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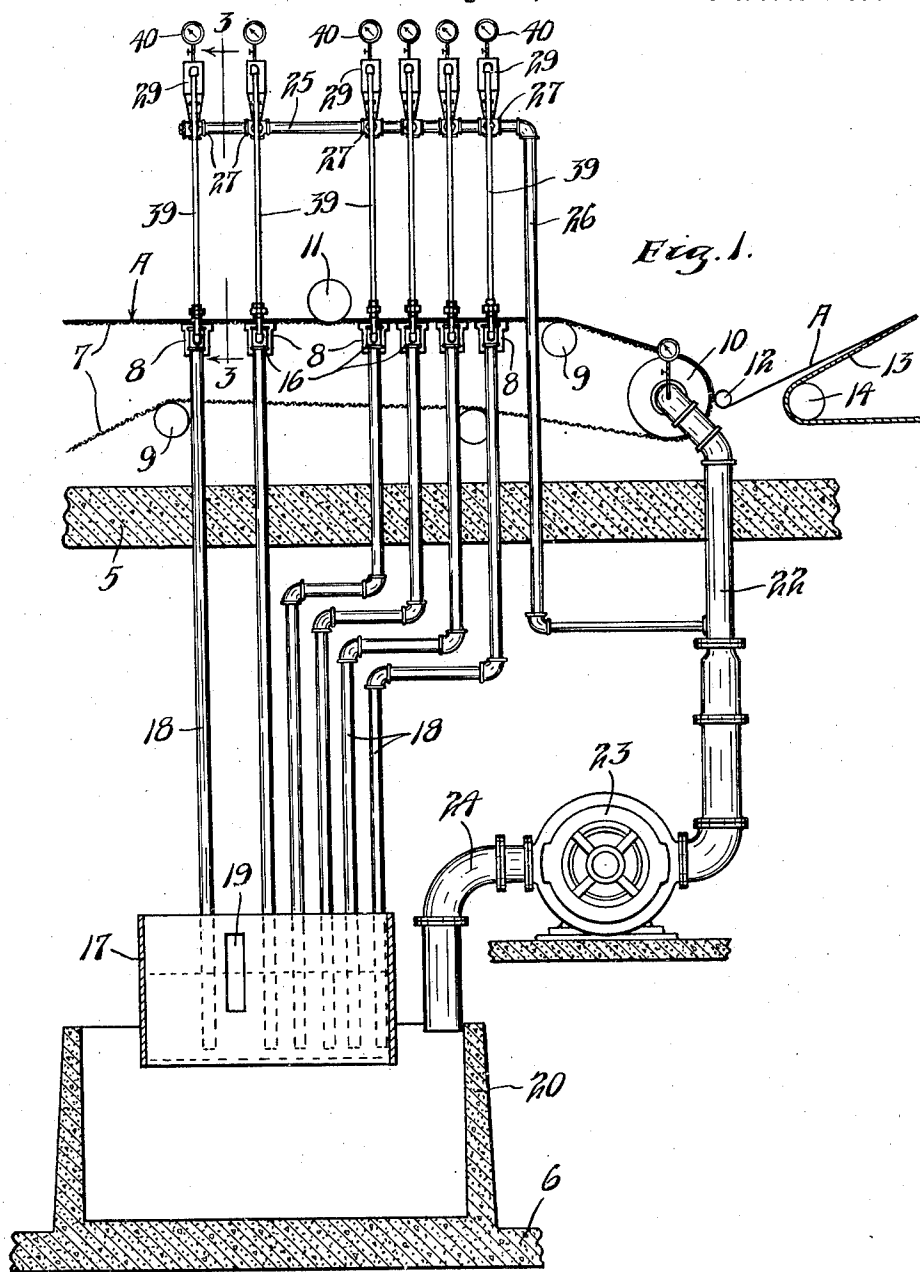
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VACUUM CONTROL MECHANISM

Filed Aug. 28, 1933

3 Sheets-Sheet 1



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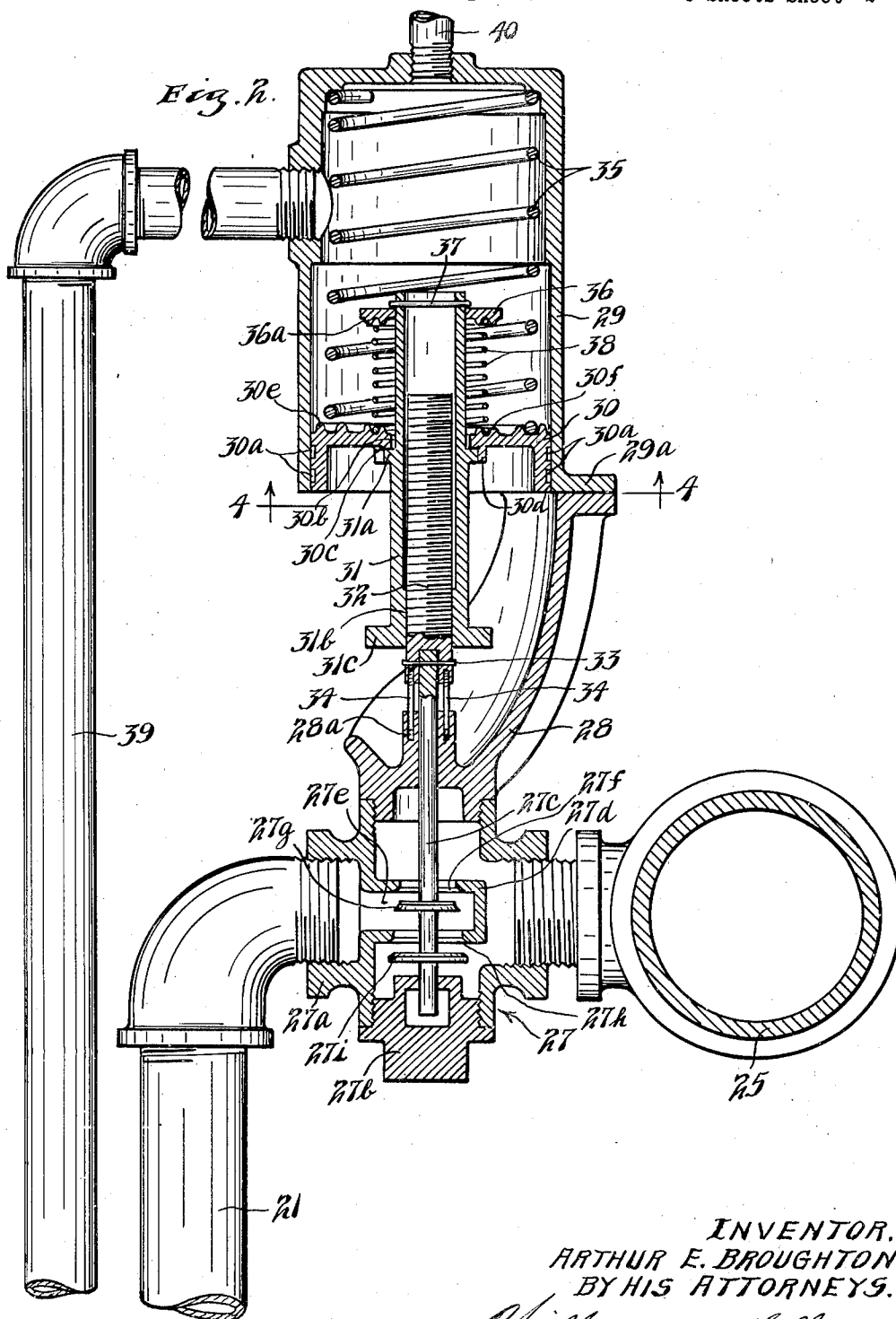
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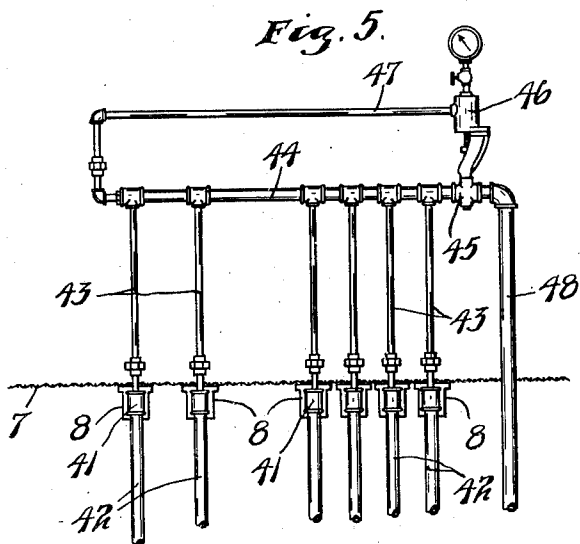
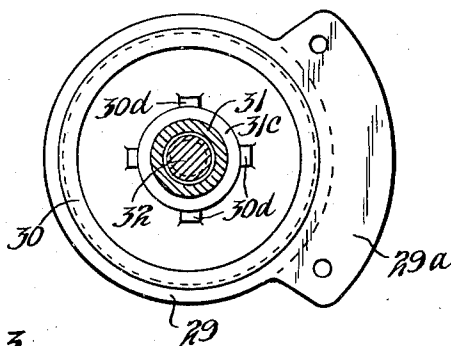
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UNITED STATES PATENT OFFICE

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VACUUM CONTROL MECHANISM

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14 Claims. (Cl. 92-44)

This invention relates to vacuum control mechanisms which, although particularly adapted for use in connection with paper making machines, are also adapted for use elsewhere 5 wherever it is desired to maintain a substantially constant vacuum pressure.

It is the general object of the invention to provide novel and improved mechanism for automatically maintaining the pressure in a vacuum 10 head substantially constant.

It is another object to provide mechanism for maintaining the pressure in a vacuum head at a desired constant.

More specifically it is an object of the invention to provide novel means for automatically 15 controlling the pressure in the suction heads of a paper making machine, such as the flat boxes, couch rolls, felt suction boxes, and the suction press rolls over which the paper web 20 runs.

The objects and advantages of the present invention will more fully appear from the following description, made in connection with the accompanying drawings, wherein like reference 25 characters refer to the same or similar parts throughout the various views, and, in which,

Fig. 1 is a view diagrammatically illustrating an application of the invention applied to the flat boxes of a paper making machine;

Fig. 2 is a view taken chiefly in vertical transverse section through the major part of one control mechanism shown in Fig. 1, the view 30 being in enlarged scale;

Fig. 3 is a vertical section taken on the line 3-3 of Fig. 1, as indicated by the arrows;

Fig. 4 is a horizontal section taken on the line 4-4 of Fig. 2, as indicated by the arrows; 35 and

Fig. 5 shows a modified application of the invention to the flat boxes of a paper making machine.

Referring to the drawings, and particularly to Figs. 1, 2, 3 and 4 thereof, there are more or less diagrammatically illustrated certain parts 45 of a paper making machine of standard construction. The first floor of a paper mill is designated by the numeral 5, while the basement floor is designated by the numeral 6. The Fourdrinier wire upon which the mat of paper is formed at the wet end of the paper machine is designated by the numeral 7 and this wire runs over flat boxes 8, rollers 9 and couch roll 10. The dandy roll 11 located between the 55 second and third flat boxes 8 is illustrated, as

is the roller 12 under which the web of paper A passes as the sheet is carried off the wire 7 at the couch roll 10 and moves on to the felt 13 from whence it advances to the presses (not illustrated). One of the rollers over which 60 the felt 13 travels is shown and designated by the numeral 14. Each of the flat boxes 8 over which the wire 7 travels is connected by a flexible connection 15 to a four-way fitting 16 which I substitute for the usual tee found on a paper 65 making machine of usual construction. The water drawn from the paper web A, as it is carried over the flat boxes 8 by the wire 7, is separated from the air drawn from the various flat boxes in the various four-way fittings 16 70 and the water from each flat box runs downwardly from the fitting 16 connected thereto into a seal box 17 through a water leg or pipe 18 connected at its upper end to the lower connection of the particular fitting 16. The water legs 75 18 running downwardly from the fittings 16 connected to the first two flat boxes 8 are preferably vertical pipes, in order that as the water passes down through these pipes considerable suction will be created to assist in maintaining 80 or to maintain without assistance the necessary vacuum in the first two flat boxes. The seal box 17 is provided with a wiler 19 which empties into a tank 20 located usually on the basement floor 6. Air legs or pipes 21 are connected to 85 the upper connections of the four-way fittings 16 and these air legs run upwardly therefrom to carry off the air separated from the water in the four-way fittings 16.

A conduit 22 runs from the couch roll 10 to 90 the intake side of a couch pump 23 and this couch pump is provided with an outlet 24 which drains into the tank 20 in accordance with the usual practice. A manifold 25 located well above the flat boxes 8 is connected by a pipe 26 95 to the conduit 22 running to the couch pump 23.

In accordance with the invention, the air legs 21 are connected at their upper ends to valves 27 which are in turn connected to the manifold 25. Each valve 27 may include a body 27a closed 100 at its lower end by a plug 27b forming a lower guide for a vertically reciprocating valve stem 27c. The valve 27 used is preferably a double seated valve, and includes a U-shaped web 27d in vertical cross section which forms a chamber 105 27e joining the intake port of the valve. An upper valve seat 27f is provided in the top of the web 27d for cooperation with an upwardly engaging valve member 27g, while the bottom of the web 27d is provided with a lower valve 110

seat 27h of a diameter slightly greater than the diameter of the valve member 27g and with which a valve member 27i is adapted to cooperatively engage by upward movement. Of course, the two valve members 27g and 27i are secured to the valve stem 27c. The upper end of the valve body 27a is closed by a casting 28 through which the stem 27c extends and this casting 28 curves upwardly and outwardly from the valve 27 to form a support for a cylinder 29. This cylinder 29 is closed at its upper end, open at its lower end and is provided with an outturned flange 29a at its open end connected to the upper end of the casting 28.

Within the cylinder 29 is a piston or plunger 30. This piston, in order that it may work freely within the cylinder, is provided with circumferential oil and dirt receiving grooves 30a. The piston 30 is provided with a central aperture 30b of somewhat larger size than a sleeve 31 which projects therethrough into the cylinder 29. This sleeve below the piston 30 is provided with an external flange 31a which cooperates with a downwardly extending ridge 30c on the piston 30 adjacent the aperture 30b as do a valve member and valve seat. To guide the flange 31a and prevent lateral movement of the sleeve 31 relative to the piston 30, the piston 30 is provided with a number of downwardly projecting lugs 30d between which the flange 31a is received. The sleeve 31 near its lower end is provided with an internally reduced end screw threaded portion 31b which is screwed onto the stud 32 secured as by a cross pin 33 to the upper end of the valve stem 27c. It is desirable to prevent rotation of the stud 32 and valve stem 27c and for this purpose a pair of small pins 34 are secured in the lower end of the stud 32 and these pins project downwardly therefrom and are received within pin receiving openings 28a formed in an upwardly projecting boss on the casting 28. It will be understood that the pins 34 can freely slide upwardly and downwardly in the pin receiving openings 28a. The lower end of the sleeve 31 is preferably provided with an external flange 31c having a knurled outer surface for hand operation. The casting 28 adjacent the sleeve 31 is preferably cupped as shown so as to permit of easy access to the sleeve 31 for turning the same.

A relatively heavy coiled compression spring 35 is located within the cylinder 29 and bears at one end against the closed end of the cylinder and it bears at its other end against the upper side of the piston 30, the piston being preferably provided with a grooved rib 30e to receive the lower end of the spring. The sleeve 31 projects for some little distance beyond the piston 30 into the cylinder 29 and a collar 36 is mounted on the sleeve near its upper end and retained in position on the sleeve as by means of a cross pin 37. A coiled compression spring 38 considerably lighter than the spring 35 surrounds the upper portion of the sleeve 31 and bears at one end against the collar 36 and at its other end against the piston 30. The collar 36 is preferably provided with a grooved rib 36a to receive the upper end of the spring 38, while the piston 30 is preferably provided with a grooved rib 30f to receive the lower end of the same spring.

Each cylinder 29 has connected thereto between its closed end and the piston 30, a pressure equalizing pipe 39 which runs downwardly from the cylinder and is connected to the four-

way fitting 16 for the flat box 8 in connection with which the cylinder 29 is used. A pressure gauge 20 is preferably connected to the closed end of each cylinder 29.

In a paper making machine, it is highly desirable that the vacuum pressure in each flat box 8 be maintained as nearly constant as possible when paper is being made but at the same time it is highly desirable that it be possible to change the vacuum pressure in the flat box when desired to maintain the flat box under a different substantially constant vacuum pressure. With the present control mechanism, it is possible to automatically maintain the vacuum pressure substantially constant in each flat box and it is also possible to readily adjust the mechanism to permit the flat box to be automatically maintained under a different substantially constant vacuum pressure.

Assuming that the paper making machine with my mechanism applied thereto, as shown in Figs. 1 to 4 inclusive, is in full operation, the couch pump 23 will, of course, tend to withdraw the air from the manifold 25 and pipe 26 into the conduit 22 and from this conduit into the pump to discharge with the air and water from the couch roll 10 through the outlet 24. The position of the valve members 27g and 27i of each valve 27, relative to the seats 27f and 27h of that valve, will, of course, determine whether or not air will be drawn by the couch pump from the particular air leg 21 connected to that valve 27. Let us consider the action of a single control mechanism in connection with a single flat box 8 and let us assume further that when the paper web A is running over the flat box, the proper vacuum is provided in the flat box when the valve 27 is partly opened up. When operating in this manner, the parts of the control mechanism will assume approximately the position shown in Fig. 2 with possibly the valve closed to a slightly greater extent than as illustrated. As the pressure equalizing pipe 39 is connected to the four-way fitting 16 communicating directly with the flat box 8 through the flexible connection 15, and as this pressure equalizing pipe communicates at its upper end with the cylinder 29, there will be the same air pressure, as registered by the gauge 40, in the cylinder 29 as in the flat box. As this pressure is considerably below atmospheric pressure, there is partial vacuum created in the cylinder 29 which tends to raise the piston 30. Raising movement of the piston is balanced by the spring 35, which, of course, exerts its pressure to remove the piston downwardly. The spring 38 which bears against the piston 30 exerts its pressure against the collar 36 to move the sleeve upwardly to thereby maintain the flange 31a in seating relation with the ridge 30b, so that no atmospheric air can pass into the cylinder 29 through the aperture 30b which is of course closed when the flange 31a bears against the ridge 30b.

Now let us assume that for some reason the vacuum in the flat box 8 is increased beyond the requisite degree, i.e. the pressure in the flat box is reduced. When this occurs, of course, the pressure in the cylinder 29 will be correspondingly reduced and the piston 30 will rise against the tension of the spring 35. As this occurs, the spring 38 will force the sleeve 31 upwardly with the piston until such time as the pressure in the flat box has been increased to its former level or until such time as the two

valve members 27g and 27i close against the seats 27f and 27h respectively. As the valve members more closely approach their seats, of course, less air will be drawn from the air leg 21 than formerly into the manifold 25 by the couch pump 23 until when the valve members are seated, no further air will be drawn from the air leg 21 into the manifold. If the vacuum in the flat box still remains higher, when the valve 27 is closed, than the requisite vacuum for which the control mechanism is set, of course, piston 30 will continue to rise in the cylinder 29 but the sleeve 31 cannot follow up the movement of the piston, as engagement of the valve members 27g and 27i with their respective seats will limit the possible upward movement of the sleeve. The piston 30, accordingly, will draw away from the flange 31a of the sleeve to expose the aperture 30b and allow air at atmospheric pressure to run into the cylinder 29 through the aperture 30b and break the vacuum in the cylinder and in the flat box 8, the air being communicated to the flat box through the pressure equalizing pipe 39, four-way fitting 16 and flexible connection 15. Atmospheric air rushing into the cylinder 29 will permit the spring 35 to again move the piston 30 downwardly until the ridge 30c seats with the flange 31a of the sleeve 31, whereupon no further air can be admitted through the aperture 30b into the cylinder and the correct vacuum in the flat box will be restored either through opening of the valve 27 or by the vacuum created by reason of the passage of water through the water leg 18 connected to the flat box.

If for any reason the vacuum in the flat box should fall beyond the level for which the control mechanism is set, i.e. the pressure in the flat box should increase, then the pressure within the cylinder 29 will similarly increase and the spring 35 will force the piston 30 downwardly to push the sleeve 31 and valve stem 27c downwardly to open valve 27 farther, so that the couch pump 23 may draw greater quantities of air from the air leg 21. The control mechanism, therefore, automatically controls and maintains the vacuum pressure in the flat box substantially constant irrespective of outside factors that may tend to change the vacuum in the flat box.

The pressure level at which the vacuum is maintained in the flat box, is dependent entirely upon adjustment of the sleeve 31 relative to the stud 32. By unscrewing the sleeve 31 somewhat from the stud 32, the air pressure in the flat box may be maintained lower than formerly. By screwing the sleeve 31 farther up onto the stud 32, the air pressure in the flat box may be maintained higher than formerly. As the stud 32 is guided in its movement by the pins 34 working in the pin openings 28a, so that the stud cannot turn, it will be seen that the control mechanism can be very easily adjusted as occasion demands by merely turning one part, the sleeve 31. The casting 28 is so constructed that easy access may be had to the head of this sleeve to permit the same being readily turned by hand. It will, of course, be appreciated that mechanism can be provided (not illustrated), to enable the sleeve to be adjusted from a point remote from the control mechanism proper.

The movement of the flange 31a away from the ridge 30c of the piston 30 is at most but slight and the lugs 30d serve to guide the sleeve during this movement. Preferably the double

seated valve 27 is used in place of a single seated valve to reduce resistance to the opening and closing movement of the valve. It will of course be appreciated that any suitable type of valve may be substituted for that shown.

In the application of the invention to the various flat boxes as shown in Figs. 1 to 4 of the drawings, it will be observed that there is an individual control mechanism for each flat box. It is accordingly possible to maintain each flat box under a desired vacuum pressure which may be the same or different than the vacuum pressure maintained on the other boxes. This is often highly desirable depending on what type of sheet is being run.

Instead of providing an individual control mechanism for each flat box, a single control mechanism may be provided for a group of flat boxes or for all the flat boxes in the paper making machine as shown in Fig. 5. When a single control mechanism is used for a plurality of flat boxes 8, the flat boxes may be connected to the usual type of tee 41 from which water legs 42 run downwardly and from which air legs 43 run upwardly. The air legs 43 may be all connected at their upper ends to a manifold 44, connected to a valve 45 exactly similar to the valve 27 previously described. A control mechanism 46 exactly similar to the control mechanism of the previously described mechanism is used for operating the valve 45 and for admitting atmospheric air at proper times to the cylinder of the control mechanism and a pressure equalizing pipe 47 corresponding to the pressure equalizing pipe 39 runs from the cylinder of the control mechanism into the end of the manifold 44 remote from the valve 45. Of course a pipe 48 runs from the valve 45 and connects into the receiving conduit of the couch pump (not illustrated). The one control mechanism 46 acts to maintain all of the flat boxes automatically under substantially the same constant pressure, in the same manner that the control mechanism previously described automatically maintains a single flat box under substantially a constant pressure.

Although the control mechanism of the present invention is illustrated as applied to the flat boxes of a paper making machine, to control the vacuum pressure therein, it will be understood that the control mechanism can as well be used for controlling the vacuum pressure in couch rolls, felt suction boxes and suction press rolls of paper making machines. It will further be understood that the invention is not limited to its use with paper making machines inasmuch as the control mechanism may be used for automatically maintaining a substantially constant vacuum pressure in any box, vacuum head, line etc. subject to vacuum pressure.

The control mechanism of the invention is simple of construction and it can be easily installed. The control mechanism has been successfully demonstrated in actual practice on paper making machines.

In some paper making machines, both the water and air from the flat boxes or couch rolls, or felt suction boxes or press rolls are carried together through a common conduit rather than divided into water streams and air streams in water and air legs. The control mechanism of the invention can be effectively applied to these conduits which carry away both the air and the water from the different parts of the machine.

It will, of course, be understood that various

changes may be made in the form, details, arrangement and proportions of the various parts without departing from the scope of the present invention, which, generally stated, consists in the matter shown and described and set forth in the appended claims.

What is claimed is:—

1. In a paper making machine, the combination of a suction head over which the pulp web travels, a conduit receiving from said head, means for withdrawing the fluid from said conduit, a valve in said conduit controlling the flow of fluid therethrough and automatic means closing off said valve and supplying atmospheric air to said head to break the vacuum therein as the vacuum increases beyond a certain point and opening said valve as the vacuum in said head decreases beyond a certain point.

2. In a paper making machine, the combination of a suction head over which the pulp web travels, a conduit receiving from said head, means for withdrawing the fluid from said conduit, a valve in said conduit controlling the flow of fluid therethrough, automatic means closing off said valve and supplying atmospheric air to said head to break the vacuum therein as the vacuum increases beyond a certain point and opening said valve as the vacuum in said head decreases beyond a certain point, and means for regulating said automatic means to vary the substantially constant vacuum pressure under which said head will be maintained.

3. In a paper making machine, the combination of a suction head over which the pulp web travels, a conduit receiving from said head, means for withdrawing the fluid from said conduit, a valve in said conduit controlling the flow of fluid therethrough, automatic means closing off said valve and supplying atmospheric air to said head to break the vacuum therein as the vacuum increases beyond a certain point and opening said valve as the vacuum in said head decreases beyond a certain point, and a single adjustable member for regulating said automatic means to vary the substantially constant vacuum pressure under which said head will be maintained.

4. In a paper making machine, the combination of a suction head over which the pulp web travels, a separator chamber communicating with said head, a water leg running downwardly from said chamber, an air leg running upwardly therefrom, a suction pump, a conduit connecting said air leg to said suction pump, a valve in said conduit controlling the flow of air therethrough, and automatic means closing off said valve and supplying atmospheric air to said head to break the vacuum therein as the vacuum increases beyond a certain point and opening said valve as the vacuum in said head decreases beyond a certain point.

5. In a paper making machine, the combination of a suction head over which the pulp web travels, a conduit receiving from said head, means for withdrawing the fluid from said conduit, a valve in said conduit controlling the flow of fluid therethrough, an air chamber communicating with said suction head, a movable member controlled by the pressure of air within said air chamber, an operative connection between said member and said valve for closing said valve as the pressure of said air chamber falls below a certain point and for opening said valve as the air pressure in said chamber rises above a certain point and means controlled by the move-

ment of said member after it has closed said valve for admitting air under atmospheric pressure to said head to break the vacuum therein.

6. In a paper making machine, the combination of a suction head over which the pulp web travels, a conduit receiving from said head, means for withdrawing the fluid from said conduit, a valve in said conduit controlling the flow of fluid therethrough, a cylinder open at one end and closed at its other end and communicating with said suction head, a piston working within said cylinder, resilient means urging said piston toward the open end of said cylinder and means operatively associated with said piston and said valve and opening said valve as said piston moves towards the open end of said cylinder, closing said valve as said piston moves towards the closed end of said cylinder and supplying air to said piston to break the vacuum in said head after said piston has moved towards the closed end of said cylinder beyond a position where said valve is completely closed.

7. In a paper making machine, the combination of a suction head over which the pulp web travels, a conduit receiving from said head, means for withdrawing the fluid from said conduit, a valve in said conduit controlling the flow of fluid therethrough, a cylinder open at one end and closed at its other end and communicating with said suction head, a piston working within said cylinder, resilient means urging said piston toward the open end of said cylinder, said piston having an aperture therein, a member resiliently urged against said piston toward the closed end of said cylinder to normally close said aperture and moving for a limited distance with said piston as said piston moves and a connection between said member and said valve for closing and opening said valve as said member moves respectively to and from the closed end of said cylinder, said member being limited in its movement toward the closed end of said cylinder by the closing of said valve, said piston being capable of movement away from said member after said valve has closed to expose said aperture and admit air to said cylinder to break the vacuum in said head.

8. In a paper making machine, the combination of a suction head over which the pulp web travels, a conduit receiving from said head, means for withdrawing the fluid from said conduit, a valve in said conduit controlling the flow of fluid therethrough, said valve including a valve stem for operating the same, a cylinder open at one end and closed at its other end and communicating with said suction head, a piston working within said cylinder, resilient means urging said piston toward the open end of said cylinder, said piston having an aperture therein, a member resiliently urged against said piston toward the closed end of said cylinder to normally close said aperture and move for a limited distance with said piston as said piston moves toward the closed end of said cylinder, and a longitudinally adjustable connection between said member and said valve stem, said connection causing said valve stem to move to close the valve as said piston moves towards the closed end of said cylinder and causing said valve stem to move to open the valve as said piston moves towards the open end of said cylinder, the movement of said member toward the closed end of said cylinder being limited by said valve as said valve is closed and said piston being capable of movement away from said member after said

valve has been closed to expose said aperture and admit air to said cylinder to break the vacuum in said head.

9. Mechanism for automatically controlling and maintaining a substantially constant vacuum pressure in a vacuum head, comprising a conduit adapted to communicate at one end with the head and at its other end with a suction pump, a valve in said conduit controlling the passage of fluid therethrough, a cylinder open at one end and closed at its other end and mounted adjacent said valve, a piston working within said cylinder, resilient means urging said piston toward the open end of said cylinder, a conduit adapted to communicate at one end with the head and communicating at its other end with said cylinder between the closed end thereof and said piston, and means operatively associated with said piston and said valve and opening said valve as said piston moves toward the open end of said cylinder, closing said valve as said piston moves toward the closed end of said cylinder and supplying air to said piston to break the vacuum in said head after said piston has moved toward the closed end of said cylinder beyond a position where said valve is completely closed.

10. Mechanism for automatically controlling and maintaining a substantially constant vacuum pressure in a vacuum head, comprising a conduit adapted to communicate at one end with the head and at its other end with a suction line, a valve in said conduit controlling the passage of air therethrough, said valve having a stem, a cylinder closed at one end and open at its other end and mounted adjacent said valve, a piston working within said cylinder and having an aperture therein, a pressure equalization conduit connected to said cylinder between the closed end thereof and the said piston and adapted to be connected at its other end to the vacuum head, a rod connected to said valve stem, said rod at its end remote from said valve forming a closure member for said aperture, resilient means urging said piston toward the open end of said cylinder, resilient means urging said closure member into engagement with said

piston to close said aperture in a direction toward the closed end of said piston, said valve closing as said closure member moves toward the closed end of said cylinder and opening as said closure member moves in an opposite direction.

11. The structure defined in claim 10, said rod being longitudinally adjustable and including two parts movable to and from each other.

12. The structure defined in claim 10, said rod comprising a stud connected to said stem, and a sleeve having screw threaded engagement with said stud, said sleeve having the closure member formed thereon.

13. Mechanism for automatically controlling and maintaining a substantially constant vacuum pressure in a vacuum head, comprising a conduit adapted to communicate at one end with the head and at its other end with a suction line, a valve in said conduit controlling the passage of air therethrough, said valve having a stem, a cylinder closed at one end and open at its other end and mounted adjacent said valve, a piston working within said cylinder and having a central aperture therein, a rod connected to said stem and projecting through the central aperture in said piston into said cylinder, said rod having a flange outwardly disposed from said piston relative to said cylinder and forming a valve member with which the portions of said piston adjacent said aperture may engage to close said aperture, a compression spring interposed between the closed end of said cylinder and said piston and a compression spring interposed between the inner end of said rod and said piston, said valve in said conduit closing as said rod moves toward the closed end of the cylinder and opening as it moves in the opposite direction.

14. The structure defined in claim 13, said rod comprising a stud connected to said stem, means guiding said stud for reciprocating movement to and from said valve without turning and a sleeve having screw threaded engagement with said stud, said sleeve carrying said flange.

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