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Lindqvist et al.

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[54] **PLANTS COMPRISING A COMBUSTION ENGINE AND A COMPRESSOR DRIVEN BY SAID ENGINE**

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Related U.S. Application Data

[63] Continuation of Ser. No. 85,213, Oct. 29, 1970, which is a continuation of Ser. No. 740,203, June 26, 1969, abandoned.

[52] **U.S. Cl.** **417/23**, 417/24, 417/28, 417/34, 417/281, 417/282, 417/295

[51] **Int. Cl.** **F04b 49/02**

[58] **Field of Search** 417/24, 26, 23, 28, 34, 417/281, 282, 295

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[57] **ABSTRACT**

A governor for combustion engine driven compressors includes two piston members. The first piston member is actuated by oil pressure and a second piston member is actuated in an opposite direction by the compressor discharge fluid pressure. The governor is responsive to the differential between a pre-determined low working pressure and the compressor discharge fluid pressure. A governor spring member acts to move a fuel control member for the engine between an idle position and full speed position. The governor spring member is subjected to power bias by the two piston members under various operating conditions. The governor includes an unloading control valve which is movable to unloading and loading positions when the fuel control member is adjacent the idle position. A compressor inlet valve and compressor vent valve are provided for loading and unloading the compressor. The second piston member controls the fuel supply in response to compressor delivery of compressed fluid when the plant is operating between an intermediate and full capacity.

11 Claims, 3 Drawing Figures

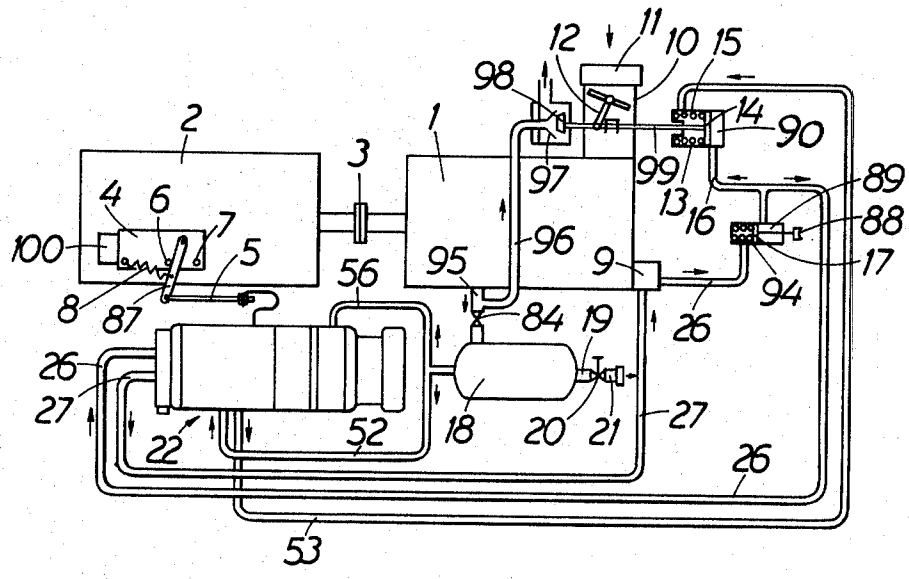

Fig. 1

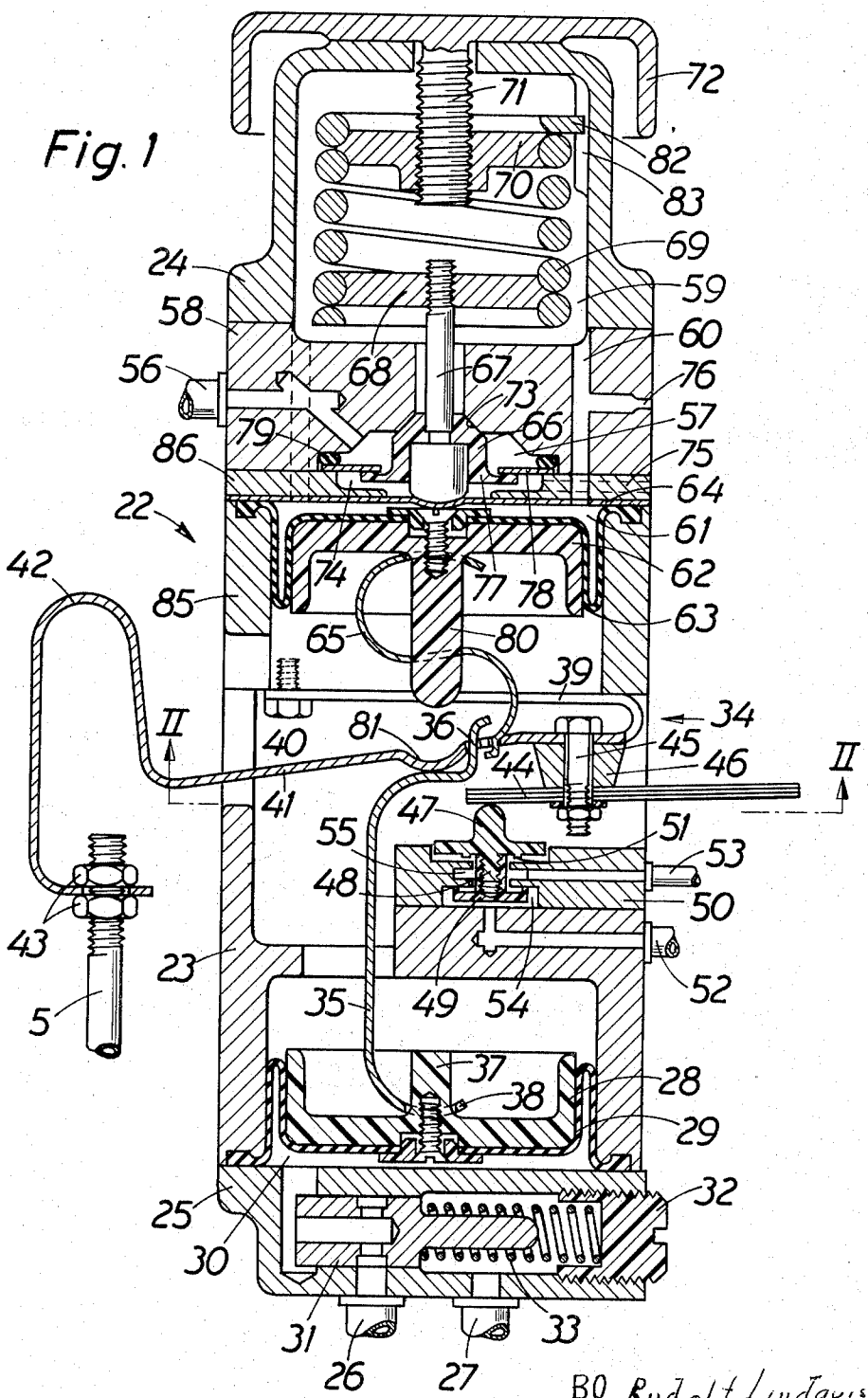

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Fig. 3

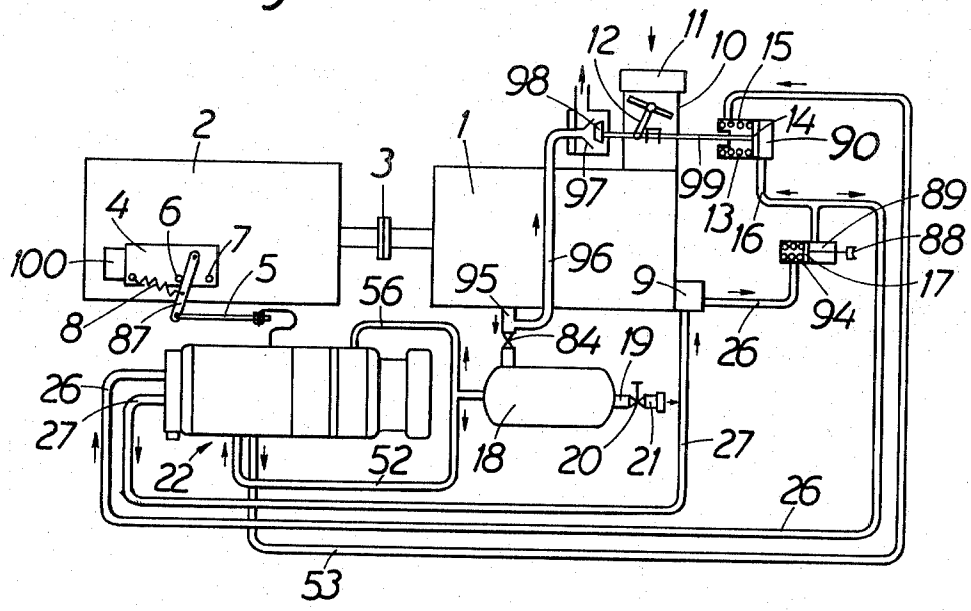
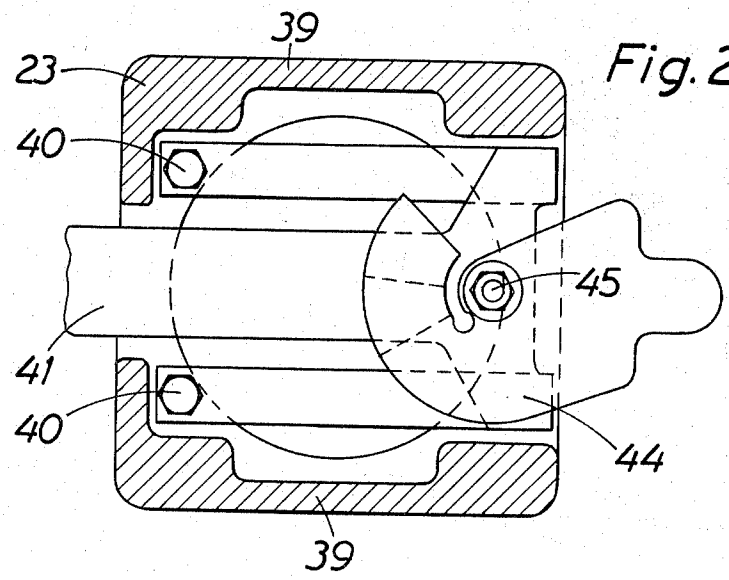


Fig. 2



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PLANTS COMPRISING A COMBUSTION ENGINE AND A COMPRESSOR DRIVEN BY SAID ENGINE

RELATED APPLICATIONS

This is a continuation of copending application, Ser. No. 85,213 filed Oct. 29, 1970, which in turn was a continuation of copending application, Ser. No. 740,203 filed June 26, 1969, now abandoned.

PURPOSE OF THE INVENTION

The primary object of this invention is to provide a governor which controls fuel supply and engine speed within the high and medium capacity range of a plant comprising a combustion engine and a compressor driven by the engine.

Another object of this invention is to provide a governor which controls fuel supply and engine speed to follow the consumption of compressed fluid as closely as possible.

A further object of this invention is to provide a governor that controls a combustion engine so that it runs at idling speed and produces unloading and reloading substantially without changing the engine speed when the plant is operated at a capacity less than the capacity at idling speed of the engine.

A still further object of the invention is to provide a governor for a plant of the type indicated above which is reliable in structure and which friction between the moving parts has been eliminated or reduced to a large extent.

SUMMARY OF THE INVENTION

The combination of this invention is directed generally to the use of a governor with a combustion engine and a fluid compressor driven by the combustion engine. The governor is responsive to discharge pressure of the compressor over a pre-determined discharge pressure range. The engine is adapted for having its operating speed controlled by the governor. Valve means are provided for loading and unloading the compressor within the predetermined discharge pressure range. Means are provided for actuating the valve means to loading and unloading conditions of the compressor. A fluid pressure is applied to the actuating means for unloading the compressor when the compressor discharge pressure exceeds the predetermined high value. The combination of this invention provides for speed regulation of the engine between idle speed and full speed. In addition, the compressor may be loaded and unloaded while the engine is running at idle speed condition.

In a more specific embodiment, a first valve means is movable in an opening and a closing direction for loading and unloading the compressor respectively within the pressure range. An actuating means is provided for the first valve means controlling the compressor conditions. A first means is used for applying liquid pressure on the actuating means for loading the compressor and a second means is used for applying fluid pressure on the actuating means for unloading the compressor when the compressor discharge pressure exceeds a predetermined high value. Various other structural elements and mechanisms are provided to effect the desired results of this invention.

BRIEF DESCRIPTION OF DRAWINGS

Other objects of this invention will appear in the following description and appended claims, reference being made to the accompanying drawings forming a part of the specification wherein like reference characters designate corresponding parts in the several views.

FIG. 1 is a diagrammatic plan view partially in section of a governor device made in accordance with this invention,

FIG. 2 is a cross-sectional view along the line II—II of FIG. 1, and

FIG. 3 is a diagrammatic view of a plant incorporating the governor of this invention.

DESCRIPTION OF SPECIFIC EMBODIMENTS

More specifically, a plant as shown in FIG. 3 includes a compressor **1** and a combustion engine **2** such as a diesel engine. The engine **2** drives the compressor **1** through a suitable transmission **3**. The engine **2** has a conventional fuel control device which may be fuel injection pump **4** having a rod **5** constituting a fuel control member. The rod **5** is movable to various positions between an idle stop **6** and a full speed stop **7**. A conventional speed governor **100** is used for controlling the speed of the engine **2** within the idling range thereof. The conventional speed governor **100** may be of a standard centrifugal type available in the prior art. The spring **8** acts on the fuel control rod **5** to bias it toward the idle stop **6**.

The compressor **1** is provided with a lubricating oil pump **9** of a conventional type. The pump **9** supplies lubricating oil to the compressor bearings and other moving parts under a pressure which is usually controlled by a relief valve in the lubricating oil pump **9**. The compressor **1** may naturally be of any design but the invention is particularly intended for use in connection with positive displacement compressors such as reciprocating piston compressors, screw compressors, rotary vane compressors or the like. The compressor **1** includes a fluid inlet conduit **10** and an inlet filter **11** through which air or gas is drawn to the compressor **1** for compression therein. The inlet conduit contains a suitable suction valve **12** of any conventional design. The compressor inlet valve **12** is actuated in a closing or throttling direction by a spring **13** and by liquid pressure acting on a piston **14** disposed in a cylinder **15**. The liquid pressure is effected on the piston **14** via the conduit **53** as described hereinbelow. A rod **99** connects the piston **14** with the valve **12** and a vent valve **98**.

The piston **14** may be actuated in the opening direction of the valve **12** by oil pressure in a conduit **16** which is connected to the compressor oil pump. A valve **17** is operated by a press button **88** and controls the oil supply to the conduit **16**. When valve **17** is opened, the compressor **1** is loaded. When the valve button **88** is pushed, it remains open as long as oil pressure is available from conduit **26** or until it is pulled to a closed position. The operation of the valve **17** permits the engine **2** to be run warm before the compressor **1** is loaded. The compressor **1** is unloaded as shown in FIG. **3**. Oil pressure may also be established in the conduit **16** through the use of an engine oil pump which is not shown in this particular embodiment.

When the valve 12 is opened, fluid such as air or gas enters the compressor inlet conduit 10. Fluid is compressed in the compressor 1 and delivered to a receiver 18. The compressed fluid may be discharged through the conduit 19 and the valve 20 which is connected to a compressed air or gas network 21. Any type of well known fluid may be compressed for supply to any well known compressed fluid consumer. In screw compressor plants, a check valve 84 may be located in the conduit 95 leading from the compressor 1 to the receiver 18. A conduit 96 is connected to conduit 95 and extends to a vent chamber 97 which is controlled by the vent valve 98. The valve 98 is opened when the compressor 1 is unloaded. As shown in FIG. 3, the valve 98 is opened and the valve 17 is closed thereby showing the compressor 1 to be in the unloaded condition.

The governor, generally designated 22, controls the plant which is illustrated in FIG. 3. Detailed illustrations of the governor 22 are shown in FIGS. 1 and 2. The governor 22 consists of a governor casing comprising casing portions 23, 85, 86 and 58. The casing portions 86 and 58 form a valve housing toward one end of the governor 22. An amplifier housing 24 is located at one end of the governor 22 and a pressure liquid housing 25 is located at the other end thereof.

A conduit 26 extends between the pressure liquid housing 25 to a source of pressure fluid. In this enbodiment, the source of pressure fluid is the lubricating oil pump 9. The valve 17 is located in the conduit 26 and controls the flow of pressure liquid therethrough. A return or drain conduit 27 also connects the housing 25 with the pump 9. A rolling diaphragm 29 is fixed to a first piston member 28 and clamped between the housing 25 and the casing portion 23. A pressure liquid chamber 30 is formed by the first piston member 28, rolling diaphragm 29 and housing 25. A constant pressure valve device 31 is located in the housing 25 and controls the pressure in the pressure chamber 30 so that the pressure therein is kept constant. The tension in the spring 33 is controlled by the adjustable screw 32 so that the desired constant pressure level is obtained in the chamber 30.

A linking bar 35 connects the first piston member 28 to a governor spring device, generally designated 34. One end of the bar 35 is hooked into the spring device 34 at the interconnection 36. The other end of the bar 35 is forked around a piston rod 37 at the interconnection 38 located on the first piston member 28. The connections 36 and 38 of the bar 35 to the spring device 34 and the piston member 28, respectively, permit the piston member 28 to push the spring device 34 upwardly in FIG. 1 but do not permit the piston member 28 to pull the spring device 34 downwardly.

The spring device 34 has a flat spring structure which is generally U-shaped and has one substantially straight and forked shank 39. The end of the shank 39 is secured to the governor casing portion 86 by suitable bolts 40. The other shank 41 of the U-shaped structure has its end formed as an elastic loop 42. The end of the loop 42 is fixed to the fuel control member rod 5 between two nuts 43.

The spring device 34 carries an unloader actuating spring 44 which is a multiple leaf spring secured to the shank 41 by a bolt 45 and spaced by a steel block 46. The spring 44 is arc shaped as shown in FIG. 2 and is rotatably mounted on the bolt 45 so that various portions of the spring 44 come into contact with an unloading control valve actuator 47. The actuator 47 is fitted with a spindle 48 and an unloading control valve 49.

The unloading control valve 49 is disposed in a valve housing 50 fitted on governor casing portion 23. The control valve 49 is a type which snaps over from closed to open positions upon a very small movement of the unloading control valve actuator 47. The valve 49 is shown in Closed position in FIG. 1. When the actuator 47 is depressed downwardly, the valve 49 is caused to move quickly to open position and simultaneously therewith, the actuator 47 seats on the housing 50 with a ring flange 51. The housing 50 communicates with the receiver 18 through a conduit 52. The housing 50 also communicates with the unloading valve operating cylinder 15 through a conduit 53. Chamber 54 located in housing 50 is in open communication with the receiver 18 through the conduit 52. Therefore, the discharge pressure established by the compressor 1 is normally available in the chamber 54. This discharge pressure is the same pressure available in the receiver 18 and may be defined as a differential pressure between a predetermined low working fluid pressure and the discharge pressure range of the compressor 1. On the other hand, the chamber 55 located in housing 50 is vented and connected through the conduit 53 to the unloading valve cylinder 15 only when unloading takes place. When the control valve 49 is in open position, the compressed fluid moves through conduit 53 to the valve cylinder 15 where the piston 14 is actuated thereby closing valve 12 and opening vent 98.

The conduit 56 connects the receiver 18 with a chamber 57 formed in the valve housing 58. Consequently, the discharge fluid pressure available in receiver 18 is also supplied to the chamber 58 and a chamber 59 formed in the amplifier housing 24. The chamber 59 is in communication with the chamber 61 by several bore holes 60 located in the valve housing 58. The chamber 61 is formed between a second piston member 62 and a retaining rolling diaphragm 63 and a second diaphragm member 64.

A valve member 66 is disposed in the valve housing 58 and has a spindle 67 screwed into a disk 68. The disk 68 is fixed between the windings of a helical spring 69. A second disk 70 is fitted between the two spring windings at the opposite end of the helical spring 69 and threaded on a spindle 71 of an adjusting hand wheel 72. The tension of the spring 69 may be adjusted by turning the hand wheel 72. Adjustment of the tension in spring 69 by the turning of the hand wheel 72 necessarily adjusts the pull on the valve spindle 67. The tension adjustment thereby controls the force necessary to lift or open the valve 66 from its seat 73. This force will be provided by the compressed fluid entering chamber 57 via conduit 56. The forked lug 82 which is formed by the spring end rides along the end of the spring 69 and along an axial guide rib 83. The rib 83 is formed at the inside of the housing 24. The lug 82 prevents the spring 69 from turning.

A chamber 74 is located in the casing 86 between the diaphragm 64 and the valve member 66. The chamber 74 is vented to the atmosphere through a passage 75 located in the casing portion 86. The chamber 59 is also vented to the atmosphere through a small restricted passage 76. The chambers 57 and 74 are separated by a flat sheet metal ring 78 together with a

flange 77 located on the valve member 66. The ring 78 is fitted in the valve housing 58, 86 and sealed at its outer edge by a sealing ring 79.

The second piston member 62 has a spindle 80 and is kept in raised position as shown in FIG. 1 by a soft S-shaped spring 65 which is secured to the shank 41 of the spring device 34.

OPERATION

As the oil pressure is raised via conduit 26 in the constant pressure chamber 30, the first piston member 28 moves and consequently moves the control rod member 5 with the attached lever 87 toward the stop 7. During the movement of the first piston member 28, the spindle 80 is contacted by a seat portion 81 formed in the shank 41 of the spring device 34.

The fuel control member 5 and governor pistons 28 and 62 are illustrated in the positions which they take when the engine 2 and compressor 1 are at rest. The unloading control valve 49 is shown closed and the chamber 55 is then vented to the atmosphere over the ring flange 51. The spring 13 keeps the suction valve 12 in closed or throttled position. The compressore 1 is unloaded and there is no fuel pressure in conduit 16.

If the engine 2 is started, nothing is changed in the compressor 1 with the unloading control valve 49 and valve 12 in the positions just described. Therefore, the compressor 1 is driven unloaded at the idling speed of the engine 2 which is controlled by the governor 100. This enables the engine 2 to be warmed up, if desired. Once the engine 2 has started, oil is supplied under pressure from the compressor oil pump 9 through the conduit 26 into the housing 94 of the valve 17.

In order to start operation of the compressor 1, the operating button 88 is depressed so that the oil is admitted under pressure to the chamber 89. Oil is subsequently admitted to the constant pressure chamber 30 below the diaphragm 29 via the conduit 26. Pressure oil in conduit 16 and chamber 89 acts on the piston 14 thereby opening valve 12 against the pressure of the spring 13. Simultaneously, the pressure oil closes the vent valve 98 while the pressure oil in the chamber 30 moves the engine fuel control rod 5 toward the full speed stop 7. The compressor 1 starts to build up pressure by compressing fluid such as air or gas thereby raising the pressure in the receiver 18. If the pressure supply through the delivery conduit 21 is less than the supply of compressed fluid delivered by the compressor 1, a pressure buildup results in the receiver 18 thereby causing fluid pressure to be supplied through conduits 52 and 56 to the chambers 54 and 57, respectively.

At a certain predetermined pressure level such as 100 p.s.i., the pressure in the chamber 57 overcomes the pull of the spring 69 so that the valve 66 is unseated. The pressure level is determined by the amount of tension in spring 69 adjustable in the manner described hereinabove. Compressed fluid is then admitted to chamber 59 which is connected to the atmosphere through a small vent passage 76. The passage 76 also vents the chamber 61. When the supply of compressed pressure fluid past valve member 66 is sufficient to raise the pressure in chambers 59 and 61, the second piston member 62 starts to move downwardly relative to the other parts as shown in FIG. 1. Since the spindle 80 abuts the seat 81, the fuel control member 5 is moved toward the idle stop 6. That is, the rod 5 is lowered relative to other parts as shown in FIG. 1 and the speed of the engine 2 is reduced. The movement of piston 62 continues as long as the compressor 1 delivers more fluid than the consumer consumes and the pressure continues to build up in the receiver 18. Naturally, if the delivery of the compressor 1 and the fluid consumption reach equilibrium, the movement of the fuel control rod 5 stops and the engine 2 drives the compressor 1 at a reduced speed which corresponds to the consumption of pressure fluid. If, however, the consumption of compressed pressure fluid is so low that the pressure in the receiver 18 continues to rise, then the fuel control member 5 is moved until it rests against the idle stop 6.

Now, if the pressure in the receiver 18 still continues to rise while rod 5 is at idle stop 6, the second piston member 62 forces the spring device 34 downwardly with respect to the other parts shown in FIG. 1. Continued movement of the piston 62 toward the spring device 34 causes the shank 39 to be lifted from its seat on the governor casing portion 85 and the downwardly moving spring element 44 then actuates unloading control valve actuator 47. The control valve 49 is consequently lifted from its seat and ring flange 51 is seated on the valve housing 50. The compressed pressure fluid which has previously been admitted to chamber 54 via conduit 52 is only now admitted to chamber 55 and out through the conduit 53 to the unloading cylinder 15. The discharge of compressed pressure fluid through conduit 53 causes the compressor inlet valve 12 to move to a closed or throttled position by virtue of the pressure action against the piston 14. The compressor 1 now runs unloaded with the next valve 98 in open position.

Now, if pressure in the receiver 18 falls, the fluid pressure on the second piston member 62 is reduced. Consequently, the force of spring element 44 is reduced on valve actuator 47 so that control valve 49 closes and chamber 55 and conduit 53 are vented. Compressed fluid no longer passes to cylinder 15 so that the compressor 1 is reloaded by oil pressure on the piston 14 via conduit 16. As long as a comparatively small compressed fluid consumption is maintained at supply outlet 21, the compressor 1 is loaded and unloaded with the engine running at substantially idle speed with the fuel control rod 5 resting against the idle stop 6 as illustrated in FIG. 1. Now, if compressed fluid consumption increases over the capacity of the compressor 1 while the engine 2 is running at idle speed, then the spring device 34 moves upwardly with respect to the other parts as shown in FIG. 1 against the force being imposed on the second piston member 62. The upward action of spring device 34 causes the engine speed to increase according to the demand of compressed fluid from the consumer. Sudden changes in fluid consumption which might cause sudden changes in engine speed are damped by oil acting on the first piston member 28.

The illustrated governor 22 may be used for various sizes and types of compressor and for various conditions. In order to meet such varying conditions, the moment when the unloading control valve 49 is actuated may be adjusted by turning the spring element 44 to a suitable position.

While the plants comprising a combustion engine and a compressor driven by said engine has been shown

and described in detail, it is obvious that this invention is not to be considered as being limited to the exact form disclosed, and that changes in detail and construction may be made therein within the scope of the invention, without departing from the spirit thereof.

Having thus set forth and disclosed the nature of this invention, what is claimed is:

1. In a plant comprising a combustion engine and a fluid compressor driven by said engine, the combination comprising:

a. a governor responsive to variations in discharge pressure of the working fluid in the compressor over a predetermined discharge pressure range,

b. said engine being adapted for having its operating speed controlled by said governor,

c. said governor comprising means for increasing the speed of the engine as said discharge pressure falls and for decreasing the speed as the discharge pressure rises.

d. valve means for loading and unloading the compressor within said pressure range,

e. means for actuating said valve means to said loading and unloading conditions,

f. means for applying fluid pressure on said actuating means for unloading said compressor when said compressor discharge pressure exceeds a predetermined high value,

g. said combustion engine including a fuel control member operable between a maximum load full speed position and a reduced idle speed position, and said governor including a spring device having a first portion connected to said fuel control member, a first piston member operable to actuate said first spring portion to move the fuel control member toward said full speed position, and a second piston member operable to actuate said first spring portion to move the fuel control member toward said reduced idle speed position,

h. said first piston member being operated from a pressure liquid source and said second piston member being actuated by the discharge pressure of the compressor.

2. In a plant comprising a combustion engine and a fluid compressor driven by said engine, the combination comprising:

a. a governor responsive to a discharge pressure of the compressor over a predetermined discharge pressure range,

b. said governor providing a control for the operating speed of the engine,

c. a first valve means movable in an opening and a closing direction for loading and unloading the compressor, respectively, within said pressure range,

d. actuating means for said first valve means,

e. first means for applying liquid pressure on said actuating means for loading said compressor,

f. second means for applying fluid pressure on said actuating means for unloading said compressor when said compressor discharge pressure exceeds a pre-determined high value,

g. said combustion engine including a fuel control member operable between a maximum load full speed position and a reduced idle speed position,

h. said governor including a spring device having a first portion connected to said fuel control member, a first piston member operable to actuate said first spring portion to move the fuel control member toward said full speed position and a second piston member operable to actuate said first spring portion to move the fuel control member toward said reduced idle speed position, and

i. said first piston member being operated from a pressure liquid source and said second piston member being actuated by the discharge pressure of the compressor.

3. In a plant comprising a combustion engine and a fluid compressor driven by the combustion engine, the combination comprising:

a. a governor responsive to variations in discharge pressure of the compressor over a predetermined discharge range for controlling the speed of the engine,

b. a valve operable to open and closed positions for controlling the flow of fluid through the compressor,

c. actuating means for said compressor fluid flow valve,

d. first means for applying liquid pressure on said actuating means to move said fluid flow valve to the open position,

e. second means for applying fluid pressure on said actuating means to move said fluid flow valve to the closed position at a predetermined value of differential pressure to thereby unload the compressor,

f. said second pressure applying means including an unloading control valve operable to supply pressure fluid to said actuating means for moving said compressor fluid flow valve to the unloading closed position,

g. said governor including an unloading control valve actuator, at least one fluid actuated piston member, a spring device and said unloading control valve,

h. said spring device being connected to a fuel control member which controls fuel supply to the engine,

i. one portion of said spring device being adapted to move the fuel control member between an idle stop and a full speed maximum load stop, and

j. a second portion of said spring device operable by said fluid actuated piston member to move said unloading control valve actuator to a position for actuating said unloading control valve thereby supplying pressure fluid for unloading the compressor in response to a predetermined discharge fluid pressure.

k. said second spring portion being adjustable to vary the predetermined discharge valve pressure at which said valve actuator responds,

l. said second spring portion comprising a number of arcuate leaf springs of different lengths and adjustable by turning to different positions in which one or more leaf springs are effective.

4. In a plant comprising a combustion engine and a fluid compressor driven by said engine, the combination comprising:

a. an oil pump driven by the plant and providing a source of substantially constant oil pressure,

b. a member operable to control fuel supply to the combustion engine,

c. a first valve means having open and closed positions for controlling the flow of working fluid through the compressor between loading and unloading conditions, respectively,
d. a second valve means adapted to control a pressure fluid bias on said first valve means,
e. a governor having a casing,
f. a spring device disposed in said governor casing and being connected to said fuel control member,
g. one portion of said spring device being adapted to move the fuel control member between an idle stop and a full speed maximum load stop,
h. a second portion of said spring device being adapted to effect movement of said second valve means from a loading to an unloading position,
i. said governor includes a first piston member actuated by said constant pressure oil and a second piston member actuated by a differential between a predetermined low working fluid pressure and a discharge pressure range of the compressor,
j. said first piston member being adapted to produce upon actuation thereof a power bias on the spring device in a first direction toward said full speed stop for increasing fuel supply to the engine,
k. said second piston member being adapted to produce upon actuation thereof a power bias on said spring device in a second direction opposite said first direction for reducing the fuel supply to the engine, said actuation being effected upon an increase in said differential pressure over a high predetermined value.

5. In a plant as defined in claim **4** wherein
a discharge fluid pressure amplifier is provided for actuation of said second piston member,
said discharge fluid pressure amplifier comprising a housing, a discharge conduit leading from said compressor, a chamber in said amplifier housing communicating with said discharge conduit, an amplifier valve in said housing operable to open substantially at a first predetermined pressure value and to admit said discharge fluid to actuate said second piston member for reducing the fuel supply upon further increase of said discharge fluid pressure.

6. In a plant as defined in claim **5** wherein
a spring is provided in said amplifier housing and arranged to bias said amplifier valve in a closing direction, and means are disposed on the amplifier housing for adjusting the spring bias.

7. In a plant as defined in claim **5** wherein
a vent passage is provided between the chamber in the amplifier housing and the atmosphere.

8. In a plant comprising a combustion engine and a compressor driven by said engine, the combination comprising:
a. a source of substantially constant pressure liquid,
b. a member operable to control fuel supply to the combustion engine,
c. a first valve means having open and closed positions for controlling fluid flow through said compresssor for unloading and loading the compressor, respectively,
d. a second valve means operable to control a pressure fluid bias on said first valve means for said compressor,
e. a governor having a casing,
f. a spring device disposed in said governor casing and being connected to said fuel control member,
g. one portion of said spring device being adapted to move the fuel control member between an idle stop and a full speed maximum load stop,
h. a second portion of said spring device being adapted to effect movement of said second valve means from a loading to an unloading position,
i. said governor includes a first piston member actuated by said constant pressure liquid and a second piston member actuated by discharge fluid pressure of said compressor,
j. said first piston member being adapted to produce upon actuation thereof a power bias on the spring device in a first direction toward said full speed stop for increasing fuel supply to the engine,
k. said second piston member being adapted to produce upon actuation thereof a power bias on said spring device in a second direction opposite said first direction for reducing the fuel supply to the engine, said actuation being effected upon an increase in said discharge pressure over a first predetermined value,
l. said spring device comprising a generally U-shaped flat spring having two shanks, a first shank being fixed with its end to the casing and a second shank forming a loop secured with its end to said fuel supply control member.

9. In a plant comprising a combustion engine and a compressor driven by said engine, the combination comprising:
a. a source of substantially constant pressure fluid,
b. a member operable to control fuel supply to the combustion engine,
c. a first valve means for controlling fluid flow through said compressor for unloading of the compressor,
d. a second valve means operable to control a pressure fluid bias on said first valve means,
e. a governor having a casing,
f. a spring device disposed in said governor casing and being connected to said fuel control member,
g. one portion of said device being adapted to move the control member between an idle stop and a full speed maximum load stop,
h. a second portion of said device being adapted to effect movement of said second valve means from a loading to an unloading position,
i. said governor includes a first piston member actuated by said constant pressure liquid and a second piston member actuated by a discharge fluid pressure of said compressor,
j. said first piston member being adapted to produce upon actuation thereof a power bias on the spring device in a first direction toward said full speed stop for increasing fuel supply to the engine,
k. said second piston member being adapted to produce upon actuation thereof a power bias on said spring device in a second direction opposite said first direction for reducing the flow of fuel supply to the engine, said actuation being effected upon an increase in said discharge pressure over a first predetermined value,

l. a spring element forming said second portion of said spring device,

m. said spring element being arranged to actuate said second valve means to unload the compressor with the spring device when the spring device has returned the fuel control member to idle position and the discharge fuel pressure continues to rise,

n. said spring element being adjustable to vary the moment when unloading and loading takes place,

o. said spring device comprising an arc-shaped flat spring,

p. the effective length and distance from the second valve means being adjustable by swinging of the spring element on a supporting pivot carried by the valve device.

10. In a plant comprising a combustion engine and a compressor driven by said engine, the combination comprising:

a. an oil pump driven by the plant and providing a source of substantially constant pressure oil,

b. a member operable to control fuel supply to the combustion engine,

c. a first valve means for controlling the flow of working fluid through the compressor,

d. a second valve means adapted for providing pressure fluid bias on said first valve means,

e. a governor having a casing,

f. a spring device disposed in said governor casing and being connected to said fuel control member,

g. one portion of said device being adapted to move the fuel control member between an idle stop and a full speed maximum load stop,

h. a second portion of said device being adapted to effect movement of said second valve means from a loading to an unloading position,

i. said governor includes a first piston member actuated by said constant pressure oil and a second piston member actuated by a differential between a predetermined low working fluid pressure and a discharge pressure range of the compressor,

j. said first piston member being adapted to produce upon actuation thereof a power bias on the spring device in a first direction toward said full speed stop for increasing the fuel supply to the engine,

k. said second piston member being adapted to produce upon actuation thereof a power bias on said spring device in a second direction opposite said first direction for reducing the fuel supply to the engine, said actuation being effected upon an increase in said differential pressure over a high predetermined value,

l. said governor further including a pressure liquid housing communicating with a source of pressure liquid,

m. a chamber in said pressure liquid housing in which said first piston member is movable,

n. a conduit leading from a source of pressure liquid to said chamber, and

o. a constant pressure control valve in said communication arranged to provide a substantially constant pressure in said chamber thereby actuating the first piston for producing said power bias to the spring device.

11. In a plant comprising a combustion engine and a fluid compressor driven by said engine, the combination comprising:

a. a governor responsive to a differential between a predetermined low working fluid pressure and discharge pressure range of the compressor,

b. said governor including a spring device,

c. a fuel control member for said combustion engine operable between a maximum load full speed position and a reduced idle speed position,

d. a first portion of said spring device being connected to said fuel control member,

e. a first pressure liquid actuated member operable to actuate said first spring portion to move said fluid control member toward said full speed position in an increased speed direction,

f. a second pressure fluid actuated member operable to actuate said first spring portion to move said fuel control member in reduced speed direction within said pressure range,

g. a first valve means operable to open and closed positions for controlling the flow of fluid through the compressor within said pressure range,

h. actuating means for said first valve means,

i. means for applying liquid pressure on said actuating means in the opening direction of the first valve means,

j. a second control valve means disposed in said governor and operable to supply pressure fluid to the actuating means for moving said compressor fluid flow valve to the closed position,

k. a means disposed in said governor for activating the second control valve means.

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UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 3,796,515 Dated March 12, 1974

Inventor(s) Bo Rudolf Lindqvist; Jan Edvard Persson

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

[63] Related U.S. Application Data

Continuation of Ser. No. 85,213, Oct. 29, 1970, which is a continuation of Ser. No. 740,203, June 26, 1968, abandoned.

Signed and sealed this 10th day of September 1974.

(SEAL)
Attest:

McCOY M. GIBSON, JR.
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents

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* U.S. GOVERNMENT PRINTING OFFICE : 1969 O—366-334.