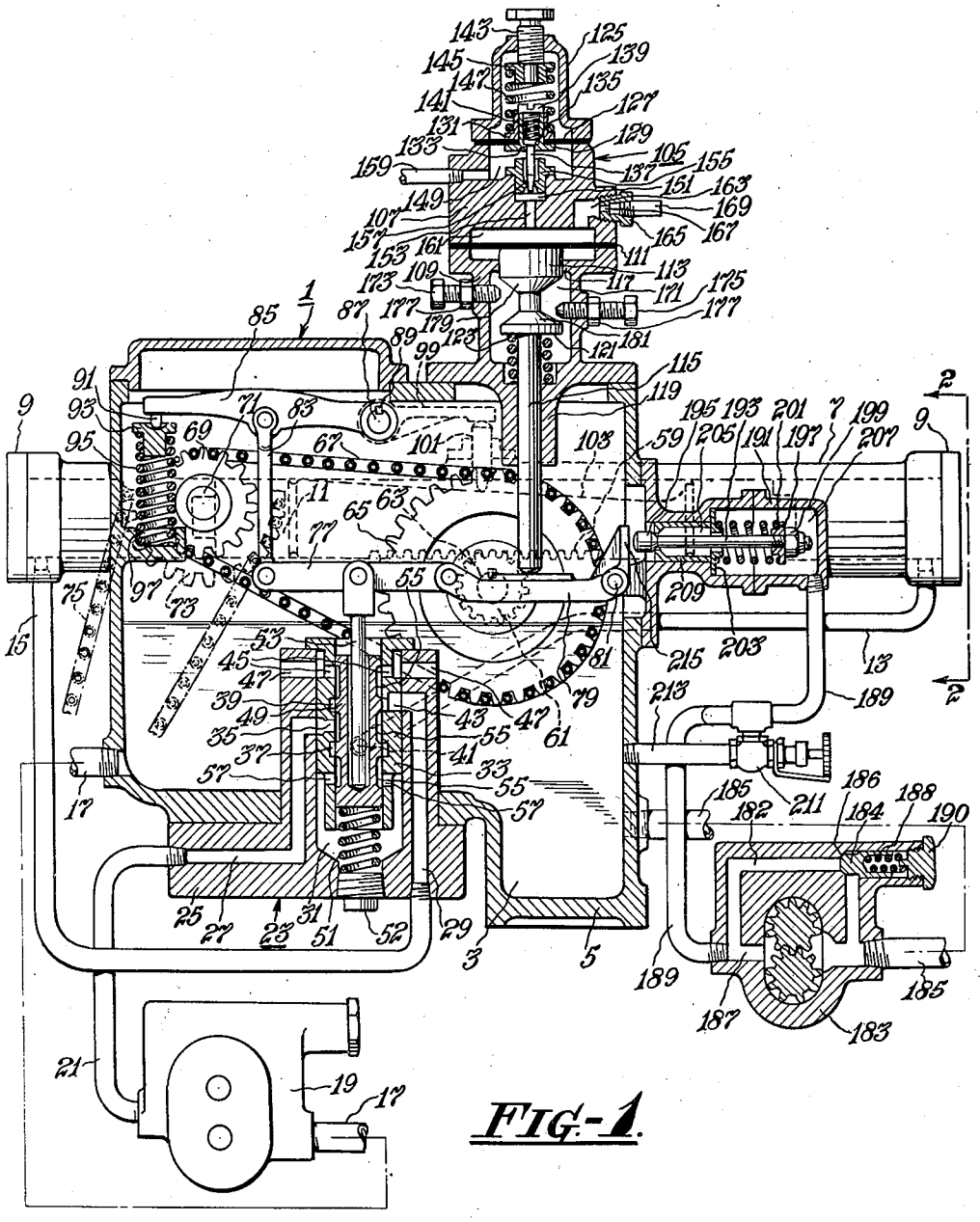


FIG. 1.

INVENTORS
Allan O. Carpenter
Charles S. Baker.
BY
THEIR ATTORNEY.

Sept. 9, 1941. C. S. BAKER ET AL 2,255,095

CONTROLLING DEVICE

Filed Sept. 6, 1940 2 Sheets-Sheet 2

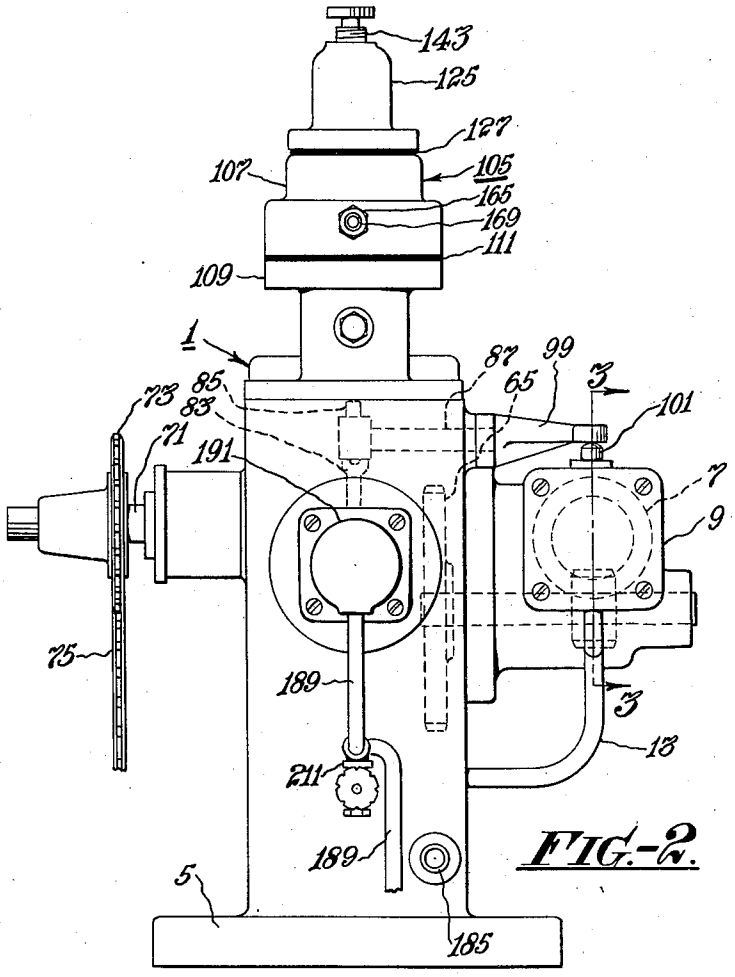


FIG.-2.

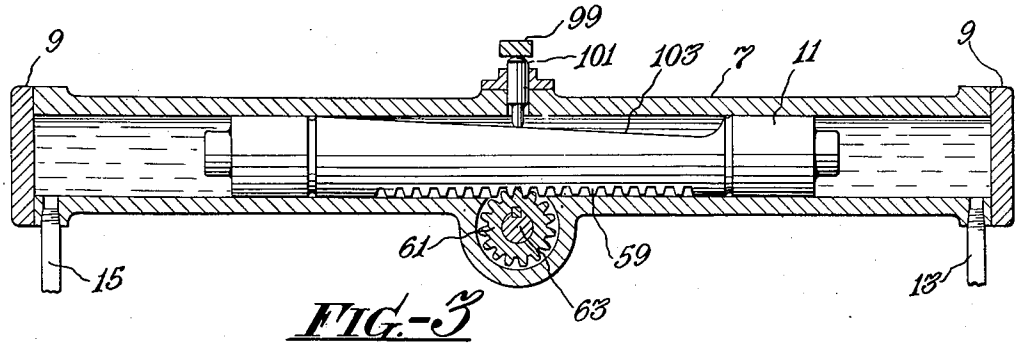


FIG.-3.

INVENTORS
Allan O. Carpenter
Charles S. Baker
BY
THEIR ATTORNEY

Patented Sept. 9, 1941 2,255,095

UNITED STATES PATENT OFFICE

2,255,095

CONTROLLING DEVICE

Charles S. Baker and Allan O. Carpenter, Corning, N. Y., assignors to Ingersoll-Rand Company, New York, N. Y., a corporation of New Jersey

Application September 6, 1940, Serial No. 355,574

19 Claims. (Cl. 230—9)

This invention relates to a controlling device and, more particularly, it relates to means for regulating the speed of an engine driven fluid compressor.

In most engine driven fluid compressors an attempt is usually made to regulate the speed of the engine in some manner so that the compressor unit will operate at the speed necessary to deliver the fluid under pressure required by the load demands from time to time. One method of gauging the load requirements is by variations in the compressor discharge pressure. A fall in pressure indicates an increase in load and necessitates an increase in speed while a rise in pressure indicates a decrease in load and that a decrease in speed is advisable for economy's sake.

Such changes in pressure may occur at frequent intervals and, where the means controlling the supply of energizing fluid to the engine is employed to govern the speed of the engine, there must be some device for moving such a means in accordance with the compressor discharge pressure variations. When the compressor is being driven by a steam engine, such a device must be able to bring about movement of the valve gear which may involve certain difficulties due to the design and weight of the engine valve gear.

It is, accordingly, an object of the present invention to provide a controlling device for an engine driven fluid compressor.

Another object is to provide means to control the operation of a steam engine driven fluid compressor.

Still another object is to provide a simple and effective means to control the operation of an engine driven fluid compressor in accordance with the compressor discharge pressure variations.

A further object is to provide means to control the operation of an engine driven fluid compressor in accordance with the load requirements and to prevent over-speed of the engine.

These and other objects will be apparent from the following description of which the drawings form a part and wherein

Figure 1 is a view partly in section and partly in elevation showing a controlling device constructed and arranged in accordance with the principles of the present invention.

Figure 2 is an elevational view of the controlling device taken along line 2—2 of Fig. 1.

Figure 3 is a sectional view taken along line 3—3 of Fig. 2.

Referring to the drawings, the controlling device is generally indicated at 1 and includes an oil reservoir 3 defined by a casing 5. Supported adjacent one side of the casing 5, as can be seen from Fig. 2, is a fluid pressure actuated means, or cylinder, 7. The ends 9 of the cylinder 7 serve to form a fluid tight chamber for the double-acting piston 11 (Fig. 3) slidably engaging the bore of the cylinder. Fluid under pressure may be supplied to either end of the cylinder by means of conduits 13 and 15.

With this arrangement, if it is desired to move the piston 11 toward the left hand end of the cylinder, fluid under pressure must be admitted through the conduit 13. As the fluid is admitted, any fluid at the left hand end of the cylinder can escape through the conduit 15. Similarly, if it is desired to move the piston toward the right, fluid under pressure is admitted through conduit 15 while conduit 13 serves to remove any fluid in the cylinder space at the right of the piston.

The fluid under pressure employed for this purpose, in the present instance, is oil which is withdrawn from the reservoir 3, through the pipe 17, by the pump 19 driven by the engine on which the controlling device is provided. The discharge pipe 21, for pump 19, carries oil under pressure to an oil distributor valve 23 which has an outer casing 25 provided with passages 27 and 29 respectively connected to the conduits 21 and 15. Securely fastened in a recess 31, formed in the casing 25, is sleeve 33 having a port 35 opening into passage 27; annular recesses 37 and 39; a second port 41 communicating with conduit 13 and a third port 43 opening into passage 29. The second port 41 establishes communication between the annular recess 37 and the conduit 13 leading to the cylinder 7, while the third port 43 similarly permits communication between the conduit 15 and the annular recess 39. Near the top of the sleeve are two more ports 45 opening into the passages 47 extending through the casing 25 and opening into the reservoir 3.

Slidably maintained in the bore of sleeve 33 is a second sleeve 49 resting on a spring 51, in the recess 31 and on the plug 52, and held thereagainst by the stem 53. The sleeve 49 has three annular recesses 55. With this arrangement, when the sleeve 49 is in the position shown in Fig. 1, any oil supplied through the discharge pipe 21 from the pump 19 cannot flow to the cylinder 7. However, if the stem 53 moves the sleeve 49 downwardly, oil entering from passage 27 through the port 35 may flow through the middle annular recess 55 to the annular recess

37 and thence through opening 41 and conduit 13 to the right hand end of the cylinder 7 to move the piston 11 toward the left. At the same time, the upper annular passage 55 permits communication between the annular recess 39 and the ports 45 so that any oil flowing from the cylinder through the conduit 15 to the distributing valve 23 may escape through one of the passages 47 to the oil reservoir 3.

If, on the other hand, the stem allows the sleeve 49 to rise, communication is established by the middle annular recess 55 between the port 35 and the annular recess 39 so that oil may flow therethrough to the conduit 15 and into the left hand end of the cylinder to drive the piston toward the right. Simultaneously therewith, the lower annular recess 55 establishes communication between the annular recess 37 and discharge ports 57 in the sleeve 33 so that oil returning from the cylinder through conduit 13 may flow into the recess 31 and thence into the oil reservoir 3 through appropriate passages (not shown).

Any movement of the piston 11 is transmitted to the valve gear of the engine (not shown) being controlled by the device of the present invention to change the supply of energizing fluid to the engine. To this end the piston is provided with a rack 59 for engaging the pinion 61 suitably keyed to a shaft 63 on which is secured a sprocket wheel 65. The chain 67 transmits movement of the sprocket wheel 65 to a second sprocket 69 keyed to shaft 71. The shaft 71 has mounted thereon a third sprocket 73 and engages the chain 75 which is designed to mesh with a fourth sprocket (not shown) mounted on the valve gear.

As a result, any movement of the piston to the right of left will be transmitted by the above described sprocket and chain arrangement. With the arrangement here shown movement of the piston toward the right will increase the speed of the engine and movement toward the left will decrease the speed of the engine. Movement of the piston is, of course, controlled by the distributing valve 23 which is, in turn, moved in accordance with variations in the fluid discharge pressure of the compressor driven by the engine, to which the controlling device is attached, and also by the speed of the engine, after it reaches a predetermined maximum speed.

A distributor valve linkage, or series of levers, is employed in moving the distributor valve 23 by moving the stem 53. Pivotally connected to the stem is a lever 77 which is pinned at one end to a second lever 79, pivoted at 81, and at the opposite end to a third lever 83. The lever 83 is in turn pivotally mounted on a rocker arm 85 secured on a shaft 87 by the key 89. One end of the rocker arm has a projection 91 resting on the bearing member 93 to compress a spring 95 against the cup 97 formed in the casing 5. Also fastened to the shaft 87 is an arm 99 resting on the plunger 101 extending through and guided by an appropriate opening in the cylinder 7. Formed on piston 11 is a groove 103 of tapering depth, being deeper at its right hand end that at it left hand end. Upon movement of the piston 11 the plunger 101 is raised or lowered depending upon the direction of movement of groove 103 in which the plunger 101 is held by the spring 95. The lever system actuated by the plunger 101 and groove 103, consisting in general of arm 99, shaft 87, rocker arm 85 and the lever 83, is generally designated as the compensating linkage in that this linkage, because of the design of the groove, tends to return the sleeve 49 to the position where no fluid is supplied to the cylinder 7 whenever the piston has been moved by admission of fluid under pressure to the cylinder 7.

The pressure responsive means employed to move the oil distributor valve in accordance with variations in the compressor discharge pressure is the valve 105. This valve comprises a valve body composed of an upper portion 107 and a lower portion 109 resting on the upper part of casing 5. The two valve body portions 107 and 109 are suitably secured to each other and clamp therebetween a flexible diaphragm 111 which rests on the head 113 of the valve plunger 115. The valve plunger 115 is slidably mounted in the lower valve body portion 109 and is guided by the wall 117 and an extension 119 of the valve body portion 109. A short distance below the enlarged head 113 of the plunger is a shoulder 121 adapted to bear on the spring 123 surrounding the plunger 115 and resting in a suitable recess provided in the extension 119. Normally, this spring holds the plunger 115 in its upper position to prevent the plunger from depressing, or in any way affecting, the position of the lever 79 with which it is in contact.

Mounted on the upper valve body portion 107 is the valve bonnet 125 cooperating with the upper valve body portion 107 to clamp a second flexible diaphragm 127 therebetween. A bushing 129 extends through the center portion of the diaphragm 127 and securely engages a second bushing 131. These two bushings cooperate to clamp the diaphragm 127 between them so that any movement of the diaphragm will also move the bushing and there can be no leakage of fluid under pressure therebetween. The bore of bushing 129 is reduced in diameter at its lower end in order to provide a shoulder 133 on which rests the head 135 of the needle valve 137.

The upper opening of the bore in bushing 129 is closed by a plug 139 and a spring 141 is compressed between this plug and the head 135 of the needle valve. Extending through the upper portion of the bonnet 125 is a hand screw 143 carrying a bushing member 145 free to rotate with respect to the hand screw. Between the bushing member 145 and the bushing 131 is a spring 147 which encompasses bushing 131 and normally urges the diaphragm 127 downwardly. The compressive force of the spring may be regulated by the adjustment of the hand screw 143.

In the upper portion 107 of the valve body is a chamber 149 opening into a recess of reduced diameter 151 that terminates in a small bore 153. The recess 151 is designed to receive the valve seat bushing 155 which may be secured thereto by threads (not shown). The valve seat bushing 155 has a metering orifice 157 to serve as a seat for needle valve 137 and to regulate the flow of any fluid supplied by conduit 159 to chamber 149 therethrough into the chamber 161 provided above the diaphragm 111. In accordance with the practice of this invention, the conduit 159 is connected directly to the source of compressor discharge pressure, namely, the receiver, and if the pressure of this fluid is sufficient to raise the diaphragm 127, from its normal position as shown in Fig. 1, the upward movement of the diaphragm and bushing 129 will raise the needle valve 137 from its seat 157 and will provide a passage for the fluid from chamber 149 to chamber 161, the size of which will be determined by the pressure

acting on diaphragm 127. Any pressure fluid flowing through the orifice and bore 153 into chamber 161 will act on the diaphragm 111 in order to move it downwardly.

On one side of the chamber 161 is a passage 163 which is closed at its outer end by the bushing 165 having an orifice 167 and threadedly engaging the vent pipe 169. The function of this arrangement is to permit the escape of fluid under pressure from the chamber 161 in order that the variations in pressure may be communicated to the diaphragm 111 and, also, when needle valve 137 is resting on the seat 157, the pressure in chamber 161 may be relieved. Thus, as the pressure in the receiver tank of the compressor rises, the increase of pressure in chamber 149 will tend to raise the diaphragm 127 allowing pressure fluid to enter chamber 161 and depress the diaphragm 111. Depression of the diaphragm will, of course, force the plunger 115 downwardly and rotate lever 79 about its fulcrum 81. Counterclockwise rotation of the lever 79 will lower lever 77 and move the stem 53 downwardly permitting the fluid under pressure supplied by the pump 19 to flow through passage 27, port 35, middle annular recess 55, the annular recess 37, port 41 and conduit 13 to the right hand end of the cylinder 7, thus moving the piston 11 toward the left.

Movement of the piston toward the left will lower plunger 101 and arm 99 will, consequently, rotate shaft 87 and the rocker arm 85 will tend to raise the lever 83 and move lever 77 and stem 53 upwardly so that the sleeve 49 will return to its normal position shown in Fig. 1 and prevent further supply of oil to the piston until there has been a change in the pressure acting on the diaphragms 127 and 111.

When the compressor discharge pressure decreases, the needle valve will tend to move toward its seat 157 and will, consequently, decrease or stop the flow of fluid pressure into the chamber 161. This will result in an upward movement of the valve plunger 115 so that the oil distributor valve linkage will raise the sleeve 49 and permit the oil distributor valve to supply oil under pressure to the left hand side of the piston and move the piston toward the right. Obviously, as the piston moves to the right, the compensating linkage will function to lower the sleeve 49 and thus return it to its normal non-supplying position.

It will be noted that, in the lower portion 109 of the valve body is a chamber 171 through which the valve plunger 115 passes and in which the shoulder 121 is located. Through opposite side walls of this chamber extend the bolts 173 and 175 which threadedly engage the walls and are secured in position by the lock nuts 177. The inner ends of these bolts are coniform in shape. The lower surface 179 of the head 113 and the upper surface 181 of the shoulder 121 are likewise coniform in shape and complementary to the surfaces of the bolts. These bolts serve to limit the travel of the plunger 115. The downward movement of the plunger 115 is limited by the bolt 173 and, in order to shorten this movement, the bolt is moved into the chamber. If the travel is to be lengthened, the bolt must be moved outwardly. Similarly, the position of the bolt 175 will determine the upward travel of the plunger 115.

With the present arrangement, the bolt 173 determines the minimum compressor speed that can be achieved by downward movement of the plunger 115 and the bolt 175 determines the maximum compressor speed achieved by upward movement of the plunger. Bolt 175, in other words, therefore determines the position of plunger 115 which will permit the maximum delivery of energizing fluid to the engine. If for any reason the maximum speed of the engine, as determined by the bolt 175, is exceeded while the compressor is operating, some method of controlling the speed other than by the compressor discharge pressure must be provided. For this reason, a maximum speed control assembly is provided and consists of a means to supply fluid under pressure, or pump 183, similar to pump 19, driven by the engine on which the controlling device is used. This pump withdraws oil from the reservoir 3 through the conduit 185 and discharges it through passage 187 to the pipe 189. The pipe 189 leads to the plunger casing 191, opening into the casing 5 adjacent the point where the lever 79 is fulcrumed.

A by-pass passage 182 is provided in the pump 183 to recirculate the oil through the pump if the pressure in conduit 189 and the plunger casing 191 becomes excessive. This passage is controlled by the check valve 184 held against its seat 186 by a spring 188 compressed by nut 190. Thus, the pressure at which the check valve will open to permit recirculation of oil through the pump is predetermined by the scale of the spring and the amount it is compressed by the nut 190.

A plunger 193, having an enlarged head 195, extends through the casing into the space above the oil reservoir 3. On the inner end of the plunger is a bushing 197 secured by the nut 199 and serving to adjustably compress the plunger encompassing spring 201 against the flange disk 203, which also serves to define two intercommunicating chambers 205 and 207. A cup 209 is placed in the chamber 205 and has an opening through the bottom thereof through which passes the plunger 193. The edge of the opening forms a seat for the head 195 of the plunger when the spring 201 is unopposed in its tendency to move the plunger 193 toward the right. The spring 201 normally holds cup 209 against flange disk 203 and, in order for the oil pressure to move the cup, it must be sufficient to overcome the spring pressure. The pressure supplied by the pump 183 will be governed by the speed of the engine and, also, by the by-pass control valve 211 arranged to discharge through pipe 213 into the reservoir 3. The valve 211 is a standard pressure control valve employed to control the pressure of the oil delivered by pipe 189 to the chamber 207 and, consequently, is adjustable. The details of this valve form no part of the invention and, consequently, will not be described.

Obviously, when the valve 211 is opened, the pressure of the fluid delivered to chamber 207 will be decreased, since the oil will flow through the valve and pipe 213 back into the reservoir 3 without entering the chamber 207. As the speed increases, however, the pressure will increase depending upon the position of valve 211 and when it is sufficient to overcome the tension of spring 201, it will move the cup 209 and plunger 193 toward the left. From the drawing it will be seen that this plunger is designed to contact an arm 215 formed integral with the lever 79 and, when the pressure in chamber 207 is sufficient to permit the plunger to bear against this arm 215, the rotation of this arm will rotate lever 79 about its fulcrum 81 thus lowering stem 53 of the oil distributor valve by means of the connecting linkage. Lowering of the stem 53, as has been

explained, will supply fluid under pressure to the right hand side of the piston and move the piston in the direction required to decrease the speed of the engine. In this manner then, the maximum speed at which the engine may operate can readily be determined by the adjustment of valve 211 and, if the speed of the engine should become excessive, the piston may move the valve gear to decrease the speed to a safe limit.

We claim:

1. In a speed controlling device for an engine driven compressor having means to control the supply of energizing fluid to the engine, the combination of a cylinder, a double-acting piston in the cylinder, means to supply fluid under pressure to either end of the cylinder, a valve to control the supply of fluid to the cylinder, a series of levers connected to the valve, a second valve actuated by the compressor discharge fluid to move said levers in accordance with variations in the compressor discharge pressure, a second series of levers connected to said first series of levers actuated upon movement of the piston to move the valve into a position preventing flow of fluid to either end of the cylinder.

2. In a speed controlling device for an engine driven fluid compressor having means to control the supply of energizing fluid to the engine, the combination of fluid actuated means to regulate the energizing fluid control means, means to supply pressure fluid to the fluid actuated means, a valve to control the last supply means, a series of levers connected to the valve, and means actuated by compressor discharge fluid to move the levers and valve in accordance with variations in the compressor discharge fluid pressure.

3. In a speed controlling device for an engine driven compressor having means to control the supply of energizing fluid to the engine, the combination of pressure responsive means to regulate the energizing fluid control means, means to supply fluid under pressure to the pressure responsive means, movable means to control the last said means, and compressor discharge pressure fluid actuated device to move the movable means in accordance with the variations in the compressor discharge pressure.

4. In a speed controlling device for a compressor driven by a steam engine having a steam cut-off valve for the engine, the combination of means driven by the engine to supply oil under pressure, oil pressure responsive means to control the cut-off valve, and means to regulate the oil supplied to the oil pressure responsive means actuated by the compressor discharge fluid.

5. In a speed controlling device for an engine driven fluid compressor having means to control the supply of energizing fluid to the engine, the combination of fluid pressure responsive means to actuate the supply control means, means to vary the supply fluid under pressure to the fluid pressure responsive means, and compressor discharge fluid actuated means to vary the fluid supplied to the fluid pressure responsive means.

6. In a controlling device for compressor driven by a steam engine having a steam supply control valve for the engine, the combination of a hydraulic cylinder, piston means in the cylinder, means to connect the piston means and the control valve and to transmit movement of the piston means to the valve, means to supply oil under pressure, a valve to direct oil from the supply means to the cylinder, a pressure responsive means actuated by the compressor discharge fluid to move the valve, and means actuated by the pressure responsive means to move the oil valve.

7. In a speed controlling device for an engine driven compressor having means to control the supply of energizing fluid to the engine, the combination of pressure responsive means, means connecting the pressure responsive means to the supply control means to enable the pressure responsive means to regulate the supply control means, means to supply fluid under pressure to the pressure responsive means, movable controlling means for the last said means, and compressor discharge pressure fluid actuated means to move the controlling means.

8. In a speed controlling device for an engine driven fluid compressor having means to control the supply of energizing fluid to the engine, the combination of fluid pressure responsive means movable to regulate the supply controlling means, means to transmit movement of the fluid pressure responsive means to the control means, means to supply fluid under pressure to the pressure responsive means, means to control the supply of fluid to pressure responsive means, compressor discharge fluid actuated means to actuate the last means, and means actuated upon movement of the pressure responsive means to move the last said control means to its original position and stop the supply of fluid to the pressure responsive means.

9. In a speed controlling device for an engine driven compressor having movable means to control the supply of energizing fluid to the engine, the combination of a cylinder, a double-acting piston in the cylinder, means to transmit movement of the piston to the movable means, means to supply fluid under pressure, a valve for the supply means normally directing fluid away from the cylinder and movable to direct fluid respectively to each end of the cylinder for actuating the piston, a pressure responsive valve to move said valve in accordance with variations in the compressor discharge pressure and direct fluid to the cylinder to actuate the piston, and means movable by the piston to restore said valve to its normal position.

10. In a speed controlling device for an engine driven fluid compressor having movable means to control the supply of energizing fluid to the engine and vary the speed of the engine, the combination of a cylinder, a double-acting piston in the cylinder, means to transmit movement of the piston to the movable means to vary the speed of the engine, means to supply fluid under pressure, a three-way valve to normally direct fluid from the supply means away from the cylinder adapted upon movement to direct fluid to each end of the cylinder for actuating the piston, a pressure responsive means actuated by compressor discharge fluid and movable in response to variations in the compressor discharge pressure, a series of levers to transmit movement of the pressure responsive means to the three-way valve and enable said valve to direct fluid to one end of the cylinder to actuate the piston, and a plunger movable by the piston bearing on said series of levers and adapted to actuate the levers to move the valve back to its normal position.

11. In a speed controlling device for an engine driven fluid compressor, the combination of movable means to control the supply of energizing fluid to the engine and vary the speed of the engine, a cylinder, a double-acting piston in the cylinder, means to transmit movement of the piston to the movable means to vary the speed

of the engine, means to supply fluid under pressure, a valve connected to the supply means and to each end of the cylinder movable to direct fluid to either end of the cylinder and normally preventing supply of fluid to the cylinder, a valve stem to move the valve, a series of levers pivotally connected to the valve stem, a pressure responsive device actuated by compressor discharge pressure bearing against one of said levers adapted to move the series of levers in accordance with variations in the compressor discharge pressure and thereby move the valve, a tapered groove on the piston, a second series of levers connected to the first said series of levers, a plunger in the tapered groove, and a spring to urge one of the second series of levers to bear against the plunger characterized in that movement of the piston in either direction causes the plunger and said second series of levers to move the valve back to its normal position and prevent supply of fluid to the cylinder to move the piston.

12. In a speed controlling device for an engine driven fluid compressor, the combination of movable means to control the supply of energizing fluid to the engine and vary the speed of the engine, a cylinder, a double-acting piston in the cylinder, means to transmit movement of the piston to the movable means to vary the speed of the engine, means to supply fluid under pressure, valve means associated with the supply means and the cylinder movable to direct fluid to either end of the cylinder normally preventing the supply of fluid to the cylinder, a pressure responsive device actuated by the compressor discharge fluid to move the valve means in accordance with variations in the compressor discharge pressure, means movable by the piston to move the valve to its normal position, means driven by the engine to supply fluid under pressure said pressure varying in accordance with the speed of the engine, means constantly subjected to fluid supplied by the engine driven means to move said valve means and render the pressure responsive device inoperative to move the valve means when the speed of the engine reaches a predetermined maximum speed.

13. In a speed controlling device for an engine driven fluid compressor, the combination of movable means to control the supply of energizing fluid to the engine and vary the speed of the engine, a cylinder, a double-acting piston in the cylinder, means to transmit movement of the piston to the movable means to vary the speed of the engine, means to supply fluid under pressure to the ends of the cylinder, means to control the fluid supplied by the supply means, pressure responsive means actuated by compressor discharge fluid to regulate the control means, and means to render the pressure responsive means ineffective at a predetermined engine speed.

14. In a speed controlling device for an engine driven fluid compressor, the combination of movable means to control the supply of energizing fluid to the engine and vary the speed of the engine, a cylinder, a double-acting piston in the cylinder, means to transmit movement of the piston to the movable means to vary the speed of the engine, means to supply fluid under pressure, a valve to direct fluid from the supply means to either end of the cylinder normally preventing the supply of fluid to the cylinder, pressure responsive means actuated by the compressor discharge fluid to move the valve and direct fluid to either end of the cylinder to actuate the piston in accordance with variations in the compressor discharge pressure, and engine speed responsive means to render the pressure responsive means ineffective to move the valve at a predetermined engine speed.

15. In a speed controlling device for an engine driven fluid compressor, the combination of movable means to control the supply of energizing fluid to the engine and vary the speed of the engine, a cylinder, a double-acting piston in the cylinder, means to transmit movement of the piston to the movable means to vary the speed of the engine, means to supply a fluid under pressure, a valve to direct fluid from the last means to either end of the cylinder normally preventing the supply of fluid to the cylinder, pressure responsive means actuated by the compressor discharge fluid and movable in accordance with variations in the compressor discharge pressure, means to connect the pressure responsive means and the valve for moving the valve, engine driven means to supply a fluid under pressure, the pressure varying in accordance with the speed of the engine, and means actuated by fluid supplied by the engine driven means and acting on said connecting means to render the pressure responsive means ineffective to move the valve at a predetermined speed.

16. In a speed controlling device for an engine driven fluid compressor having movable means to control the supply of energizing fluid to the engine and vary the speed of the engine, the combination of a cylinder, a double-acting piston in the cylinder, means to transmit movement of the piston to the movable means to vary the speed of the engine, means to supply fluid under pressure to movably arrange to direct fluid to either end of the cylinder, means actuated by the compressor discharge fluid to move the supply means in accordance with the variations in the compressor discharge pressure means to move the supply in accordance with engine speed upon a predetermined engine speed and render the compressor discharge fluid actuated means ineffective, and means actuated by movement of the piston to stop the supply of fluid under pressure to either end of the cylinder until either of the supply means again initiates the supply of fluid to the ends of the cylinders.

17. In a speed controlling device for an engine driven fluid compressor, the combination of movable means to control the supply of energizing fluid to the engine and vary the speed of the engine, a cylinder, a double-acting piston in the cylinder, means to transmit movement of the piston to the movable means to vary the speed of the engine, means to supply fluid under pressure, a valve to direct fluid supplied by the last means to either end of the cylinder normally preventing the supply of fluid to the cylinder, means actuated by the compressor discharge fluid to move the valve, pressure responsive means to move the valve in accordance with the engine speed upon a predetermined engine speed and render the last means ineffective, and means actuated by movement of the piston to move the valve to prevent supply of fluid to the cylinder until either responsive means moves the valve to supply fluid to the cylinder.

18. In a speed controlling device for an engine driven fluid compressor having movable means to control the supply of energizing fluid to the engine and vary the speed of the engine, the combination of a cylinder, a double-acting piston in the cylinder, means to transmit movement of

the piston to the movable means to vary the speed of the engine, means to supply fluid under pressure, a movable valve adapted to direct fluid to each end of the cylinder depending on the direction of the valve movement and normally preventing the flow of fluid to the cylinder, a pressure responsive device actuated by the compressor discharge fluid and movable in accordance with variations in the compressor discharge pressure, means movable by the pressure responsive device to move the valve to supply fluid to either end of the cylinder, and means connected to the last said means movable by the piston to render the valve ineffective to supply fluid to the ends of the cylinders until further movement of the pressure responsive device occurs.

19. In a speed controlling device for an engine driven fluid compressor having movable means to control the supply of energizing fluid to the engine and vary the speed of the engine, the combination of a cylinder, a double-acting piston in the cylinder, means to transmit movement of the piston to the movable means to vary the speed of the engine, means to supply fluid under pressure, a movable valve adapted to direct fluid to each end of the cylinder depending on the direction of the valve movement and normally preventing the flow of fluid to the cylinder, a pressure responsive device actuated by the compressor discharge fluid and movable in accordance with variations in the compressor discharge pressure, means movable by the pressure responsive device to move the valve to supply fluid to either end of the cylinder, means actuated by a pressure fluid varying in accordance with the speed of the engine to actuate said movable means at a predetermined engine speed and render the pressure responsive device inactive, and means connected to the movable means movable by the piston to render the valve ineffective to supply fluid to the ends of the cylinder until a change in compressor discharge pressure or engine speed occurs.

CHARLES S. BAKER.
ALLAN O. CARPENTER.