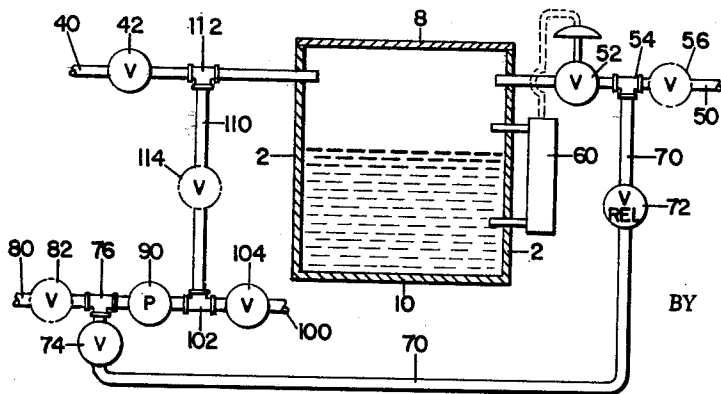
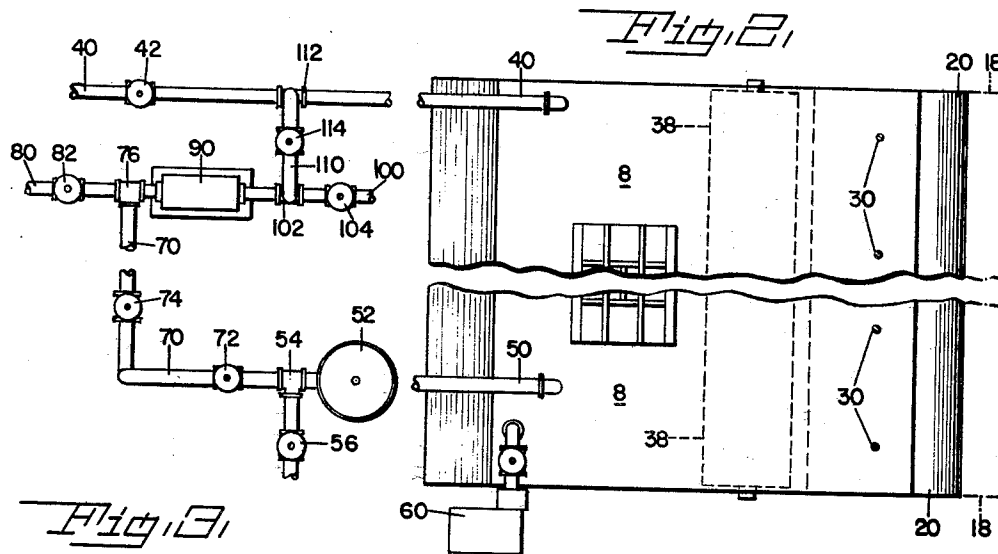
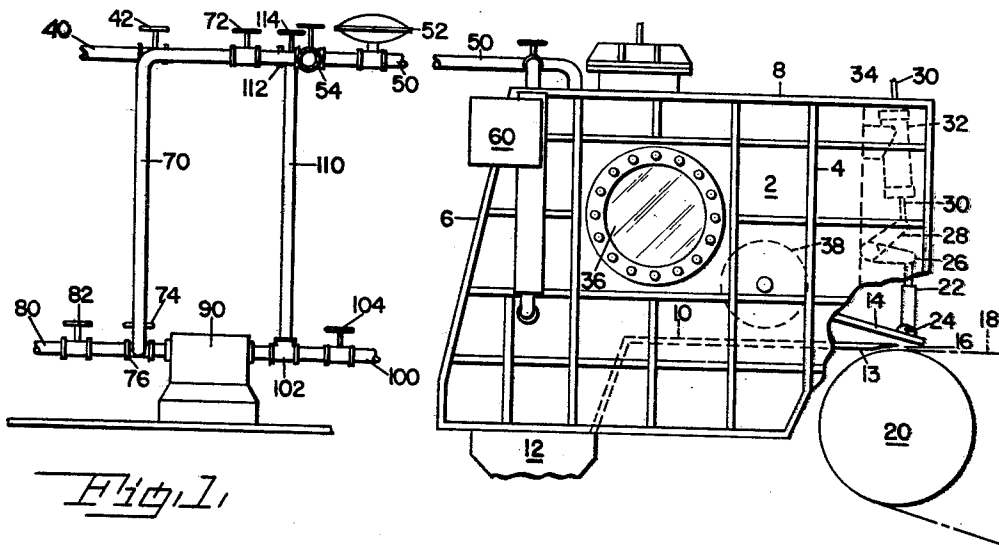


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LIQUID LEVEL CONTROL FOR A PRESSURIZED HEADBOX
OF A PAPER-MAKING MACHINE
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3,135,652



PRESSURE APPLICATION

V OPENED V CLOSED

VACUUM APPLICATION

(V) CLOSED (V) OPENED

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1

3,135,652

LIQUID LEVEL CONTROL FOR A PRESSURIZED HEADBOX OF A PAPER-MAKING MACHINE

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1 Claim. (Cl. 162-259)

This concerns a pressurized headbox of a papermaking machine and means for employing same in either high or low speed operations under predetermined and controlled stock level or head conditions selectively in a pressurized air or vacuum system, according to the dictates of practical operating speed capabilities of the machine in forming a specific sheet type from the dilute aqueous suspension of papermaking fibers delivered to the web-forming region from the headbox.

In high speed operation, a pressure within the headbox of atmospheric or above, allowing a certain controlled headbox head, may be a desideratum for the attainment of optimum sheet-forming conditions. Contrariwise, in low speed operation, a pressure below atmospheric, allowing a controlled headbox head less than or below said certain level, may be a desideratum and for the identical reason.

The maintenance of such head as to maintain the rectifying means in a continuously submerged condition below the stock level is a primary consideration, as a rotative roll not thusly covered exhibits a capacity to splash stock onto the headbox walls allowing stock lumping, with the lumps rolling back into the stock and passing out into the web-forming region with objectionable results.

In the manufacture of a given weight paper, there is normally an optimum depth for the headbox stock generally independent of the machine operating speed, although to achieve best machine operating conditions, it is necessary to supply the stock at a pressure or under a vacuum capable of producing a spouting velocity at the slice substantially equal to the forming wire velocity.

To obtain such a pressure by prior conventional means, it has been necessary to provide a relatively high headbox head, but in such case, the stock velocity in the headbox may be so slow that the fibers settle, leading to poor paper formation. The two requirements being inherently conflicting, a compromise means for obtaining optimum results is requisite.

Pressurized head boxes have been used where part of the liquid head is replaced by a pressurized air pad in the upper portion of the ponding chamber to maintain the required head, having the effect of reducing the stock level to allow an increase in liquid velocity within the headbox and thus prevent settling, while maintaining sufficient pressure to allow adequate spouting velocity, but same have been deficient in adequate head control means.

I offer means for accurately controlling the head level to maintain a constant stock velocity where air pressure or vacuum and head are directly interrelated to allow control of the latter as a function of the former, with the consequent elimination of the transient instabilities and operational difficulties of previously known constructions as presented by the inherent necessity for maintaining a head higher than practical for a specific spouting velocity due to the omnipresent roll submergence problem.

Whereas, in high speed operation, a higher head is needed than in low speed operations and a pressurized headbox best accommodates the needs, in low speed operations, a vacuum within the headbox best serves. The system hereof advantageously allows the use of a single headbox and cooperant instrumentation alternately for high speed and/or low speed operations, and admirably

2

accommodates both operating conditions while insuring accurate stock level control.

Illustrative of the desirability of employing a condition of vacuum in preference to one of pressurized air, assume that a 20" head is requisite to keep the rectifying roll fully submerged, but assume further that a run of 500 feet per minute is desired, with known optimum spouting velocity at the slice being obtained with no greater than an 8" head. The two conflicting factors, one of a certain stock level requisite for adequate roll covering and the other of a different stock level requisite for allowing optimum spouting velocity, are herein compensated for by means allowing an artificial or synthetic elevated head reaching to a mean datum line at the 20" level to preclude rectifier exposure and a real head such as to ensure proper spouting velocity, 12" of the head thus being artificial and ineffective, and 8" thereof thus being real and effective as to spouting velocity.

This control system, pneumatically or hydraulically operated, relates the air pressure or vacuum in the headbox, as the case may be, to the head, whereby the head can be accurately controlled within narrow limits at a predetermined optimum level, the control means being rapidly and automatically responsive to stock level changes to effectuate the requisite adjustments to bring the level back to the predetermined optimum mean.

I provide, within a closed headbox receiving a predetermined constant stock gallonage, a condition, either of air of a desired pressure or of vacuum, whereby, in either case, a throttling is effected by means of a diaphragm-operated control valve sensed by a liquid level control means to effectuate the appropriate opening or closing of valve means and resultant maintenance of the predetermined head. In one instance, pressurized air is introduced into the headbox; in the other instance, air is evacuated from the headbox. Through the same instrumentation, the liquid level control means serves, in either instance, the identical purpose of sensing the liquid level change, with the intelligence being reflected in automatic valve opening or closing functions.

In the drawings:

FIG. 1 is a fragmentary and broken side elevational view of a headbox embodying the invention;

FIG. 2 is a broken top plan view of the headbox shown in FIG. 1; and

FIG. 3 is a schematic diagram for illustrating the principles of the invention.

In the drawings, 2 represents one of a pair of transversely-spaced headbox side walls or pond sides joined by transversely-extending forward, rearward, top and bottom walls 4, 6, 8, and 10 respectively to provide a closed receptacle of comparatively small vertical dimension, supported in cooperative relation to the other machine elements.

An inlet 12 of appropriate configuration is connected to a stock source (not shown) wherewith stock is forced to the headbox by a suitable pump (not shown) and at a predetermined constant gallonage.

Bottom wall 10 has a forwardly-projecting extension to provide an apron 13 disposed vertically below and spaced from a vertically-adjustable throttling lip 14, comprising the lower portion of forward wall 4, to form a slice or discharge opening 16 therebetween through which stock flows onto a web forming wire 18 entrained around a breast roll 20.

Lip 14 may be adjusted in conventional manner to vary the cross-sectional slice dimension as by a plurality of transversely-spaced rods 22 pivoted to brackets 24 secured to the lip and having upper ends coupled as by interconnecting links 26 and 28 to pistons 30 of hydraulic or pneumatic cylinders 32 and supported relative to the lip as by a transversely-extending beam 34.

Windows 36 may allow observation of the headbox interior.

One or more power driven rotatable distributor rolls 38 may be provided within the ponding chamber and may be adjustable.

An air inlet 40, suitably valved at 42, is connected at its outboard terminus to a pressure source and at its inboard terminus to and through a headbox wall.

An outlet pipe 50 extends from the headbox and is suitably valved by a diaphragm operated control valve 52 on the inboard side of a T coupling 54 and an air exhaust valve 56 on the outboard side thereof, the outer free extremity of the pipe leading to atmosphere.

Spaced from a headbox side wall exteriorly of the headbox so as not to be adversely affected by conditions or turbulence therewithin, a vertically-extending liquid level controller 60, of commercially available type, such as Mason-Neilan liquid level controller (produced by Mason-Neilan Division, Worthington Corporation, Norwood, Massachusetts, U.S.A.) or equivalent, is stationarily secured and is of such design as to be operable by displacement accordingly as the stock level increases or decreases, and to control or operate cooperant means for effectuating the retention of air within or discharge of air from the headbox.

Control valve 52 is operated by and is under the control of the sensing mechanism incorporated within controller 60, it being responsive in its movements directly proportional to the output signal generated by the sensing mechanism which in turn is directly proportional to the head under control.

A connecting pipe 70 is connected to coupling 54 and has a spring-loaded vacuum relief valve 72 provided therealong adjacent coupling 54 and a valve 74 provided therealong adjacent a coupling 76 at its opposite terminus.

An air entering pipe 80 has a valve 82 provided therealong at one side of its interconnection with coupling 76 opposite from a vacuum pump 90 also provided therealong.

Vacuum pump 90 is also provided with a pipe 100 having a coupling 102 provided therealong and a valve 104 provided therealong outwardly of coupling 102.

A pipe 110 is coupled to coupling 102 at one terminus and to a coupling 112 at its opposite terminus connecting it to pipe 40 with a valve 114 provided along its length.

Valve members 42, 56, 74, 82, 104 and 114 may take any practical form desired.

In the case of pressure application, stock is supplied to inlet 12 at a predetermined constant gallonage and simultaneously therewith air, under predetermined pressure and at a constant rate of flow, is supplied the headbox through pipe 80, valve 82 in open position, vacuum pump 90, pipes 100 and 110, valve 114 and pipe 40, with valves 74 and 104 and 42 being set in closed position.

Slice lip 14 is adjusted to restrict the stock flow onto the wire, and thereby, the stock level is lowered with an increase of pressure within the box, resulting in an increasing spouting velocity.

As the head attains the predetermined optimum level, and under the predetermined air pressure condition, the hydraulic pressure at that moment will be such as to cause a sufficient signal to be communicated to diaphragm operated control valve 52 to effectuate its closing wherefor normal operation ensues.

If the stock level were to rise above or drop from the predetermined optimum level, the resultant increase or decrease in hydraulic pressure would be transmitted to control means 60 causing a decreased or increased signal to be communicated to control valve 52, which valve in turn partially opens or closes accordingly, thus precluding or allowing the bleeding of air from within the headbox resulting in a raising of the headbox air pressure to allow the stock level to drop to the predetermined optimum level or a lowering of the headbox air pressure to

allow the stock level to rise to the predetermined optimum level.

In the case of vacuum application, stock is supplied to inlet 12 at a predetermined constant gallonage. Simultaneously therewith, a vacuum is created by vacuum pump 90 which causes air to be drawn from the headbox through pipe 50, control valve 52, pipe 70, relief valve 72, valve 74, pipe 80, pump 90, pipe 100, and valve 104 to atmosphere, with valves 42, 56, 82 and 114 being set in closed position, valve 114 being closed.

The lip of the slice is adjusted and gradually closed to restrict the flow of stock from the outlet and onto the wire so that the stock level in the headbox rises with an increase of vacuum within the box and results in increasing velocity of stock from the outlet.

As the stock attains the predetermined level, liquid level controller 60 assumes a closing position to cause air pressure to activate the diaphragm of control valve 52 to throttle the discharge of air in pipe 50 from the headbox, and to result in an increase of air pressure within the headbox. Air pressure in the headbox does not activate the diaphragm valve, the mill air compressor system being used for this purpose.

As the sensing valve of controller 60 moves from a position, and in closing direction, it causes valve 52 to restrict the flow of pressure from the headbox in pipe 50.

As the level of stock in the headbox decreases, the sensing valve operates the air discharge mechanism so that pressure within the headbox is reduced.

I claim:

In apparatus of the class described cooperant with a web forming device and inclusive of means defining the walls of an enclosed headbox adapted to receive stock with a stock inflow opening leading therein to and a stock outflow opening leading therefrom and means for delivering stock continuously to the headbox through the stock inflow opening and for discharging stock continuously therefrom through the outflow opening and a rectifying means submerged within the liquid head of the stock, the improvement of a means for creating selective headbox conditions of pressures of atmospheric and above and below atmospheric for supplying stock selectively at a pressure and under a vacuum capable of producing a spouting velocity at the stock outflow opening substantially equal to the velocity of the web forming device and controlling the liquid head as a function of headbox air pressure and vacuum by sensing liquid head changes and effectuating responsive adjustments accordingly for restoring the head to a predetermined optimum mean comprising, a primary air inlet connected at its outboard terminus to a pressure source and at its inboard terminus to the headbox, a primary air inlet valve in said primary air inlet for controlling the ingress of air into said primary air inlet and into the headbox and the air pressure therewithin, a primary air outlet connected at its inboard terminus to the headbox and at its outboard terminus to atmosphere, a diaphragm-operated control valve in said primary air outlet, a primary air outlet valve in said primary air outlet outboard of said control valve for controlling the egress of air from the headbox and said control valve to atmosphere, a secondary air outlet connected at one terminus to said primary air outlet outboard of said control valve and inboard of said primary air outlet valve, a vacuum pump, a secondary air inlet connected at its outboard terminus to a pressure source and at its inboard terminus to said vacuum pump, a secondary air inlet valve in said secondary air inlet, the other terminus of said secondary air outlet being connected to said secondary air inlet outboard of said vacuum pump and inboard of said secondary air inlet valve, a spring-loaded vacuum relief valve and a valve in said secondary air outlet, a primary conduit connecting between said vacuum pump and atmosphere, a primary conduit valve in said primary conduit, a secondary conduit connecting between said primary conduit

outboard of said primary conduit valve and said primary air inlet inboard of said primary air inlet valve, a secondary conduit valve in said secondary conduit, and a level sensing means, said control valve being operated by said liquid level sensing means upon sensing a liquid level change within the headbox for effectuating appropriate valve opening and closing for the control of the liquid head at the predetermined optimum means.

5

2,677,991
2,736,246
2,901,040
2,979,130

References Cited in the file of this patent**UNITED STATES PATENTS**

Goumeniouk ----- May 11, 1954
Critteneen et al. ----- Feb. 28, 1956
Gade ----- Aug. 25, 1959
Smith ----- Apr. 11, 1961