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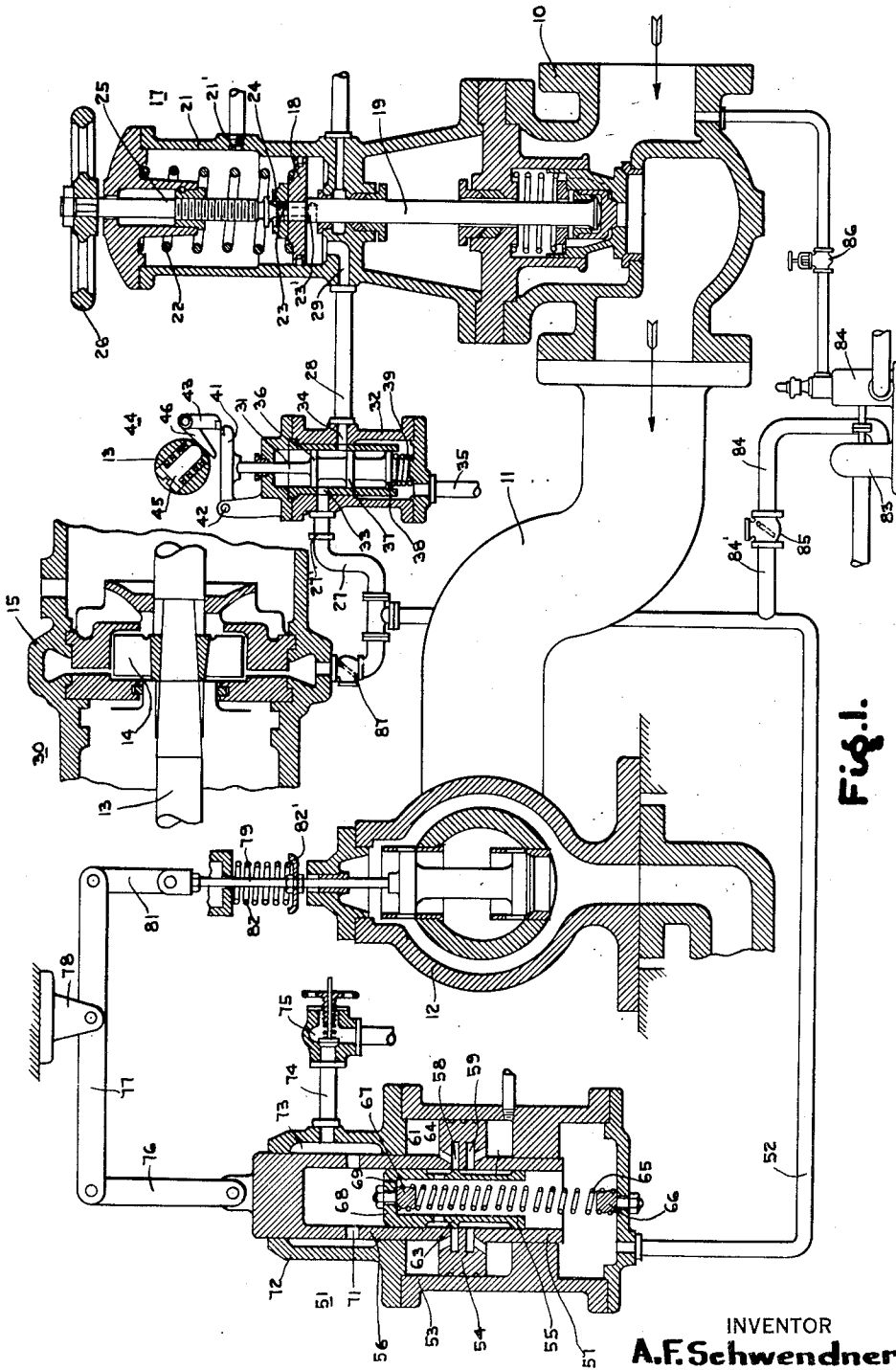
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1,729,458

VALVE OPERATING MECHANISM

Filed Aug. 9, 1927

2 Sheets-Sheet 1



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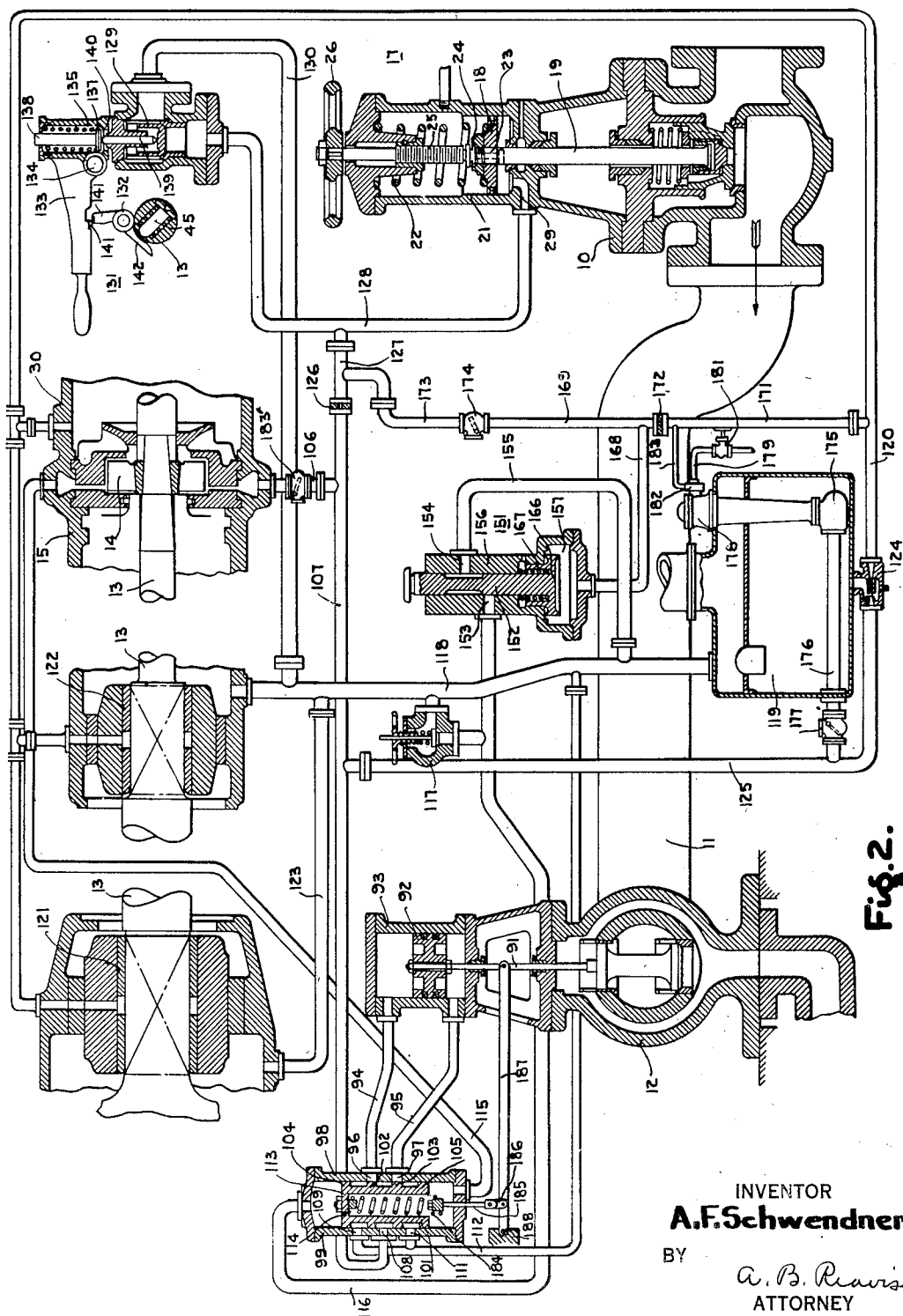
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VALVE OPERATING MECHANISM

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2 Sheets-Sheet 2



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VALVE-OPERATING MECHANISM

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My invention relates to a governing system for prime movers, and it has for its object to provide a governing system embodying therein a throttle valve controlling the admission
5 of motive fluid to the prime mover which is automatically closed upon the occurrence of conditions making further operation of the prime mover unsafe or undesirable.

Another object is to provide a governing
10 system embodying a fluid pressure governor and a throttle valve which is automatically closed upon failure of fluid pressure in the governing system.

Another object is to provide a governing
15 system embodying a throttle valve which is biased to closed position and is opened in opposition to said bias by means operated directly by the prime mover shaft.

A further object is to provide a governing
20 system for a prime mover which will not permit the prime mover to be started until the lubrication system of said prime mover is placed in operation.

Still another object is to provide a throttle
25 valve operating mechanism which will not allow the throttle valve to be opened too rapidly.

In accordance with my invention, I provide a throttle valve connected to a piston
30 operating in a suitable cylinder. A spring, or other biasing means, is applied to the piston, or to the valve or the connection between the two, to urge the valve to closed position. Fluid pressure is used in the fluid pressure
35 governor and it is admitted to the cylinder to act upon the piston to open the valve in opposition to the pressure of the spring. Means are further provided for retaining the valve closed when it has once tripped until the
40 throttle valve is opened slowly and intentionally.

Apparatus exemplifying my invention is illustrated in the accompanying drawings, in which:

45 Fig. 1 is a diagrammatic view, with parts in section, of one embodiment; and

Fig. 2 is a diagrammatic view, with parts in section, of another embodiment.

Referring to the drawings in detail, I show,
50 at 10, the throttle valve of a prime mover,

for example, a steam turbine. From the throttle valve 10 the motive fluid, in this case steam, is transmitted through a conduit 11 to the governor controlled valve 12, from which
55 it may be admitted to the nozzle chamber of the steam turbine.

The prime mover embodies a shaft 13, upon which is mounted an impeller 14. The impeller 14 rotates in a pump housing 15, forming therewith the pump 30. The fluid
60 pressure developed by the pump 30 is proportional to the speed of rotation of the shaft 13.

I preferably use lubricating oil as the medium of fluid pressure in my governing system, but it will be apparent that other fluids,
65 particularly liquids, may be used.

The throttle valve 10 is operated by a valve operating mechanism indicated at 17, consisting, generally, of a piston 18, connected to the valve 10 as by a rod or stem 19, and a
70 cylinder 21. Any suitable means is provided for exerting a force on the valve or the valve-operating mechanism in the direction to close the valve. I show a compression spring 22 for this purpose, which is interposed between
75 the upper end of the cylinder and the upper side of the piston, and which closes the valve 10 in the absence of sufficient opposing force.

An axially-extending passage 23 is formed in the valve stem 19, and extends from the
80 upper end thereof to a point immediately below the piston 18 where it communicates with the interior of the cylinder through a radially-extending portion 23'. The upper end of the passage forms a port designated
85 24.

A screw stem 25, is disposed in axial alignment with the valve stem 19, and the lower end thereof abuts against the upper end of the valve stem and closes the port 24 upon
90 sufficient downward movement of the screw stem. The stem 25 is adapted to be raised and lowered by means of a handwheel 26 attached to the upper end thereof.

Fluid pressure developed by the pump 30,
95 and transmitted through the pipes 27 and 28, is communicated to the lower end of the cylinder 21 through an opening 29, and acts on the lower side of the piston 18 to open the throttle valve. The cylinder 21 is also pro-
100

vided with a discharge port 21' which is disposed above the upper limit of travel of the piston 18.

A valve 31 is interposed between the pipes 27 and 28. As may be seen from Fig. 1, this valve operates in a valve casing 32, having a port 33 communicating with the conduit 27, and a port 34 communicating with the conduit 28. The valve casing 32 also communicates at its lower end with a drain conduit 35. The valve 31 is provided with piston portions 36, 37 and 38. The piston portions 36 and 37 are so disposed that the space therebetween is always in communication with the port 33 during the full travel of the valve. The piston portion 37 is so disposed that it will be immediately below the port 34 when the valve is in its lowermost position to provide communication between the ports 33 and 34, and so that it will be immediately above the port 34 when the valve is in the upper end of its travel, when communication of the port 34 with the port 33 is cut off and the port 34 is placed in communication with the drain conduit 35.

A spring 39, at the lower end of the valve casing 32, urges the valve 31 upwardly. The valve 31 is normally held at the lower end of its travel by a lever 41, pivoted at 42 to a stationary member, such as a bracket of the valve casing 32. The lever 41 is normally held at its free end by the arm 43 of the auto-stop mechanism 44. The arm 43 is adapted to be moved out of engagement with the lever 41 upon the weight 45 striking the arm 46, which is connected to and moves the arm 43.

A restricted orifice 27' is provided in the conduit 27 near the end communicating with the valve casing 32, and restricts the flow of fluid to the throttle valve operating mechanism 17.

A governor 51, operating the valve 12, consists of a casing 53, an operating piston 54 and a pressure-responsive pilot valve 55. The governor 51 is controlled and operated by the fluid pressure developed by the pump 30, which is transmitted through conduits 27 and 52 to the lower end of the casing 53. The piston 54 is provided with an upper tubular extension 56 and a lower tubular extension 57. A cylinder extending through the portions 56 and 57 and through the piston itself is formed in the interior thereof. The pilot valve 55 which has a hollow interior and a closed upper end 68, is disposed within the cylinder and controls the movements of the operating piston. The operating piston 54 is provided at the interior cylindrical surface with an annular series of ports 58, which open into the upper end of the piston 54. A similar annular series of ports 59 communicates with the lower end of the piston 54. The pilot valve 55 is provided with recessed portions 61 and 62, forming a piston

portion 63 therebetween. A series of ports 64 provides communication between the recessed portion 61 and the hollow interior of the pilot valve 55.

A spring 65 is disposed within the hollow interior of the pilot valve, being secured at its lower end to a spring-holding member 66 fastened to the casing 53, and at its upper end to a spring-holding member 67 carried by the closed upper end 68 of the pilot valve. The closed upper end 68 is provided with a restricted opening 69, permitting a restricted flow of fluid therethrough.

The upper tubular extension 56 of the operating piston 54 is provided with openings 71, which are disposed so as to be above the pilot valve 55 at all times. The casing 53 is provided with an upper extension 72 having a recessed portion 73 which is sufficiently elongated to communicate with the openings 71 at all times. A conduit 74 communicates with the recessed portion 73, and has a back-pressure valve 75 interposed therein. The valve 75 may be adjusted to any desired back pressure.

The upper end of the operating piston 54 is pivoted to a link 76, which is pivoted at its other end to one end of the lever 77. The lever 77 is pivoted to a stationary bracket 78 intermediate its ends, and the other end is connected to the valve stem 79 of the valve 12 through a link 81. The valve 12 is urged to closed position by any suitable means such as a compression spring 82, acting against a collar 82' on the valve stem 79.

An auxiliary pump 83 is driven by a small turbine 84, and develops a fluid pressure which may be communicated to the conduit 52 through a conduit 84'. A check valve 85 is interposed in the conduit 84' which permits fluid to flow from the pump 83 to the conduit 52, but prevents flow in the reverse direction. The supply of motive fluid to the small turbine 84 is controlled by a hand valve 86.

A check valve 87 in the conduit 27 permits delivery of fluid pressure from the pump 30 but prevents escape of fluid pressure to the latter when idle.

The operation of this embodiment of my invention is as follows:

Assuming the prime mover to be idle, it is necessary to provide fluid pressure from a source other than the impeller 14 in order to open the throttle valve 10. The hand valve 86 is therefore opened, thereby admitting motive fluid to operate the small turbine 84, which drives the auxiliary pump 83. The fluid pressure developed by the pump 83 is transmitted through the conduits to the governor 51 and to the throttle valve operating mechanism 17. The escape of fluid pressure through the main pump 30, which is not yet in operation, is prevented by the check valve 87.

The piston 18 is held against upward move-

ment by the screw stem 25, and it is therefore necessary to raise the stem by turning the handwheel 26. As the stem 25 is raised, the fluid pressure beneath the piston 18 raises the piston and causes it to follow the screw stem 25. During such movement the stem 25 closes the port 24, and thereby prevents escape of fluid pressure through the passage 23 into the space above the piston 18. The throttle valve 10 is thereby opened and motive fluid is admitted therethrough to the conduit 11, through which it flows to the governor valve 12.

The speed with which the throttle valve is opened is limited by the rate of oil flow through the orifice 27'. If the stem 25 is raised at a higher rate, it uncovers the port 24, and the oil pressure escapes through the passage 23, allowing the spring 22 to shut the throttle valve 10. This is desirable to prevent racing of the prime mover in starting, especially in the case of a turbo-generator which is started without load. To close the throttle valve 10, the handwheel 26 is turned to lower the stem 25, which forces the piston 18 downwardly against the fluid pressure.

The fluid pressure developed by the auxiliary pump 83 is also communicated to the governor 51 and admitted through the ports 64 to the recessed portion 61 of the pilot valve. Upon starting, the pilot valve 55 is in a lower position than that shown in the drawing due to the action of the spring 65, and the fluid pressure, therefore, flows through the ports 58 to the upper side of the piston 54 and acts thereon to lower the piston and to open the valve 12.

The fluid pressure developed by the auxiliary pump 83 is less than that developed by the main impeller 14 at or near operating speed, and, therefore, as the prime mover comes into operation and approaches its normal operating speed, the pressure developed by the pump 30 exceeds the pressure developed by the auxiliary pump 83. The supply of motive fluid to the small turbine 84 is shut off by any suitable means such as the hand valve 86 and the escape of fluid pressure through the conduit 84' is prevented by the check valve 85.

The pressure developed by the pump 30, which is a function of the speed of the prime mover, acts on the pilot valve 55 against the tension of the spring 65. A restricted flow of this fluid pressure is permitted through the restricted opening 69, and passes through the openings 71 and the recessed portion 73 to the conduit 74. The back pressure valve 75 is adjusted to a desired pressure, and imposes a back pressure upon the fluid flow therethrough. It will be apparent therefore that there is a pressure on the upper side of the pilot valve 55 which cooperates with the spring 65 to oppose and balance the fluid pressure beneath the pilot valve.

As the speed of the prime mover approaches the desired operating speed the pilot valve 55 is raised until the governor valve 12 is brought to the proper position.

The action of the pilot valve in controlling the piston is as follows: As the speed of the prime mover increases, the fluid pressure acting on the pilot valve 55 increases and raises the pilot valve. This places the ports 58 and 59 in communication with the recessed portion 62. The fluid above the piston 54 may therefore flow to the lower side thereof, such flow being brought about by the action of the spring 82 and the oil pressure on the lower end of the lower tubular extension 57, which tend to close the valve 12 and to move the operating piston 54 upwardly. This movement continues until the ports 58 are covered by the piston portion 63 when movement of the operating piston ceases.

Upon an increase of load on the prime mover, resulting in a reduced speed thereof, the resulting reduced pressure on the pilot valve 55 permits the spring 65 to lower the pilot valve. This movement uncovers the ports 58 and places them in communication with fluid pressure through the recessed portion 61 and the ports 64. The operating piston therefore moves downwardly to open the valve until the ports 58 are again covered by the piston portion 63.

The auto-stop mechanism for closing the throttle valve in case the prime mover exceeds a certain predetermined speed, generally 10% above the normal operating speed, operates as follows:

Upon the predetermined speed being attained, the weight 45, whose center of gravity is offset from the axis of the shaft 13, flies outwardly and strikes the arm 46, which, in turn, moves the arm 43 out of engagement with the lever 41. The valve 31 is then moved upwardly by the force of the spring 39, the piston portion 37 moving upwardly above the port 34. The supply of fluid pressure from conduit 27 to the throttle valve operating mechanism 17 is now cut off and the conduit 28 is in communication with the drain conduit 35. The fluid pressure in the cylinder 22 beneath the piston 18 is released and the piston 18 is lowered by force of the compression spring 22. The escape of the fluid beneath the piston 18 is further accelerated by the passage 23, which is opened as the piston leaves the screw stem 25. Downward movement of the piston 18 continues until the throttle valve 10 is closed.

It is important that the throttle valve 10 be not opened suddenly or unintentionally, such as might be done by resetting the valve 31. This is accomplished by the passage 23. Should the valve 31 be reset without lowering the screw stem 25, the fluid pressure admitted to the cylinder 21 would escape through the passage 23 and would not raise

the piston 18. It is therefore necessary to lower the stem 25 until the port 24 is closed. The throttle valve may then be opened by raising the stem 25, which permits the fluid pressure beneath the piston 18 to move the

5 pressure beneath the piston 18 to move the same upwardly following the stem 25.
The restricted orifice 27', in limiting the oil flow to the throttle valve operating mechanism, prevents loss of pressure in the conduit 27, should the valve 31 be reset before
10 the stem 25 is lowered to close the port 24.

Inasmuch as the throttle valve is opened only by pressure in the governing system, it will be seen that, should such pressure fail,
15 the prime mover is shut down. This is true even though the failure be but momentary, for the reason that when the piston 18 once moves down away from the stem 25 the port 24 is uncovered and the pressure beneath the
20 piston escapes through the passage 23. The prime mover cannot again be placed in operation until the fluid pressure is restored.

In Fig. 2, I show a modification of my invention wherein the lubrication system is embodied with the governing system, the lubricating oil being used as the medium of fluid pressure. This modification also embodies other developments of the governing system as applied to prime movers.

30 The throttle valve 10 is controlled by a valve-operating mechanism 17 identical with that described in connection with the embodiment shown in Fig. 1. The pump 30 is also identical with that shown in Fig. 1.

35 Oil pressure for operating the mechanism 17, is supplied, as before, from the oil pressure in the governing system, in this case being supplied through a restricted orifice 126 and conduits 127 and 128. The conduit 128
40 communicates with a valve 129, which is normally closed. When opened, the valve 129 releases the oil pressure in the conduit 128, and permits the oil to flow to a drain conduit 130.

45 The valve 129 is normally held in closed position by an auto-stop mechanism indicated generally at 131, which includes a lever 133 pivoted at 134 for holding the valve closed, a bell crank lever 132 engaging the
50 lever 133, and a governor weight 45 disposed in a diametrical opening in the prime mover shaft 13.

The governor valve 12 is controlled by an oil pressure governor somewhat different in
55 detail. The valve stem 91 of the governor valve is directly connected to a piston 92 operating in a cylinder 93. Oil pressure for operating the piston 92 is supplied through conduits 94 and 95 from ports 96 and 97
60 of a relay valve 98. The relay valve 98 comprises a casing 99 and a pilot valve 101. The pilot valve 101 is provided with piston portions 102 and 103 which normally cover the
65 ports 96 and 97, respectively, and with piston

portions 104 and 105 at the upper and lower ends thereof, respectively.

The relay valve is supplied with oil pressure from the pump 30 through conduits 106 and 107, the latter communicating with the port 108 which is always in communication with the space between the piston portions 102 and 103. The valve casing 99 is further provided with discharge ports 109 and 111 which communicate with the space between the piston portions 104 and 102, and with the space between the piston portions 103 and 105, respectively. These ports communicate with a drain conduit 112. The pilot valve 101 is formed with a hollow interior and a closed upper end 113. The closed end 113 has a restricted opening 114 therein.

A tension spring 184 is disposed within the hollow interior of the pilot valve 101, the upper end being secured to the closed end 113, and the lower end being secured to the upper end of a stem 185. The stem 185 extends through the valve casing 99, the lower end being pivoted, through a short link 186, to a lever 187, intermediate the ends of the latter. The lever 187 is pivoted at one end to a stationary part 188, and at the other end to the valve stem 91.

Oil pressure from the pump 30 is transmitted directly to the lower end of the casing 99 through a conduit 115, which does not communicate with any other conduit. A conduit 116 communicates with the upper end of the casing 99 and receives the oil passing through the restricted opening 114. The escape of oil through the conduit 116 is normally controlled by the back pressure valve 117. The valve 117 is adjustable, whereby a back pressure of any desired value may be imposed on the oil flowing through the conduit 116 and upon the oil above the pilot valve 101. The oil released by the back-pressure valve is discharged into a drain conduit 118.

In this modification, an oil reservoir 119 is disposed at a level below the pump 30, and is adapted to receive the lubricating oil discharged from the bearings 121 and 122 through the conduits 123 and 118. An ejector 124 is disposed below the reservoir 119, and the oil in the reservoir 119 flows to the entraining chamber of the ejector by gravity. The ejector is supplied with oil under pressure from the pump 30 through the conduits 106, 107 and 125. This oil under pressure entrains oil from the reservoir and supplies the same to the conduit 120 at a lower pressure, for example 5 pounds per square inch. The conduit 120 supplies oil to the bearings 121 and 122. This conduit also supplies oil to the inlet of the pump 30, which is therefore supplied with oil under positive pressure.

A trip mechanism 151 is provided for releasing the pressure above the pilot valve 101

upon a failure of the bearing oil pressure. This trip includes a valve 152; and a valve casing 156, having a port 153 communicating with the upper end of the valve casing 99 through the conduit 116, and having a discharge port 154 communicating with the drain conduit 118 through a conduit 155. The valve 152 is controlled by a piston 166, preferably integral therewith, and subjected on its lower side of the pressure in the chamber 157 formed in the lower end of the casing 156. The piston 166 is urged in the direction to open the valve 152 by a spring 167.

Bearing oil pressure is transmitted from the conduit 120 to the chamber 157 through a conduit 171, a restricted orifice 172, and conduits 169 and 168.

The conduit 169 also communicates with the conduit 127 through a check valve 174 and a conduit 173. The check valve 174 opens to permit flow from the conduit 169 to the conduit 173, but prevents flow in the opposite direction.

An auxiliary oil pump 175, disposed in the bottom of the oil reservoir 119, is provided for maintaining oil pressure when the pump 30 does not provide sufficient pressure; that is, in starting and shutting down the turbine. The auxiliary pump 175 discharges to the conduit 125 through a conduit 176, having a check valve 177 disposed therein to prevent release of oil pressure in the conduit 125 when the same exceeds the pressure developed by the auxiliary pump or when the auxiliary pump is not in operation. The auxiliary pump 175 is driven by the small turbine 178, provided with motive fluid, such as steam, through a conduit 179, in which a hand valve 181 is preferably disposed. The admission of motive fluid to the turbine 178 is further controlled by a pressure governor 182, in response to the bearing oil pressure which is transmitted thereto through the conduit 183 from the conduit 171.

A check valve 183' is provided in the conduit 106 to prevent the release of oil pressure through the main pump 30 when the auxiliary pump 175 is in operation.

The operation of the above described embodiment is as follows:

To start the turbine it is necessary to have oil pressure to open the throttle valve 10. The hand valve 181 is therefore opened and steam admitted to the turbine 178, whereupon the auxiliary pump 175 builds up oil pressure which is transmitted to the conduit 125, and from there to other parts of the system. It flows through the conduit 107, the orifice 126, and conduits 127 and 128 to the cylinder 21, in which it is available for opening the throttle valve.

If the stem 25 is not in its lowermost position, the port 24 is open and the oil escapes through the passage 23. The stem 25 is therefore lowered by the handwheel 26 so that the

lower end thereof abuts against the valve stem 19 and closes the port 24. The stem 25 is then raised, whereupon oil pressure raises the piston 18 to open the throttle valve.

The release of the pressure developed by the auxiliary pump to the main pump 30, which has not yet come into operation, is prevented by the check valve 183'.

When oil pressure is established in the conduit 125, it is supplied to the ejector 124 for motivating the same, and the latter supplies oil through the conduit 120 to the inlet of the main pump 30 and to the bearings 121 and 122.

As the bearing oil pressure is established in the conduit 120, it is communicated to the chamber 157, where it moves the piston 166 in opposition to the spring 167 to close the valve 152. The only escape for oil from the conduit 116 is now through the valve 117, which imposes a back pressure on the oil in the conduit 116 and in the upper end of valve casing 99 above the pilot valve 101.

The oil pressure established in the conduit 125 is also transmitted through the conduit 107 to the inlet port 108 of the relay valve 98 for actuating the governor piston 92. Such pressure, however, is not applied to the lower end of the pilot valve 101, and the latter is therefore held in its lowermost position by the spring 184. The port 108 is therefore in communication with the port 97, and oil pressure is transmitted through conduit 95 to the lower side of the piston 92, and actuates the same to open the governor valve 12. Motive fluid now flows through the throttle valve 10 and the governor valve 12 to the prime mover to operate the same. The shaft 13 is thus rotated and the pump 30 begins to build up oil pressure.

As the prime mover approaches its operating speed, the pressure developed by the pump 30 exceeds the pressure developed by the auxiliary pump 175. The check valve 183' therefore opens and the check valve 177 closes. A higher pressure is also transmitted to the ejector 124, causing a resultant increased bearing oil pressure in the conduit 120, and also in the conduit 171. The auxiliary pump governor 182 is so designed that as the bearing pressure increases in accordance with the pressure developed by the pump 30, the governor 182 shuts off the admission of motive fluid to the turbine 178.

The pressure developed by the pump 30 is transmitted through the conduit 115 to the relay valve 98, and is applied to the lower end of the pilot valve 101 in opposition to the force of the spring 184. The restricted orifice 114 permits a restricted flow of oil there-through, and the escape of this oil is controlled by the valve 117, which imposes a back pressure thereon. The pilot valve 101 is thus subjected to this back pressure on the upper end thereof. The purpose of the back

pressure is to permit a lighter spring 184 having a sufficient scale; also to provide a speed changer for controlling the speed or load of the prime mover.

5 As the prime mover attains its operating speed, the governing oil pressure increases and the pilot valve 101 moves upwardly to control the ports 96 and 97.

10 The oil governor controls the valve 12 during normal variations in load and speed as follows:

15 Upon an increase in load and a resultant decrease in speed the governing oil pressure is reduced, causing the pilot valve 101 to be lowered from the position shown in the drawing. Oil pressure from the port 108 now flows to the port 97 and to the lower side of the piston 92. The port 96 is in communication with the discharge port 109, permitting the discharge of the oil above the piston 92. 20 The valve 12 is therefore moved upwardly in opening direction. At the same time the lever 187 moves upwardly, permitting the pilot valve 101 to move upwardly until the ports 96 and 97 are again closed.

25 Upon a decrease in load and increased speed, the oil pressure is increased and raises the pilot valve 101. The port 96 is now in communication with the oil pressure supply port 108 and the port 97 with the discharge port 111. The valve 12 is therefore moved in closing direction until the pilot valve 101 is lowered to normal position through the lever 187.

35 Suppose that, for some reason, the speed of the prime mover increases to more than a predetermined overspeed, usually 10% above normal speed. The autostop governor weight 45, whose center of gravity is offset from the axis of the shaft 13, flies outwardly and strikes the lever 132, which, in turn, disengages the lever 133. The lever 133 is now free to move about the pivot 134, permitting the valve 139 to open under pressure of the 45 oil in the conduit 128.

The oil pressure in the conduit 128 and in the cylinder 21 below the piston 18 is therefore released, whereupon the spring 22 moves the piston 18 downwardly to shut the throttle valve 10, in the same manner as described in connection with Fig. 1.

55 The restricted orifice 126 permits the escape of some oil from the high-pressure conduit 107, but prevents the loss of sufficient oil to destroy the pressure therein.

When the pressure in the conduit 128 is released, the pressure in the chamber 157 is also released through the check valve 174 and the communicating conduits, the check valve opening in this direction. The restricted orifice 172 prevents the escape of sufficient oil into the conduit 169 to destroy the bearing oil pressure. The valve 152 is therefore opened, permitting the release of the pressure in the conduit 116 and in the space above

the pilot valve 101. The oil pressure beneath the latter readily overcomes the spring 184 and moves the pilot valve upwardly, causing a closing of the governor valve 12.

When the cause of the overspeeding has been remedied, the auto-stop mechanism 131 is reset, closing the valve 139. The stem 25 is lowered to close the port 24. Oil from the conduit 107 now flows slowly through the orifice 126 to the cylinder 21, and the piston 18 may be raised by raising the stem 25.

The check valve 174 closes upon restoration of oil pressure in the conduit 173, which is greater than the bearing oil pressure in the conduit 169. The oil pressure in the chamber 157 is also restored by flow of oil through the orifice 172, and the valve 152 is closed, permitting normal operation of the governor.

Assume now that the bearing oil pressure fails, an event unlikely to occur with the present arrangement, although it is possible. The pressure in the chamber 157 would drop, opening the valve 152, and causing closing of the governor valve 12 in the manner described above. The pressure governor 182 would also admit motive fluid to the small turbine 178 for driving the auxiliary oil pump 175, which would provide high-pressure fluid to motivate the ejector 124.

It will be seen from the above description, that I have connected the throttle valve operating mechanism with the fluid pressure governing system in such manner that opening of the throttle valve is at all times dependent upon fluid pressure in the governing system. Should a failure of fluid pressure occur, the throttle valve is closed and cannot again be opened until fluid pressure is restored and then only after the handwheel which controls the throttle valve is brought down to closing position of the valve. It will thus be apparent that the safety of the prime mover is substantially increased.

While I have shown my invention in two forms, it will be obvious to those skilled in the art that it is not so limited, but is susceptible of various other changes and modifications, without departing from the spirit thereof, and I desire, therefore, that only such limitations shall be placed thereupon as are imposed by the prior art or as are specifically set forth in the appended claims.

What I claim is:

1. The combination with a prime mover having a valve for regulating the admission of motive fluid thereto and a throttle valve arranged in series with the regulating valve, of a governing system for said valves comprising means providing a fluid pressure varying as a function of the speed of the prime mover, means for actuating said regulating valve in response to said fluid pressure, means for biasing said throttle valve to closed position, and means for applying fluid pressure from said first-mentioned means

for opening the throttle valve in opposition to said bias.

2. The combination with a prime mover having a valve for regulating the admission of motive fluid thereto and a throttle valve arranged in series with the regulating valve, of a governing system for said valves comprising means operated by the prime mover for developing a fluid pressure varying as a function of the speed of the prime mover, means for actuating said regulating valve in response to said fluid pressure, means for biasing said throttle valve to closed position, means for applying fluid pressure from said first-mentioned means for opening the throttle in opposition to said bias, and means responsive to a predetermined overspeed of the prime mover for releasing the fluid pressure in the last-named means to permit said bias to close the throttle valve.

3. The combination with a prime mover having a valve regulating the admission of motive fluid thereto and a throttle valve arranged in series with the regulating valve, of a governing system for said valves comprising an impeller mounted on a shaft of said prime mover and developing a fluid pressure varying as a function of the speed of the prime mover, means for operating the regulating valve in response to said fluid pressure, means biasing the throttle valve to closed position, means for applying fluid pressure developed by said impeller to open the throttle valve in opposition to said bias, and means responsive to an abnormal operating condition of the prime mover for releasing the fluid pressure in the last-named means to permit said bias to close the throttle valve.

4. The combination with a prime mover having a valve for regulating the admission of motive fluid thereto and a throttle valve arranged in series with the regulating valve, of a governing system for said valves comprising means providing a fluid pressure varying as a function of the speed of the prime mover including fluid-pressure-developing means operated by the prime mover, a fluid pressure relay controlled in response to said variable fluid pressure and actuated by fluid pressure developed by the fluid-pressure-developing means for actuating the regulating valve, a spring for biasing the throttle valve to closed position, means for applying fluid pressure developed by said fluid-pressure-developing means for opening the throttle valve in opposition to the bias of said spring, and means responsive to a predetermined overspeed of said prime mover for releasing the fluid pressure in said last-named means.

In testimony whereof, I have hereunto subscribed my name this first day of August, 1927.

ANTHONY F. SCHWENDNER.