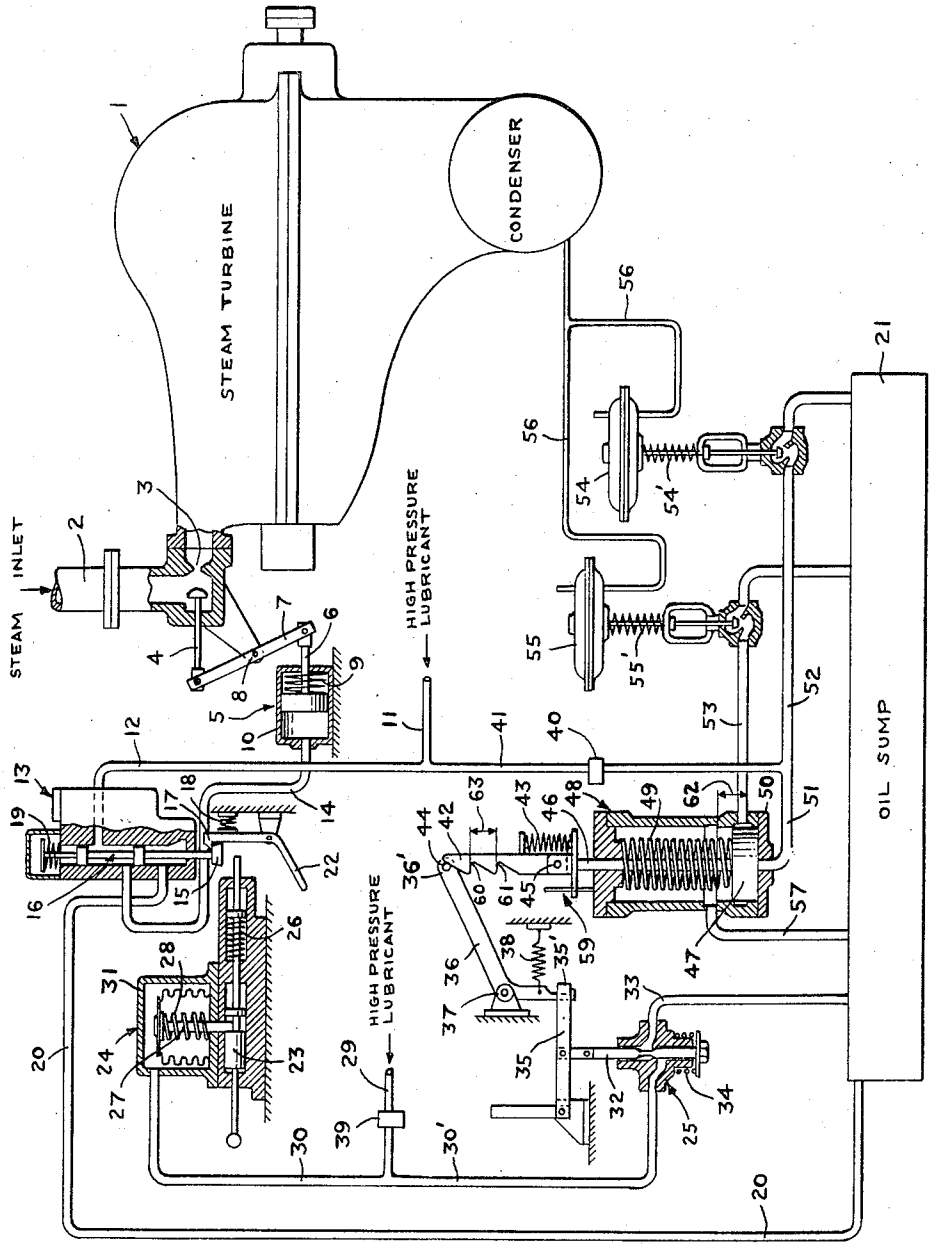
Oct. 14, 1958 A. A. LUOMA 2,855,942

SHUT DOWN MECHANISM

Filed July 5, 1957



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United States Patent Office 2,855,942 Patented Oct. 14, 1958

2,855,942

SHUT DOWN MECHANISM

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Application July 5, 1957, Serial No. 670,059

5 Claims. (Cl. 137—37)

This invention relates to a shut down mechanism for an elastic fluid turbine-condenser unit, and specifically to one which closes the inlet valve of the turbine in response to a loss in vacuum in the condenser during both the initial and subsequent stages of operation of the turbine.

As shown in U. S. Patent No. 2,116,385, turbine shut down mechanisms which are responsive to changes in vacuum in the condenser are generally known in the prior art. However, none of these prior art mechanisms make allowances for the changing conditions of vacuum in the condenser during the initial and subsequent normal stages of operation of the turbine. Yet, it is desirable to be able to shut down the turbine if the vacuum in the condenser should fall below a relatively low value during turbine starting, and also if the vacuum should fall below a higher value during normal turbine operation.

Accordingly, it is an object of the present invention to provide a shut down mechanism responsive to a loss in vacuum in the condenser during both turbine starting, and also normal turbine operation.

More specifically, it is an object to provide a shut down mechanism which is adapted to shut down the turbine if the vacuum in the condenser falls below a first predetermined value during turbine starting, and also if the vacuum falls below a second high predetermined value during normal turbine operation.

To accomplish these objects, it is provided that a pilot valve control the closing of the turbine inlet valve to shut down the turbine whenever a normally closed control valve is opened. And to control the opening of this normally closed control valve, a servo-motor is provided which is adapted to move in one direction during vacuum build-up in the condenser and in the opposite direction during vacuum loss. This servo-motor during vacuum build-up attains two distinct positions, from which positions it is adapted to open the control valve if subsequently caused to move in the direction corresponding to a loss of vacuum in the condenser. The first of these positions corresponds to a relatively low minimum value for the vacuum during turbine starting, and the second position to a higher minimum value for the vacuum during normal turbine operation.

The invention will be better understood when considered in connection with the accompanying specification and drawing forming a part thereof, in which drawing is shown:

A turbine-condenser unit and a vacuum responsive shut down mechanism constructed in accordance with the present invention.

Turbine-condenser unit

Referring to the drawing, a typical steam turbine-condenser unit, generally designated 1, is shown, into which unit steam for driving the turbine is supplied through an inlet pipe 2 connected to one end of the turbine. In passing from the inlet pipe 2 to the turbine, the steam flows through an inlet valve opening 3, which opening

can be closed by a slideable plunger 4 whenever it is desired to shut down the turbine.

Turbine shut down mechanism

The sliding movement of this plunger 4 is controlled by a piston valve, generally designated 5. The end of the piston 6 of this piston valve 5 and the end of the turbine inlet valve plunger 4 are connected to opposite ends of a bar member 7 which is pivotally mounted as at 8 to the turbine. Thus, when the piston 6 is to the left its normal position under the urgency of a spring 9, the inlet valve plunger 4 is forced to the right closing the turbine inlet valve opening 3.

However, to maintain the turbine inlet valve opening 3 in open position, high pressure fluid, which in the present embodiment is the high pressure lubricant used to lubricate the turbine, is introduced into the cylindrical casing 10 of the piston valve 5 to force the piston 6 to the right. This high pressure lubricant is delivered to the piston valve 5 through an inlet line 11, a branch line 12, a pilot valve 13, and finally through a line 14 connected to the piston valve casing 10. The piston 6 is continuously maintained by the high pressure lubricant in its position to the right as long as the bottom end 15 of the plunger 16 of the pilot valve 13 is held by the latch 17 of the latch and spring arrangement 18. However, if the latch 17 is caused to release the pilot valve plunger 16, the plunger will then move upward under the urgency of a spring 19 and thereby allow the high pressure lubricant holding the piston 6 to escape through a line 20 leading from the pilot valve 13 to the turbine oil sump 21.

While the unlatching of the pilot valve plunger 16 can be done manually as by raising the lower end 22 of the latch 17, in accordance with the present invention, an automatic mechanism is provided for this purpose.

Automatic unlatching mechanism

Part of this automatic unlatching mechanism consists of a tripping plunger 23, a holding valve 24, and a control valve 25. The tripping plunger 23 is held against the urgency of a spring 26 in a cocked position to strike the latch 17 and thus release the pilot valve plunger 16 by a member 27 of the holding valve 24. This member 27 is forced downward against the urgency of a spring 28 in a position holding the tripping plunger 23 by high pressure lubricant delivered through an inlet line 29, restriction orifice 39, and a branch line 30 into the casing 31 of the holding valve 24. High pressure lubricant also passes from the inlet line 29 through a lower branch line 30' to the control valve 25, where a sliding plug member 32 of the control valve, in the position as shown, prevents the high pressure lubricant from further escaping through a line 33 to the turbine oil sump 21. This sliding plug member 32 is held against the urgency of a spring 34 in a position closing the control valve by a cross bar 35 pivotal about one end. The cross bar 35 in turn is held in position by an L-shaped bar 36 which is latched to the swinging end 35' of the cross bar 35. The L-shaped bar 36 is pivotal about its heel 37 and is held in engagement with the cross bar 35 by a spring 38. Thus, to open the normally closed control valve 25 and thereby enable the high pressure lubricant to escape from the holding valve 24 to the turbine oil sump 21, it is necessary to rotate or trip the end 36' of the L-shaped bar 36 in a clockwise direction.

In practice, these elements of the automatic unlatching mechanism are set in proper position to shut down the turbine before the turbine is started. More specifically, the cross bar 35 is first manually set in its latched position with the L-shaped bar 36 to close the control valve 25. The high pressure lubricant being introduced through the inlet line 29 will then force down the member 27 of

the holding valve 24, thereupon permitting the tripping plunger 23 to be manually set in its cocked position. A restriction orifice 39 in the inlet line 29 helps maintain the pressure in the line 30.

Next, the lower end of the pilot valve plunger 16 is manually moved into its latched position with the latch 17. When this is done, high pressure lubricant flows through the branch line 12 to the piston valve 5 and forces the piston 6 to the right. This in turn results in the turbine inlet valve plunger 4 being held away from the turbine inlet valve opening 3 and thereby enables steam to be introduced into the turbine through the inlet valve opening 3 for driving the turbine.

A latching element 42 is provided to trip the L-shaped bar 36 whenever there is a loss of vacuum in the condenser. This latching element has a notched left side that is continuously biased by a spring arrangement 43 against a pin 44 in the end 36' of the L-shaped bar 36. In a manner to be subsequently described, this latching element 42 is raised during vacuum build-up in the condenser, and lowered whenever there is a vacuum loss. Thus, if during vacuum build-up a notch of the latching element 42 is once raised above the pin 44, upon vacuum loss in the condenser, this notch will engage the pin 44 to trip the L-shaped bar 36 as the latching element 42 is lowered.

Vacuum responsive means

The latching element 42 is pivotally connected at 45 to the top of a valve stem 46 of a slideable piston 47 of a servo-motor 48. The slideable piston 47 of this servo-motor 48 is adapted to be lifted against the urgency of a spring 49 by high pressure lubricant which is introduced into the servo-motor casing 50 through a line 51, and through a restriction orifice 40 in the lower branch line 41 of the main inlet line 11. Normally the high pressure lubricant discharges without effect on the servo-motor piston 47 to the turbine oil sump 21 through the outlet line 52. However, disposed in this outlet line and escape line 53 are two normally open diaphragm valves 54 and 55 connected by vacuum sensing lines 56 to the condenser, and adapted to close these lines during vacuum build-up in the condenser. More specifically, according to their well known principle of operation, these diaphragm valves are adapted to close their respective line only when the vacuum in the sensing lines 56 is sufficient to overcome the opposing force of the respective spring members 54' and 55' of each of the valves. In the present invention a spring member is selected for the diaphragm valve 54 to permit closing at a relatively low vacuum, while that of the diaphragm valve 55 for a relatively high vacuum.

Operation of the vacuum responsive means

In practise therefore as the vacuum builds up in the condenser, the outlet line 52 is first to close. When this occurs, the servo-motor piston 47 will be lifted by the high pressure lubricant until the escape line 53 connected from the servo-motor 48 to the turbine oil sump 21 is uncovered, and the high pressure lubricant which normally discharged through the outlet line 52 is thereby able to discharge through this escape line 53. Similarly, when the escape line 53 is next closed during vacuum build-up, the piston 47 will be lifted by the high pressure lubricant until the escape line 57 is uncovered. Thus, during vacuum build-up in the condenser, the servo-motor piston assumes two distinct raised positions: one immediately above the escape line 53 when the vacuum in the condenser has reached a lower predetermined value during turbine starting and the diaphragm valve 54 has closed the outlet 52; and the other above the escape line 57 when the vacuum in the condenser has reached a higher predetermined value during turbine normal operation and the diaphragm valve 55 has closed the escape line 53.

In moving to the first raised position, the piston 47 acting through the valve stem 46, which is suitably guided to move in substantially a straight line by the guiding arrangement 59, raises the latching element 42 so that the upper notch 60 of the latching element 42 is above the pin 44 in the end of the L-shaped bar 36. Thereafter, if the condenser vacuum should fall below the value necessary for the diaphragm valve 54 to maintain the outlet line 52 closed, this outlet line will open and thus the piston 47 and the latching element 42 will be lowered by the servo-motor spring 49. In being lowered, the latching element 42 will engage the pin 44 with the notch 60 and thereupon trip the L-shaped bar 36. This in turn will open the normally closed control valve 25 and set the automatic unlatching mechanism into operation to shut down the turbine.

If after moving to the first raised position, there is a continued build-up of vacuum in the condenser, the piston 47 will be lifted to its so-called second raised position. In this position, it is the lower notch 61 of the latching element 42 that will be above the pin 44. To assure this, the distance 62 between the escape lines 53, 57, is purposely made slightly greater than the distance 63 between the notches 61, 60. In this second raised position, if the condenser vacuum should fall below the value necessary to maintain the escape line 53 closed, this escape line will open, and in the same manner as previously described, but this time with notch 61, the latching element 42 will trip the L-shaped bar 36 causing the normally closed control valve 25 to open.

Thus, the turbine-condenser unit 1 is provided with shut down protection in the event that there is a loss of vacuum in the condenser during the initial stages of operation of the turbine, and also during the subsequent normal stages of operation of the turbine.

It will be understood that the invention is not to be limited to the specific construction or arrangement of parts shown, but that they may be widely modified within the invention defined by the claims.

What is claimed is:

1. An elastic fluid turbine arrangement including the combination of a turbine having an inlet valve for controlling the flow of actuating fluid thereto, a condenser for condensing elastic fluid exhausted from the turbine, and means for closing the turbine inlet valve upon loss of vacuum in the condenser below a first predetermined value during turbine starting, and below a second predetermined value during turbine normal operation, said means including a normally closed control valve which when opened will cause the turbine inlet valve to close, a servo-motor operatively responsive to the vacuum in the condenser and adapted to move in one direction to at least two positions corresponding to the said first and second predetermined values respectively on vacuum build-up, and in the opposite direction from these positions on vacuum loss, and means connected between the servo-motor and the normally closed control valve, and adapted to open the normally closed control valve whenever the servo-motor moves from either position in the direction corresponding to vacuum loss.

2. The elastic fluid turbine arrangement as claimed in claim 1 wherein the servo-motor comprises a hollow cylindrical casing, a piston disposed in the casing and operatively adapted to be raised during vacuum build-up in the condenser and lowered during vacuum loss, a valve stem connected to the piston and extending through the top of the casing, a latching element pivotally connected to the extended end of the valve stem, the latching element having at least two notches therein adapted to successively engage a linkage means connected to the normally closed control valve as the piston of the servo-motor is raised during vacuum build-up, whereby after engagement of the linkage means by the latching element, if the piston of the servo-motor is lowered due to vacuum loss in the

condenser, the linkage means is caused to open the normally closed control valve.

3. The servo-motor as claimed in claim 2 wherein the means for raising and lowering the piston of the servo-motor comprises, an inlet in the bottom of the servo-motor for introducing high pressure fluid into the servo-motor, an outlet line connected to normally permit the discharge of this high pressure fluid from the servo-motor, at least two escape lines at a prescribed spaced interval in the servo-motor, a first normally open diaphragm valve in the outlet line and connected to the condenser so that on vacuum build-up the said valve closes the said outlet line whereby the high pressure fluid will lift the piston of the servo-motor until a first escape line is uncovered, a second normally open diaphragm valve in the first escape line and connected to the condenser so that on further vacuum build-up the said valve closes the said escape line whereby the high pressure fluid will lift the piston in the servo-motor until the other escape line is uncovered, and a spring element disposed in the servo-motor to move the piston downwardly whenever either the outlet line or first escape line is opened due to a loss of vacuum in the condenser.

4. An elastic fluid turbine arrangement including the combination of a turbine having an inlet valve for controlling the flow of actuating fluid thereto, a condenser for condensing elastic fluid exhausted from the turbine, and means for closing the turbine inlet valve upon loss of vacuum in the condenser below a first predetermined value during turbine starting, and below a second predetermined value during normal turbine operation, said means including a normally closed control valve which when opened will cause the turbine inlet valve to close, a servo-motor operatively responsive to the vacuum in the condenser, said servo-motor comprising a hollow cylindrical casing, a piston disposed in the casing and adapted to be lifted during vacuum build-up in the condenser and lowered during vacuum loss, a valve stem connected to the piston and extending through the top of the casing, and a latching element pivotally connected to the extended end of the valve stem, linkage means connected to the normally closed control valve for opening the said

valve, and at least two notches at a prescribed spaced interval in the latching element adapted to successively engage the linkage means as the piston of the servo-motor is lifted during vacuum build-up during turbine starting and subsequently during normal turbine operation, whereby after engagement of the linkage means by the latching element, if the piston of the servo-motor is lowered due to vacuum loss in the condenser, the normally closed control valve will be opened by the linkage means.

5. The servo-motor as claimed in claim 4 wherein the means for lifting and lowering the piston of the servo-motor comprises, an inlet in the bottom of the casing for introducing high pressure fluid into the casing, an outlet line connected to normally permit the discharge of the high pressure fluid from the servo-motor, at least two escape lines in the casing spaced a greater distance from each other than the distance between the notches in the latching element, a first normally open diaphragm valve in the outlet line and connected to the condenser so that on vacuum build-up the said valve closes the said outlet line whereby the high pressure fluid will lift the piston of the servo-motor until the first escape line is uncovered and the latching element is engaging the linkage means with its uppermost notch, a second normally open diaphragm valve in the first escape line and connected to the condenser so that on further vacuum build-up the said valve closes the said escape line whereby the high pressure fluid will lift the piston of the servo-motor until the other escape line is uncovered and the latching element is engaging the linkage means with its lowermost notch, and a spring element disposed in the servo-motor casing to move the piston downwardly whenever either the outlet line or first escape line is opened due to a loss of vacuum in the condenser.

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