No. 747,773. PATENTED DEC. 22, 1903.

F. M. RITES.

FLUID COMPRESSOR.

APPLICATION FILED SEPT. 19, 1902. RENEWED OCT. 1, 1903.

NO MODEL. 2 SHEETS—SHEET 1.

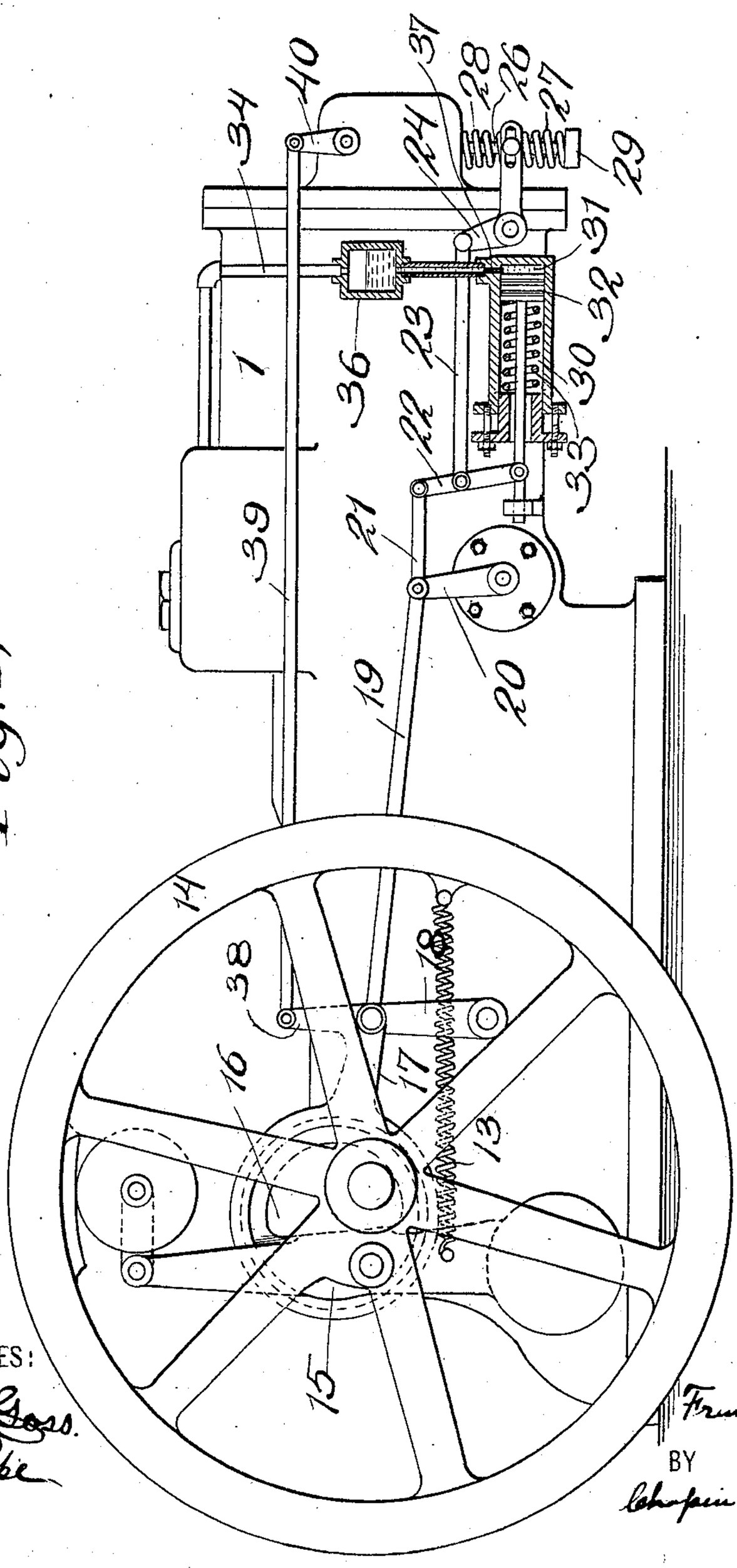

Fig. 1.

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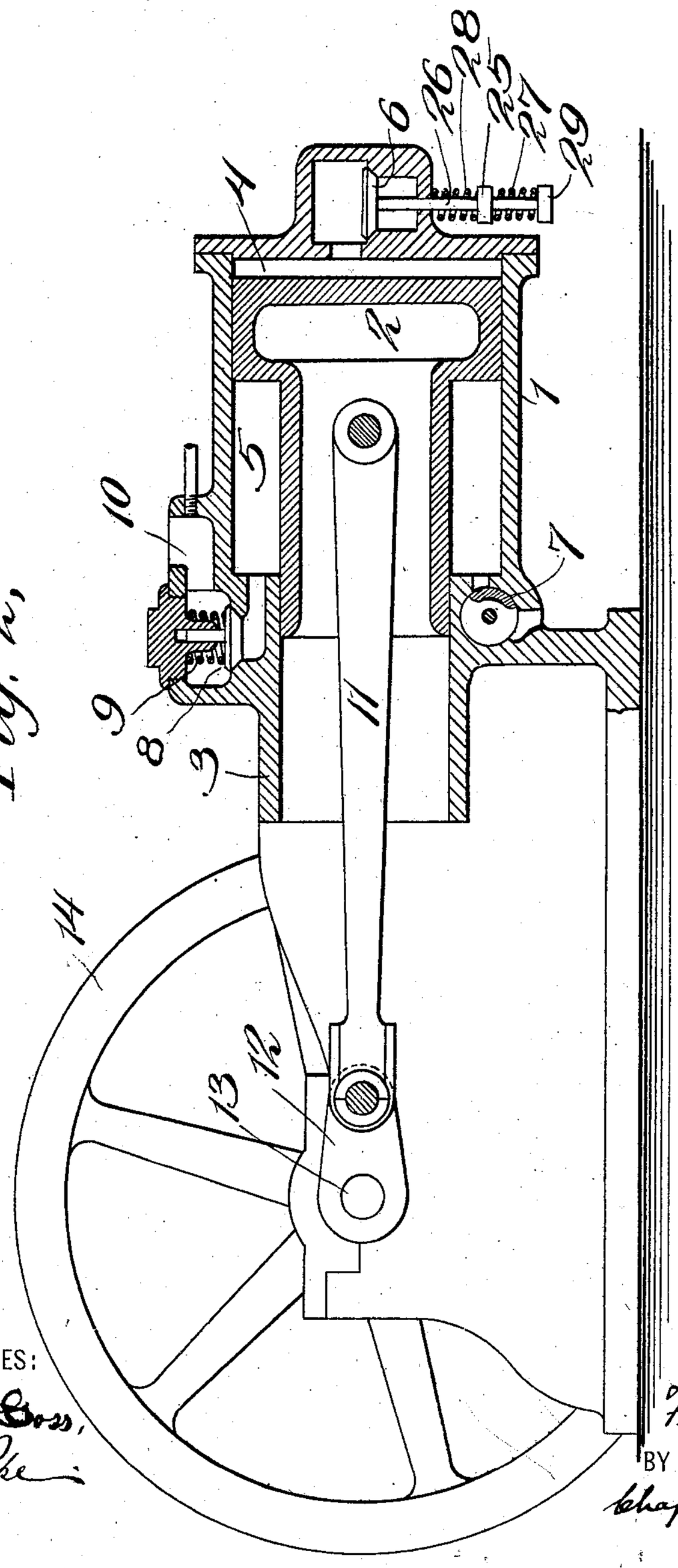
NO MODEL. 2 SHEETS—SHEET 2.

Fig. 2.



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No. 747,773. Patented December 22, 1903.

UNITED STATES PATENT OFFICE.

FRANCIS M. RITES, OF ITHACA, NEW YORK.

FLUID-COMPRESSOR.

SPECIFICATION forming part of Letters Patent No. 747,773, dated December 22, 1903.

Application filed September 19, 1902. Renewed October 1, 1903. Serial No. 175,322. (No model.)

To all whom it may concern:

Be it known that I, FRANCIS M. RITES, a citizen of the United States, residing at Ithaca, in the county of Tompkins and State of New York, have invented certain new and useful Improvements in Fluid-Compressors; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

My invention relates to improvements in fluid-compressors such as are employed for compressing air and other gases; and while the motive power for operating the compressor may be derived in any suitable way or by any suitable means I more especially intend it to be derived from a fluid-pressure motor, such as a steam or gas engine, mechanically combined with and forming a part of the compressor.

In the particular embodiment of my invention illustrated in the accompanying drawings the compressor is shown as combined with an engine of the explosive or internal-combustion type, a single engine-cylinder serving both for driving the compressor and for compressing the air or other gases therein.

My invention consists in the novel manner of regulating the action of the compressor and of controlling the output thereof, in the novel valve-gear of the compressor, and in various other features, as hereinafter set forth in the claims.

The objects of my invention are to improve and simplify the construction of fluid-compressors, and more especially of compressors operated by internal-combustion engines, to improve the regulating devices employed for controlling the output of such compressors, and to prevent material fluctuations of speed thereof.

I will now proceed to describe my invention with reference to the accompanying drawings, in which one embodiment of my invention is illustrated, and will then set forth the novel features in claims.

In the drawings, Figure 1 shows an elevation of the admission-valve-gear side of a combined compressor and gas-engine. Fig. 2 shows a central vertical section of the same.

The engine shown in the drawings has a single cylinder 1 and a single trunk-piston 2, the front portion of this piston being of smaller diameter than the rear portion thereof and working within a guide-cylinder 3. The portion 4 of cylinder 1 in rear of the piston corresponds to the combustion-chamber of an ordinary gas-engine, and the annular space 5 in front of the larger portion of the piston forms the compression chamber or cylinder of the engine.

The engine is provided with the usual puppet admission-valve 6, controlling the admission of the explosive charge to the engine-cylinder, and, as hereinafter described, the valve-gear by which this admission-valve is operated is arranged to vary the point of cut-off of said valve in accordance with the work required of the engine, such valve-gear being operated by an automatic speed-governor. The exhaust-valve gear of the engine is not shown, but may be of any suitable and ordinary type, and the engine may be either a "two-cycle" or a "four-cycle" engine, (as such terms are customarily used in speaking of internal-combustion engines,) as preferred.

The admission-valve 7 to the compression-space is here shown as a valve of the rotary type; but I do not limit myself to the use of a valve of this type. The discharge-valve 8 shown is of the puppet type, seated both by gravity and by the action of a spring 9; but I do not limit myself to the use of a discharge-valve of any particular type. The discharge-port 10 of the engine may be connected to any suitable receiver of fluid under pressure.

The piston 2 is connected by the customary connecting-rod 11 and crank 12 to a crank-shaft 13, carrying the usual fly-wheel 14, upon which is mounted a combined centrifugal and inertia governor 15, which may be and is shown as of the type covered by my Patents No. 534,579, dated February 19, 1895, and No. 646,314, dated March 27, 1900, said governor being arranged to operate a shifting eccentric 16. This eccentric may be connected by an eccentric-rod 17 to a rocker-arm 18, itself connected by a rod 19, forming substantially a continuation of the eccentric-rod, to a rocker-arm 20, connected to the air-admission valve 7. A link 21 connects rocker-arm 20 with another arm 22, itself connected by a link 23 to one arm of a bell-crank 24, the other arm of which is connected to a col-

lar 25, arranged to move up and down upon the stem 26 of the gas-admission valve 6. Two springs 27 and 28 surround this stem. Spring 27 works between collar 25 and a head 29 on the valve-stem and serves as the means for closing the valve when collar 25 moves downward. Spring 28 works between collar 25 and a fixed portion of the engine-cylinder and is used principally to produce a balanced spring reaction on the valve-gear and centrifugal governor.

The lower end of rocker-arm 22 is pivoted to and supported by the piston-rod 30 of a pressure-cylinder 31, in the front end of the piston 32 of which there may be a spring 33. The portion of this cylinder 31 in rear of the piston is connected by a pipe 34 with the discharge-port 10 of the engine.

In the pipe 34 there is interposed a reservoir 36, adapted to contain oil or other suitable liquid. The connection of pipe 34 with cylinder 31 may be by a very fine port 37.

The eccentric-rod 17 is, in fact, one arm of a bell-crank, the other arm, 38, of which is connected by a link 39 to an arm 40, operating electrical igniting devices. (Not shown.) The effect of variation in the throw of the eccentric 16 is to vary the lead of these igniting devices, and thereby to vary the point of ignition in accordance with variation in the point of cut-off, as set forth in my applications for Letters Patent for improvements in valve-gear and igniting mechanism for explosive and internal-combustion engines filed January 14, 1902, Serial No. 89,645, and filed March 1, 1902, Serial No. 86,201.

The operation of the compressor is as follows: Admission of the explosive charge to the combustion-space 4 of cylinder 1, the compression of such charge, the ignition thereof, and after ignition the expansion of the gases and their exhaust are conducted substantially in the same manner as in an ordinary gas-engine and require no special description here. At the beginning of each backward stroke of the piston 2 the admission-valve 7 of the compression-space 5 is opened, and air or other gas to be compressed is drawn into said space. Valve 7 may be closed at the end of such admission-stroke or at an earlier period, as determined by the governor, all as hereinafter described. If valve 7 is closed before the end of the admission-stroke is reached, the air within the space 5 is expanded slightly below atmospheric pressure; but no power is lost in so doing, since on the next forward stroke the air in such space returns to atmospheric pressure as the piston advances and is then compressed to a higher pressure. When the air has been compressed to the pressure to which valve 8 has been set, the latter opens and permits the compressed air to be discharged through port 10 to any suitable receiver which may be connected to said port.

Regulation of the operation of the compressor takes place as follows: When operating at full power, the admission-valve 7 is not closed until about the end of the suction-stroke of the piston, and the gas-admission valve 6 cuts off at the point best adapted to give maximum power. Spring 33 is under such initial pressure that the piston 32 does not move within cylinder 31 until a receiver-pressure has been reached approximating that which it is desired to maintain. As the receiver-pressure rises above that corresponding to the initial pressure of the spring piston 32 moves slightly to the left, thereby advancing the pivotal point of rocker-arm 22; but since receiver-pressure is transmitted to cylinder 31 through the liquid in chamber 36, which communicates with cylinder 31 through the very small port 37, such motion of piston 32 is sufficiently slow to prevent overthrow of the parts. For the same reason there is no perceptible motion of the piston due to reaction of the valve-gear.

The connections from the eccentric to bell-crank 24 are such that pressure upon the spring 27 is relieved at or about the beginning of the forward stroke of the piston 2, thus permitting valve 6 to open by suction. Closure of this valve and cut off of the explosive charge take place when the bell-crank again presses against spring 27, and this is determined by the position of the eccentric 16, being relatively late in the stroke when the throw of said eccentric is large and being early in the stroke when the throw of said eccentric is small.

Now the effect of a slight forward movement of piston 32 is to change slightly the angularity of bell-crank 24, so as to make the point of cut-off by valve 6 relatively later than it was before. The effect of later cut-off is to cause the speed of the engine to increase temporarily, whereupon the centrifugal governor will respond to this slight increase in speed by moving the eccentric 16 to a position for shorter cut-off, thereby causing valve 6 to cut off at the same point as before or at an earlier point, and at the same time causing the valve 7 to cut off earlier. Adjustment will take place in this manner until the output of the compressor is just that required to maintain the desired pressure. Conversely, if the pressure in the receiver falls below that which the compressor is to maintain the spring 33 will move piston 32 backward slightly, thus causing cut-off by valve 6 to occur earlier than before. The speed of the engine will then fall slightly, and the governor by readjusting the position of the eccentric so as to maintain normal speed will make the cut-off of both valve 6 and valve 7 later. It will be seen, therefore, that the regulation of the amount of air admitted to the compression-space is effected by so varying an adjustable connection between the admission-valves of the compression and working sides of the engine as to cause the governor to adjust the point of cut-off by both admission-valves as may be

required to maintain substantially constant speed and the desired pressure.

Since the speed of the engine remains nearly constant whether the amount of air compressed and discharged is small or large, the compressor will respond very quickly to sudden variations in the demand upon it, for in making new adjustments of the parts the engine does not have to overcome the inertia of the heavy fly-wheel, as would be the case were the output of the compressor varied by varying the speed.

It is obvious that my invention is susceptible to various modifications, that various forms of governor may be used and various valve-gear, and that various motors other than gas or oil motors may be used as a source of power. I therefore do not limit myself to the form of compressor shown in the drawings and above described.

What I claim is—

1. In a compressor, the combination with a compression-chamber, means for compressing fluid therein, and a motor therefor, of a valve controlling the output of said compressor, means controlling the power of the motor, a governor controlling both said valve and said motor-controlling means, and means, other than said governor, for varying the adjustment of the motor-controlling means with respect to the governor with variation in load on the compressor.

2. In a compressor, the combination with a compression-chamber, means for compressing fluid therein, and a fluid-pressure motor therefor, of a valve controlling the output of said compressor, means controlling the power of the motor, a governor controlling both said valve and said motor-controlling means, and means, other than said governor, for varying the adjustment of the motor-controlling means with respect to the governor with variation in load on the compressor.

3. In a compressor, the combination with a compression-chamber, means for compressing fluid therein, and a fluid-pressure motor therefor, of a valve controlling said motor, means for operating the same, a valve controlling the output of said compressor, a governor controlling both said valves, and means other than said governor, for varying the adjustment of said valve-operating means with respect to the governor with variation in load on the compressor.

4. In a compressor, the combination with a compression-chamber, means for compressing fluid therein, and driving means therefor, of a regulating-valve controlling the output of said compressor, a valve controlling the action of the motor, valve-gear for operating said valves and a governor controlling both valves therethrough, said valve-gear comprising an operating member for said motor-valve and means for varying the adjustment of said operating device with respect to the governor, with variation in load on the compressor.

5. In a compressor, the combination with a compression-chamber, means for compressing fluid therein, and driving means therefor, of a regulating-valve controlling the output of said compressor, a valve controlling the action of the motor, valve-gear for operating said valves comprising adjustable means for varying the relative action of said valves, and a governor.

6. In a compressor, the combination with a compression-chamber, means for compressing fluid therein, and driving means therefor, of a valve controlling the output of the compressor, a valve controlling the action of the driving means, valve-gear for operating said valves, and a governor controlling the same and arranged to vary the period during which each valve is open, said valve-gear comprising adjustable means for varying the relative duration of the periods during which said valves are open.

7. In a compressor, the combination with a compression-chamber, means for compressing fluid therein, and driving means therefor, of a valve controlling the output of the compressor, a valve controlling the action of the driving means, valve-gear for operating said valves, and a governor controlling the same and arranged to vary the period during which each valve is open, said valve-gear comprising adjustable means for varying the relative duration of the periods during which said valves are open, and automatic means for making such adjustment.

8. In a compressor, the combination with a compression-chamber, means for compressing fluid therein, and driving means therefor, of a valve controlling the output of the compressor, a valve controlling the action of the driving means, valve-gear for operating said valves, and a governor controlling the same and arranged to vary the period during which each valve is open, said valve-gear comprising adjustable means for varying the relative duration of the periods during which said valves are open, and automatic fluid-pressure-operated means for making such adjustment.

9. In a compressor, the combination with a compression-chamber, means for compressing fluid therein, and a motor for operating the same, of a valve for said compression-chamber, a valve for said motor, a variable cut-off governor and valve-gear operated thereby for operating both said valves, comprising adjustable means connecting said valves, and automatic means for varying the connection between the valves to make the cut-off of the motor-valve earlier or later with respect to that of the compression-chamber valve, according as the load on the compressor decreases or increases, respectively.

10. In a compressor, the combination with a compression-chamber, means for compressing fluid therein, and a motor for operating the same, of a valve for said compression-chamber, a valve for said motor, a variable cut-off governor and valve-gear operated

thereby for operating both said valves, comprising adjustable means connecting said valves, and automatic fluid-pressure-actuated means for varying the connection between the valves to make the cut-off of the motor-valve earlier or later with respect to that of the compression-chamber valve, according as the load on the compressor decreases or increases, respectively.

11. In a compressor, the combination with a compression-chamber, means for compressing fluid therein, and a motor for operating the same, of a valve for said compression-chamber, a valve for said motor, a variable cut-off governor and valve-gear operated thereby for operating both said valves, comprising an adjustable connection between the valves, and automatic means for varying such connection to temporarily increase or decrease the speed of the motor, according as the output of the compressor is to be decreased or increased, respectively.

12. In a compressor, the combination with a compression-chamber, means for compressing fluid therein, and a motor for driving the same, of admission-valves for the compression-chamber and motor, a variable cut-off governor and valve-gear operated thereby for variably operating both said valves, said valve-gear comprising a rocker-arm for operating each valve and an adjustable connection between said arms adapted to permit one to be advanced or moved backward in angular position with respect to the other.

13. In a compressor, the combination with a compression-chamber, means for compressing fluid therein, and a motor for driving the same, of admission-valves for the compression-chamber and motor, a variable cut-off governor and valve-gear operated thereby for variably operating both said valves, said valve-gear comprising a rocker-arm for operating each valve and a pressure-cylinder having a piston to which one of said arms is pivoted, and means for adjusting the position of said piston within said cylinder.

14. In a compressor, the combination with a compression-chamber, means for compressing fluid therein, and a motor for driving the same, of admission-valves for the compression-chamber and motor, a variable cut-off governor and valve-gear operated thereby for variably operating both said valves, said valve-gear comprising a rocker-arm for operating each valve, a pressure-cylinder having a piston to which one of said arms is pivoted, said cylinder being connected to the discharge of said compression-chamber, a liquid-containing chamber interposed between the said discharge and the cylinder, and means for opposing fluid-pressure on said piston.

15. In a compressor, the combination with a compression-chamber, means for compressing fluid therein, and a motor therefor, of an admission-valve for said compression-chamber, a governor and variable cut-off valve-gear operated thereby for operating said valve, arranged to open said valve for a greater or less portion of the admission-stroke according to the adjustment of the governor, and means for varying the speed at which said governor is driven.

16. In a compressor, the combination with a compression-chamber, means for compressing fluid therein, and a motor therefor, of an admission-valve for said compression-chamber, means controlling the power of the motor, a governor and variable cut-off valve-gear operated thereby for operating said valve and said motor-controlling means, arranged to open said valve for a greater or less portion of the admission-stroke, and to operate said motor-controlling means to regulate the power of the motor, according to the adjustment of the governor, and means for varying the adjustment of said motor-controlling means with respect to the governor.

17. In a compressor, the combination with a cylinder, and a piston therein, one end of the cylinder constituting a motor-cylinder, the other end constituting a compression-chamber, of admission-valves for said motor-cylinder and compression-chamber, variable cut-off valve-gear for operating said valves, comprising means for varying the relative duration of the admission period of one valve with respect to that of the other valve, and a governor for operating said valve-gear.

18. In a compressor, the combination with a compression-chamber, means for compressing fluid therein, a motor, a crank-shaft, and a fly-wheel governor thereon, of admission-valves for said compression-chamber and motor, and valve-gear for operating the same controlled by said governor and comprising means for varying the power of the motor with variation in load on the compressor, without material permanent variation in the speed of the compressor.

19. In a compressor, the combination with a compression-chamber, means for compressing fluid therein, a motor, a crank-shaft, and a shifting eccentric thereon, of admission-valves for said compression-chamber and motor, and valve-gear for operating the same controlled by said eccentric and comprising means for varying the power of the motor with variation in load on the compressor, without material permanent variation in the speed of the compressor.

In testimony whereof I affix my signature in the presence of two witnesses.

FRANCIS M. RITES.

Witnesses:
HARRY M. MARBLE,
C. F. CARRINGTON.