Feb. 24, 1953 C. S. BAKER 2,629,536

CONTROLLING DEVICE FOR ENGINE DRIVEN COMPRESSOR UNITS

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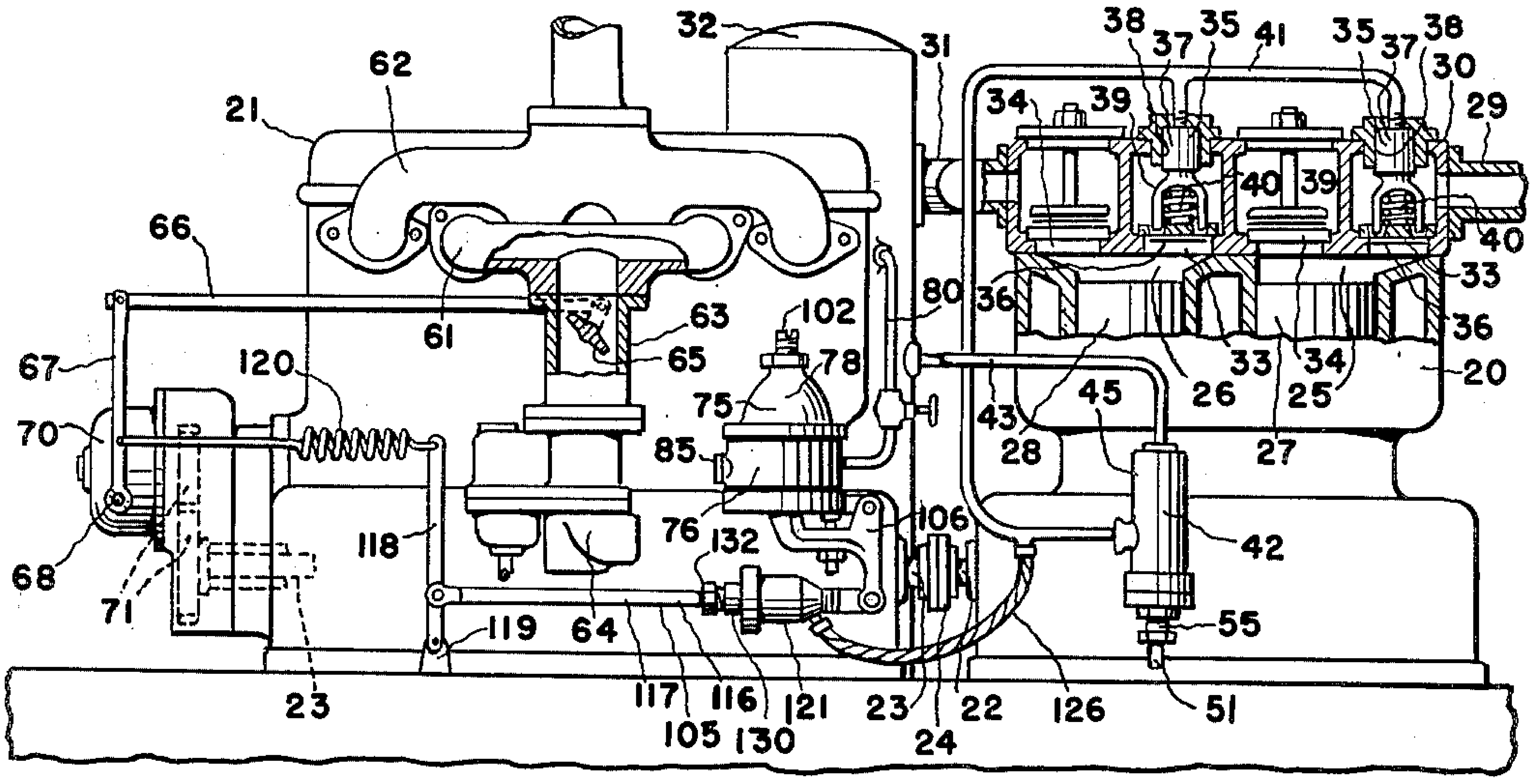

FIG-1.

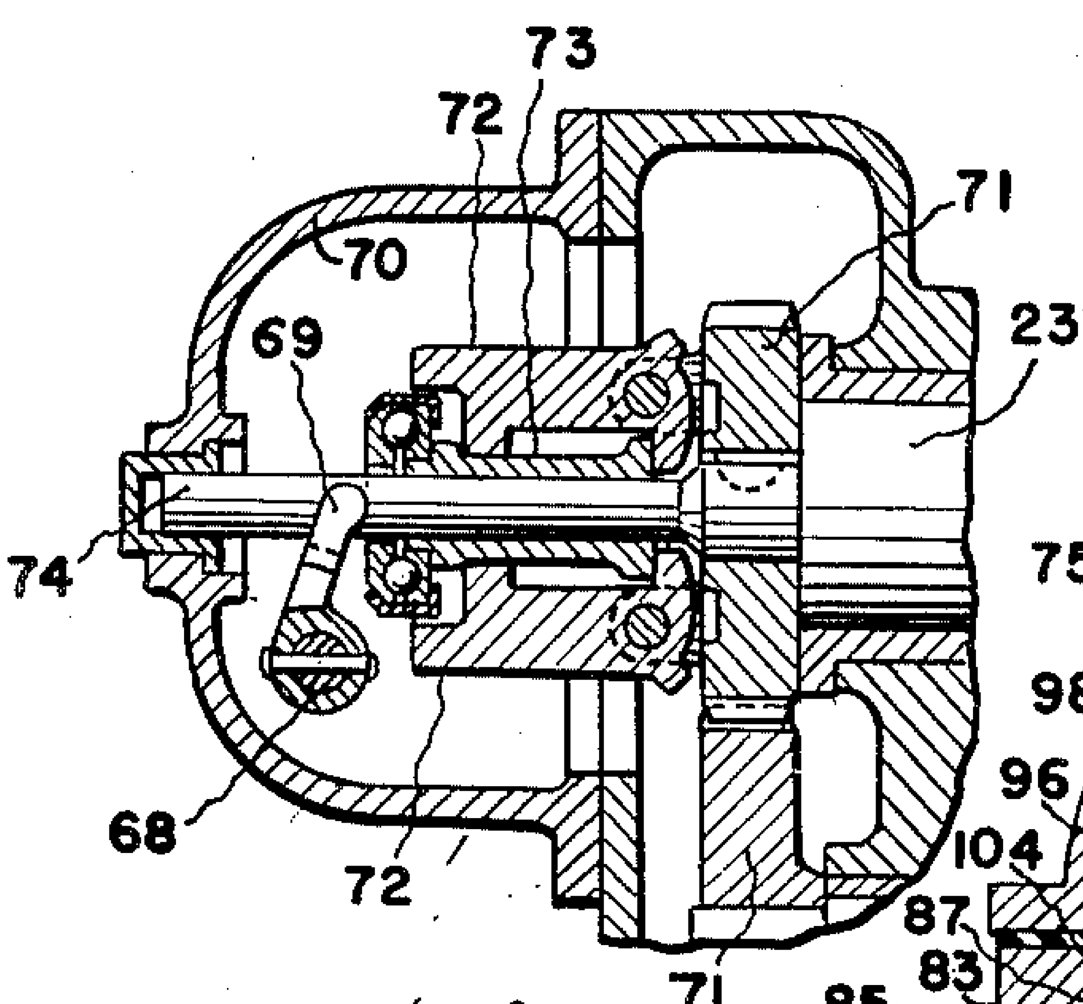

FIG-3.

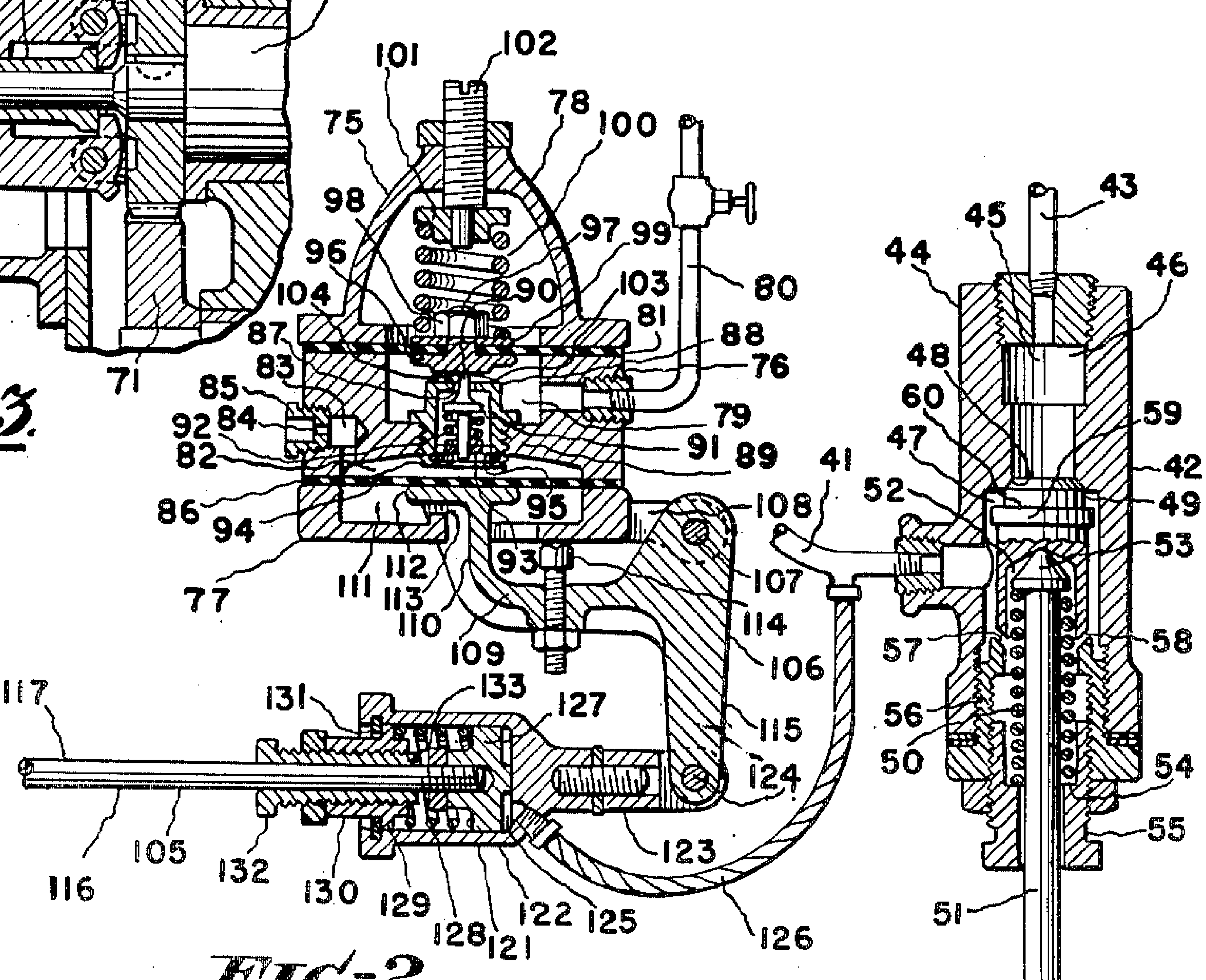

FIG-2.

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CONTROLLING DEVICE FOR ENGINE DRIVEN COMPRESSOR UNITS

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5 Claims. (Cl. 230—3)

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This invention relates to compressor apparatus, and more particularly to a controlling device for combustion engine driven compressor units.

One object of the invention is to control the speed of the unit and, therefore, the discharge output of the compressor in accordance with the variations in the rate at which the discharge output of the compressor is consumed.

Another object is to minimize the number of periods of unloading and reloading of the compressor.

Other objects will be in part obvious and in part pointed out hereinafter.

In the drawings accompanying this specification and in which similar reference numerals refer to similar parts,

Figure 1 is a side elevation, partly broken away, of a compressor unit equipped with a controlling device constructed in accordance with the practice of the invention, and

Figures 2 and 3 are vertical views, partly in section, of details of the invention.

Referring more particularly to the drawings, 20 designates the compressor and 21 the internal combustion engine of the unit having their respective shafts 22 and 23 connected together by a coupling 24.

The compressor 20 is shown as being of the multi-stage vertical type having a first stage cylinder 25 and a second stage cylinder 26 and pistons 27 and 28, respectively therein for compressing the fluid medium which is delivered to the compressor by an inlet conduit 29 connected to a head 30 for the cylinders. The discharge output of the compressor passes from the head 30 through a conduit 31 connected to a storage receiver 32.

The admission of fluid into the cylinders 25 and 26 is controlled by suitable inlet valve mechanisms 33 arranged in the head 30. The head also contains discharge valve mechanisms 34 for controlling the discharge of compressed fluid from the cylinders into the head, and the head 30 may be provided with a suitable passage (not shown) to convey the fluid from the discharge valve of the low pressure cylinder to the inlet valve of the high pressure cylinder.

The load on the cylinders 25 and 26 is controlled by unloading devices 35 that operate to unseat the valve elements 36 of the valve mechanisms 33. In the form shown each unloading device 35 comprises a piston 37 which is reciprocable in a chamber 38 in the upper wall of the head 30 and depending fingers 39 on the piston for engagement with the valve element 36. A

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spring 40 interposed between the valve mechanism 33 and the piston 37 normally holds the piston 37 in retracted position and the fingers 39 out of the engagement with the valve element 36.

The pistons 37 are actuated for unseating the valve elements 36 by pressure fluid which is conveyed to the chambers 38 by a conduit 41 leading from an auxiliary valve mechanism 42 to which pressure fluid is conveyed from the receiver 32 by a conduit 43. The valve mechanism 42 comprises a casing 44 having an axial bore 45 the upper portion of which is in constant communication with the conduit 43 and constitutes a pressure chamber 46. The chamber 46 opens at its lower end into a valve chamber 47, and at the juncture of the chambers is a beveled seat 48 for a valve 49 reciprocable in the chamber 47.

The valve 49 is normally held against the seat 48 by a spring 50 encircling a guide rod 51 that extends into a recess 52 in the lower portion of the valve and has a coniform head 53 for point-engagement with the valve. The spring 50 is calibrated to yield to a predetermined maximum receiver pressure. Its upper end seats against the coniform head 53 and the lower end against a shoulder 54 within a sleeve 55 which loosely encircles the guide rod 51 and is threaded into the lower end portion of the casing 44 for varying the force of the spring 50. More particularly, the sleeve 55 is in threaded engagement with a bushing 56 which is itself threaded into the casing 44 for adjustment endwise thereof and is provided at its upper end with a beveled seat 57 for a corresponding beveled seating surface 58 at the lower end of the valve 49.

The valve 49 is guided only by the guide rod 51 and is of smaller diameter than the chamber 47 to define a pathway for the passage of pressure fluid to the conduit 41 which opens into the valve chamber 47 at a point between the seats 48 and 57. Near the upper portion of the valve is an external flange 59 which is of slightly smaller diameter than the chamber 47 to partly restrict the flow of the pressure fluid passing to the conduit 41, and the upper surface of said flange 59 constitutes a pressure surface 60 against which the fluid impinges at the instant communication is established between the chambers 46 and 47 to cause the valve to quickly snap downwardly against the seat 57 and thereby prevent the loss of pressure fluid through the bushing 56 and the sleeve 55 to the atmosphere.

In practice, the upper end of the valve 49 is constantly subjected to the force of the pressure in the chamber 46, this being receiver pressure, and the spring 50 is adjusted to yield to a certain predetermined maximum receiver pressure. Thus, when the pressure fluid in the chamber 46 reaches that certain predetermined maximum value it will unseat the valve 49 and, striking against the flange 59, will cause the valve 49 to be quickly moved downwardly against the seat 57 and to be held in that position by the pressure of the fluid acting against the upper end of the valve and the pressure surface 60. Pressure fluid will then flow from the valve chamber 47 through the conduit 41 into the chambers 38 against the piston 37 and cause the fingers 39 to unseat the valve elements 36.

In this way, the compressor cylinders will be unloaded and will remain thus until the receiver pressure falls below the force exerted by the spring 50 and the spring 50 will then act to shift the valve 49 against the seat 48 and cut-off the communication between the storage receiver and the conduit 41. The pressure fluid will then exhaust from the chambers 38 through the conduit 41 into the chamber 47, thence through the space between the seat 57 and the seating surface 58 and through the bushing 56 and the sleeve 55 to the atmosphere. At the same time the springs 40 will move the fingers 39 out of engagement with the valve elements 36 which will then again function in the normal manner to control fluid admission into the compressor cylinders.

The internal combustion engine 21 driving the compressor may be of a conventional type, having the usual inlet and exhaust manifolds 61 and 62, an inlet conduit 63 connecting a carburetor 64 to the inlet manifold and a butterfly valve 65 in the conduit 63 for controlling the fuel supply to the engine. Movement is transmitted to the valve 65 for setting it in its different fuel controlling positions by a rod 66 which is pivotally connected at one end to the valve 65 and at its other end, in like manner, to a lever 67 affixed to the shaft 68 of a rocker arm 69 which seats against the speed governor 70 of the engine 21. The governor, which is shown positioned at an end of the engine to be driven by its crankshaft through a suitable gear train 71, is of the well known type having centrifugally actuated arms 72 pivotally connected to the driven gear of the train 71 to act against a sleeve 73 which is slidable upon a shaft 74 on the driven gear and constantly abuts the free end of the rocker arm 69 for tilting said rocker arm. The arrangement of these parts is such that they tend to rotate the butterfly valve 65 for diminishing the fuel supply to the engine when its speed exceeds a certain predetermind maximum rate and to permit the valve 65 to move in the reverse direction for increasing the fuel supply to the engine.

Normally, however, the speed of the engine and, therefore, the output of the compressor are controlled entirely by mechanism acting responsively to the pressure within the receiver 32. This mechanism, in a preferred form, comprises a regulator 75 the casing of which consists of an intermediate body 76, a plate-like cover 77 at one end of the body and a dome-shaped cover 78 at the opposite end. The body 76 is recessed in the side confronting the cover 78 to provide a chamber 79 which is in constant communication with the receiver 32 through a conduit 80, and its outer end is sealed by a diaphragm 81 that is clamped at its marginal portion between the body 76 and the cover 78.

The opposite end of the body 76 is likewise recessed to provide a chamber 82 which is in constant communication with the atmosphere through a passage 83 in the body 76 and an orifice 84 in a plug 85 threadedly connected to the body. The outer end of the chamber 82 is sealed by a diaphragm 86 clamped between the body and the cover 77, and pressure fluid for actuating the diaphragm 86 passes to the chamber 82 from the chamber 79 through an orifice 87 in the end of a cup-shaped member 88 threaded, in inverted position, into the wall 89 separating the chambers 79 and 82 from each other.

The effective area of the orifice 87 is determined by a metering pin 90 in the member 88 and movable axially thereof. The pin 90 extends into the orifice 87 and is of conniform shape so that when it rises within the member 88 said pin decreases the flow area of the orifice and increases the area of communication between the chambers 79—82 when moving in the opposite direction.

The pin 90 has a shoulder 91 at the large end of its coniform portion to serve as a seat for a spring 92 which rests at its other end on a spring seat 93 in the lower end of the member 88 and tends constantly to urge the pin 90 upwardly for closing the orifice 87. The spring seat 93 is retained within the member 88 by a retaining ring 94 seated in the lower end of the member 88 and has suitable perforations 95 for the passage of pressure fluid from the member 88 into the chamber 82.

The spring 92 is capable of exerting a force sufficient to retain the pin 90 in position to close the orifice 87 against the pressure in the chamber 79, and the downward or opening movement of the pin 90 is effected by the diaphragm 81 which has attached to its underside a plate 96 to overlie and engage the end of the pin 90. The plate 96 has a stem 97 extending through the diaphragm, and a nut 98 threaded onto the stem 97 serves to clamp the diaphragm 81 between the plate 96 and a washer 99 interposed between the nut 98 and the diaphrgam. The washer 99 also serves as a seat for an end of a spring 100 the opposite end of which bears against a plate 101 on the lower end of a screw 102 threaded through the outer end wall of the dome-shaped cover 78 for selectively varying the force of the spring 100.

In the relaxed position of the diaphragm 81, as when the pressure within the chamber 79 is of insufficient value to raise the diaphragm against the force exerted by the spring 100, the plate 96 rests upon the end of the member 88. In order, therefore, to prevent said plate from blocking off the orifice 87 the outer end surface 103 of the member 88 is rounded and a radial groove, or grooves, 104 is formed in the end of the member 88 to afford constant communication between the chamber 79 and the orifice 87 to supply pressure fluid to the chamber 82 for actuating the diaphragm 86.

Such movement of the diaphragm serves to normally actuate the butterfly valve 65 and is transmitted thereto by linkage designated in its entirety by 105 and connected to the lever 67. This linkage comprises a bell crank 106 which is pivoted at its angle on a pin 107 seated in a lug 108 at the side of the cover 77. One arm 109 of the bell crank extends part-way along the cover 77 and has an upwardly directed portion 110 that extends into a recess 111 in the cover and terminates in a plate portion 112 that lies perpendicular to the portion 110 and bears against the underside of the diaphragm 86.

Suitable stop means are provided to limit the degree of movement of the bell crank 106 and to determine the limiting positions of the valve 65. To this end the cover is provided on its inner surface with an upwardly extending projection 113 which the underside of the plate 112 engages when in its lowermost limiting position, and which position corresponds with the maximum speed setting of the valve 65. The opposite limiting position to which the bell crank 106 may move is determined by a stop member in the form of a bolt 114 threaded into the arm 109 to abut the underside of the cover 77. The bolt 114 is threaded into the arm 109 and is, therefore, readily adjustable in the arm to vary the degree of movement of the bell crank and thus, of course, also of the valve 65. In the present instance, however, it is intended that the bolt be so adjusted that when it engages the cover 77 the valve 65 will occupy a position to cause the engine 21 to operate at a predetermined intermediate rate of speed as for example, one half the predetermined maximum speed.

The free end of the other arm 115 is pivotally connected to a transmission member which is designated in its entirety by 116 and comprises a rod 117 that is pivotally connected to an intermediate portion of a rocker 118 pivoted at its lower end to a lug 119 adjacent the base of the engine 21, the upper end of the rocker 118 being connected to an end of a helical tension spring 120 the opposite end of which is connected to the intermediate portion of the lever 67 for holding the rocker arm 69 against the sleeve 73. Owing to this arrangement the thrust of the rocker 118 is transmitted through the spring 120 to the lever 67 and thus to the valve 65.

The spring 120 also serves as the engine governor spring and is calibrated to predominate over the force exerted by the governor arms 72 throughout the entire speed range between the predetermined intermediate and the predetermined maximum speeds and to yield to the force of the governor arms for controlling the throttle valve only in the event that the engine speed exceeds the predetermined maximum rate. Thus, as will be understood, the throttle valve 65 is entirely under the control of the regulator 75 during the normal operation of the unit and the governor 70 assumes control of the throttle valve only in the event that, for some cause, as for example, the faulty adjustment of any of the parts, the speed of the engine exceeds the predetermined maximum rate in an undesirable degree.

In order to obviate a speeding-up of the engine 21 at the instant the compressor 20 is unloaded, such as might otherwise occur in a given setting of the valve 65 when the compressor is suddenly unloaded, the transmission member 116 is provided in its organization with a fluid actuated adjustor 121 that serves to impart to the valve 65 the closing movement required to prevent the acceleration of the engine. The adjustor comprises a casing 122 having a stem 123 at one end which is pivotally connected to the free end of the arm 115 by a pin 124. Within the casing 122 is a chamber 125 to which pressure fluid is conveyed from the conduit 41 by a conduit 126. The pressure fluid thus introduced into the chamber 125 serves to actuate a reciprocatory piston 127 which is threadedly connected to the end of the rod 117.

The piston 127 is normally retained in its retracted position by a spring 128 that acts at one end against the piston and at the other end against a flange 129 on the periphery of a bushing 130 extending into the open end of the chamber 125. The flange 129 rests upon a retainer ring 131 embedded in the wall of the chamber 125 and is held thereagainst by the spring 128. In order to limit the degree of movement of the piston 127 to the extent required for imparting such slight degree of compensatory movement to the valve 65, a stop member 132 in the form of a sleeve encircling the rod 117 is threaded into the bushing 130 to position its inner end 133 in suitably spaced relation with respect to the piston 127 to serve as a stop therefor.

In practice, and at the beginning of an operating period of the compressor 20 against an empty system, and with the spring 120 fully contracted, the linkage 105 will hold the butterfly valve 65 in a position to supply fuel to the engine at the rate required for operating it at the predetermined high rate and will hold the bolt 114 against the cover 77. The metering pin 90 is then fully retracted to permit a maximum area of communication between the chambers 79 and 82 through the orifice 87. The bell crank 106 will then also occupy a position wherein the bolt 114 seats against the cover 77, this being the position of the bell crank that corresponds to the setting of the valve 65 for operating the engine at the predetermined high speed and also to determine the starting speed of the engine.

Under these conditions, pressure fluid discharged into the storage receiver 32 will flow into the chamber 79 and through the orifice 87 into the chamber 82. A portion of such pressure fluid will, of course, escape from the chamber 82 to the atmosphere through the passage 83 and the orifice 84. However, as the pressure in the chamber 82 rises it will depress the diaphragm 86 and rock the bell crank 106, about the pivot 107 to move the plate portion 112 in the direction of the projection 113, and when the pressure in the chamber 82 reaches a value of, say, twenty-five pounds per square inch the diaphragm 86 will be fully depressed. This movement of the bell crank is transmitted to the valve 65, by the linkage 105, the lever 67 and the rod 66 for opening said valve to the position required for operating the engine at the predetermined maximum speed. In this speed position of the valve 65 the plate portion 112 rests upon the projection 113 and the valve 65 will remain stationary so that the speed of the engine will remain at a substantially constant rate.

The unit will continue to operate in the manner described until the pressure within the storage receiver 32 and, therefore, in the chamber 79 reaches that predetermined high value, say 100 pounds, at which it will overcome the force exerted by the spring 100 against the diaphragm 81. If, thereafter the pressure in the chamber 79 continues to increase, the diaphragm 81 will rise and the pin 90 will also move upwardly under the force of the spring 92 and reduce the effective flow area of the orifice 87 accordingly. At the same time pressure fluid constantly passes from the chamber 82 through the orifice 84 to the atmosphere so that the pressure within the chamber 82 decreases progressively, both by reason of the decreasing flow area of the orifice 87 and the constant bleeding off of pressure fluid to the atmosphere from the chamber 82.

When the pressure in the chamber 82 has been reduced to a lower value than the force exerted by the governor arms 72 the said arms will quickly shift the valve 65 in the direction required to reduce the fuel supply to the engine and will also rock the bell crank 106 about the pivot 107 to cause said bell crank to follow the upward movement of the diaphragm 86. If, during such upward movement of the diaphragm, the demand on the pressure fluid in the storage receiver 32 increases and causes the receiver pressure to fall the diaphragm 81 will descend responsively thereto and depress the pin 90 to again increase the flow of pressure fluid into the chamber 82 for shifting the valve 65 to accelerate the speed of the engine.

If, on the other hand, the receiver pressure continues to rise say, to a predetermined maximum value of 105 pounds, the diaphragm 81 and the pin 90 will rise and reduce the supply of pressure fluid to the chamber 82 accordingly, or possibly cut-off the flow of pressure fluid through the orifice 87 into said chamber altogether. The bell crank will then swing about the pivot 107 to seat the bolt 114 against the cover 77 and to place the butterfly valve 65 in the position required to cause the engine to operate at the predetermined high speed, thereby reducing the output of the compressor 20.

The compressor unit will continue to operate at the reduced speed and the pressure in the receiver 32 to increase and fall in accordance with variations in demand. However, if the receiver pressure continues to rise and exceeds the force exerted by the spring 50, of the valve mechanism 42, it will unseat the valve 49. The pressure fluid thus admitted into the chamber 47 against the pressure surface 60 will then quickly drive the valve downwardly against the seat 57. At the same time, pressure fluid will flow through the conduit 41 into the chambers 38 and drive the fingers 39 against the valve elements 36 of the inlet valve mechanisms for unseating them. The compressor will then be fully unloaded.

Simultaneously with the valving of pressure fluid to the inlet valve mechanisms pressure fluid will flow through the conduit 126 into the chamber 125 of the fluid actuated adjustor 121 and drive the piston 127 against the stop 133. This movement of the piston 127, transmitted through the linkage connecting it with the valve 65, will impart a further slight degree of closing movement to the valve 65 and thereby obviate an increase of speed such as ordinarily occurs in a given setting of the power controlling valve of an engine following the removal of the load from a compressor.

The parts controlling the load on the compressor and the speed of the engine will remain in the positions described as long as the pressure in the receiver exceeds the force of the spring 50, but when it falls below that value the spring 50 will return the valve 49 to the seat 48. The pressure fluid in the cylinders 38 will then escape through the conduit 41 into the valve chamber 47, thence through the space between the lower end of the valve 49 and the seat 57 and through the bushing 56 and the sleeve 55 to the atmosphere. At the same time, the pressure fluid in the chamber 125 will also escape through the conduits 126—41 and through the valve mechanism 42 to the atmosphere. The spring 128 will then retract the piston 127 and thus move the valve 65 to the predetermined high speed controlling position.

If, thereafter, the pressure in the receiver falls to a value that permits the diaphragm 81 to descend upon the pin 90 and open the orifice 87, pressure fluid will again flow into the chamber 82 and when the pressure therein reaches a value capable of overcoming the force of the governor arms 72 it will shift the valve 65 for increasing the engine speed. And when the pressure in the chamber 79 reaches a value below that exerted by the spring 100 the diaphragm 81 will descend to open the pin 90 to wide limits. The pressure fluid thereafter admitted into the chamber 82 will move the plate 112 against the projection 113 and position the valve 65 for operating the engine 21 at maximum speed.

In practice, the present invention has been found highly desirable for controlling the operation of a compressor unit serving to supply the power demands of a group of machines that are operated intermittently, as for example rock drills, since, when the receiver pressure has attained the value necessary for the efficient operation of such machines the speed of the engine is automatically decreased or increased in accordance with the demands imposed by such intermittent operation of the rock drills. And if the demand upon pressure fluid supply is insufficient to maintain the storage pressure below a certain predetermined value the controlling device will operate to cause the engine to run at the predetermined lower rate of speed, thereby lowering the output of the compressor which will continue operating at the lower speed until the receiver pressure reaches the predetermined maximum value at which the compressor is unloaded.

I claim:

1. In a controlling device for an internal combustion engine and a compressor driven thereby, a throttle valve for controlling the fuel supply for the engine having limiting positions corresponding to predetermined high and maximum engine speeds, a fluid actuated member serving as the sole power actuator for shifting the throttle valve, linkage for transmitting movement from only the fluid actuated member to the throttle valve and to initially hold the throttle valve in an open position for causing operation of the engine at such predetermined high speed, valve means for varying the supply of pressure fluid to the fluid actuated member, control means operatively engaging the valve means acting constantly responsively to pressure variations in the compressor discharge pressure above a certain predetermined high value to vary the position of the valve means and thereby the position of the fluid actuated member for varying the speed-setting of the throttle valve in accordance with variations in the discharge pressure of the compressor and to cut-off the supply of pressure fluid to the fluid actuated member when the discharge pressure reaches a predetermined maximum value, and means yieldingly opposing the maximum speed movement of the fluid actuated member to position the throttle valve for operation of the engine at such predetermined high speed upon the attainment of the predetermined maximum discharge pressure.

2. In a controlling device for an internal combustion engine and a compressor driven thereby, a throttle valve for controlling the fuel supply to the engine having limiting positions corresponding to predetermined high and maximum engine speeds, a fluid pressed member serving as the sole power actuator for the throttle valve, linkage for transmitting movement from only the fluid pressed member to the throttle valve and to initially hold the throttle valve in an open

position for causing operation of the engine at such predetermined high speed, means for varying the supply of pressure fluid to the member for shifting the throttle valve to and holding it immovable in the maximum speed-setting, means in engagement with the first mentioned means acting responsively to compressor discharge pressure of a predetermined high value and to variations of pressure between such predetermined high pressure and a predetermined maximum discharge pressure for varying the position of the first said means and thereby varying the supply of pressure fluid to the member to change the speed-setting of the throttle valve in accordance with variations in the compressor discharge pressure, and means yieldingly opposing maximum speed movement of the throttle valve and acting to move the throttle valve to the predetermined high speed-setting whenever the pressure against the member falls below the force exerted by the last said means.

3. In a controlling device for an internal combustion engine and a compressor driven thereby, a throttle valve for controlling the supply of fuel to the engine having limiting positions corresponding to predetermined high and maximum engine speeds, a fluid pressed member serving as the sole power actuator for the throttle valve, linkage connected to the throttle valve associated with and actuated by only the member and serving to initially hold the throttle valve in an open position for causing operation of the engine at such predetermined high rate of speed, valve means for varying the supply of pressure fluid to the member for moving the throttle valve from the predetermined high speed-setting to and holding said throttle valve in the maximum speed-setting, means acting responsively to a predetermined high compressor discharge pressure engaging the valve means for varying the position of said valve means and thereby varying the supply of pressure fluid to the member for shifting the throttle valve in accordance with variations in the discharge pressure between such predetermined high value and a predetermined maximum value and to cut-off the supply of pressure fluid to the member when the discharge pressure reaches such predetermined maximum value, and means yieldingly pressing against the linkage to oppose the maximum speed movement of the throttle valve and acting to move the throttle valve to the predetermined high speed-setting whenever the pressure acting against the member falls below the force exerted by the last said means.

4. In a controlling device for an internal combustion engine and a compressor driven thereby, a throttle valve for controlling the fuel supply to the engine having limiting positions corresponding to predetermined high and maximum engine speeds, linkage connected to the throttle valve for shifting said valve and to initially hold said throttle valve in an open position for causing operation of the engine at such predetermined high speed, a fluid pressure actuated member for holding the linkage immovable to position the throttle valve for operation of the engine at the predetermined maximum speed until the compressor discharge pressure reaches a predetermined high value and serving as the sole power actuator for the throttle valve and the linkage, valve means for valving pressure fluid to the member acting responsively to compressor discharge pressure in excess of such predetermined high value to vary the value of the pressure acting against the member and to cut-off the supply of pressure fluid to the member whenever the compressor discharge pressure reaches a predetermined maximum value, and means yieldingly pressing against the linkage to oppose the maximum speed movement of the throttle valve and acting to move the throttle valve to the predetermined high speed-setting whenever the pressure acting against the member falls below the force exerted by the last said means.

5. In a controlling device for an internal combustion engine and a compressor driven thereby, a throttle valve for controlling the supply of fuel to the engine having limiting positions corresponding to predetermined high and maximum engine speeds, linkage connected to the throttle valve to initially hold said throttle valve in an open position for causing operation of the engine at such predetermined high speed and to move the throttle valve to the maximum speed-setting, a pressure fluid actuated member acting against the linkage and serving as the sole actuator for moving the throttle valve to and holding it in the maximum speed-setting, valve means for varying the supply of pressure fluid to the member, means associated with the valve means acting responsively to compressor discharge pressure of a predetermined high value and to variations of pressure between such predetermined high pressure and a predetermined maximum discharge pressure for varying the position of the valve means and thereby varying the supply of pressure fluid to the member to change the speed-setting of the throttle valve in accordance with variations in value of the compressor discharge pressure and to cut-off the supply of pressure fluid to the member when the discharge pressure reaches the predetermined maximum value, and means yieldingly pressing against the linkage to oppose the maximum speed movement of the throttle valve and acting to move the throttle valve to the predetermined high speed-setting whenever the pressure acting against the member falls below the force exerted by the last said means.

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