No. 727,466. PATENTED MAY 5, 1903.

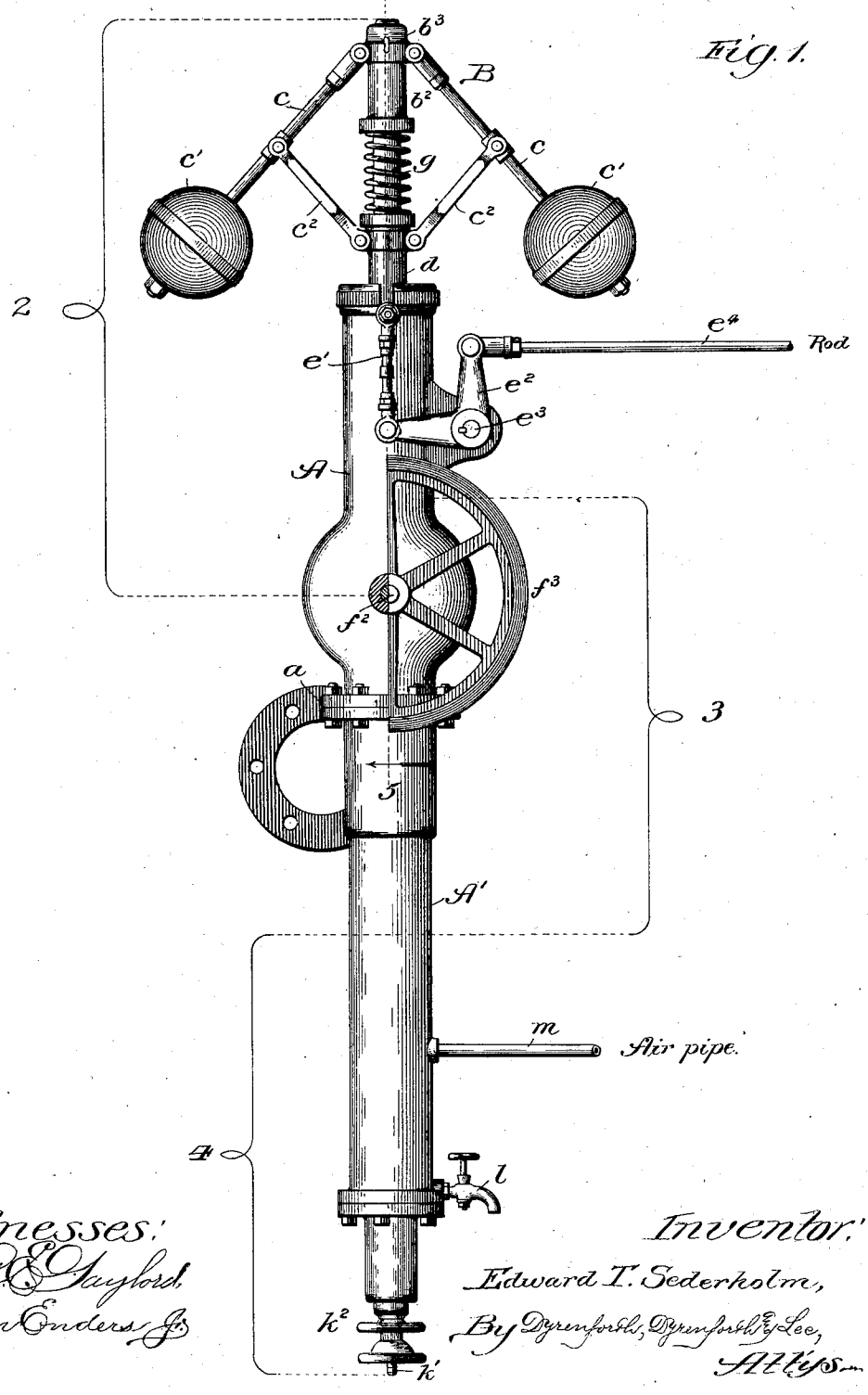
E. T. SEDERHOLM.

GOVERNOR.

APPLICATION FILED MAY 11, 1901.

NO MODEL. 4 SHEETS—SHEET 1.

Fig. 1.



Witnesses:
Chas. E. Taylord.
John Enders, Jr.

Inventor:
Edward T. Sederholm,
By Dyrenforth, Dyrenforth & Lee,
Attys.

THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

No. 727,466. PATENTED MAY 5, 1903.

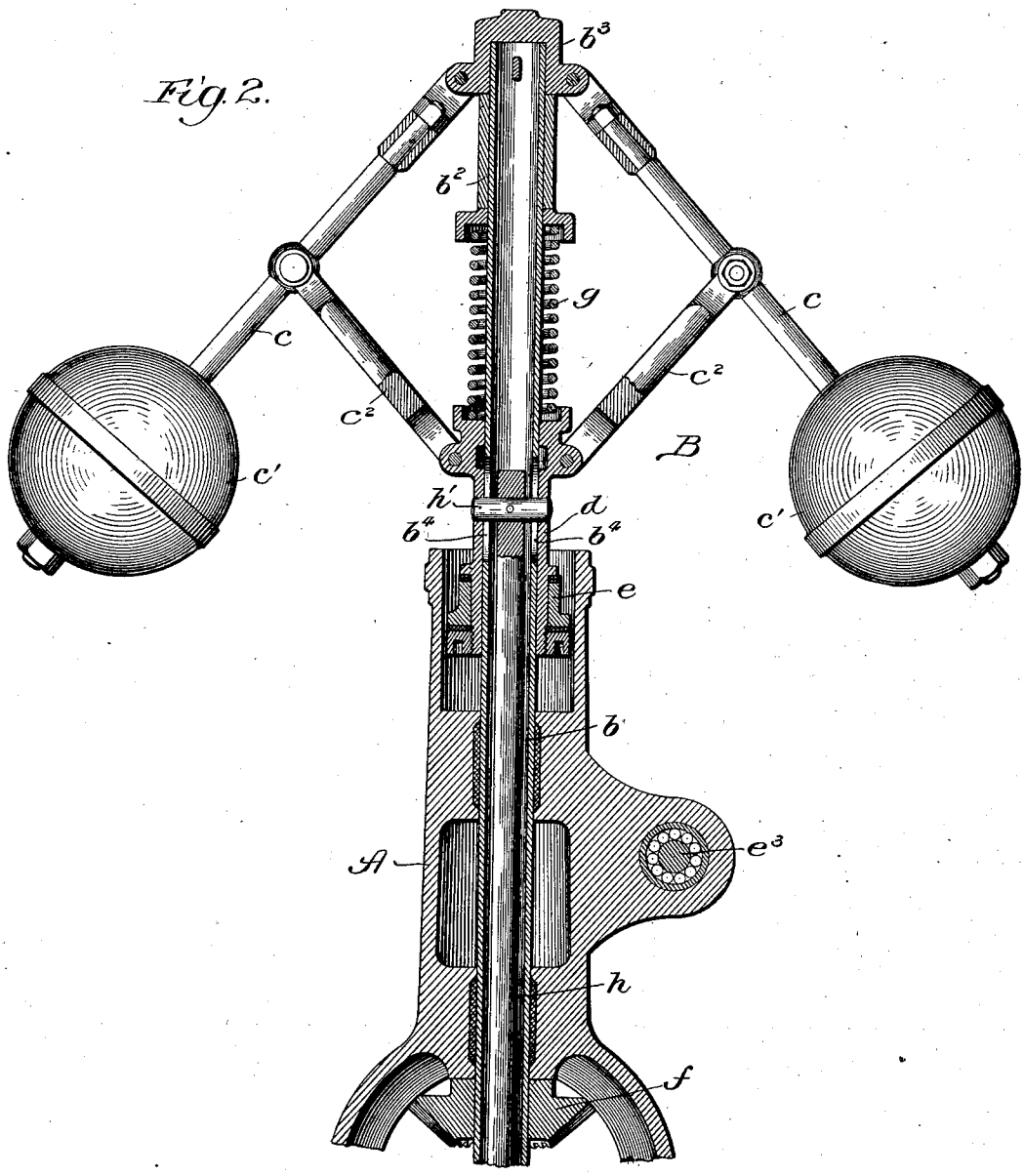
E. T. SEDERHOLM.

GOVERNOR.

APPLICATION FILED MAY 11, 1901.

NO MODEL. 4 SHEETS—SHEET 2.

Fig. 2.



Witnesses:
Chas. E. Taylor,
John Enders Jr.

Inventor:
Edward T. Sederholm,
By Dyrenforth, Dyrenforth & Lee,
Attys.

THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

No. 727,466. PATENTED MAY 5, 1903.

E. T. SEDERHOLM.

GOVERNOR.

APPLICATION FILED MAY 11, 1901.

NO MODEL. 4 SHEETS—SHEET 3.

Fig. 4.

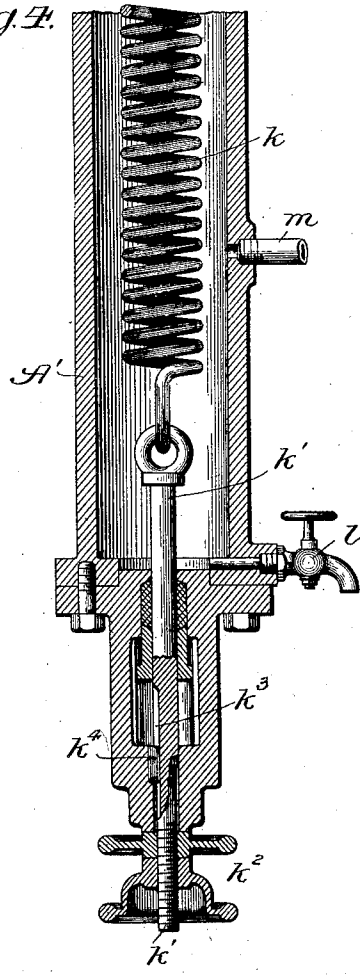
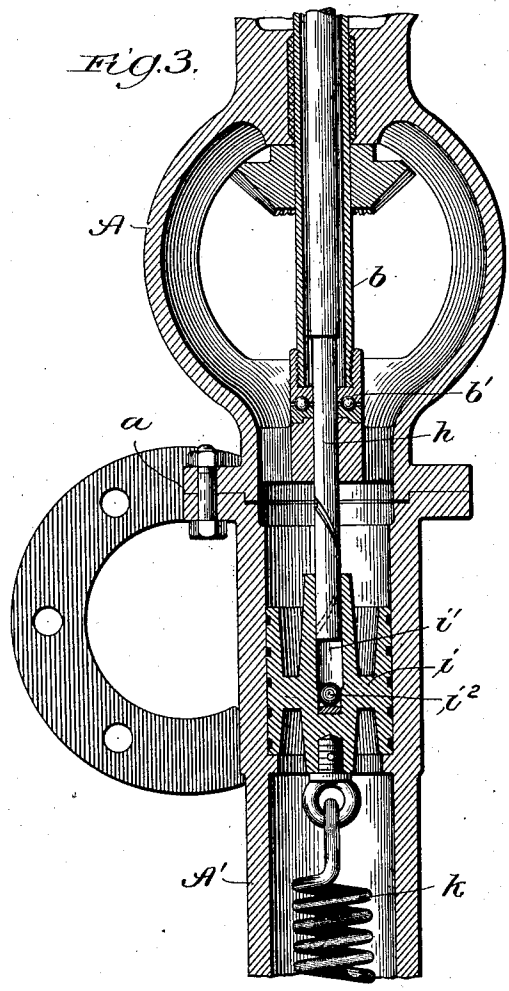


Fig. 3.



Witnesses:
Chas. E. Gaylord,
John Enders Jr.

Inventor:
Edward T. Sederholm,
By Brumbaugh, Brumbaugh & Lee,
Attys.

THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

No. 727,466. PATENTED MAY 5, 1903.

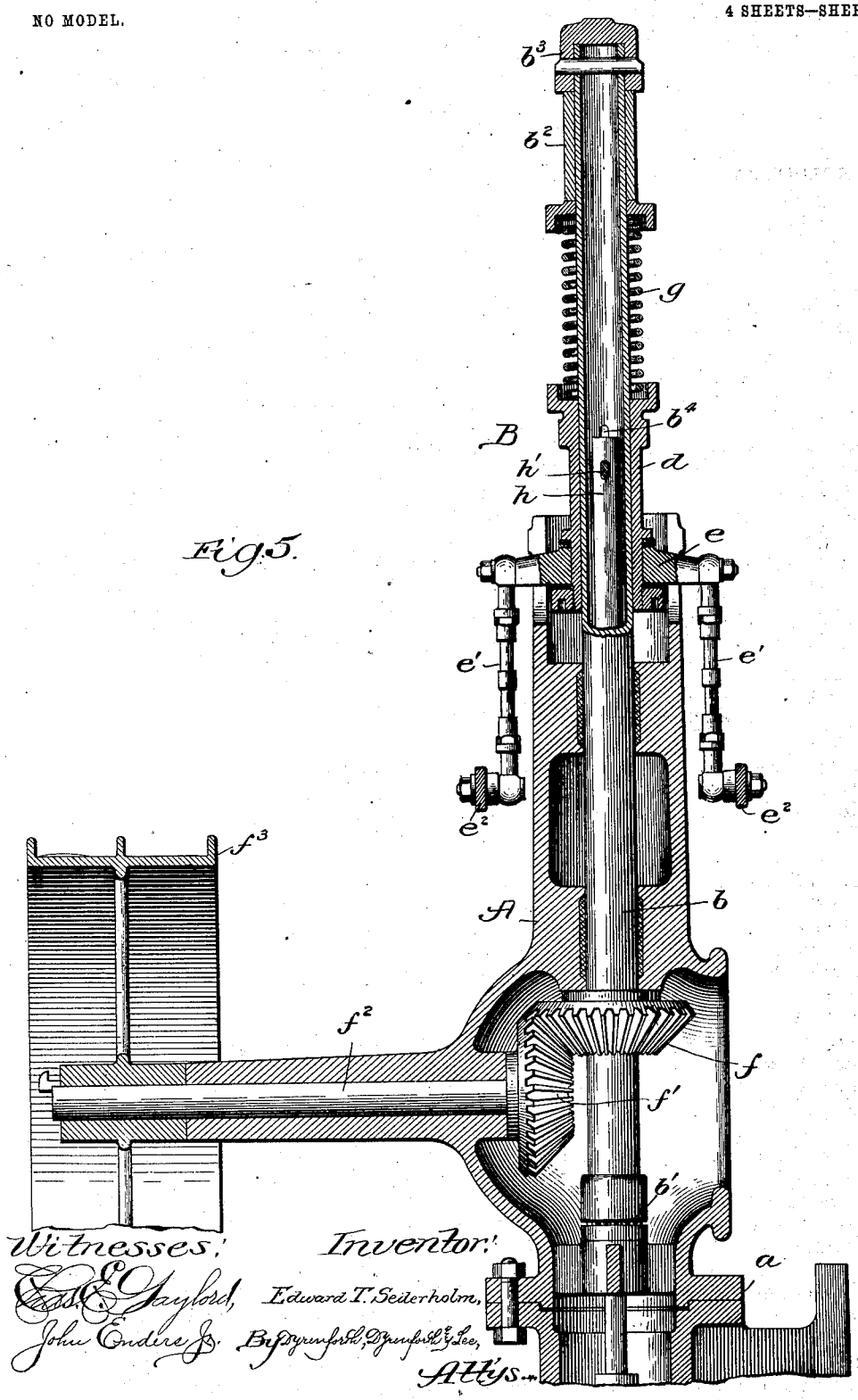
E. T. SEDERHOLM.

GOVERNOR.

APPLICATION FILED MAY 11, 1901.

NO MODEL. 4 SHEETS—SHEET 4.

Fig. 5.



Witnesses:
Chas. E. Gaylord,
John Endicott Jr.

Inventor:
Edward T. Sederholm,
By Dyrenforth, Dyrenforth & Lee,
Att'ys.

THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

No. 727,466. Patented May 5, 1903.

UNITED STATES PATENT OFFICE.

EDWARD T. SEDERHOLM, OF CHICAGO, ILLINOIS, ASSIGNOR TO ALLIS-CHALMERS COMPANY, OF CHICAGO, ILLINOIS, A CORPORATION OF NEW JERSEY.

GOVERNOR.

SPECIFICATION forming part of Letters Patent No. 727,466, dated May 5, 1903.

Application filed May 11, 1901. Serial No. 59,811. (No model.)

To all whom it may concern:

Be it known that I, EDWARD T. SEDERHOLM, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented a new and useful Improvement in Governors, of which the following is a specification.

My invention relates to improvements in governors for engines employed in driving air-compressors or fluid-pumps generally.

Although my invention is not to be limited to any particular type of pump or compressor driving engine, I have devised it more especially for use where, as at mines, compressors of comparatively great capacity are employed and operated by Corliss or other steam-engines constructed with dash-pots or equivalent detaching-gear for controlling the cut-off. At at a mine, for example, it is essential, or at least desirable, that the compressor shall be operated to supply air at a given pressure which shall not vary materially with any material change in demand. It is also necessary, or at least desirable for the sake of economy, that the engine shall not be called upon to perform more than the work necessary to maintain the desired quantity and degree of air-pressure; also, that under varying conditions of steam-pressure and of load the engine shall neither race nor slow down to stoppage. It is not thought necessary here to enumerate the many influences to which a compressor-driving steam-engine, particularly at a mine, is subjected in operation and which tend to interfere with its perfect working. Such influences are particularly numerous and pronounced where the boilers are also employed to furnish steam for hoisting or other machinery. It will suffice to say that the various governing mechanisms heretofore devised and of which I am aware whether controlled by the speed of the engine alone or by the air-pressure alone, or by both independently, have not met the requirements in a manner either as satisfactory or economical as desired.

My object is to provide governing mechanism of improved construction more especially for compressor-driving steam-engines which will overcome the objections to governing devices as heretofore provided.

In carrying out my invention I employ governing means controlled directly and conjointly by the speed of the engine and the pumped-fluid pressure, whereby under normal conditions they will simultaneously influence the admission of the motive fluid to the engine-cylinders.

Referring to the drawings, which show my improvements as I prefer to construct them when applied to an air-compressing steam-engine, Figure 1 shows my improved governing device in one form, partly in elevation and partly in section. Figs. 2, 3, and 4 are enlarged sections taken centrally through the device in a plane parallel with Fig. 1 and respectively embracing the parts indicated by the brackets bearing the corresponding numerals, and Fig. 5 an enlarged section taken on line 5 in Fig. 1 and viewed in the direction of the arrow.

The casing proper of the governing device is in two parts A and A′, bolted together at *a*. The part A carries the mechanism of a centrifugal governor B, and the part A′ forms an air-cylinder and spring-chamber. Passing through the part A is the sleeve *b*, rotating at its lower end on a ball-bearing *b′* in the casing and provided at its upper end with a bearing cup or collar b^2 and with a cap b^3, from which the rods *c*, carrying the governor-balls *c′*, are pivotally suspended. The links c^2 connect with a vertically-sliding collar or cup-piece *d*, surrounding the sleeve *b*, and surrounding the collar *d* is a collar *e*, connected by means of links *e′* with a bell-crank lever e^2, fulcrumed at e^3 upon the casing. The collar *e* loosely surrounds the rotary collar *d*, but does not rotate, though it rises and falls with the sliding collar *d* to swing the bell-crank lever. On the sleeve *b* is a beveled pinion *f*, geared to the beveled pinion *f′* on the shaft f^2, carrying the pulley or sheave f^3. The sheave f^3 may be driven by a belt from the engine to rotate the centrifugal governor in a common manner. Confined between the bearing-cups b^2 *d* is a spring *g*. Extending into the sleeve *b* is a stem or rod *h*, fastened at its upper end by means of a pin *h′* to the sliding collar or cup *d*. The pin *h′* passes through vertically-elongated slots b^4 in the sleeve *b*, whereby the rod will rise and de-

scend with the collar d without interference from the sleeve b. The lower end of the rod h projects downward into the air-cylinder A'.

Working in the air-cylinder A' is a piston i. The piston is formed with a socket i' in its upper side to receive the lower end of the rod h, and resting loosely in the base of the socket is an antifriction bearing-ball i^2 to contact with the lower end of the rotating rod h when the piston i rises, as hereinafter explained. Fastened to the under side of the piston i is a spring k, secured at its lower end to a tensioning-bolt k', which passes through a stuffing-box in the lower end of the cylinder and is provided with the adjusting and locking nuts k^2. The bolt k' is held against rotation by a feather k^4 in the casing engaging the groove k^3. In the lower end of the cylinder is a drainage-cock l. The cylinder A' communicates through a pipe m below the piston with the air-compressor reservoir, (not shown,) and the bell-crank lever e^2 may be connected through a rod e^4 with the cut-off valve-gear of the compressor-driving engine to operate in any well-known manner.

The centrifugal governor is preferably very static—that is to say, the speed corresponding to its lowest position is considerably lower than the speed required, relatively speaking, to raise it to its highest position. The air-governor is also by preference rendered very static by the provision of a stiff spring k. The construction is such that the piston i may be started to rise by a comparatively low air-pressure, and will not reach its highest point in the cylinder until the air-pressure is somewhat higher than the normal for which the governor is designed. When the bearing-ball i^2 contacts with the lower end of the rod h, any further upward movement of the piston will have a tendency to raise the rod or stem h and the centrifugal governor, which, however, is free to rise by itself without being held in any way by the air-governor. I prefer in practice to provide a spring g of a resistance which will cause the centrifugal governor to tend normally to maintain the engine at a predetermined normal speed, and I prefer to provide a spring k, which will so resist rise of the piston i that when the air in the compressor-cylinder is at its predetermined normal pressure the ball i^2 will contact without material pressure against the lower end of the rod h. Under these conditions it will be seen that the governor mechanism is in balance—that is to say, the air-pressure against the piston i just balances the force of the spring k upon the piston at normal position, and the centrifugal action of the governor is such as to keep the governor itself floating in perfect balance in its correct position. However, it is not necessary in practice that the centrifugal governor shall be capable in itself of an exact balance and that the air-pressure in itself shall entirely balance the force of the spring k when the piston is at normal position, but the two together, forming the entire governing device, should coact to cause the mechanism as a whole to be in perfect balance when the engine and compressor are operating at normal.

The operation is as follows: When the demand upon the air is normal, causing the pressure in the air-reservoir to be at normal, and the speed of the engine is also at normal, the governing mechanism will be in balance, as described. In the event that the demand on air from the reservoir should suddenly decrease to a material extent the air-pressure in the cylinder A' would immediately begin to rise, causing the piston i to press the rod h in the upward direction and thereby tend to actuate the cut-off of the engine to reduce the speed of the latter. In the event that the demand on air from the air-reservoir should suddenly increase to a material extent the air-pressure in the cylinder A' would begin to fall immediately, causing the piston i to descend, whereby the engine would be under the sole control of the centrifugal governor and may gradually increase in speed under the decreased resistance at the compressor-piston until it reaches the limit of its speed. It will be understood, of course, that the centrifugal governor is constructed in the usual way to limit the speed of the engine when it increases gradually. Thus it will be understood that if more air is required than the engine will supply at any speed at which it is running below maximum the resulting drop in air-pressure will not only tend to cause the engine to run faster, due to the decreased resistance, while the cut-off remains the same, but since the drop in air-pressure will cause the piston i to descend it will permit the centrifugal governor to fall and increase the amount of steam that may be admitted to the cylinder at each stroke. This will cause the engine to run still faster, thus keeping up with the air consumption and maintaining the pressure practically constant. If less air is required, the reverse action takes place. If more air is required than the engine is able to supply at a safe speed, then the centrifugal governor comes alone into play and prevents the engine from running faster than desired no matter how much the air-pressure may fall during this period. In case of a sudden great decrease in the demand of air and consequent slowing down of the engine the centrifugal governor will commence to drop and press against the air-piston, which in turn will tend to uphold it until they are in balance again.

In the action of the dash-pots in a Corliss or any other detaching-gear the cut-off is only partly controlled by the point of the stroke at which the detachment takes place, because after unhooking an appreciable time elapses before the dash-pot comes into action and has actually closed the steam-port. This time is much longer than it is popularly supposed to be and is, furthermore, for any particular engine practically constant as long as

the point of cut-off remains about the same. This time being the same, it is evident that the distance that the compressor-piston travels between the time when the unhooking takes place and the time when the steam-valve is actually closed becomes greater the higher the piston speed is and less when the speed of the engine is decreased. If the unhooking takes place at a fixed part of the stroke, the actual cut-off will be later the faster the engine runs and will more nearly correspond with the unhooking-point the slower the engine runs. In order, therefore, to maintain the same actual point of cut-off for different speeds, it becomes necessary to alter the point at which the unhooking takes place. In other words, in order to supply the same amount of steam to the cylinder in each case the governor will have to be in a lower position when the engine runs at a slow speed than when it runs at a high speed. In the action of my improved governor as the engine slows down the centrifugal governor commences to drop, as before stated, and press against the air-piston *i*. In addition to this, independently of the governor, the slowing down of the engine will cause the cut-off to become earlier, due to the delayed action of the dash-pots before described. It will therefore be seen that up to a certain degree the governor will continue to drop and the engine will still continue to slow down until again a position has been found at which the governing mechanism balances, as before. By reason of the fact that the spring *g* is of a finite length it will press with less force against the collar or cup *d* of the governor the lower that collar is moved, so that as the centrifugal governor takes up a lower position the action of the spring *g* becomes weakened. The weight action on the governor-balls will cause a downward pressure as soon as the speed is slackened; but this downward action is modified by the said spring action. In a similar way the strength of the spring *k* varies with the different positions of the air-piston, and by properly proportioning the springs *g* and *k* to each other it is possible to make the action of the air-piston *i* anything desired and cause the said piston to take any desired position in the air-cylinder for a certain predetermined drop or rise in air-pressure. The coöperation of the air-governor and centrifugal governor is also important when a sudden material change takes place in the steam-pressure. Should the steam-pressure suddenly drop to a material extent, the engine would immediately slow down. The centrifugal governor being in partial control would immediately produce a downward pressure on the air-piston *i* and tend to force the latter downward with it, and thus admit more steam to the steam-cylinders. This makes it unnecessary to keep the throttle partially closed, as has been usual in practice hitherto, even when the automatic governors were employed. Keeping the throttle partially closed is productive of waste of steam, and therefore to be avoided. A sudden rise in steam-pressure would in a similar manner act directly on the speed of the engine and on the position of the centrifugal governor, which, therefore, will automatically adjust the point of the cut-off so as to maintain the speed at that which will correspond to the demand on air in a measure independently of the steam-pressure. I say in a measure, because it will be readily understood that the air-pressure will vary slightly with the steam-pressure, due to the action of one governor against the other; but this variation can be kept down, so that it becomes unimportant, and the main result obtained with my improved governor device is that the engine can never stop and that the throttle-valve can be kept wide open. This has not been possible under all conditions in the use of any governor of which I am aware. The effect is, furthermore, to minimize the racing of the engine, so that all the changes in speed become gradual because the equilibrium in the governing device will be established almost as soon as the change takes place.

Although I have taken pains in the foregoing description to point out the specific nature of the various details of construction as they appear in the drawings, I do not wish to be understood as limiting my invention thereto. My improvements may be applied without departing from the invention to govern hydraulic engines as well as engines employing steam as the motive fluid and whether the engine drives an aeriform-fluid compressor or a liquid-pump. Where the engine is employed to drive a liquid-pump, the chamber or cylinder A′ or its equivalent would be a liquid-chamber and the piston *i* or equivalent movable abutment would be actuated by the pressure of the pumped liquid instead of air-pressure. Therefore while the construction shown and described is an operative and desirable embodiment of my invention, it may be modified to suit varying conditions and requirements without departing from the spirit of my invention as defined by the claims.

What I claim as new, and desire to secure by Letters Patent, is—

1. In a governing device for fluid-pumping engines, the combination of a centrifugal governor actuated by the speed of the engine and controlling the ingress of motive fluid thereto, a chamber in open communication with the pumped-fluid reservoir, an abutment in said chamber movable under variations in pressure of the pumped fluid, and a stem connected with the centrifugal governor and movable thereby in the path of said abutment, whereby in controlling the ingress of motive fluid to the engine, the action of the centrifugal governor may be varied by the pressure of the pumped fluid, substantially as set forth.

2. In a governing device for fluid-pumping engines, the combination of a centrifugal governor actuated by the speed of the engine to control the ingress of motive fluid thereto, a chamber in open communication with the pumped-fluid reservoir, an abutment in said chamber movable under variations in pressure of the pumped fluid, a stem connected with the centrifugal governor and movable thereby in the path of said abutment, and spring mechanism in the device tending normally to resist movement of the abutment under rise of the pumped-fluid pressure whereby in controlling the ingress of motive fluid to the engine the action of the centrifugal governor may be varied by the pressure of the pumped fluid modified by the resistance of said spring, substantially as set forth.

3. In a governing device for fluid-pumping engines, the combination of a centrifugal governor, actuated by the speed of the engine to control the ingress of motive fluid thereto, a chamber in open communication with the pumped-fluid reservoir, an abutment in said chamber movable under variations in pressure of the pumped fluid, a stem connected with the centrifugal governor and movable thereby in the path of said abutment, a spring acting with gradually-increasing resistance against movement of the abutment under rise of the pumped-fluid pressure, and a spring upon the centrifugal governor acting with gradually-increasing resistance against centrifugal movement thereof, whereby in controlling the ingress of motive fluid to the engine the action of the centrifugal governor is modified by the spring thereon and may be varied by the pumped-fluid pressure modified by the resistance of the spring which acts against said abutment, substantially as set forth.

4. In a governing device for fluid-pumping steam-engines having cut-off-valve gear, the combination of a centrifugal governor actuated by the speed of the engine to control the cut-off, a spring upon the centrifugal governor acting with gradually-increasing resistance against its centrifugal movement, a chamber communicating with the pumped-fluid reservoir, an abutment in said chamber movable under variations of the pumped-fluid pressure in said chamber, a spring acting with gradually-increasing resistance against movement of the said abutment under rise of pressure in the said chamber, and a stem movable with the centrifugal governor in the path of said abutment whereby the centrifugal movement of the centrifugal governor, and the movement, under fluid-pressure, of the abutment, are modified by the said springs, and the action of the centrifugal governor in controlling the cut-off may be varied by pressure of the pumped fluid, substantially as set forth.

EDWARD T. SEDERHOLM.

In presence of—
D. W. LEE,
ALBERT D. BACCI.