Oct. 14, 1941. E. C. READ 2,258,688

GOVERNOR

Filed Nov. 15, 1940 3 Sheets-Sheet 1

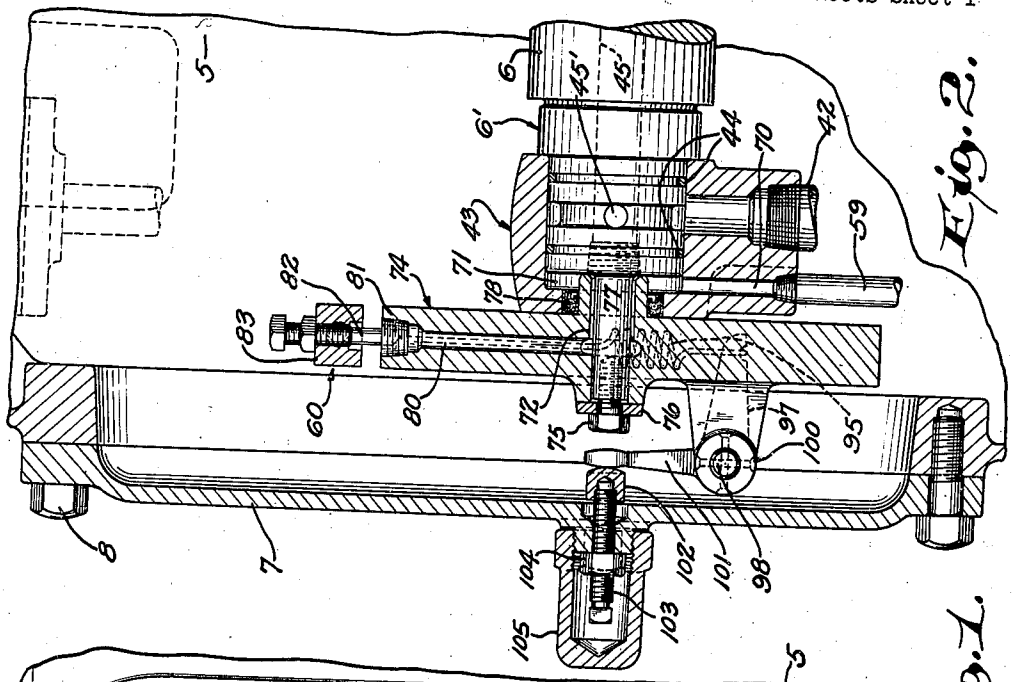

Fig. 2.

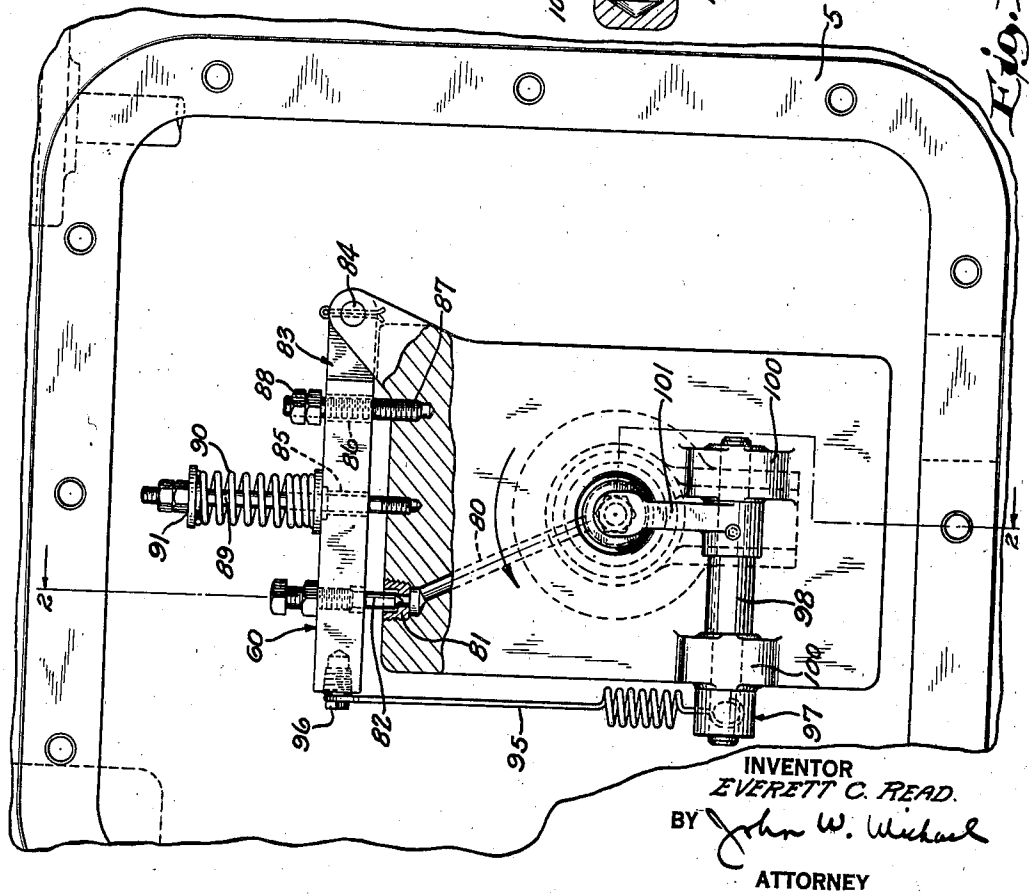

Fig. 1.

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Fig. 4.

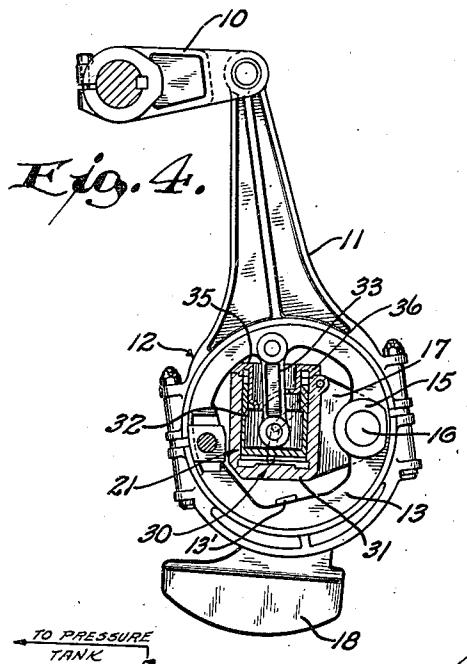

Fig. 3.

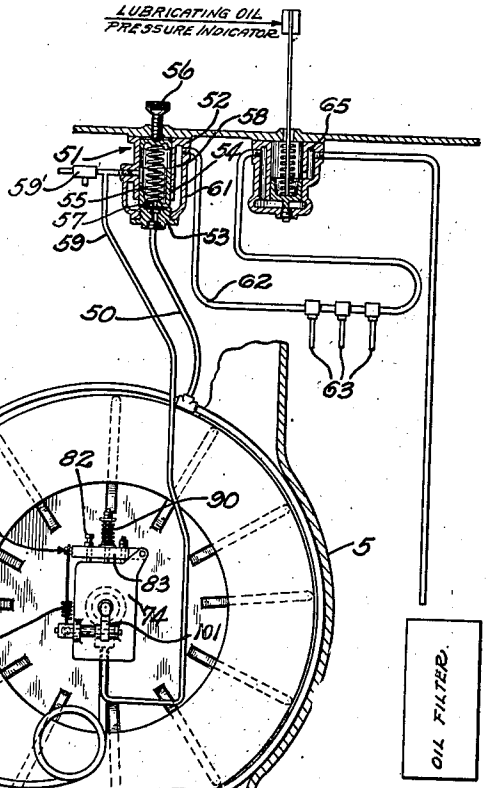

Fig. 7.

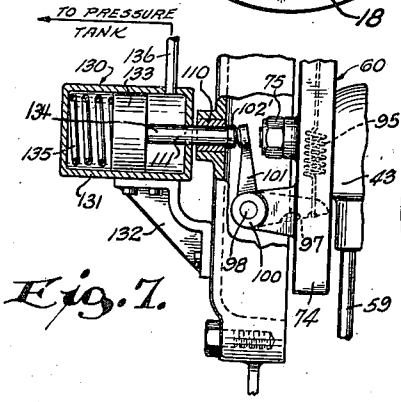

Fig. 8.

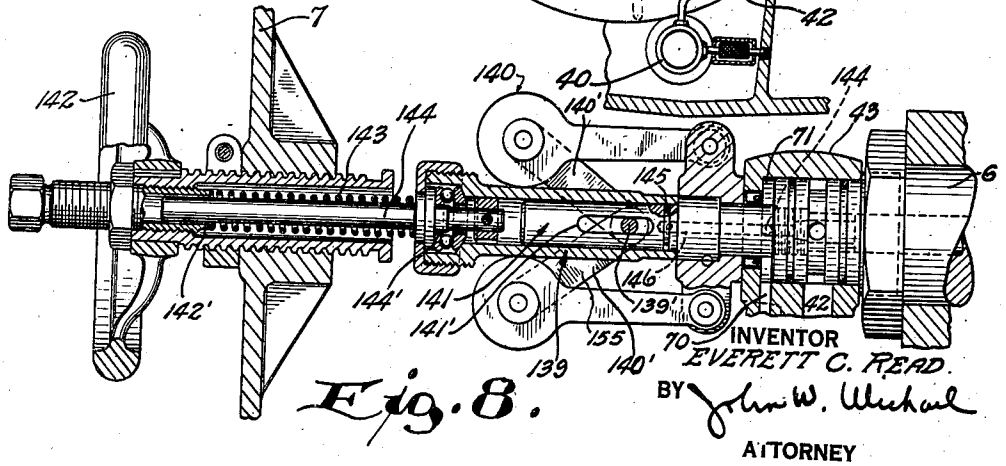

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Fig. 6.

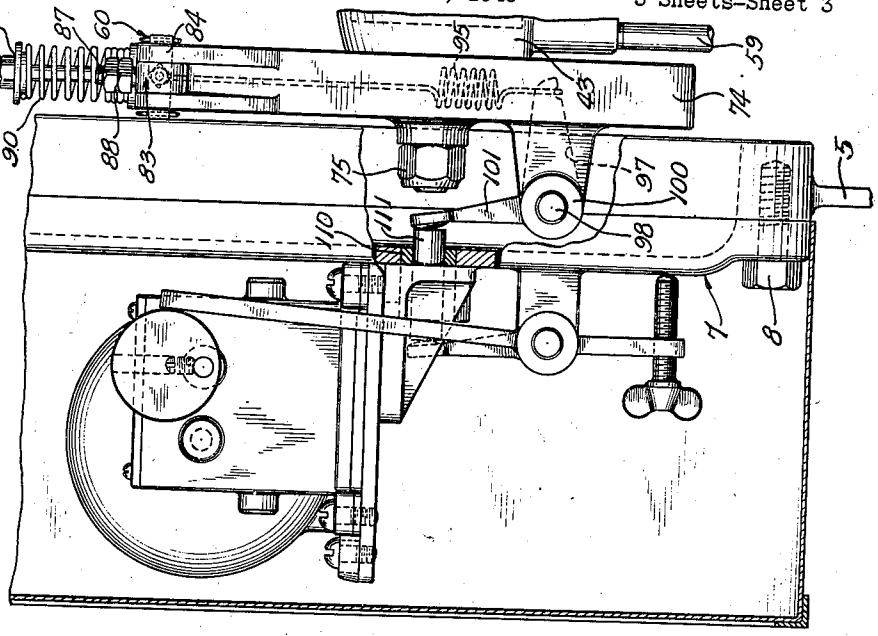
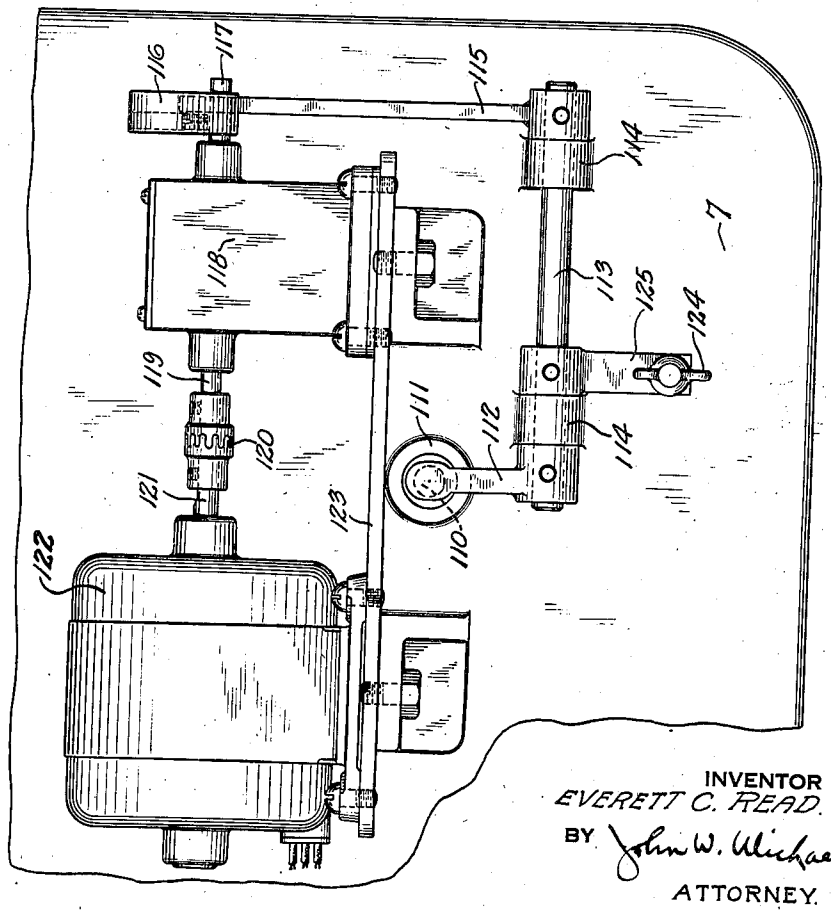


Fig. 5.



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Patented Oct. 14, 1941 2,258,688

UNITED STATES PATENT OFFICE

2,258,688

GOVERNOR

Everett C. Read, Milwaukee, Wis., assignor to The Filer & Stowell Co., Milwaukee, Wis., a corporation of Wisconsin

Application November 15, 1940, Serial No. 365,794

15 Claims. (Cl. 121—174)

This invention relates to an improvement in governors for steam engines.

One of the objects of the invention is to obtain a selective, though close, regulation over the speed of the engine and to accomplish this hydraulically and with a structure which is simple, compact, closely organized and reliable, and efficient, and yet conveniently adjustable while the engine is running, to select or determine any particular speed within the range of adjustment which the governor provides.

In carrying out the invention the speed of the engine is controlled by a centrifugal inertia-type governor having a fluid pressure motor combined therewith after the manner of a hydraulic relay. The governor controls the displacement of the steam eccentric, which in turn imparts such movement to the steam valve as to bring about a cut-off corresponding to any existing load.

The fluid under pressure is supplied to the motor by means of a pump which may be driven from the engine shaft. Pressure relief means is combined with the fluid pressure supply means and is governed in its action by a control device which is responsive to a characteristic of the performance of the engine which varies as a function of the load. In the present instance the pressure relief means includes a suitable pipe and valve arrangement including an oil control valve which is opened and closed under the control of a speed responsive device rotated with the engine shaft. The speed responsive device acts directly on the valve, and as the speed of the engine increases tends under the influence of centrifugal force to open the valve. The valve is biased toward closed position under the influence of suitable spring means. For example, a single spring may be employed, or in some instances the valve may be biased to closed position under the conjoint influence of a main governor spring and an auxiliary speed control spring which may be adjusted while the engine is running to select an engine speed somewhat above or somewhat below that determined by the setting of the main governor spring. Various types of oil control valves may be used. One simple arrangement employs a poppet valve, but other embodiments may employ a sleeve-type valve or a piston-type valve. The control thus had over a range of engine speeds and practically available while the engine is running has a number of advantages important among which is that it provides a simple way of synchronizing the speed of two or more engines.

Various types of means may be employed to adjust or vary tension of the governor spring or spring means which regulates the action of the oil control valve. In its simplest form the adjustment may be effected by means of a manually operable screw suitably combined with instrumentalities which control the tension of the spring and accessible from the exterior of the engine.

The invention also contemplates the provision of a remote control for adjusting the governor spring, and this may conveniently comprise a small reversible electric motor, push button controlled and acting through reduction gearing and suitable motion transmission means to change the spring tension. Obviously a solenoid could be substituted for the motor and a rheostat used to vary the force applied by the solenoid.

Other types of controls may also be employed, and in some instances they be automatic in their character. For example, if the engine is used to drive an air compressor, a fluid pressure motor may be combined with the compressor and with the governor spring to maintain a constant pressure in the storage tank to which compressor delivers its compressed air.

Other objects and advantages reside in certain novel features of the construction, arrangement, and combination of parts, which will be hereinafter more fully described and particularly pointed out in the appended claims, reference being had to the accompanying drawings forming a part of this specification, and in which:

Figure 1 is a fragmentary view in end elevation of one embodiment of the invention and illustrating one type of speed responsive device for regulating the discharge of the pressure relief means, the removable end plate of the engine housing being removed for the sake of illustration;

Figure 2 is a fragmentary view in longitudinal cross section taken on line 2—2 of Figure 1;

Figure 3 is a fragmentary view, partly in end elevation and partly in transverse vertical cross section, showing in a diagrammatic fashion how the speed responsive control for the pressure relief means is combined with the system in this form of the invention;

Figure 4 is a fragmentary view in transverse vertical cross section illustrating how the fluid pressure motor of the system is combined with the engine shaft and eccentric sheave in this type of structure;

Figure 5 is a fragmentary view in front elevation illustrating one type of remote control

which may be provided for varying the tension of the spring means;

Figure 6 is a fragmentary view partly in end elevation and partly in section further illustrating the remote control shown in Figure 5;

Figure 7 is a fragmentary view partly in central vertical longitudinal section and partly in side elevation illustrating one type of automatic control for the governor spring tension; and

Figure 8 is a view partly in elevation and partly in longitudinal, vertical cross section illustrating a modification of the invention wherein a speed sensitive fly ball governor is employed in combination with a sleeve-type of valve.

Referring to the drawings, the numeral 5 designates a fragment of the crank case of the housing of a steam engine constructed in accordance with the present invention. This housing supports and encloses the bearings (not shown) in which the main shaft or crank shaft 6 of the engine is supported for rotation. One end of the housing is provided for a removable end plate or cover plate 7, which, when applied to the housing, is secured in position by a suitable number of stud bolts 8.

The governor embodying the present invention is that type of structure illustrated in Figures 15, 16, and 17 of my application for Governors, filed January 18, 1939, Serial No. 251,460, now Patent 2,230,263, and reference is made to said application and patent for a more complete disclosure of this type of governor and its various modes of embodiment.

The speed of the engine is controlled by a distributing valve (not shown), and more especially by varying the point of cut-off of the distributing valve in accordance with the well-known practice. The distributing valve is actuated by a suitable valve gear, which, as shown in Figure 4, includes a rocker arm 10 actuated by means of an eccentric rod 11 extending from an eccentric strap 12. The eccentric strap 12 is fitted about an eccentric sheave 13, which is shifted relative to the main shaft or crank shaft in the engine to vary the point of cut off. To support the eccentric sheave 13 on the crank shaft for swinging or shifting movement relative thereto, the sheave 13 is formed with a transverse bearing 15 through which a pivot pin 16 extends, the pin 16 being supported on a bracket 17 formed as an integral part of the crank shaft 6 of the engine. The combined weight of the eccentric sheave 13, and part of the eccentric strap 12, together with the extra weights 18, suitably connected to the eccentric sheave 13, provides the actual governor weight. The center of gravity of this governor weight is located some distance from the center of the main shaft of the engine, the distance naturally changing with the position of the eccentric sheave. Centrifugal force acting on the governor weight provides means for causing the combined governor weights to swing or shift outwardly with respect to the engine shaft. This action of the centrifugal force may be opposed by means of a torsion spring in the manner disclosed in the application above referred to. This action of the centrifugal force is also opposed by means of a fluid pressure motor designated generally at 21, and it is with the control had over the action of this motor that the present invention is concerned.

The fluid pressure motor 21 comprises a cylinder 30 formed integral with or rigidly connected to the engine shaft. The cylinder 30 has one open end and has its other end closed by an integral head 31. A piston 32 is fitted in the cylinder 30. A connecting link 33 has one end connected to the piston adjacent its head and has its opposite end pivotally connected to the eccentric sheave. This link 33 extends through a cap or fitting 35 surrounding the open end of the cylinder and having an annular groove 36 in which the skirt of the piston works to provide a dash-pot or dampening means for the motor. With a construction as thus far described, and oil under pressure supplied to the space between the head 31 of the cylinder and the head of the piston 32, and with the engine not running, the eccentric sheave will assume a position wherein its pad 13' will bear against the outer face of the head 31 of the cylinder. This position of the eccentric sheave corresponds to maximum cut off, and after the engine has come up to almost normal speed, centrifugal force is increased to such an extent that it now balances the existing oil pressure under the piston 32, and, also, the tension of the spring, if one is used. The eccentric is thereby moved in by centrifugal force to decrease the cut-off until the steam admitted to the cylinder corresponds to the present load.

In the description of the operation just concluded we have assumed that the oil pressure under the piston is constant. A still closer regulation can be accomplished by the introduction of means for varying the oil pressure under the piston to such an extent that for any change in load the oil pressure is changed correspondingly in the same instant.

Referring now to Figure 3, the present invention, as in the preceding application above referred to, proposes to provide an oil pump 40 located in the sump of the crank case and suitably driven from the engine shaft. The outlet of the pump discharges into a pipe line 42, which may be of tubing, and which in turn connects to a distributing manifold ring, designated generally at 43. This ring 43, which is stationary, surrounds a circumferentially grooved end portion 6' of the crank shaft 6. Packing rings 44 are provided between the ring 43 and the annularly grooved end portion 6' of the crank shaft so that the oil delivered to the grooves in the end portion 6' of the shaft will flow through radial passages 45' therein into a longitudinal duct 45, which communicates with the space between the head of the piston 32 and the head 31 of the cylinder 30. A branch line 50 also of tubing leads from the oil line 42 to a governor oil pressure-regulating valve, designated generally at 51.

The valve 51 comprises a casing 52 having a valve seat 53 with which a poppet valve 54 coacts. The branch 50 connects with the portion of the valve on which the seat 53 is formed so that when the poppet valve is engaged with the seat, or closed, flow of oil through the branch 50 into the valve 51 is stopped. The poppet valve is loaded by means of a spring 55 whose tension may be adjusted by means of adjusting screw 56. Its head is provided with a small port 57 which permits the pressure from the branch 50 to pass on to the opposite side of the valve from its seat and into a chamber 58. The chamber 58 connects with the pipe line 59 which leads down to an oil relief valve arrangement, designated generally at 60, and responsive in its action to the speed of the engine.

A relief valve 59' may be incorporated in the pipe line 59 to relieve any excess pressure which might occur while the engine is running at a

speed below that at which the oil control valve 82 will function.

The chamber 58 is surrounded by a jacket 61 which communicates with the branch 50 when the valve 51 is open. The jacket 61 connects with the pipe 62 which has branches 63 leading to the points to be lubricated. A lubricating oil pressure valve, designated at 65, connects up with the pipe 62 and regulates the pressure in the lubricating system of the engine served by the pipe 62.

The pressure in the governing system is determined by the tension of the spring 55 and the oil pressure above the poppet valve 54. In other words, the force due to the oil pressure acting under the valve is balanced by spring tension plus the oil pressure above the valve. Hence, the oil pressure in the governing system, which is acting on the piston 32 in the fluid pressure motor 21, can be regulated within wide limits by varying the oil pressure acting on the top of the valve 54. Such variation of the oil pressure acting on top of the valve 54 is effected by more or less restricting the flow of oil from the space above the valve, and the means provided for this purpose in the present instance is the oil relief valve arrangement 60.

As shown to advantage in Figures 2 and 3, the pipe 59, which has one end connected to the chamber 58, has its opposite end connected and communicating with the outer end of a passage-way 70 provided in the manifold ring 43. This passage 70 opens into a chamber 71 formed within the ring 43 and in open communication with an axial passage-way 72 provided in the hub portion of a valve block 74. The valve block 74 is fastened by means of a stud 75 and washer 76 to the outer end of an extension 77 of the crank shaft 6. The hub of this valve block projects into the chamber 71. Packing 78 is provided between the manifold ring 43 and the extension of the valve block. The axial passage-way 72 through the hub communicates with the transversely extending passage-way 80, which leads to the periphery of the block and is provided at its outer end with a valve seat 81. The flow of oil out through the passage 80 and past the valve seat 81 is controlled by needle valve 82, which may be conveniently supported on the valve-operating lever 83. One end of the lever 83 is fulcrumed as at 84 on the valve block. Intermediate its ends the lever is provided with openings 85 and 86. A stop screw 87 extends loosely through the opening 86 and is provided with adjustable stop nuts 88 to limit the extent to which the lever 83 may swing outwardly. A bolt 89 extends loosely through the opening 85 and threads into the valve block. A loading spring 90 encircles the bolt 89 and has one end bearing on the valve lever and its opposite end engaging the abutment 91 provided at the outer end of the bolt 89.

The weight of the lever 83 and of the valve 82 under the influence of centrifugal force tends to swing the valve-operating lever 83 and valve 82 outwardly or to open position against the action of the spring 90. The opposition that the spring 90 presents to such opening of the valve is supplemented, or may be entirely replaced, by a retractile coil spring 95 having one end connected, as at 96, to the outer end of the valve lever 83, and having its inner end connected to an adjustable abutment 97 which is preferably in the form of a rock arm fixed to one end of a rock shaft 98 supported in bearings 100 provided therefor in the valve block. A shaft-operating lever 101 is also pinned to the rock shaft 98 and is formed with a rounded bearing pad at its outer end which engages the rounded inner end of an adjustable abutment 102.

In the form of the invention shown in Figures 1 and 2, the abutment 102 is preferably in the form of a leaded bronze cap mounted on the inner end of an adjusting screw 103 threaded into an internally threaded bearing provided therefor on a removable cover 7 and held in position by lock nut 104. A cap 105 may be provided to enclose the outer end of the screw 103 and its lock nut 104. By removing the cap 106 and adjusting the screw 103, the tension of the spring 95 may be varied while the engine is running. In this way the speed may be varied over a considerable range while the engine is running.

In the construction described the spring 90 is first adjusted or set to function as the main governor spring, and the spring 95 may be readily adjusted at any time from the exterior of the engine housing so as to select a speed somewhat under or somewhat over the speed determined by the setting of the spring 90, the spring 95 thus functioning as an auxiliary speed control spring.

In lieu of a manually adjustable screw, such as screw 103, for varying the tension of the spring means, be the latter a single spring or an auxiliary control spring, remote control means may be provided for this purpose. As illustrated in Figure 6, the leaded bronze cap, adjusting screw 103, lock nut 104, and cap 105 may be omitted, and a smooth or bushed bearing 110 may be substituted for the threaded bearing for the screw 103. An abutment pin 111 is slidably fitted in the bushed bearing 110 and is engaged at its inner end with the rounded bearing pad at the outer end of the lever 101. The outer end of the pin 110 projects beyond the bearing 111 and is engaged with a rock arm 112 pinned to one end of a shaft 113. The shaft 113 is supported for rotation or rocking movement in bearings 114 provided on the cover 7. At the end of the shaft 113 opposite the rock arm 112 a lever 115 is pinned to the shaft. The outer end of this lever is engaged with a cam 116 fixed to a shaft 117 which is the output shaft of a speed reducer or reduction gear set 118. The drive shaft or input shaft 119 of the speed reducer is coupled as at 120 to the armature shaft 121 of a small electric motor 122, which, along with the speed reducer, is supported on bracket 123 carried by the cover plate 7. The motor 122 is a reversible eelctric motor and may be controlled from a push button station mounted on a switch board, whereby the operator can increase or decrease the speed through this electric remote control device. The extent to which the shaft 113 may be rotated in one direction, that is in the direction to reduce the tension of the spring 95, is limited by means of stop screw 124 carried at the outer end of an arm 125 pinned to an intermediate portion of the shaft 113. Obviously, a solenoid could be substituted for the motor and a rheostat used to vary the electromotive force impressed upon the solenoid.

In instances where an engine of this type is used to drive an air compressor, a fluid pressure motor may be utilized to control the speed of the engine in such manner as to maintain a constant air pressure. In such an application, and as illustrated in Figure 7, a fluid pressure motor, designated generally at 130, is mounted

on the cover plate 7 and is operatively interrelated with the lever 101. In the construction shown in Figure 7, the motor 130 comprises a cylinder 131 which is fixedly supported upon bracket 132 fastened to the cover plate 7. A piston 133 is slidably fitted in the cylinder 131. A piston rod 134 has one end fixed to the piston 133 and has its other end projecting beyond one of the end heads of the cylinder and slidable through the bearing 111 of the cover plate. A bronze cap 102', similar to the bronze cap 102, may be fitted on the outer end of the piston rod and is engaged with the rounded or padlike end of the lever 101. A spring 135 is interposed between the head of the piston and one of the head end walls or end walls of the cylinder 131 and tends to force the piston to the right, as shown in Figure 5, thereby increasing the tension of spring 95. The space between the piston 133 and the end wall of the cylinder opposite that engaged by the spring 135, is connected by a pipe line 136 to the pressure tank (not shown) to which the air under pressure is delivered by the compressor. With this construction, upon a decrease in air pressure, the spring 135 forces the piston 133 to the right, as shown in Figure 7, thereby increasing the tension of the spring 95, so that the engine will speed up until the desired or controlled air pressure is reestablished. As the pressure builds up it offsets the action of the spring 135 and relieves the governor spring 95 of its excess tension. Obviously, a diaphragm type of motor could be substituted for the piston type motor.

While the oil relief valve arrangement 60, shown in Figures 1, 2, 3, and 6, has a number of special advantages, the present invention also contemplates the use of different types of valves to control the relief of the pressure-acting on top of the valve 54 embodied in the oil pressure-regulating valve 51. For example, in lieu of the valve 60 a sleeve type of valve, designated generally at 139, may be combined with a speed sensitive fly ball governor, designated generally at 140, mounted on and driven by one end of the crank shaft 6 of the engine, in the manner illustrated in Figure 8. The rotating spindle or shaft 141 of the governor is fixed to or constituted by an extension of the crank shaft 6 of the engine. The sleeve valve 139 is constrained to rotate with the spindle 141 by means of a pin 139' passing through diametrically opposite openings in the sleeve valve 139 and through a lengthwise slot 141' provided in the spindle or shaft 141. The ends of the pin 139' project beyond the diametrically opposite openings in the sleeve valve 139 and are pivotally interconnected with the links 140' of the fly ball governor 140. Since the pin 139' is slidably fitted in the slot 141, the sleeve valve 139, while constrained to rotate with the spindle 141, may slide longitudinally thereof. In the position shown in Figure 8, the sleeve valve covers and closes an annular groove 145 provided in the spindle or shaft 141. This groove 145 communicates through radial and axial passages 146 in the spindle or shaft 141 with the passageway 70 in the distributing or manifold ring 43, which, as in the other embodiments of the invention, is connected up through pipe 59 (not shown in Figure 8, but shown in Figure 3) with the top of the valve 54.

As the speed of the engine increases, centrifugal force acting on the fly ball governor 140 tends to throw the balls thereof outwardly, and consequently tends, through the connection afforded by the links 140' and pin 139', to slide the sleeve valve 139 to the left, as viewed in Figure 8. A predetermined movement of the sleeve valve 139 to the left, as viewed in Figure 8, will uncover the annular groove 145, thereby causing the pressure in the fluid pressure motor 21 to be relieved.

The speed at which this relief is effected is determined by the adjustment of a spring 143 which is combined with the sleeve valve 139 to resiliently oppose sliding movement thereof to the left, as viewed in Figure 8, the spring 143 biasing the sleeve valve 139 to closed position, that is, to a position where it covers the annular groove 145. The spring 143 has one end bearing against the headed end of a plunger 144. Between the headed end of the plunger and the sleeve valve 139 is a suitable ball thrust bearing 144'. The tension of the spring 143 may be conveniently varied by means of a hand-wheel 142 threadedly mounted on the cover plate 7 and having a spring abutment 142' in its hub engaging the opposite end of the spring 143 from that engaged with the headed plunger 144. Obviously, by adjusting the hand-wheel 142 the speed of the engine may be varied.

While I have shown and described several constructions in which the invention may be advantageously embodied, it is to be understood that the constructions shown have been selected merely for the purpose of illustration or example, and that various changes in the size, shape, and arrangement of the parts may be made without departing from the spirit of the invention or the scope of the subjoined claims.

I claim:

1. A governor for engines of the type having an engine shaft actuated distributing valve gear including a shiftable eccentric sheave mounted on the engine shaft and weighted so as to be shifted with respect thereto under the influence of centrifugal force to decrease the cut off and comprising a fluid pressure motor operatively interposed between the shaft and the sheave and acting when supplied with fluid under pressure to cause the sheave to shift with respect to the shaft to advance the cut off, a pump, means connecting the pump with the motor, a pressure-regulating valve having one side connected to said last-named means, an oil relief valve connected to the other side of said pressure-regulating valve and including a valve block fixed to and rotated with the engine shaft and having a pressure discharge port, a valve cooperable with said port to regulate the discharge therethrough, a valve lever pivoted on the block and carrying said valve, said lever and said valve being urged to open position under the influence of centrifugal force, and a spring coacting with the lever to bias the same to move the valve toward closed position.

2. A governor for engines of the type having an engine shaft actuated distributing valve gear including a shiftable eccentric sheave mounted on the engine shaft and weighted so as to be shifted with respect thereto under the influence of centrifugal force to decrease the cut off and comprising a fluid pressure motor operatively interposed between the shaft and the sheave and acting when supplied with fluid under pressure to cause the sheave to shift with respect to the shaft to advance the cut off, a pump, means connecting the pump with the motor, a pressure-regulating valve having one side connected to said last-named means, an oil relief valve con-

nected to the other side of said pressure-regulating valve and including a valve block fixed to and rotated with the engine shaft and having a pressure discharge port, a valve cooperable with said port to regulate the discharge therethrough, a valve lever pivoted on the block and carrying said valve, said lever and said valve being urged to open position under the influence of a centrifugal force, a spring coacting with the lever to bias the same to move the valve toward closed position, and means adjustable from the exterior of the engine for varying the tension of said spring.

3. A governor for engines of the type having an engine shaft actuated distributing valve gear including a shiftable eccentric sheave mounted on the engine shaft and weighted so as to be shifted with respect thereto under the influence of centrifugal force to decrease the cut off and comprising a fluid pressure motor operatively interposed between the shaft and the sheave and acting when supplied with fluid under pressure to cause the sheave to shift with respect to the shaft to advance the cut off, a pump, means connecting the pump with the motor, a pressure-regulating valve having one side connected to said last-named means, an oil relief valve connected to the other side of said pressure-regulating valve and including a valve block fixed to and rotated with the engine shaft and having a pressure discharge port, a valve cooperable with said port to regulate the discharge therethrough, a valve lever pivoted on the block and carrying said valve, said lever and said valve being urged to open position under the influence of a centrifugal force, a spring coacting with the lever to bias the same to move the valve toward closed position, and means adjustable from the exterior of the engine for varying the tension of said spring and including an adjustable abutment for the spring comprising a rock arm, a rock shaft rotatably supported on the valve block and carrying said rock arm, an operating lever for said rock shaft having a bearing pad at its outer end, and an adjustable abutment mounted on the engine housing and in engagement with said rounded pad to control the position of said lever, shaft, and arm.

4. A governor for engines of the type having an engine shaft actuated distributing valve gear including a shiftable eccentric sheave mounted on the engine shaft and shifted with respect thereto under the influence of centrifugal force to decrease the cut off and comprising a fluid pressure motor operatively interposed between the shaft and the sheave and acting when supplied with fluid under pressure to cause the sheave to shift with respect to the shaft to advance the cut off, means for supplying fluid under pressure to said motor, and means for varying the pressure of the fluid which said first mentioned means supplies to said motor and comprising a valve block fixed to the engine shaft and having a discharge port connected to said fluid pressure supply means, a valve for regulating the flow of fluid through said discharge port, an operator for said valve mounted on the valve block, said operator and said valve tending under the influence of centrifugal force to open the valve, a main governor spring coacting with said operator to bias said valve to closed position, and an auxiliary speed control spring also coacting with said valve operator to bias it and the valve to closed position, and means for adjusting the tension of said auxiliary speed control spring.

5. A governor for engines of the type having an engine shaft actuated distributing valve gear including a shiftable eccentric sheave mounted on the engine shaft and shifted with respect thereto under the influence of centrifugal force to decrease the cut off and comprising a fluid pressure motor operatively interposed between the shaft and the sheave and acting when supplied with fluid under pressure to cause the sheave to shift with respect to the shaft to advance the cut off, means for supplying fluid under pressure to said motor, and means for varying the pressure of the fluid which said first mentioned means supplies to said motor and comprising a valve block fixed to the engine shaft and having a discharge port connected to said fluid pressure supply means, a valve for regulating the flow of fluid through said discharge port, an operator for said valve mounted on the valve block, said operator and said valve tending under the influence of centrifugal force to open the valve, a main governor spring coacting with said operator to bias said valve to closed position, and an auxiliary speed control spring also coacting with said valve operator to bias it and the valve to closed position, and means for adjusting the tension of said auxiliary speed control spring and including an adjustable abutment for one end of said auxiliary speed control spring comprising a rock arm, a rock shaft rotatably supported on the valve block and to which said rock arm is fixed, an operating lever for said rock shaft having a bearing pad at its outer end, an adjusting screw mounted on the housing of the engine and adjustable from the exterior thereof and having its inner end engageable with said bearing pad.

6. A governor for engines of the type having an engine shaft actuated distributing valve gear including a shiftable eccentric sheave mounted on the engine shaft and shifted with respect thereto under the influence of centrifugal force to decrease the cut off and comprising a fluid pressure motor operatively interposed between the shaft and the sheave and acting when supplied with fluid under pressure to cause the sheave to shift with respect to the shaft to advance the cut off, means for supplying fluid under pressure to said motor, and means for varying the pressure of the fluid which said first mentioned means supplies to said motor and comprising a valve block fixed to the engine shaft and having a discharge port connected to said fluid pressure supply means, a valve for regulating the flow of fluid through said discharge port, an operator for said valve mounted on the valve block, said operator and said valve tending under the influence of centrifugal force to open the valve, a main governor spring coacting with said operator to bias said valve to closed position, an auxiliary speed control spring also coacting with said valve operator to bias it and the valve to closed position, means for adjusting the tension of said auxiliary speed control spring and including an adjustable abutment for one end of said auxiliary speed control spring comprising a rock arm, a rock shaft rotatably supported on the valve block and to which said rock arm is fixed, an operating lever for said rock shaft having a bearing pad at its outer end, an adjustable screw mounted on the housing of the engine and adjustable from the exterior thereof, and a leaded bronze cap mounted on the inner end of the adjustable screw and engageable with said bearing pad.

7. A governor for engines of the type having an engine shaft actuated distributing valve gear including a shiftable eccentric sheave mounted on the engine shaft and weighted so as to be shifted with respect thereto under the influence of centrifugal force to decrease the cut off and comprising a fluid pressure motor operatively interposed between the shaft and the sheave and acting when supplied with fluid under pressure to cause the sheave to shift with respect to the shaft to advance the cut off, a pump, means connecting the pump with the motor, a pressure-regulating valve having one side connected to said last-named means, an oil relief valve connected to the other side of said pressure-regulating means and including a valve block fixed to and rotated with the engine shaft and having a pressure discharge port, a valve cooperable with said port to regulate the discharge therethrough, a valve lever pivoted on the block and carrying said valve, said lever and said valve being urged to open position under the influence of centrifugal force, a main governor spring co-acting with the lever to bias the same to move the valve toward closed position, an auxiliary speed control spring also co-acting with the lever and supplementing the action of the main governor spring, and means for varying the tension of the auxiliary speed control spring from the exterior of the engine housing and while the engine is running.

8. A governor for steam engines of the type having a housing and an engine shaft actuated distributing valve gear including a shiftable eccentric sheave mounted on the engine shaft and weighted so as to be shifted with respect thereto under the influence of centrifugal force to decrease the cut off and comprising a fluid pressure motor operatively interposed between the shaft and the sheave and acting when supplied with fluid under pressure to cause the sheave to shift with respect to the shaft to increase the cut off, a source of supply of fluid under pressure, a connection between said source and said motor, pressure relief means in communication with said connection and including a valve block fixed to the engine shaft and having a fluid pressure relief port, a valve cooperable with said port to regulate the discharge therethrough, a valve lever pivoted on the block and carrying said valve, said lever and said valve being urged to open position under the influence of centrifugal force, a main governor spring cooperable with the lever to bias the same and the valve toward closed position, an auxiliary speed control spring interconnecting the block and the lever and supplementing the action of the main governor spring, and means adjustable from the exterior of the housing and operable to vary the tension of the auxiliary speed control spring from the exterior of the housing and while the engine is running.

9. A governor for steam engines of the type having a housing and an engine shaft actuated distributing valve gear including a shiftable eccentric sheave mounted on the engine shaft and weighted so as to be shifted with respect thereto under the influence of centrifugal force to decrease the cut off and comprising a fluid pressure motor operatively interposed between the shaft and the sheave and acting when supplied with fluid under pressure to cause the sheave to shift with respect to the shaft to increase the cut off, a source of supply of fluid under pressure, a connection between said source and said motor, pressure relief means in communication with said connection and including a valve block fixed to the engine shaft and having a fluid pressure relief port, a valve cooperable with said port to regulate the discharge therethrough, a valve lever pivoted on the block and carrying said valve, said lever and said valve being urged to open position under the influence of centrifugal force, and adjustable spring means cooperable with the lever to bias the same and the valve toward a closed position.

10. A governor for steam engines of the type having a housing and an engine shaft actuated distributing valve gear and including a shiftable eccentric sheave mounted on the engine shaft and weighted so as to be shifted with respect thereto under the influence of centrifugal force to decrease the cut-off and comprising a fluid pressure motor operatively interposed between the shaft and sheave and acting when supplied with fluid under pressure to cause the sheave to shift with respect to the shaft to increase the cut-off, a pump, means connecting the pump with the motor, a pressure-regulating valve having one side connected to said last-named means, an oil relief valve connected to the other side of said pressure-regulating valve, means driven in timed relation to the engine shaft intending to open said oil relief valve under the influence of centrifugal force, spring means for biasing the oil relief valve to closed position, mechanism for varying the adjustment of said spring means, and a control device for said mechanism operable from the exterior of the engine housing and operable to actuate said mechanism when the engine is running.

11. A governor for steam engines of the type having a housing and an engine shaft actuated distributing valve gear including a shiftable eccentric sheave mounted on the engine shaft and weighted so as to be shifted with respect thereto under the influence of centrifugal force to decrease the cut-off and comprising a fluid pressure motor operatively interposed between the shaft and the sheave and acting when supplied with fluid under pressure to cause the sheave to shift with respect to the shaft to increase the cut-off, means for varying the pressure of the fluid supplied to the motor and including an oil relief valve, means driven in timed relation to the engine tending to open said oil relief valve under the influence of centrifugal force, a spring for biasing the oil relief valve to closed position, adjusting means for varying the tension of the spring, and a screw mounted on the engine housing and adjustable from the exterior thereof to control the action of said adjusting means.

12. A governor for steam engines of the type having a housing and an engine shaft actuated distributing valve gear including a shiftable eccentric sheave mounted on the engine shaft and weighted so as to be shifted with respect thereto under the influence of centrifugal force to decrease the cut-off and comprising a fluid pressure motor operatively interposed between the shaft and the sheave and acting when supplied with fluid under pressure to cause the sheave to shift with respect to the shaft to increase the cut-off, means for varying the pressure of the fluid supplied to the motor and including an oil relief valve, means driven in timed relation to the engine tending to open said oil relief valve under the influence of centrifugal force, a spring for biasing the oil relief valve to closed position, adjusting means for varying the tension of the spring, and a hand-wheel mounted on the engine housing and operable from the exterior thereof

and interconnecting the said adjusting means to vary the action thereof.

13. A governor for steam engines of the type having a housing and an engine shaft actuated distributing valve gear including a shiftable eccentric sheave mounted on the engine shaft and weighted so as to be shifted with respect thereto under the influence of centrifugal force to decrease the cut-off and comprising a fluid pressure motor operatively interposed between the shaft and the sheave and acting when supplied with fluid under pressure to cause the sheave to shift with respect to the shaft to increase the cut-off, means for varying the pressure of the fluid supplied to the motor and including an oil relief valve, means driven in timed relation to the engine tending to open said oil relief valve under the influence of centrifugal force, a spring for biasing the oil relief valve to closed position, adjusting means for varying the tension of the spring, and a remote control device mounted on the exterior of the engine housing and interconnected with said adjusting means to vary the action thereof.

14. A governor for steam engines of the type having a housing and an engine shaft actuated distributing valve gear including a shiftable eccentric sheave mounted on the engine shaft and weighted so as to be shifted with respect thereto under the influence of centrifugal force to decrease the cut-off and comprising a fluid pressure motor operatively interposed between the shaft and the sheave and acting when supplied with fluid under pressure to cause the sheave to shift with respect to the shaft to increase the cut-off, means for varying the pressure of the fluid supplied to the motor and including an oil relief valve, means driven in timed relation to the engine tending to open said oil relief valve under the influence of centrifugal force, a spring for biasing the oil relief valve to closed position, adjusting means for varying the tension of the spring, and a remote control device mounted on the exterior of the engine housing and interconnected with said adjusting means to vary the action thereof and comprising a reversible electric motor and motion transmission means between said motor and said spring.

15. A governor for steam engines of the type having a housing and an engine shaft actuated distributing valve gear including a shiftable eccentric sheave mounted on the engine shaft and weighted so as to be shifted with respect thereto under the influence of centrifugal force to decrease the cut-off and comprising a fluid pressure motor operatively interposed between the shaft and the sheave and acting when supplied with fluid under pressure to cause the sheave to shift with respect to the shaft to increase the cut-off, means for varying the pressure of the fluid supplied to the motor and including an oil relief valve, means driven in timed relation to the engine tending to open said oil relief valve under the influence of centrifugal force, a spring for biasing the oil relief valve to closed position, adjusting means for varying the tension of the spring, and means for automatically regulating the action of said adjusting means including a fluid pressure motor mounted on the exterior of the engine housing and operatively connected with said adjusting means.

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