United States Patent [19]

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[11] **3,746,299**

[45] **July 17, 1973**

[54] **QUICK OPERATING DEVICE FOR A VALVE**

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[22] Filed: **July 19, 1971**

[21] Appl. No.: **163,582**

[52] **U.S. Cl.** **251/25,** 251/73

[51] **Int. Cl.** **F16k 31/143**

[58] **Field of Search** 251/73, 27, 136, 251/25

[56] **References Cited**

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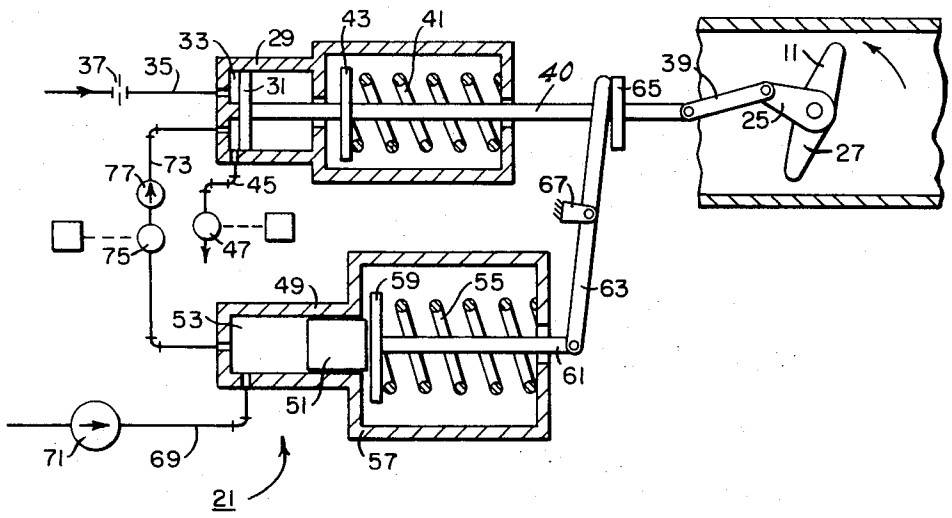
[57] **ABSTRACT**

A mechanism utilizing a pair of cooperatively associated hydraulic cylinders and springs for absorbing and storing the energy produced by slowing down a large on-off type valve having a fast closing action as the valve approaches its closed position and releasing the energy to open the valve quickly.

8 Claims, 2 Drawing Figures



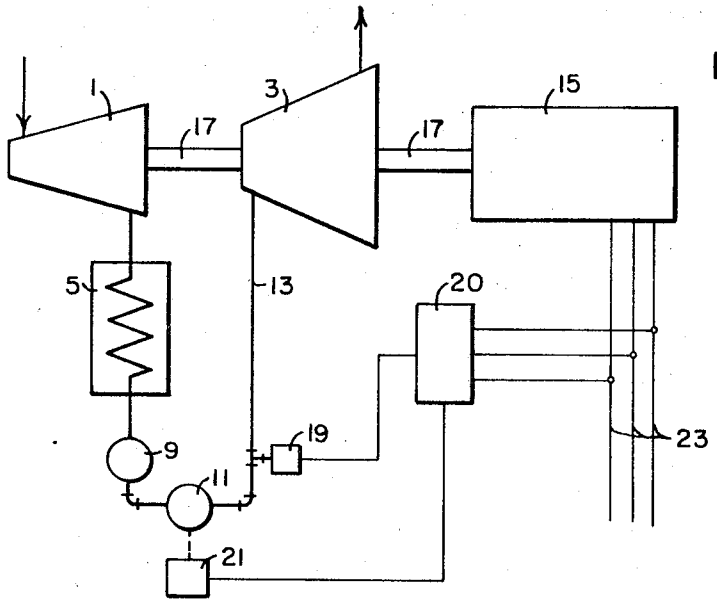


FIG. 1

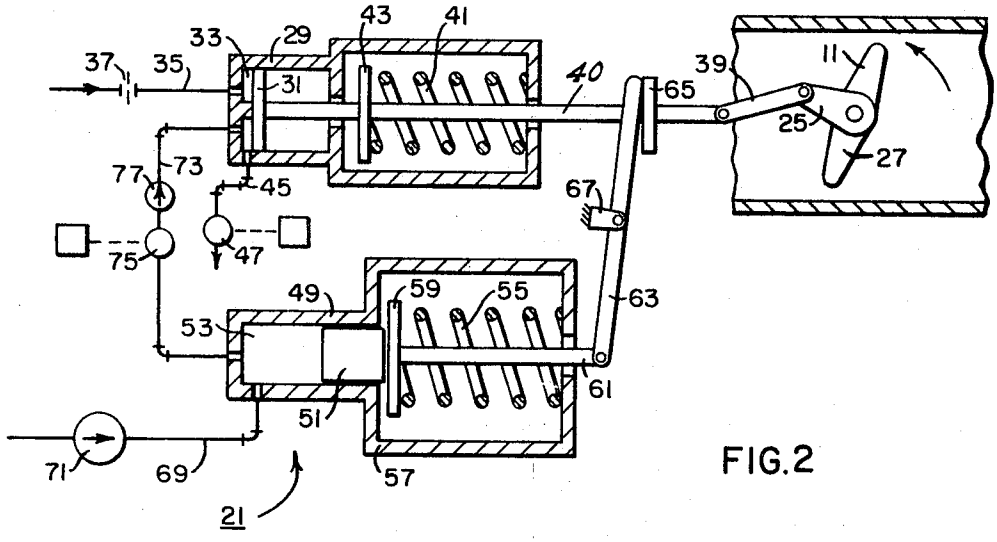


FIG. 2

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QUICK OPERATING DEVICE FOR A VALVE

BACKGROUND OF THE INVENTION

This invention pertains to a quick operating valve for a steam turbine and more particularly to a large quick operating valve in which energy absorbed from the valve as it approaches its closed position is stored and subsequently released to open the valve rapidly.

To keep pace with the high rate of growth of power consumption, power companies have been installing larger and larger turbogenerator units operating at high pressures and temperatures, which make reheating the steam after it has been partially expanded in the high pressure portion of the turbine economical. Utilizing reheat cycles necessitates installing stop and interceptor valves in the piping between the reheater and the turbine as the reheater contains a large quantity of steam, which if allowed to expand through the turbine after the turbine loses its load, could cause internal damage to the turbine. The intercept valve is controlled by a controller responsive to the electrical load on the generator and the pressure in the reheat piping so that the intercept valve anticipate losses of electrical load to begin shutting down the turbine at the first indication of loss of electrical load. Many of the disturbances, which cause a circuit breaker to open and produce an indication of loss of load on the turbine, will be transient and clear themselves. Thus, it is common practice to provide circuit breakers, which will automatically reclose one or more times before finally locking themselves out. Quick operating valves, thus serve two functions, the first being to cut off the steam to the low pressure portion of the turbine as fast as possible by initiating closing of the intercept valve upon the first indication of possible loss of load, and the second being to provide an interruption in the steam flow to balance the transient loss of load on the generator. A momentary loss of load on the generator causes the turbine to speed up which is compensated for by a momentary closing of the intercept valve providing a coarse speed control, thus reducing changes necessary in the main steam control system to keep the speed of the turbine constant irrespective of the rapid variations in load associated with opening and reclosing of the circuit breakers during transient load losses.

SUMMARY OF THE INVENTION

In general, a device for operating an on-off valve, when made in accordance with this invention, comprises a hydraulic mechanism for opening the valve at a relatively slow rate, a combined hydraulic and mechanical mechanism for closing the valve rapidly, a combined hydraulic and mechanical mechanism for absorbing and storing the energy associated with slowing the valve down as it approaches its closed position, and a device for releasing the stored energy to accelerate the valve in opening direction to open the valve quickly.

BRIEF DESCRIPTION OF THE DRAWINGS

The objects and advantages of this invention will become more apparent from reading the following detailed description in connection with the accompanying drawings, in which:

FIG. 1 is a schematic diagram of a turbogenerator unit having an intercept valve disposed therein; and

FIG. 2 is a schematic diagram of an operator for an intercept valve made in accordance with this invention.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to the drawings in detail, FIG. 1 shows a turbogenerator unit comprising a high pressure turbine 1, an intermediate pressure turbine 3 and a reheater 5 disposed between the turbines to reheat the partially expanded steam leaving the high pressure turbine 1 before it enters the intermediate pressure turbine 3.

A stop valve 9 and an intercept valve 11 are disposed in a conduit or piping 13 connecting the reheater 5 to the intermediate pressure turbine 3.

A generator 15 and the turbines 1 and 3 are shown connected to a common shaft 17.

The intercept valve 11 is controlled by a signal produced by a transducer 19 responsive to the pressure in the piping 13 between the reheater and the intermediate pressure turbine 3 and a signal proportional to the load on the generator 15. These signals are proportional to each other so that when the signals become unbalanced a signal from a controller 20 is sent to a device 21 operating the intercept valve 11 to cause it to close rapidly. The signal to close the valve could be caused by any unbalance due to any momentary trouble in a transmission line 23, such a momentary fault due to lightning or other causes, which would open a circuit breaker (not shown). When the circuit breaker opens the load is reduced causing an unbalance between the reheat pressure and the load resulting in the signal being sent from the controller 20 to the operating device 21 of the intercept valve 11 causing the valve to close rapidly. After a time delay the operating device 21 tries to reset itself, if the circuit breaker remains open the unbalance remains and the intercept valve does not reset, but remains closed. On the other hand, if the circuit breaker recloses, due to the fault on the transmission line 23 having cleared itself, the breaker remains closed and the controller resets itself sending a signal to the device 21 to open the valve 11 rapidly. The reduction in the amount of power produced by the generator when the breaker is open approaches the amount of power not produced by the turbine, when the intercept valve is closed, reducing the number of changes that would normally be required in the steam flow control system to slow the turbine down when the breaker opens and then to speed the turbine up when the breaker closes again picking up the load. While the load loss due to the circuit breaker opening does not match the reduction in load associated with closing the intercept valve, they are sufficiently closely related to prevent overspeeding of the turbine to such a degree that it will trip the overspeed trip and also reduce the hunting in the control system.

As shown in FIG. 2, the intercept valve 11 is a butterfly valve having a crank arm 25 disposed normal to a disc 27 and the disc 27 is mounted so that it rotates 90° from the valve's fully open position to the valve's closed position. The device 21 for operating the valve 11 comprises a first single acting hydraulic cylinder 29 having a first movable abutment or piston 31 disposed therein to form a first chamber 33. A supply conduit 35, having an orifice 37 disposed therein, supplies pressurized fluid to one side of the piston 31 to bias a piston rod 40 in one direction to open the valve 11 at a normal rate. The piston rod 40 is pivotally connected at its free

end to one end of a connecting rod 39. The other end of the connecting rod 39 is pivotally connected to the end of the crank arm 25. A first spring 41 reacts against a disc 43 fastened to the piston rod 40 to bias the valve 11 in closing direction. The spring 41 has a sufficiently large modulus or rate to close the valve rapidly, when the pressurized fluid biasing the valve in opening direction is dumped from the chamber 33. A drain conduit 45 is connected to the first chamber 33 and has a quick opening valve 47 disposed therein to dump the pressurized fluid from the chamber 33 to allow the valve 11 to close quickly.

The device 21 also comprises a second hydraulic cylinder 49 having a second movable abutment or free piston 51 disposed therein to form a second chamber 53, and a second spring 55. The second spring 55 is enclosed in a housing 57 and reacts against the housing and a disc 59 connected to one end of a rod 61 slidably disposed with respect to the housing 57. The piston rod 40 and the rod 61 are connected by a balance arm or lever 63 pivotally mounted adjacent its center. One end of the balance arm 63 is disposed to slidably engage a disc 65 fastened to the piston rod 40, when the valve 11 approaches its closed position, and the other end is pivotally connected to one end of the rod 61 so that as the valve 11 approaches its closed position the balance arm 63 pivots about its center mount 67 to stress or compress the second spring 55 absorbing energy from the valve 11 as it approaches its closed position. The valve 11 may be several feet in diameter and weigh several tons and the velocities associated wijh quick closing are high, so that the inertia of the valve 11 or available energy to compress the spring 55 is very large. The time interval during which the second spring 55 is compressed is short, so that the disc 59 leaves the free piston 51 during that time interval. The free piston 51 is biased toward the disc 59 by pressurized fluid supplied through a supply conduit 69 having a check valve 71 disposed therein. The area of the piston and the pressure of the pressurized fluid are not sufficiently large in combination, to compress the second spring, but the pressurized fluid moves the free piston toward the disc 59 filling the chamber 53 with pressurized fluid. The first and second chambers 33 and 53, respectively, are placed in communication by a connecting duct 73 having a fast operating valve 75 and a check valve 77 disposed therein.

The valve 75 is operable from a signal from the controller 20 indicating that the valve 11 should open rapidly to allow pressurized fluid from the second chamber 53 to flow to the first chamber 33 and cooperate with the second spring 55, which acts through the balance arm 63, to accelerate the valve in opening direction. The check valve 77 ensures that the fluid flows from chamber 53 to chamber 33 preventing flow in the reverse direction if the pressure in chamber 33 is momentarily higher than the pressure in chamber 53, during the initiation of the quick opening portion of the cycle. The second spring 55 and the second chamber 53 cooperate to supply the force necessary to accelerate the valve 11 in opening direction and to supply the necessary quantity of fluid to the first chamber 33 to allow the valve 11 to be opened rapidly. Thus, the first and second cylinders 29 and 49 are cooperatively associated to absorb energy from the valve 11 as it approaches its closed position and to store this energy in the second cylinder 49 and second spring 55 and to release the stored energy to open the valve rapidly upon receiving the proper signal from the controller 20.

What is claimed:

1. A quick operating device for a valve, said device comprising a first chamber and a first movable abutment disposed therein, said first movable abutment being cooperatively associated with said valve to open and close said valve, a first spring cooperatively associated with said first movable abutment to bias the valve in closing direction,

a second chamber and a second movable abutment disposed therein,

a second spring cooperatively associated with said first movable abutment to absorb energy from the valve as the valve approaches its closed position, means for supplying a charge of pressurized fluid to said second chamber when said second spring is compressed,

a conduit between said first and second chamber, and means for controlling the flow in said conduit so that pressurized fluid from said second chamber may be supplied to said first chamber to open said valve quickly.

2. A device as set forth in claim 1 and further comprising means for supplying pressurized fluid to said first chamber to open said valve at a normal rate.

3. A device as set forth in claim 1 and further comprising means for dumping the fluid in said first chamber to close the valve quickly.

4. A device as set forth in claim 1, wherein the second chamber is a hydraulic cylinder and the second movable abutment is a floating piston movable in one direction by a pressurized fluid when the second spring is compressed and movable in the other direction by the second spring to supply pressurized fluid to said first chamber at a high rate to close the valve quickly.

5. A device as set forth in claim 1, wherein the means for supplying pressurized fluid to the second chamber is the supply conduit for pressurized fluid with a check valve disposed therein.

6. A device as set forth in claim 1, wherein said second spring is cooperatively associated with said second movable abutment to provide the sufficient charge in pressurized fluid to produce rapid acceleration of said valve in opening direction when the flow control means is open.

7. A device as set forth in claim 1, wherein the second spring and said charge of pressurized fluid cooperate to accelerate the valve in opening direction when the control means is open.

8. A device as set forth in claim 1 wherein the modulus of the first spring is greater than the modulus of the second spring.

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