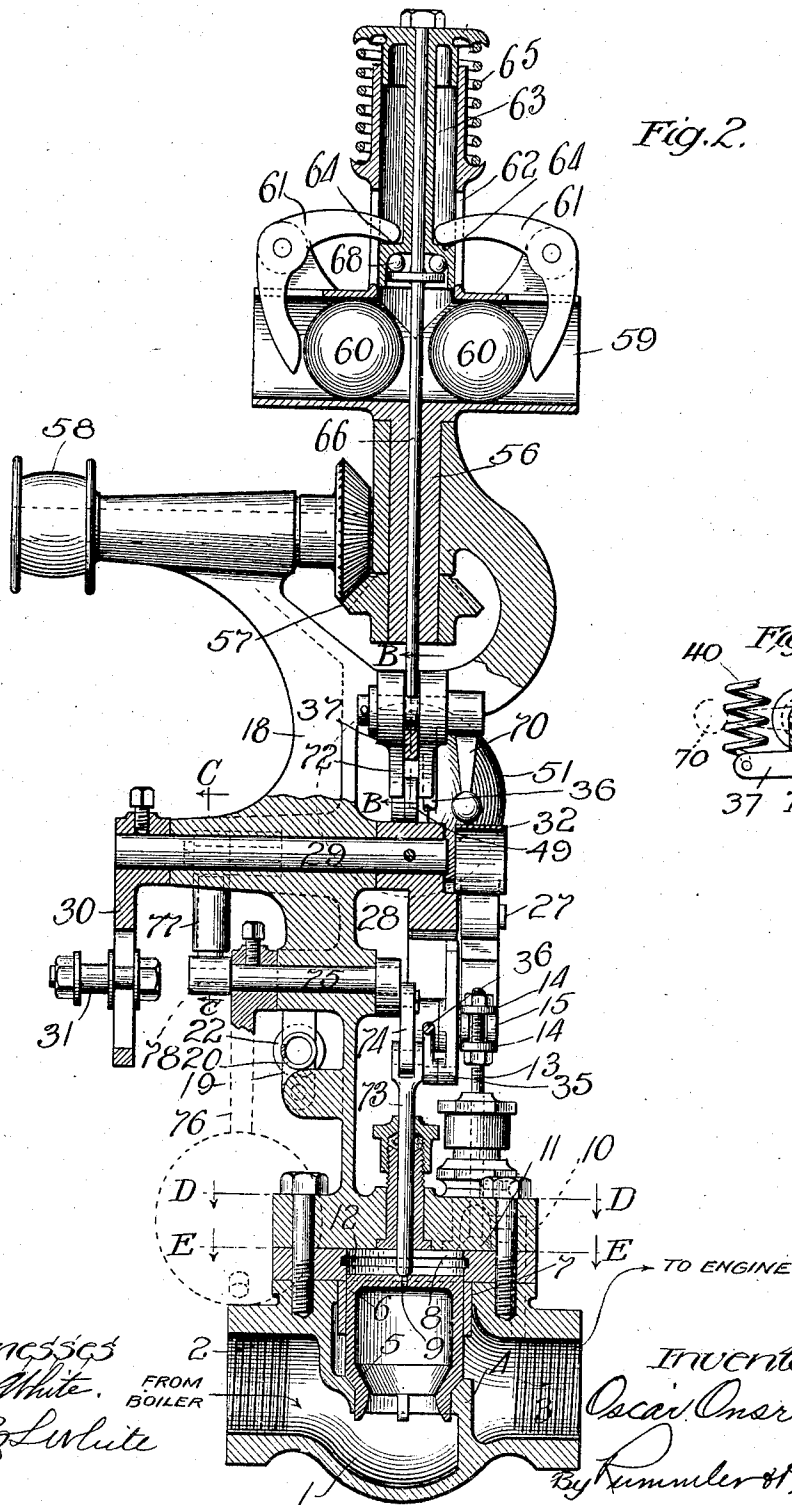


O. ONSRUD.
 AUTOMATIC CUT-OFF GOVERNOR.
 APPLICATION FILED JUNE 5, 1909.

967,963.

Patented Aug. 23, 1910.

4 SHEETS—SHEET 2.



Witnesses
 R. A. White.
 H. R. White

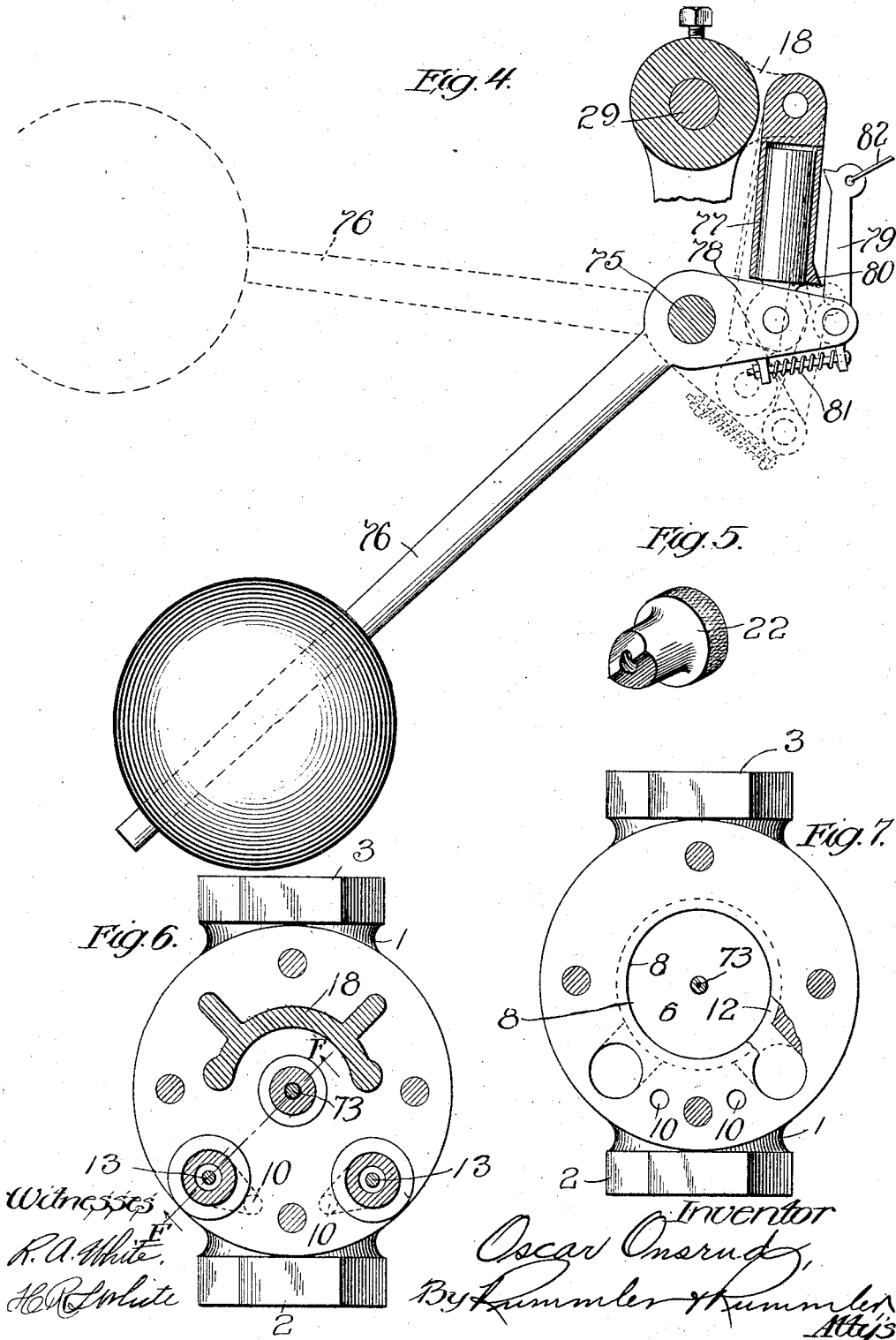
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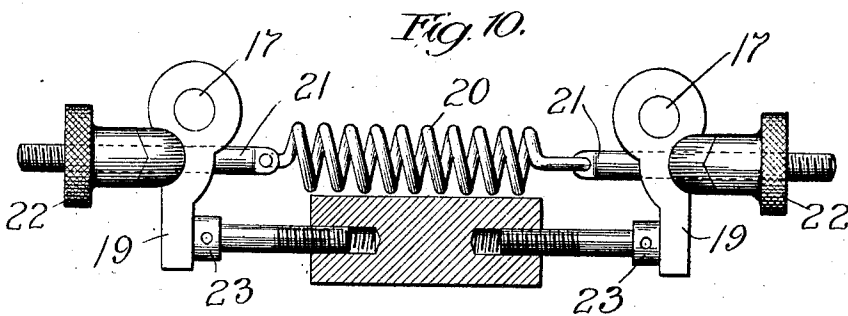
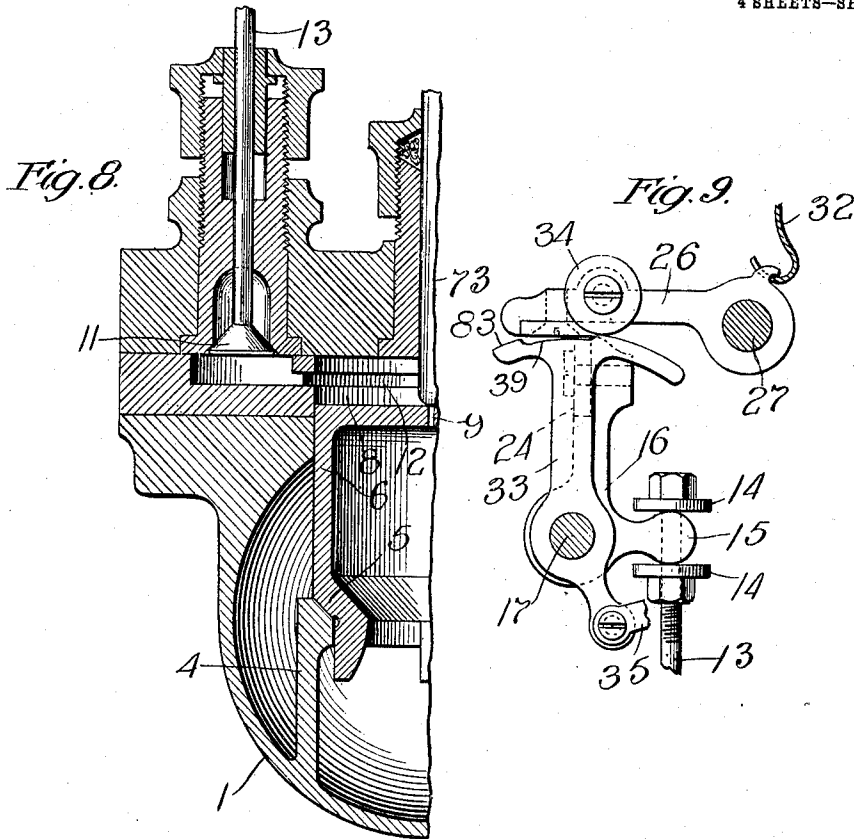


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Witnesses
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UNITED STATES PATENT OFFICE.

OSCAR ONSRUD, OF CHICAGO, ILLINOIS.

AUTOMATIC CUT-OFF GOVERNOR.

967,963.

Specification of Letters Patent. Patented Aug. 23, 1910.

Application filed June 5, 1909. Serial No. 500,344.

To all whom it may concern:

Be it known that I, OSCAR ONSRUD, a citizen of the United States of America, and a resident of Chicago, county of Cook, State of Illinois, have invented certain new and useful Improvements in Automatic Cut-Off Governors, of which the following is a specification.

The main objects of this invention are to provide an improved form of cut-off governor particularly adapted for controlling the operation of an engine by varying the cut-off of the steam supply; to provide a governor of this type which will be sensitive both to changes in the speed of the engine and to fluctuations in the fluid pressure, in cases where all or part of the power of the engine is transmitted by hydraulic or pneumatic means; to provide an improved form of pressure actuated throttling valve; to provide an improved form of governor for controlling the movements of such valve through changes in the speed of the engine or motor; and to provide an improved form of cut-off governor which is sufficiently sensitive to instantly and accurately control the speed of high speed engines.

A specific embodiment of this invention is illustrated in the accompanying drawings, in which:

Figure 1 is a front elevation of an automatic cut-off governor constructed according to this invention and especially designed for controlling the speed of an engine operating an air compressor, some of the parts being shown in section. Fig. 2 is a section on the line A—A of Fig. 1. Fig. 3 is an enlarged sectional detail of the device by means of which the governor is held inoperative until the engine has reached its normal speed after starting, the section being taken on the line B—B of Fig. 2. Fig. 4 is an enlarged detail of the trip mechanism whereby the engine may be instantly stopped from a distant point in case of emergency, some of the parts being in section on the line C—C of Fig. 2. Fig. 5 is a detail of one of the adjusting nuts of the spring shown in Fig. 10. Fig. 6 is a horizontal section on the line D—D of Fig. 2. Fig. 7 is a top plan of the lower part of the valve casing, the parts above the plane of the line E—E being removed. Fig. 8 is an enlarged sectional detail illustrating the construction of the parts adjacent to the auxiliary valves which control the operation of the cut-off valve, the

plane of section being indicated by the line F—F of Fig. 6. Fig. 9 is an enlarged detail of the mechanism for actuating the auxiliary valves. Fig. 10 is a detail of the spring which normally urges the auxiliary valves to their closed positions. Fig. 11 is a diagram showing the general arrangement of a compressor plant equipped with governing cut-off mechanism constructed according to this invention.

The device shown in the drawings is particularly designed for governing an engine and an air compressor, being arranged to be controlled both by the speed of the engine and by the pressure produced by the compressor.

In the form shown, the valve casing 1 is connected in the steam admission conduit leading to the engine. The inlet or high pressure opening of the casing is designated 2, and the outlet or low pressure opening is designated 3. A partition 4 containing a valve seat similar to that in an ordinary "globe" valve extends across the casing between the inlet and outlet openings, and the valve 5 is vertically movable. The upper part of the valve 5 is shaped to form a piston 6, and the upper part of the casing 1 forms a cylinder 7 fitting the piston 6. The chamber 8 in the upper part of the cylinder communicates with the chamber at the high pressure side of the partition 4 through the restricted passage 9 and communicates with the low pressure side of the partition 4 through two passages 10 controlled by auxiliary valves 11. The passages 10 communicate with the chamber 8 of the cylinder through an annular channel 12 in the side walls of the cylinder. The channel 12 is located a considerable distance below the top of the chamber 8, so that the upper part of said chamber will serve as a dash-pot for preventing shock through the sudden lifting of the valve 5 from its seat.

The valves 11 are operated by means of stems 13, each provided at its upper end with a pair of shoulders 14 spaced apart to engage opposite sides of the forked arms 15 of bell cranks or rock-levers 16. There is a rock-lever 16 for each valve 11, and these are rigid on the shafts 17 which carry them, as appears in Fig. 1. The shafts 17 are journaled in fixed bearings in the frame 18 which extends upwardly from the casing 1. At the rearward ends of the shafts 17 are arms 19 between which a tension spring 20

is interposed. Each end of the spring 20 is connected to a threaded rod 21 which has a nut 22 bearing against the respective arm 19. The nuts 22 preferably have wedge-shaped faces fitting similarly grooved faces on the arms 19 so as to prevent the nuts from working loose through the vibration, as will be understood from Fig. 10. The normal limiting position of the arms 19 is determined by stop screws 23, as well as by the engagement of the valves 11 with their seats. The stops 23 are adjusted so as to prevent undue strain upon the valves 11 without preventing them from closing tightly on their seats. The upwardly extending arms of the rock-levers 16 are provided with face plates 24, preferably of hardened steel, for engaging similar hardened face plates 25 on the links 26, by means of which the levers 16 are oscillated. The links 26 are pivotally connected at 27 with a wrist-plate 28 carried by the shaft 29, which also has rigidly mounted thereon at the rear of the frame 18 an arm 30 carrying a wrist-pin 31 which may be connected to an eccentric on the engine. The amplitude of oscillation of the shaft 29, and the consequent stroke of the links 26, is adjustable by shifting the wrist-pin 31 toward or away from the axis of the shaft 29, said wrist-pin being mounted in a slot on the arm 30, as indicated in Fig. 2. The outer ends of the links 26 are normally urged downward into position for causing engagement of the plates 24 and 25 by means of the spring 32 bearing between shoulders on the links, as indicated in Figs. 1 and 9.

In order to permit the links 26 to engage the rock-levers 16 at certain times, and prevent such engagement at other times, there is mounted adjacent to each rock-lever 16 a cam or guide-member 33 which has a guiding surface coacting with a roller 34 on the corresponding link 26. The cams 33 are loosely journaled on the shafts 17 and are connected together by means of a link 35 in such manner that they move equal distances in opposite directions. The guide surfaces of the cams 33 are similarly but oppositely formed, so that each bears the same relation to its respective link 26 as the other does. One of the cams 33 is connected by a link 36 with a controlling lever 37 pivoted at 38 in the supporting frame. The cams 33 have depressions 39 in their guiding surfaces, adapted to allow the links 26 to engage the rock-levers 16 while the rollers 34 traverse the depressions. When the rollers 34 engage the high parts of the cams, the blocks 25 of the links 26 will be lifted clear of the blocks 24 on the rock-levers. The position of the depressions 39 determines the throw of the rock-levers 16 at each stroke of the links. The lever 37 is normally lifted by means of the spring 40

which is arranged to be adjusted by means of the nut 41.

Two governing devices are provided for moving the lever 37, one being controlled by the speed of the engine and being preferably of the centrifugal type, and the other being controlled by the air pressure in the air reservoir, assuming that the device is in use for regulating a plant such as that illustrated diagrammatically in Fig. 11. In Fig. 11 the engine is designated 42 and is connected with the air compressor 43, which supplies air to a receiver 44, from which a pipe 45 delivers the compressed air to the various mechanisms which are operated thereby.

The pressure actuated governor comprises a piston 46 mounted on a cylinder 47 and connected by a double link 48 with a lever 49, fulcrumed at 50 on a bracket on the supporting frame 18. The lever 49 has a weight 51, which normally pulls the piston 46 downward into the cylinder. A projection, preferably in the form of a roller 52, is carried by a sleeve 53 slidably mounted on the lever 49 and adjustable toward and away from the fulcrum. This shoulder bears upon the lever 37 as indicated in Fig. 1. The inlet opening 54 of the cylinder 47 communicates with the compressor through a pipe 55 in such manner that when the pressure reaches a certain maximum the piston 46 will be lifted and will cause the lever 37 to throw the cams 33 into position for preventing engagement between links 26 and the rock-levers 16, and thereby preventing the opening of the valve 5. By adjusting the sleeve 53 along the arm of the lever 49, the pressure governing device may be caused to act at different pressures.

The construction of the centrifugal governor is best seen in Fig. 2. A vertically disposed hollow spindle 56 is journaled in the upper part of the frame 18 and is connected through gears 57 with a driving pulley 58 which is in turn connected by a belt with a rotating part of the engine. The spindle 56 has a pair of tubular cross arms 59, within which are seated a pair of balls 60 loosely fitted within the cylindrical bores of the cross arms 59. The balls are free to roll along said bores. A pair of bell-crank levers 61 are fulcrumed in suitable brackets above the cross arms 59, and each has one arm extending in front of the respective balls 60. The faces of said levers which engage the balls are preferably rounded to such curvature that they bear upon the balls at a point substantially in the axes of the bores of the arms 59. There is a hollow extension 62 of the spindle 56 above the cross arms 59, within which a slide 63 is vertically movable. Arms of the levers 61 bear upon shoulders 64 of this slide and urge the slide downward when the balls 60

tend to roll outward. The slide 63 is normally lifted by means of a spring 65. A rod 66 extends loosely through the spindle 56 and slide 63, and its lower end bears upon the lever 37. There is a ball-bearing at 68 between the rod 66 and the slide 63.

In order to provide for stopping the engine in case the governor belt breaks, the lever 37 is free to move upward a considerable distance beyond its position during the normal running of the engine, and the cams 33 are provided with high surfaces 83 which come into position for engaging the rollers 34 and preventing the links 26 from engaging the levers 16 when the link 37 is at its uppermost position; that is, when the governor is at rest as would be the case when the belt is broken. Under these circumstances the valves 11 would remain closed and the valve 5 would therefore be closed by the pressure in the cylinder 8. In order to hold the cams 33 in position for permitting the starting of the engine, a cam 69 is pivoted above the lever 37 and is provided with a handle 70 by means of which it may be turned so that its high part 71 will bear upon the lever 37 and hold the same in such position that the cams 33 will permit the links 26 to engage the levers 16 for a sufficient length of time, during each oscillation of the wrist-plate, to produce the maximum stroke of the valves 11. The high part 71 of the cam 69 is preferably flattened so that the weighted handle 70 will be held at rest by the pull of the spring 40, in the position shown by dotted lines in Fig. 3. When the cam 69 is set as in Fig. 3 the valve 5 will remain wide open.

Means are provided whereby a person at a distance from the engine may cause the valve 5 to close for stopping the engine. These means comprise a rod 73 extending downward through a stuffing box in the top of the casing and bearing against the piston 6. The rod 73 is connected by means of a link 74 with a wrist-pin carried by the shaft 75 which is journaled to oscillate in the frame 18. A weighted arm 76 carried by the shaft 75 normally urges the rod 73 downward so as to force the valve 5 against its seat. A dash-pot 77 acting between the arm 78 on the shaft 75 and the frame 18 is provided for preventing shock through the sudden falling of the weighted arm 76. The dash-pot and the coating parts are best shown in Fig. 4. In order to support the weighted arm 76 in the elevated position as indicated by dotted lines in Fig. 4, a catch 79 is carried by the arm 76 in position to engage a shoulder 80 on the cylinder of the dash-pot 77. The catch is normally held in position for such engagement by means of a spring 81. The position of the various parts when the catch is in engagement with the shoulder 80 is indicated by said dotted lines

in Fig. 4. A cord 82 or other suitable means is provided for releasing the catch from the shoulder 80. This permits a person at a distance, as, for instance, the operator of a machine which is driven by the power supplied by the engine, to release the catch and thereby stop the engine.

The operation of the device shown is as follows: Assume that the valve casing 1 is connected into the steam inlet pipe of the engine of a plant similar to that indicated diagrammatically in Fig. 11. Normally the arm 76 is lifted and supported in the lifted position by means of the catch 79. This allows the valve 5 to rise freely under the pressure of the steam from the boiler. When the valves 11 are closed so as to cut off communication between the cylinder 8 and the outlet side of the valve casing, the high pressure steam flowing through the restricted passage 9 raises the pressure in the cylinder 8 to equal that at the high pressure side of the valve 5, and said valve will close by gravity. The piston area is greater than the exposed area at the opposite side of the valve 5 when closed, and the pressure in the cylinder 8 holds the valve tightly against its seat. The operation of the engine, however, oscillates the shaft 29 through the eccentric-connection with the wrist-pin 31 and causes the links 26 to alternately engage their respective rock-levers 16 and periodically open the valves 11. When one of the valves 11 opens, the pressure in the cylinder 8 falls to that of the outlet side of the valve casing 1, and the valve 5 is instantly lifted by the higher pressure on its lower side. The upward movement of the valve 5 is checked by the dash-pot formed in the top of the cylinder. During the normal operation of the engine the valve 5 opens whenever one of the valves 11 is open, and closes during intervals when both of the valves 11 are closed. The closing of the valve 5 is cushioned by the current of the steam flowing through the seat. The wrist-pin 30 may, of course, be connected to any rotating or reciprocating part of the engine, but it is preferred to connect it in such manner that one of the valves 11 will open during each forward and backward stroke of the piston of the engine.

If the engine operates at such speed as to cause the compressor to deliver air to the air reservoir more rapidly than it is consumed by the various mechanisms operated by it, then the pressure in the air reservoir would rise. The rise in pressure in the cylinder 47 would lift the piston 46, and through the system of links and levers would swing the cams 33 away from each other so as to cause the links 26 to be lifted clear of the rock-levers earlier in the stroke. This shortens the throw of the valves 11 and thereby reduces the intervals during which

they are open, thus shortening the cut-off of the engine. When the pressure of the reservoir again falls, the cams are moved back through the action of the spring 40 so as to increase the throw of the valves 11. If the speed of the engine exceeds the normal running speed to which the centrifugal governor is adjusted, the balls 60 tend to fly outward and through the levers 61 force the rod 66 downward, depressing the lever 37 and shifting the catch 33 so as to shorten the period of time during which each of the links 26 engages its respective rock-lever 16. This causes the shortening of the cut-off of the engine, as has hereinbefore been described, and reduces the speed.

On starting the engine, the operator lifts the arm 70 to the position shown by the dotted lines in Fig. 3. The pressure of the lever 37 against the flat part 71 of the cam under the action of the spring 40 holds the cam and the arm 70 in this position. This position of the lever 37 turns the cams 33 to such position that they do not interfere with the engagement of the links 26 with the rock-levers 16 and permit the latter to be swung through their full stroke. This causes the valve 5 to remain open so that there is no cut-off, and the engine therefore rapidly acquires full speed. At a certain predetermined speed of the engine the governor causes the rod 66 to press down against the lever 37 and moves it away from the cam 69, whereupon the arm 70 will fall to the position shown by full lines in Fig. 1. The regulation of the cut-off through the automatic action of the governor will then continue as hereinbefore described.

If the governor belt should break, the governor will stop rotating and will no longer press down the rod 66. The spring 40 thereupon lifts the lever 37 above the position in which it is shown in Fig. 1 and swings the cams 33 to such position that the high surfaces 83 will engage the rollers 34 and prevent the links 26 from engaging the rock-levers 16 at all. The valves 11 will then remain closed and the valve 5 will accordingly also close and stop the engine.

Although but one specific embodiment of this invention is herein shown and described it will be understood that numerous details of the construction shown may be altered or omitted within the scope of the following claims without departing from the spirit of this invention.

I claim:

1. A device of the class described, comprising a valve-casing having inlet and outlet openings, a valve controlling communication between said openings, a piston connected with said valve, a cylinder in which said piston is slidable, an inlet-passage connecting said cylinder with said inlet opening, an outlet-passage connecting said cylinder

with said outlet opening, both of said passages communicating with said cylinder at the same side of the piston, an auxiliary valve controlling one of said passages, and mechanism adapted to automatically open said auxiliary valve.

2. A device of the class described, comprising a valve-casing having inlet and outlet openings, a valve controlling communication between said openings, a piston connected with said valve, a cylinder in which said piston is slidable, an inlet-passage connecting said cylinder with said inlet opening, an outlet-passage connecting said cylinder with said outlet opening, both of said passages communicating with said cylinder at the same side of the piston, an auxiliary valve controlling one of said passages, mechanism adapted to automatically open said auxiliary valve, and governing means controlling the operation of said mechanism.

3. A device of the class described, comprising a valve-casing having inlet and outlet openings, a valve controlling communication between said openings, a piston connected with said valve, a cylinder in which said piston is slidable, an inlet-passage connecting said cylinder with said inlet opening, an outlet-passage connecting said cylinder with said outlet opening, both of said passages communicating with said cylinder at the same side of the piston, an auxiliary valve controlling one of said passages, mechanism adapted to automatically open said auxiliary valve, and pressure actuated means controlling the operation of said mechanism.

4. A device of the class described, comprising a valve-casing having inlet and outlet openings, a valve controlling communication between said openings, a piston connected with said valve, a cylinder in which said piston is slidable, an inlet-passage connecting said cylinder with said inlet opening, an outlet-passage connecting said cylinder with said outlet opening, both of said passages communicating with said cylinder at the same side of the piston, an auxiliary valve controlling one of said passages, mechanism adapted to automatically open said auxiliary valve, and a centrifugal governor controlling the operation of said mechanism.

5. A device of the class described, comprising a valve-casing having inlet and outlet openings, a valve controlling communication between said openings, a piston connected with said valve, a cylinder in which said piston is slidable, an inlet-passage connecting said cylinder with said inlet opening, an outlet-passage connecting said cylinder with said outlet opening, both of said passages communicating with said cylinder at the same side of the piston, and a valve controlling said outlet-passage, said inlet-

passage being of restricted cross-section as compared with said outlet-passage whereby the opening of the valve in said outlet-passage will cause said first valve to open.

5 6. The combination of a steam engine, a valve controlling the admission of steam to said engine and being normally urged away from its seat by the pressure of the steam on the inlet side thereof, a piston connected
10 with said valve, a cylinder in which said valve is slidable, an inlet-passage connecting said cylinder with the inlet side of said valve, an outlet-passage connecting said cylinder with the outlet side of said valve, an
15 auxiliary valve controlling said outlet-passage, being normally urged toward a closed position, and means actuated by said engine for alternately opening and closing said valve.

20 7. The combination of a steam engine, a valve controlling the admission of steam to said engine and being normally urged away from its seat by the pressure of the steam on the inlet side thereof, a piston connected
25 with said valve, a cylinder in which said valve is slidable, an inlet-passage connecting said cylinder with the inlet side of said valve, means controlling communication between said cylinder and the low pressure
30 side of said valve, and means adapted to actuate said communication controlling means through each stroke of the engine.

8. A device of the class described, comprising a valve-casing having inlet and outlet openings, a valve controlling communication between said openings, a piston connected with said valve, a cylinder in which said piston is slidable, an inlet-passage connecting said cylinder with said inlet opening,
40 an outlet-passage connecting said cylinder with said outlet opening, both of said passages communicating with said cylinder at the same side of the piston, an auxiliary valve controlling one of said passages, means
45 normally urging said auxiliary valve to its closed position, a rock-lever operatively connected with said auxiliary valve for opening it, a link mounted to reciprocate and adapted to engage said rock-lever for oscillating
50 it, said link being normally urged into position for engaging said rock-lever, a cam movably mounted adjacent to said rock-lever and movable into and out of position for preventing the operative engagement of said
55 link with said rock-lever, and governing means adapted to automatically move said cam.

9. A device of the class described, comprising a valve-casing having inlet and outlet openings, a valve controlling communication between said openings, a piston connected with said valve, a cylinder in which said piston is slidable, an inlet-passage connecting said cylinder with said inlet opening,
60 an outlet-passage connecting said cylinder with said outlet opening, both of said passages communicating with said cylinder at the same side of the piston, an auxiliary valve controlling one of said passages, means
65 normally urging said auxiliary valve to its closed position, a rock-lever operatively connected with said auxiliary valve for opening it, a link mounted to reciprocate and adapted to engage said rock-lever for oscillating it, said link being normally urged into position for engaging said rock-lever, a cam movably mounted adjacent to said rock-lever and movable into and out of position for preventing the operative engagement of said link with said rock-lever, and governing means adapted to automatically move said cam.

inder with said outlet opening, both of said passages communicating with said cylinder at the same side of the piston, an auxiliary valve controlling one of said passages, means normally urging said auxiliary valve to its closed position, a rock-lever operatively connected with said auxiliary valve for opening
70 it, a link mounted to reciprocate and adapted to engage said rock-lever for oscillating it, said link being normally urged into position for engaging said rock-lever, a cam movably mounted adjacent to said rock-lever and movable into and out of position for preventing the operative engagement of said
75 link with said rock-lever, a lever connected with said cam for shifting it into and out of position for preventing engagement between said link and lever, and a centrifugal governor acting on said lever and adapted to shift said cam so as to shorten the duration of such engagement through increase
80 in the speed of said governor.

10. A device of the class described, comprising a valve-casing having inlet and outlet openings, a valve controlling communication between said openings, a piston connected with said valve, a cylinder in which said piston is slidable, an inlet-passage connecting said cylinder with said inlet opening, a pair of outlet-passages connecting said
90 cylinder with said outlet and communicating with said cylinder at the same side of the piston as does said inlet-passage, a pair of auxiliary valves respectively controlling said outlet-passages, rock-levers for operating said auxiliary valves, a spring acting between said rock-levers and normally urging
95 said valves to their closed positions, a wrist-plate mounted to oscillate, a pair of links pivotally connected to said wrist-plate and respectively adapted to engage said rock-levers during opposite movements of said wrist-plate, said links being normally urged into position for engaging their respective
100 rock-levers, cams pivotally mounted adjacent to said rock-levers and movable into and out of position for preventing said links from engaging said rock-levers, and governing means connected with said cams and adapted to shift them automatically.
105 115

11. A device of the class described, comprising a valve-casing having inlet and outlet openings, a valve controlling communication between said openings and movable to open and closed positions through changes
120 in the relative pressures at opposite sides thereof, means adapted to close said valve independently of the pressures thereon, and adapted to hold said closing means in a retracted position.
125

12. A device of the class described, comprising a valve-casing having inlet and outlet openings, a valve controlling communication between said openings and movable to open and closed positions through changes
130

in the relative pressures at opposite sides thereof, means adapted to close said valve independently of the pressures thereon, and adapted to hold said closing means in a retracted position, and means for releasing said trip from a distance.

13. The combination of an engine, a valve controlling the admission of steam to said engine and a governor arranged to control the opening and closing of said valve, said governor comprising a vertically disposed spindle connected to the engine and adapted to be rotated thereby, a head on said spindle having thereon a plurality of symmetrically radial runways, a plurality of balls respectively mounted in individual runways, an individual lever pivotally mounted adjacent to each runway and extending into engagement with the respective ball, a rod extending longitudinally through said spindle and having a limited vertical movement thereon, means normally urging said rod toward one limit of its movement, said levers being arranged to cause said rod to be shifted toward the opposite limit of its movement through the shifting of said balls due to change in the speed of rotation of said spindle, and means interposed between said rod and valve whereby said valve will be controlled by the movements of said rod.

14. The combination of an engine, a valve controlling the admission of steam to said engine and a governor arranged to control the opening and closing of said valve, said governor comprising a vertically disposed spindle connected to the engine and adapted to be rotated thereby, a head on said spindle having thereon a plurality of symmetrically radial runways, a plurality of balls respectively mounted in individual runways, an individual lever pivotally mounted adjacent to each runway and extending into engagement with the respective ball, said levers having curved faces for engaging said balls and the curvature of said faces being such that said levers and balls will at all times contact with each other at a point located in the axis of the respective runway, a rod extending longitudinally through said spindle and having a limited vertical movement thereon, means normally urging said rod toward one limit of its movement, said levers being arranged to cause said rod to be shifted toward the opposite limit of its movement through the shifting of said balls due to change in the speed of rotation of said spindle, and means interposed between said rod and valve whereby said valve will be controlled by the movements of said rod.

15. In a device of the class described, the combination of a valve-casing having inlet and outlet-chambers, a partition extending between said chambers, an opening in said partition, a valve controlling said opening

side of the partition, a cylinder formed by said casing and fitting said piston, a chamber in said cylinder separated from said inlet and outlet-chamber, a restricted inlet-passage connecting said cylinder-chamber with said inlet-chamber, an outlet-passage connecting said cylinder-chamber with said outlet-chamber, an auxiliary valve controlling said outlet-passage, governing means for automatically operating said auxiliary valve, said piston being of greater area than the opening in said partition whereby said valve will be opened through the pressure thereon when said auxiliary valve is opened and will automatically close when said auxiliary valve is closed so as to permit the pressure in said cylinder-chamber to become equal to that of said inlet-chamber through the flow of steam through said inlet-passage.

16. In a device of the class described, the combination of a valve-casing having inlet and outlet-chambers, a partition extending between said chambers, an opening in said partition, a valve controlling said opening and being shaped to form a piston at one side of the partition, a cylinder formed by said casing and fitting said piston, a chamber in said cylinder separated from said inlet and outlet-chamber, a restricted inlet-passage connecting said cylinder-chamber with said inlet-chamber, an outlet-passage connecting said cylinder-chamber with said outlet-chamber, an auxiliary valve controlling said outlet-passage, governing means for automatically operating said auxiliary valve, said piston being of greater area than the opening in said partition whereby said valve will be opened through the pressure thereon when said auxiliary valve is opened and will automatically close when said auxiliary valve is closed so as to permit the pressure in said cylinder-chamber to become equal to that of said inlet-chamber through the flow of steam through said inlet-passage and said cylinder-chamber being extended a considerable distance beyond the point where said outlet-passage opens into it so as to provide a dash-pot for checking the opening of said valve.

17. In a cut-off governor, the combination of a cut-off valve normally urged to its closed position, mechanism for automatically opening said valve, a centrifugal governor, means controlling the opening and closing of said valve, said means being actuated by said governor and movable in one direction to lengthen the cut-off through reduction in the speed of rotation of said governor, and said means being movable still farther in said one direction to prevent said mechanism from opening said valve.

18. The combination of an engine, a cut-off valve controlling the engine and normally urged to a closed position, means ac-

tuated intermittently by the engine for opening said valve, a centrifugal governor driven by the engine, and means actuated by the governor and controlling the operation of said valve opening means, said controlling means being movable in one direction to shorten the cut-off through increase of the speed of the governor, being movable in the other direction to lengthen the cut-off through reduction of the speed of the governor, and being movable still farther in the last named direction to prevent said valve opening means from opening said valve when said governor is at rest.

19. A device of the class described, comprising a valve-casing having inlet and outlet openings, a valve controlling communication between said openings, a piston connected with said valve, a cylinder in which said piston is slidable, an inlet-passage connecting said cylinder with said inlet opening, an outlet-passage connecting said cylinder with said outlet opening, both of said passages communicating with said cylinder at the same side of the piston, an auxiliary valve controlling one of said passages, means normally urging said auxiliary valve to its closed position, a rock-lever operatively connected with said auxiliary valve for opening it, a link mounted to reciprocate and adapted to engage said rock-lever for oscillating it, said link being normally urged into position for engaging said rock-lever, a cam movably mounted adjacent to said rock-lever and movable into and out of position for preventing the operative engagement of said link with said rock-lever, a centrifugal governor adapted to move said cam, said cam having a part adapted to hold said link out of engagement with said rock-lever during the entire stroke of said link when said governor is at rest, means for holding said cam in position for permitting the engagement of said link and rock-lever while said governor is at rest, said means being adapted to be released by said governor when the governor acquires a certain predetermined speed of rotation.

20. A device of the class described, comprising a valve-casing having inlet and outlet openings, a valve controlling communication between said openings, a piston con-

nected with said valve, a cylinder in which said piston is slidable, an inlet-passage connecting said cylinder with said inlet opening, an outlet-passage connecting said cylinder with said outlet opening, both of said passages communicating with said cylinder at the same side of the piston, an auxiliary valve controlling one of said passages, means normally urging said auxiliary valve to its closed position, a rock-lever operatively connected with said auxiliary valve for opening it, a link mounted to reciprocate and adapted to engage said rock-lever for oscillating it, said link being normally urged into position for engaging said rock-lever, a cam movably mounted adjacent to said rock-lever and movable into and out of position for preventing the operative engagement of said link with said rock-lever, a centrifugal governor adapted to move said cam, said cam having a part adapted to hold said link out of engagement with said rock-lever during the entire stroke of said link when said governor is at rest, means for holding said cam in position for permitting the engagement of said link and rock-lever while said governor is at rest, said means being adapted to be released by said governor when the governor acquires a certain predetermined speed of rotation.

21. In a cut-off governor, the combination of a cut-off valve, a centrifugal governor controlling the opening and closing of said valve, means adapted to shorten the cut-off through increase in the speed of rotation of said governor, and to lengthen the cut-off through reduction of the speed, said means including a cam surface for effecting automatic closure of said valve when said governor is at rest.

Signed at Chicago this 29th day of May, 1909.

OSCAR ONSRUD.

Witnesses:

EUGENE A. RUMMLER,
MARY M. DILLMAN.