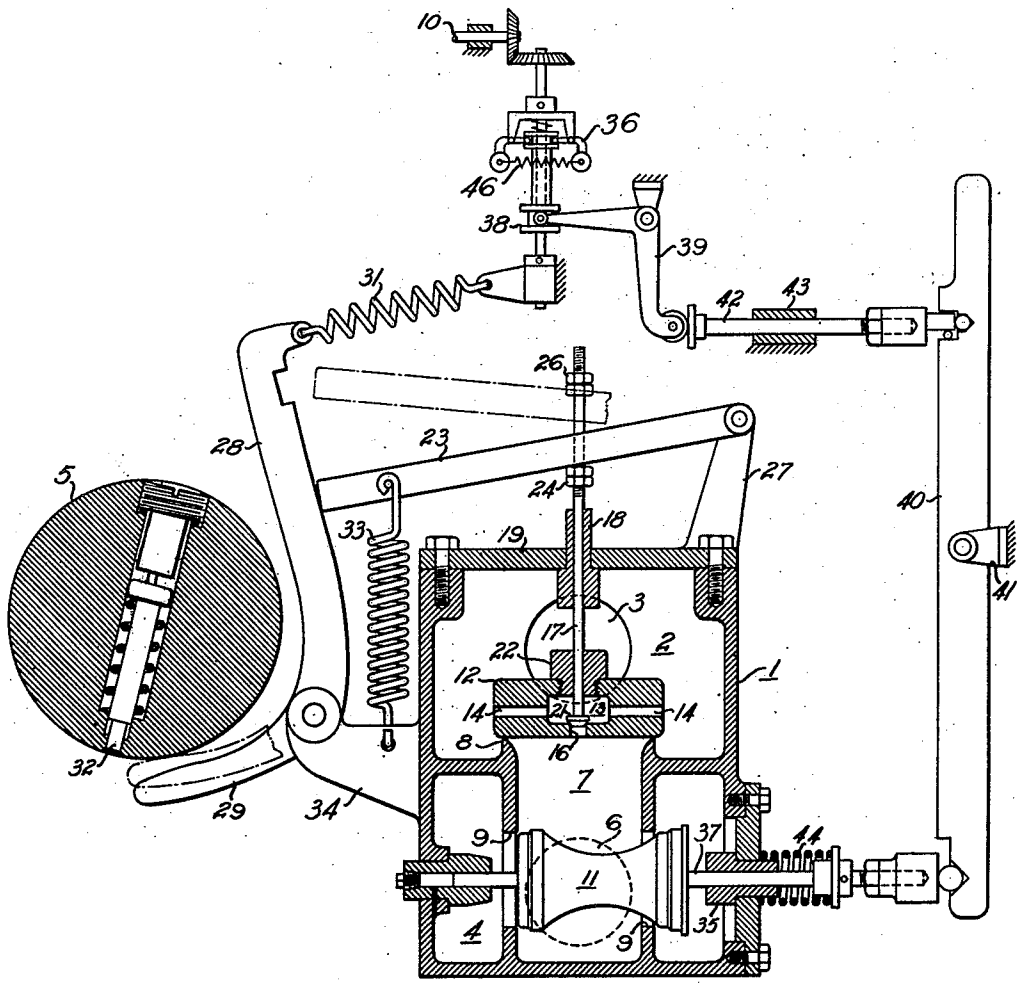
Sept. 23, 1952 E. M. KUEMMERLEIN ET AL 2,611,382

OVERSPEED TRIP VALVE MECHANISM

Filed March 15, 1946



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Patented Sept. 23, 1952

2,611,382

UNITED STATES PATENT OFFICE

2,611,382

OVERSPEED TRIP VALVE MECHANISM

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Application March 15, 1946, Serial No. 654,758

9 Claims. (Cl. 137—57)

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This invention relates generally to governing apparatus of the type including an overspeed responsive mechanism operatively associated with a driven part of a prime mover and with a valve or other means controlling delivery of motive fluid to the prime mover in a manner effective to terminate the delivery of such fluid in response to the prime mover attaining or exceeding a predetermined speed.

Some types of prime movers, especially elastic fluid turbines, include a trip valve disposed in series with the usual governor actuated regulating valve. And this trip valve is held in its fully open position by a part of the overspeed mechanism until the speed of the prime mover becomes excessive whereupon such part is released and the trip valve is immediately closed through the action of a spring, counterweights and/or other suitable devices.

When in its fully closed position, an opening movement of the trip valve is resisted by the pressure of the motive fluid on the upstream side of the valve (the pressure of any fluid remaining in the conduit on the downstream side of the trip valve is very low) and by the action of the above mentioned springs and counterweights. Consequently, it is difficult, if not impossible, for a person to reopen and reset the trip valve without the aid of additional valve means effective to initially approximately balance the fluid pressures acting on opposite sides of the valve and without the aid of an opening force applying apparatus, such as gearing and/or an electric motor, servomotor, or the like, effective to overcome the continuously acting closing force of the usual springs and/or counterweights.

However, the provision of a manually operated gearing is objectionable in that considerable time is required to fully reopen and reset the valve. And although a power actuated valve opening apparatus of the type above mentioned and heretofore employed in general operates satisfactorily, such apparatus is relatively expensive to manufacture and install and in many cases requires a considerable amount of service in order to insure satisfactory operation at all times.

The present invention is directed toward and has as an object the provision of an improved trip valve mechanism permitting the valve to be readily reopened and reset with a minimum number of parts constructed and combined to afford a simplified, durable and relatively inexpensive construction.

More particularly, the present invention is directed toward and has as a further object the provision of an improved trip valve mechanism including a main valve and a pilot valve combined for limited relative movement and operatively connected with a releasably latched valve closing member in a manner effective to immediately close the trip valve upon releasing such member and effective to immediately reopen the trip valve upon moving the member to its latched position.

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The construction, application and operation of apparatus embodying the invention will become readily apparent as the disclosure progresses and particularly points out additional objects and advantages considered of special importance. And accordingly the present invention may be considered as consisting of the various elements and/or parts constructed and combined in general as hereinafter more fully set forth in the detailed description and appended claims, reference being had to the accompanying drawing illustrating one embodiment of the invention and in which:

The figure illustrates, in part schematically, a motive fluid controlling and regulating apparatus embodying parts constructed and combined in accordance with the invention.

In the illustrated embodiment of the invention, 1 designates a valve casing internally partitioned to provide a chamber 2 having an inlet 3 connected with a suitable source of motive fluid (not shown), a chamber 4 having a motive fluid outlet 6 through which motive fluid flows to a prime mover of which only the rotating parts 5 and 10 are shown, and a passage 7 placing chamber 2 in communication with chamber 4. Passage 7 is formed in part by an upper valve seat 8 and in part by a pair of spaced coaxial valve seats 9. A balanced throttle or regulating valve 11, adapted to engage valve seats 9, controls the flow of motive fluid from passage 7 into chamber 4. And a trip valve mechanism including a main valve 12 and pilot valve 21 operable to cause the valve 12 to engage valve seat 8 controls the flow of motive fluid from chamber 2 into passage 7.

Valve 12 is constructed to include duct means comprising a central chamber 13, a pair of laterally extending ducts 14 placing chamber 13 in continuous communication with chamber 2, and a duct 16 extending coaxially from chamber 13 and through the downstream face of the valve. A rod or actuator 17 is reciprocably mounted in a bushing 18 carried by a removable cover portion 19 of casing 1 in coaxial relation with respect to passage 7 and valve seat 8 and the

inner end of rod 17 is enlarged to provide a pilot valve part 21. Valve 12 is coaxially reciprocably mounted on rod 17 by means of a removable bushing 22 positioning and retaining pilot valve part 21 within chamber 13 in coaxial controlling relation with respect to duct 16. The part 21 is reciprocably movable within the chamber 13 independently of the movement of valve 12 to afford a lost motion connection means. And it should now be obvious that rod 17 can be moved coaxially longitudinally toward or away from annular valve seat 8 and that rod 17 may be moved coaxially relative to valve 12 or valve 12 may move coaxially longitudinally of rod 17, until the pilot valve part 21 thereof either engages the underside of bushing 22 or the seat therefor defining the chamber end of duct 16.

The outer end portion of rod 17 passes through or closely adjacent an intermediate portion of a lever 23 and is provided with a pair of longitudinally spaced stop parts 24 and 26 adapted to limit relative movement of the rod and lever. One end of lever 23 is pivotally supported on a fixed bracket 27 and its other end is operatively associated with a notched latch arm 28 of a pivotally mounted element having a trip arm 29 normally positioned, by means of a weak spring 31, for actuation by a conventional overspeed responsive device 32 carried by rotating prime mover part 5. A strong spring 33 connects the latch arm end of lever 23 with a fixed bracket 34 and thus continuously acts to move lever 23 to its full line position shown in the drawing. When in this position, the free end of lever 23 abuts latch arm 28 and holds trip arm 29 out of the path of overspeed device 32. The foregoing structure, with the lost motion connection means including part 21, provides an operating means for seating the valve 12 and releasing the valve for opening movement.

As illustrated, the position of throttle valve 11 is controlled by a centrifugal governor 36 driven by the rotating prime mover part 10. Valve 11 is provided with a stem 37 reciprocably mounted in a bushing 35 carried by casing 1. And an operative connection between stem 37 and the flyball actuated collar 38 of governor 36 may include a bell crank lever 39 having one arm engaged with collar 38, a lever 40 fulcrumed intermediate its ends on a bracket 41 and having one end operatively connected with valve stem 37, and a rod 42 reciprocably mounted in a guide bushing 43 and having one end engaged with the other arm of bell crank lever 39 and having its other end engaged with the other end of lever 40. A spring 44 surrounds stem 37 and continuously acts through a collar carried by the stem to maintain same operatively engaged with lever 40 and the latter operatively engaged with rod 42. A similar function is also performed by the usual governor spring designated 46. And since valve 11 is of the balanced type, it should be obvious that a person can readily close same merely by pulling on the upper end of lever 40.

With the various parts positioned as shown, all that has to be done in order to open and reset trip valve 12 is to raise lever 23 until the free end thereof is disposed in the retaining notch shown in the opposed face of latch arm 28, thereby resetting the latch for subsequent trip by overspeed device 32 and then pull on lever 40 so as to momentarily close throttle valve 11. In this connection, the longitudinal spacing of stop parts 24 and 26 on rod 17 is such that just before lever 23 enters the retaining notch in latch arm 28, the intermediate portion of the lever engages part 26 and moves rod 17 upward a slight distance relative to valve 12 thereby opening duct 16 and placing passage 7 in communication with chamber 2. And since valve 11 is then closed, the pressure immediately builds up in passage 7 to a value equal to that in chamber 2 whereupon valve 12 is forced upward due to the fact that by upward movement of the valve body 21 against the outside of the bushing 22 the effective area of the downstream face of this valve is greater than the effective area of the upstream face thereof by an amount equal to the cross-sectional area of rod 17. Initial upward movement of valve body 21 takes place by reason of lifting of lever 23 and further upward movement so that the valve body 21 engages the under side of bushing 22 may be produced by any suitable means, in this instance the difference in effective areas of the valve body 21 and the rod 17, whereupon valve 12 and rod 17 then move upward as a unit until bushing 22 engages the adjacent end of casing mounted bushing 18. And in this connection it should be borne in mind that the longitudinal spacing of stop parts 24 and 26 must be such that when valve 12 is in its fully open position as determined by the above mentioned engagement of bushings 18 and 22, stop part 24 is in proximity to or just about to engage the underside of lever 23.

It should now be obvious that as long as lever 23 is retainably engaged by latch arm 28, valve 12 will be held in its fully open position by the pressure of the motive fluid in chamber 2, and that if the supply of motive fluid to chamber 2 should for any reason fail, valve 12 will immediately gravitate downward and engage seat 8. However, it should also be obvious that in the event such a condition should occur, bypass duct 16 will remain open since a like downward movement of rod 17 will be arrested by engagement of its stop part 26 with the upper side of latched lever 23, and that as soon as the supply of motive fluid is reestablished, valve 12 and rod 17 will again move upward until bushing 22 engages bushing 18 as previously described.

Apparatus embodying the present invention may be of a form or construction considerably different from that herein shown and described for purposes of illustraton. And it should therefore be understood that it is not intended to limit the invention to details of the particular construction herein disclosed as various modifications within the scope of the appended claims may occur to persons skilled in the art.

It is claimed and desired to secure by Letters Patent:

1. A trip valve mechanism comprising a casing having a valve seat therein, a rod mounted in said casing for longitudinal movement toward or away from said seat and including an enlarged pilot valve portion adjacent the seat end thereof, said rod being disposed in upstream relation with respect to said seat and having a portion projecting externally of said casing and provided with a pair of longitudinally spaced stop parts, a main valve body adapted to engage said seat and having a fluid bypass duct extending therethrough and including an enlarged intermediate portion providing a valve chamber with a seat in a wall portion thereof for controlling said bypass duct, said main valve body being reciprocably mounted on the inner end of said rod with the pilot valve portion thereof disposed within said chamber for limited movement

toward or away from the valve seat therein, said rod and said main valve body being freely movably mounted to move as a unit in response to fluid pressure on the downstream side of said unit, a member movable longitudinally of said rod and relative thereto for a distance determined by the longitudinal spacing of said stop parts, means continuously acting to move said member into engagement with one of said stop parts to thereby produce a movement of said valve rod sufficient to firmly engage the pilot valve end thereof and said main valve body with their respective valve seats, a releasable element for latching said member in a position such that a movement of said member into latching engagement with said element causes said member to first engage the other one of said stop parts and thereby produce a movement of said rod and said pilot valve sufficient to open said bypass duct and further movement of said rod and opening movement of said main valve body in response to fluid pressure on the downstream side of said pilot valve and main valve body, and means for terminating the further movement of said rod and the opening movement of said main valve body with said one of said stop parts disposed in proximity to said member when the latter is in latched engagement with said element.

2. A trip valve mechanism comprising a casing having a valve seat therein, a rod mounted in said casing for longitudinal movement toward or away from said seat and including an enlarged pilot valve portion adjacent the seat end thereof, said rod having a portion projecting externally of said casing and provided with a pair of longitudinally spaced stop parts, a main valve body adapted to engage said seat and having a fluid bypass duct extending therethrough and including an enlarged intermediate portion providing a valve chamber with a seat in a wall portion thereof for controlling said bypass duct, said main valve body being reciprocably mounted on the inner end of said rod with the pilot valve portion thereof disposed within said chamber for limited movement toward or away from the valve seat therein, said rod and said main valve body being freely movably mounted to move as a unit in response to fluid pressure on the downstream side of said unit, a member movable longitudinally of said rod and relative thereto for a distance determined by the longitudinal spacing of said stop parts, means continuously acting to move said member into engagement with one of said stop parts to thereby produce a movement of said valve rod sufficient to firmly engage the pilot valve end thereof and said main valve body with their respective valve seats, and a releasable element for latching said member in a position such that a movement of said member into latching engagement with said element causes said member to first engage the other one of said stop parts and thereby produce a movement of said rod and said pilot valve sufficient to open said bypass duct.

3. A trip valve mechanism comprising a casing having a valve seat therein, a rod mounted in said casing for longitudinal movement toward or away from said seat, said rod having a portion projecting externally of said casing and provided with a pair of longitudinally spaced stop parts, a main valve body and a pilot valve body carried by the casing enclosed end portion of said rod for limited longitudinal movement relative to each other, said main valve body being adapted to engage said seat and having a bypass

duct extending therethrough and including a seat portion controlled by said pilot valve body, said rod and said main valve body being freely movably mounted to move as a unit in response to fluid pressure on the downstream side of said unit, a member movable longitudinally of said rod and relative thereto for a distance determined by the longitudinal spacing of said stop parts, means continuously acting to move said member into engagement with one of said stop parts to thereby produce a movement of said rod sufficient to firmly engage said pilot and main valve bodies with their respective valve seats, a releasable element for latching said member in position such that a movement of said member into latching engagement with said element causes said member to first engage the other one of said stop parts and thereby produce a movement of said rod and of said pilot valve body sufficient to open said bypass duct and further movement of said rod and opening movement of said main valve body in response to fluid pressure on the downstream side of said pilot valve and main valve body, and means carried by said casing for terminating the further movement of said rod and the opening movement of said main valve body with said one of said stop parts disposed in proximity to said member when the latter is in latched engagement with said element.

4. A trip valve mechanism comprising a casing having a valve seat therein, an actuator having an end portion disposed within said casing for movement generally toward or away from said seat, said actuator having an external portion provided with a pair of spaced stop parts, a main valve body and a pilot valve body carried by the casing enclosed end portion of said actuator for limited movement relative to each other, said main valve body being adapted to engage said seat and having a bypass duct extending therethrough and including a seat portion controlled by said pilot valve body, said actuator and said main valve body being freely movably mounted to move as a unit in response to fluid pressure on the downstream side of said unit, a member movable in a path adjacent said actuator and relative thereto for a distance determined by the spacing of said stop parts, means continuously acting to move said member into engagement with one of said stop parts to thereby produce a movement of said actuator sufficient to firmly engage said pilot and main valve bodies with their respective seats, and a releasable element for latching said member in a position such that a movement of said member into latching engagement with said element causes said member to first engage the other one of said stop parts and thereby produce a movement of said actuator and of said pilot valve body sufficient to open said bypass duct.

5. A trip valve for controlling fluid pressure flow to a prime mover responsive to overspeed thereof and comprising a casing having a passage therein for fluid pressure flow and providing a valve seat, a main valve cooperable with said seat for closing the passage in said casing, said main valve having a bypss duct therethrough, a pilot valve for controlling flow of fluid pressure through said bypass duct and into said casing passage, a rod connected with said pilot valve for operating the same and extending outside of said casing, spaced stops on the portion of said rod outside of said casing, a lever engageable with said stops for lifting said pilot valve from the seat therefor

and for pressing said pilot valve on the seat therefor, means urging said lever toward one of said stops in the direction for pressing said pilot valve and said main valve on the seats therefor, movement of said lever into engagement with the other of said stops causing opening of said pilot valve and opening of said pilot valve causing fluid pressure produced further opening movement of said pilot valve and fluid pressure produced opening of said main valve, and a lever for releasably latching the said first lever in the pilot valve opening position.

6. A trip valve for controlling fluid pressure flow to a prime mover, comprising: a casing having a passage therein for fluid pressure flow and providing a valve seat, a main valve cooperable with said seat for closing the passage, said main valve having a bypass duct therethrough, a pilot valve for controlling flow of fluid pressure through said bypass duct and into said casing passage to equalize fluid pressure on both sides of the main valve and cause opening of said main valve solely by fluid pressure, a rod connected with said pilot valve for operating the same and extending outside of said casing, a first lever having lost motion connection with said rod outside of said casing and engageable with said rod to move said rod in either valve closing or valve opening direction and having biasing means acting on said lever to move same in valve closing direction, and a lever for releasably latching said first lever in pilot valve opening position.

7. Operating fluid control apparatus for a prime mover operable by fluid, comprising: conductor means for said fluid having interposed therein regulating valve means and having biasing means operative to move said regulating valve means toward open position; speed responsive means; means for connecting said speed responsive means to said regulating valve means for causing opening or closing movement of said regulating valve means in response to decrease or increase respectively of the speed of said prime mover in a predetermined range of speeds, said connecting means comprising a portion movable at will for closing said regulating valve means separately from said speed responsive means; trip valve means interposed in said conductor means upstream of said regulating valve means, said trip valve means having a stem extending exteriorly of said conductor means; operating means having lost motion connection with said stem, said operating means engaging said stem in valve opening direction in a first position and in valve closing direction in a second position; means biasing said operating means in valve closing direction; latch means for releasably holding said operating means in said first position; second speed responsive means separate from said first named speed responsive means and responsive to predetermined excess speed to release said operating means from said first position to close said trip valve means; and means operative when said operating means is returned to said first position for causing opening of said trip valve means upon closure of said regulating valve means by said portion.

8. A trip valve for controlling fluid pressure flow to a prime mover responsive to overspeed thereof, and comprising a casing having a passage therein for fluid pressure flow and providing a valve seat, a valve cooperable with said seat for closing said passage, means for supporting said valve for guided movement toward and away from said seat, and operating means having an actuable portion extending exteriorly of said casing and having a lost motion connection means with said valve for positively moving said valve against said seat by movement of said operating means to a first position, movement of said operating means to an opposite second position leaving said valve free to be moved to open position, said valve including duct means extending therethrough for placing an upstream portion of said passage in communication with a downstream portion thereof when said valve is in its closed position, said lost motion connection means including a part operable to close said duct means when said operating means is in said first position and operable to at least partially open said duct means when said operating means is in said second position, and said exterior actuable portion and the upstream side of said valve presenting an effective area somewhat less than that presented by the downstream side thereof whereby when the pressure in said passage is equalized on opposite sides of said valve, said valve will automatically move to a predetermined open position.

9. A trip valve for controlling fluid pressure flow to a prime mover responsive to overspeed thereof, and comprising a casing having a passage therein for fluid pressure flow and providing a valve seat, a valve cooperable with said seat for closing said passage, means for supporting said valve for guided movement toward and away from said seat, operating means having an actuable portion extending exteriorly of said casing and having a lost motion connection means with said valve for positively moving said valve against said seat by movement of said operating means to a first position, movement of said operating means to an opposite second position leaving said valve free to be moved to open position, and means for releasably latching said operating means in said second position, said valve including duct means extending therethrough for placing an upstream portion of said passage in communication with a downstream portion thereof when said valve is in its closed position, said lost motion connection means including a part operable to close said duct means when said operating means is in said first position and operable to at least partially open said duct means when said operating means is in said second position, and said exterior actuable portion and the upstream side of said valve presenting an effective area somewhat less than that presented by the downstream side thereof whereby when the pressure in said passage is equalized on opposite sides of said valve, said valve will automatically move to a predetermined open position.

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