

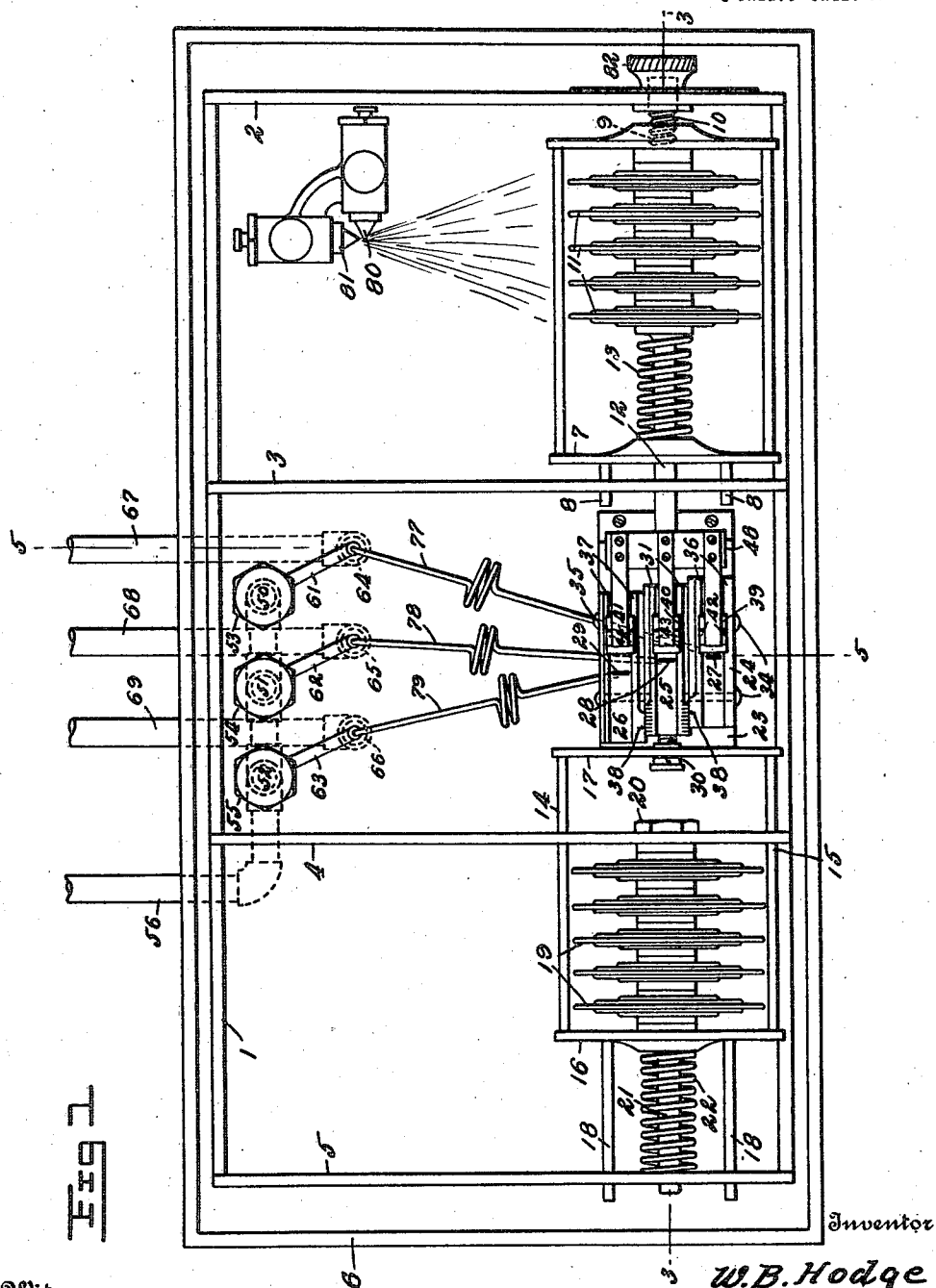
W. B. HODGE.

DIFFERENTIAL HYGROSTAT FOR CONTROLLING THE HUMIDITY OF AIR CONDITIONING SYSTEMS.
APPLICATION FILED FEB. 1, 1915.

1,284,334.

Patented Nov. 12, 1918.

3 SHEETS—SHEET 1.



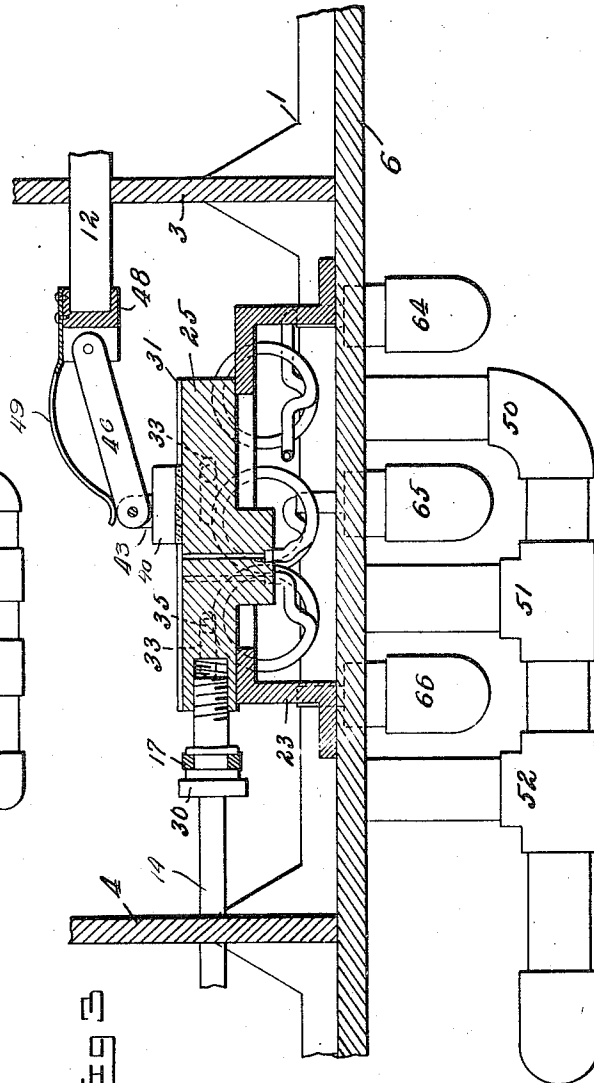
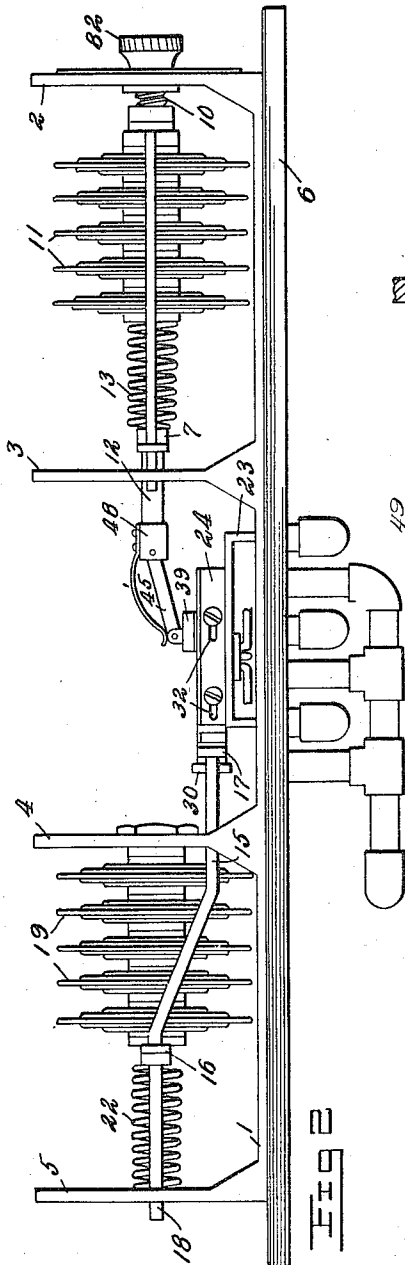
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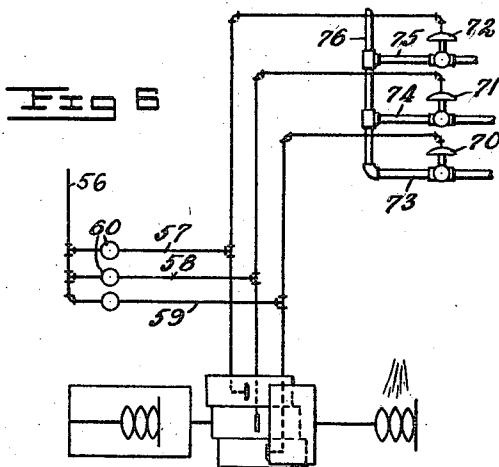
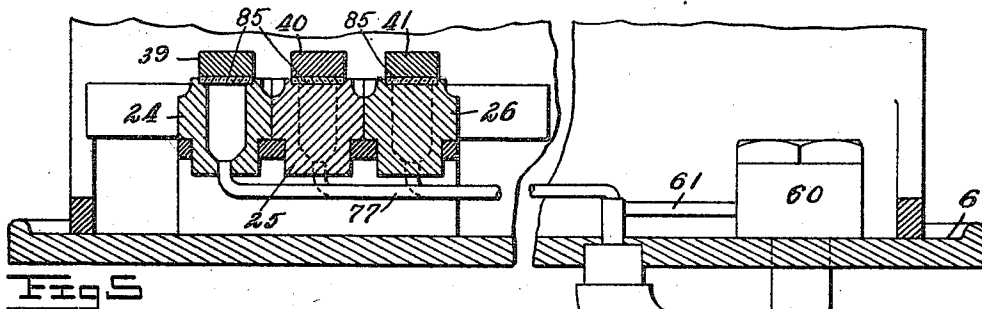
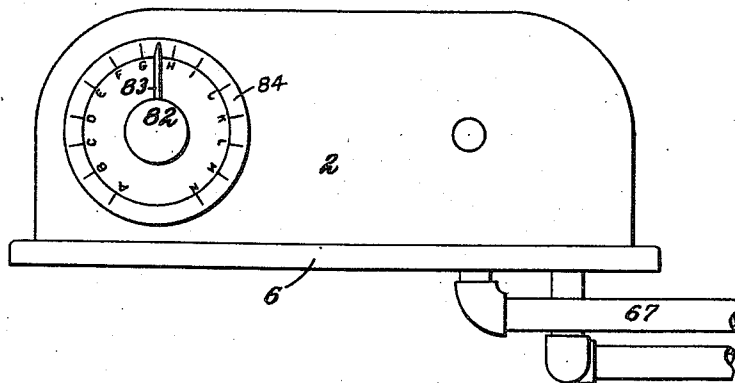


Fig 4



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UNITED STATES PATENT OFFICE.

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DIFFERENTIAL HYGROSTAT FOR CONTROLLING THE HUMIDITY OF AIR-CONDITIONING SYSTEMS.

1,284,334.

Specification of Letters Patent.

Patented Nov. 12, 1918.

Application filed February 1, 1915. Serial No. 5,536.

To all whom it may concern:

Be it known that I, WILLIAM B. HODGE, a citizen of the United States, residing at Charlotte, in the county of Mecklenburg and State of North Carolina, have invented certain new and useful Improvements in Differential Hygrostats for Controlling the Humidity of Air-Conditioning Systems; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

The invention relates to improvements in differential hygrostats for controlling the humidity of air conditioning systems.

In the use of such systems for humidifying a building, it has been found to be good practice to divide the humidifying section or nozzles into a series of banks each provided with independent means for putting into or out of operation more or less of these banks of nozzles to saturate the air to a greater or less degree.

An object of the invention is to provide a single device or instrument common to all of such banks of nozzles, aforementioned, to control the same automatically and in consecutive order, or, to operate in a manner to progressively cut in or out as many of such banks of nozzles as may be desired to maintain a predetermined degree of humidity throughout a building.

With this and other objects in view, the invention resides in certain novel constructions and arrangements as will be hereinafter more fully described, set forth in the appended claims, and illustrated in the accompanying drawing, in which:—

Figure 1 is a top plan view of the preferred embodiment of the invention.

Fig. 2 is a side elevation of the same,

Fig. 3 is a vertical longitudinal section on the line 3—3 of Fig. 1,

Fig. 4 is an end view showing the indicator for setting the device for operation at predetermined degrees of humidity,

Fig. 5 is a vertical transverse section on the line 5—5 of Fig. 1,

Fig. 6 is a diagrammatic plan view of a portion of an air conditioning system showing the invention applied thereto.

Referring to the accompanying drawing, in which like characters of reference designate corresponding parts in the several views thereof, 1 designates a suitable supporting frame having spaced vertically disposed walls or plates 2, 3, 4 and 5, rising therefrom, and is provided with a supporting plate 6 forming a bottom wall for the frame.

Interposed between the walls or plates 2 and 3, at one side of the frame 1, is a yoke 7, supported at one end by means of spaced guide rods 8 slidably supported in suitable openings formed in the wall or plate 3, and having the other of its ends provided with a threaded socket 9 adapted to receive the threaded end 10, of an adjusting screw, by means of which the yoke may be adjusted. Supported within the yoke 7 is a series of diaphragms 11 having one of its ends secured to the yoke and the other of its ends provided with an extension rod 12 which passes through the yoke and the adjacent wall or plate 3. A coiled spring 13 is carried by the extension rod 12 and is interposed between the free end of the diaphragms 11 and the opposed member of the yoke.

At the opposite end of the frame 1 and in alinement with the yoke 7, is located a second yoke having its side-bars or rods 14 and 15 projected through suitable openings formed in the wall or plate 4 and connected at their opposite ends by end-bars 16 and 17. The end-bar 16 is provided with rearwardly projecting spaced guide rods 18 engaged in suitable openings formed in the wall or plate 5. Interposed between the wall or plate 4 and the opposed end-bar 16 are a second series of diaphragms 19 which are secured at one end to the wall or plate 4 by means of nut 20 and its rear end supported by an extension rod 21 which passes through an opening formed in the end-bar 16. A coiled spring 22 is carried by the extension rod 21 and is interposed between the end-bar 16 and the opposed face of the wall or plate 5.

Located between the walls or plates 3 and 4 is a raised supporting element 23 upon which is slidably supported a plurality of valve blocks (three of such blocks being shown for obvious reasons) 24, 25 and 26, each being provided with a port 27, 28 and

29, respectively, the purpose of which will be hereinafter more fully described. The valve block 25 is adjustably secured, at one end, to the end-bar 17, by a suitable securing means 30, and has its upper face milled or cut-away to provide side flanges 31 which extend throughout the greater portion of its length. Immediately adjacent one end of the upper face of the valve block 25, and on its opposite edges, there is duplicated a series of degree indications calibrated in terms of expansion of the diaphragms 19. The oppositely disposed valve blocks 24 and 26 are adjustably secured to the valve block 25 by means of the slots 32 and 33, formed therein respectively, and which are engaged by suitable clamping elements 34 and 35 carried by the valve block 25. The upper faces of the valve blocks 24 and 26 are milled or cut-away to provide oppositely disposed flanges 36 and 37, respectively, which extend throughout the greater portion of their length. The ends of said valve blocks 24 and 26, immediately adjacent the degree marked end of the valve block 25, and their edges adjacent thereto, are provided with indicator arrows 38 by means of which the several valve blocks may be displaced longitudinally, with respect to one another, any desired number of degrees, when the clamping elements 34 and 35 are loosened to permit such adjustment.

Slidably seated upon the milled faces and between the side flanges of each of the valve blocks 24, 25 and 26 are slide valves 39, 40 and 41, respectively, each being provided with upstanding ears or lugs 42, 43 and 44, respectively, by means of which they are pivotally connected, through the medium of the links 45, 46 and 47, to a cross-head 48 carried by the projecting end of the extension rod 12 of the diaphragms 11. A suitable spring 49 is provided to bear down upon each of the slide valves 39, 40 and 41, and said springs are each secured in proper relation to the latter to the cross-head 48.

Projecting through the supporting plate 6 is a series of pipe fittings 50, 51 and 52, an equal number of such fittings corresponding to the number of valve blocks being necessary for the operation of the device, each provided with an adjustable needle or retarding valve 60, which are respectively capped with nuts 53, 54 and 55, these latter being removable for adjusting the flow of pressure through valves 60 and constituting the terminals of the fluid pressure line 56, as in Fig. 1, or the subdivided and individual terminals of the pressure lines 57, 58 and 59, as in Fig. 6, which pressure line 56, or, preferably, lines 57, 58 and 59 are each provided with suitable retarding valves 60. Arranged slightly in advance of the pipe fittings 50, 51 and 52, and connected

thereto by means of coupling connections 61, 62 and 63, respectively, are a second series of pipe fittings 64, 65 and 66, which constitute the terminals of branch fluid pressure lines 67, 68 and 69 leading to diaphragm valves 70, 71 and 72, respectively, located in the branches 73, 74 and 75 of a water supply or humidifying line 76. Leading from each of the pipe fittings 64, 65 and 66 are flexible couplings 77, 78 and 79, respectively, which connect at the ports 27, 28 and 29, of the valve blocks 24, 25 and 26, aforementioned. These two sets of pipe fittings, aforesaid, are located in spaced relation intermediate the walls or plates 3 and 4, and to the side of the frame 1 opposite to that occupied by the valve blocks and their supporting plate.

The diaphragms 19 are affected only by the dry bulb temperature of the surrounding atmosphere, while the diaphragms 11 are to be affected by the wet bulb temperature which is obtained by locating the latter diaphragms in the path of a spray from a water atomizing nozzle 80, such spray being directed upon the diaphragms 11, from the nozzle 80, by means of an air pressure nozzle 81 arranged in substantially right angular relation to the same for the purpose.

The free end of the adjusting screw 10 is provided with a milled operating head 82 which carries an indicator arm or pointer 83 adapted to be moved over the dial 84 which is calibrated in terms of wet bulb temperature, when the screw 10 is actuated to set the diaphragms 11 for any desired rise in such temperature.

In place of the water atomizing nozzle 80, the diaphragms 11 may be arranged with an absorbent covering, not shown, dipping into a water bath, or in any other convenient manner to indicate or measure the desired temperature. The device, however, may be used as a simple differential thermometer without the application of the water spray or other cooling means to either of the two sets of diaphragms.

The operation of the device is as follows:—Assuming the valve blocks 24, 25 and 26 to have been adjusted to any desired relation with respect to one another, and the pointer 83 moved to a desired position on the scale, of the dial 84, thus placing the diaphragms 11 in condition for operation, preferably, at a difference of temperature below that of the diaphragms 19, the diaphragm valves 70, 71 and 72 being in open position, since the ports of the valve blocks are uncovered and the pressure lines bled therethrough to atmosphere. As the humidity increases, the movement of the diaphragms 11 will exceed that of the diaphragms 19, the slide valve 39, during such excess movement, will cover the port 27, of the valve block 24, thus permitting the pres-

sure to pass through the branch line 67 and accumulate therein sufficiently to actuate the diaphragm valve 70 to its closed position, thus putting out of operation the corresponding branch of the system. A further increase of humidity causes an increase in the expansion of the diaphragms 11 and a subsequent closing of the port 28, of the valve block 25, by the slide valve 40, permitting pressure to pass through the branch line 68 and to accumulate therein sufficiently to actuate the diaphragm valve 71 to its closed position, thus putting out of operation its corresponding branch of the system. A still further increase in the humidity of the air causes a similar operation of the third section of the device, or as many more of such sections as may be desired for the control of a larger system, and the subsequent putting out of operation of the remaining section, or sections, as the case may be.

The slide valves 39, 40 and 41 are provided, preferably, with plates of glass 85 on their under surfaces, so as to present an extremely hard, tight-fitting surface there to contact the milled faces of the valve blocks, afore-mentioned, and one in which corroding, common with contacting metal faces, is practically eliminated.

In view of the foregoing, it is evident that the invention admits of a more gradual and uniform cutting on or off of the water supply, or humidifying of the resultant air, than has heretofore been obtained, and one which utilizes a single point of control for a plurality of banks or sections of moisture-supplying lines rather than, as is the usual case, a separate control device for each of the independent branches of the humidifying line of air conditioning systems.

It is also well understood practice in this art that electrical contacts with their connections to valves and current supply form a means of actuating valves equivalent to and interchangeable with the pneumatic means shown and described herein, and it is not desired to limit this application to merely means of pneumatic control, but to also include the well-known electrical means or any other means equivalent to the pneumatic.

Having thus fully described the invention, what is claimed, is:—

1. In a hygostat, multi-port valve seats and cooperating valves therefor, the said valve seats and valves actuated respectively by wet and dry bulb devices.

2. In a differential hygostat, multi-port valve seats and cooperating valves therefor, the said valve seats and valves actuated respectively by a plurality of thermo-responsive devices.

3. In a hygostat, a series of valve blocks each provided with a port, a slide valve for

each of said valve blocks, and thermoresponsive means for actuating said valve blocks and said slide valves relative to one another.

4. In a differential hygostat, a multi-port valve, a slide valve for each port of said valve, and thermoresponsive means for actuating said valve and said slide valves relative to one another.

5. In a differential hygostat, a multi-port valve, a slide valve for each port of said valve, and thermoresponsive means for actuating said valve and said slide valves relative to one another, said slide valves operating to open or close said ports progressively.

6. In a differential hygostat, a series of valve blocks each provided with a port, a slide valve for each port of said valve blocks, and thermoresponsive means for actuating said valve blocks and said slide valves relative to one another, said slide valves operating to open or close said ports progressively.

7. In a differential hygostat, a series of valve blocks each provided with a port, a slide valve for each port of said valve blocks, a thermo-responsive device actuating said valve blocks in one direction, and a second thermo-responsive device for actuating said slide valves to a different extent to that of said valve blocks, said slide valves operating to open or close said ports progressively.

8. In a differential hygostat, multiple adjustable valve blocks each provided with a port, a slide valve for each port of said valve blocks, and means for actuating said valve blocks and said slide valves relative to one another, said slide valves operating to open or close said ports progressively.

9. In a differential hygostat, a series of valve blocks each provided with a port, means for adjusting said valve blocks relative to one another, a slide valve for each port of said valve blocks, and means for actuating said valve blocks and said slide valves relative to one another, said slide valves operating to open or close said ports progressively.

10. In a differential hygostat, a series of valve blocks each provided with a port, means for adjusting said valve blocks relative to one another, a slide valve for each port of said valve blocks, a thermo-responsive device for actuating said valve blocks in one direction, a second thermo-responsive device for actuating said slide valves in a direction opposite to that of said valve blocks, said slide valves operating to open or close said ports progressively, and means for setting one of said thermo-responsive devices for operation at a desired degree of temperature.

11. In combination, an air conditioning system having its humidifying line arranged

to provide a plurality of banks or sections, pressure actuated devices for putting said banks or sections into or out of operation, and a single differential means for controlling said pressure actuated devices progressively.

12. In combination, an air conditioning system having its humidifying line arranged to provide a plurality of banks or sections, pressure actuated devices for putting said banks or sections into or out of operation, fluid pressure means for actuating said pressure actuated devices, and a single differential means for controlling said expansive means for the progressive actuation of said pressure actuated devices.

13. In combination, an air conditioning system having its humidifying line arranged to provide a plurality of banks or sections, a diaphragm valve for each of said banks or sections, fluid means for actuating said diaphragm valves, and a single differential means for controlling said fluid means for the progressive actuation of said diaphragm valves.

14. In combination, an air conditioning system having its humidifying line arranged to provide a plurality of banks or sections, a diaphragm valve for controlling each of said banks or sections, pneumatic means for actuating said diaphragm valves, control valves for said pneumatic means, and a single differential means for actuating said control valves for the progressive actuation of said diaphragm valves.

15. In combination, an air conditioning system having its humidifying line arranged to provide a plurality of banks or sections, a diaphragm valve for controlling each of said banks or sections, fluid pressure means for actuating said diaphragm valves, a multi-port control valve for said fluid pressure means, and a single differential means for actuating said control valve for the progressive actuation of said diaphragm valves.

16. In combination, an air conditioning system having its humidifying line arranged to provide a plurality of banks or sections, diaphragm valves for controlling said banks or sections, a main fluid pressure line, a plurality of branch fluid pressure lines connecting said main fluid pressure line with said diaphragm valves, a control valve provided with a plurality of ports each connected to one of said branch fluid pressure lines, and a single differential means for actuating said control valve for the progressive actuation of said diaphragm valves.

17. In combination, an air conditioning system having its humidifying line arranged to provide a plurality of banks or sections, diaphragm valves for controlling each of said banks or sections, a main fluid pressure line, a plurality of branch fluid pres-

sure lines connecting said main fluid pressure line with said diaphragm valves, a control valve provided with a plurality of ports each connected to one of said branch fluid pressure lines, and a differential thermostatic device for actuating said control valve for the progressive actuation of said diaphragm valves.

18. In combination, an air conditioning system having its humidifying line arranged to provide a plurality of banks or sections, diaphragm valves for controlling each of said banks or sections, a main fluid pressure line, a plurality of branch fluid pressure lines connecting said main fluid pressure line with said diaphragm valves, a control valve provided with a plurality of ports, flexible couplings connecting said branch fluid pressure lines with the ports of said control valve, and a differential thermostatic device for actuating said control valve for the progressive actuation of said diaphragm valves.

19. In combination, an air conditioning system having its humidifying line arranged to provide a plurality of banks or sections, diaphragm valves for controlling each of said banks or sections, a main fluid pressure line, a plurality of branch fluid pressure lines connecting said main fluid pressure line with said diaphragm valves, a control valve provided with a plurality of ports, flexible couplings connecting said branch fluid pressure lines with the ports of said control valve, said control valve comprising slide valves for each of said ports, and a single thermostatic device for actuating said slide valves for opening or closing the ports of said control valve progressively.

20. In combination, an air conditioning system having its humidifying line arranged to provide a plurality of banks or sections, diaphragm valves for controlling each of said banks or sections, a main fluid pressure line, a plurality of branch fluid pressure lines connecting said main fluid pressure line with said diaphragm valves, a control valve provided with a plurality of ports, flexible couplings connecting said branch fluid pressure lines with the ports of said control valve, said control valve comprising interconnected slide valves for said ports, and means for moving said control valve and said slide valves relative to one another for opening or closing the ports of the former progressively.

21. In combination, an air conditioning system having its humidifying line arranged to provide a plurality of banks or sections, diaphragm valves for controlling each of said banks or sections, a main fluid pressure line, a plurality of branch fluid pressure lines connecting said main fluid pressure line with said diaphragm valves, a plurality of valve blocks each provided with a single port, flexible couplings connecting

said branch fluid pressure lines each to a port of said valve blocks, a slide valve for each port of said valve blocks, and differential means for moving said valve blocks and said slide valves relative to one another for opening or closing the ports of the former progressively.

22. In combination, an air conditioning system having its humidifying line arranged to provide a plurality of banks or sections, diaphragm valves for controlling each of said banks or sections, a main fluid pressure line, a plurality of branch fluid pressure lines connecting said main fluid pressure line with said diaphragm valves, a plurality of valve blocks each provided with a single port, flexible couplings connecting said branch fluid pressure lines each to a port of said valve blocks, means for adjusting said valve blocks relative to one another, a slide valve for each port of said valve blocks, and differential means for moving said valve blocks and said slide valves relative to one another for opening or closing the ports of the former progressively.

23. In combination, an air conditioning system having its humidifying line arranged to provide a plurality of banks or sections, diaphragm valves for controlling each of said banks or sections, a main fluid pressure line, a plurality of branch fluid pressure lines connecting said main fluid pressure line with said diaphragm valves, a plurality of valve blocks each provided with a single port, flexible couplings connecting said branch fluid pressure lines each to a port of said valve blocks, means for adjusting said valve blocks relative to one another, a slide valve for each port of said valve blocks, a dry bulb thermo-responsive device for actuating said valve blocks, and a wet bulb thermo-responsive device for actuating said slide valves for opening or closing the ports of said valve blocks progressively.

24. In combination, an air conditioning system having its humidifying line arranged to provide a plurality of banks or sections, diaphragm valves for controlling said banks or sections, a main fluid pressure line, a plurality of branch fluid pressure lines connecting said main fluid pressure line with said diaphragm valves, a plurality of valve blocks each provided with a port, flexible couplings connecting said branch

fluid pressure lines each to a port of said valve blocks, means for adjusting said valve blocks relative to one another, a slide valve for each port of said valve blocks, a dry bulb thermo-responsive device for actuating said valve blocks, a wet bulb thermo-responsive device for actuating said slide valves for opening or closing the ports of said valve blocks progressively, and means for setting one of said thermo-responsive devices for operation at any desired degree of temperature.

25. In a differential hygostat, a series of valve blocks, each provided with a port, means for adjusting said valve blocks relative to each other, a slide valve for each port of said valve blocks, a thermo-responsive device for actuating said valve blocks in one direction, a second thermo-responsive device for actuating said valves to a different extent to that of said valve blocks, said slide valves operating to open and close said ports progressively, and means for setting one of the thermo-responsive devices for operation at a desired percentage of humidity.

26. In combination, an air conditioning system having its humidity line arranged to provide a plurality of banks or sections, diaphragm valves for controlling said banks or sections, a main fluid pressure line, a plurality of branch fluid pressure lines connecting said main fluid pressure line with said diaphragm valves, a plurality of valve blocks each provided with a port, flexible couplings connecting said branch fluid pressure lines each to a port of said valve blocks, means for adjusting said valve blocks relative to one another, a slide valve for each port of said valve blocks, a dry bulb thermo-responsive device for actuating said valve blocks, a wet bulb thermo-responsive device for actuating said slide valves for opening and closing the ports of said valve blocks progressively, and means for setting one of said thermo-responsive devices for operation at any desired percentage of humidity.

In testimony whereof I affix my signature in presence of two witnesses.

WILLIAM B. HODGE.

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