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S. M. ANDERSON

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FLUID CONDITIONING METHOD AND APPARATUS

Filed Feb. 6, 1931

2 Sheets-Sheet 1

Fig. 1

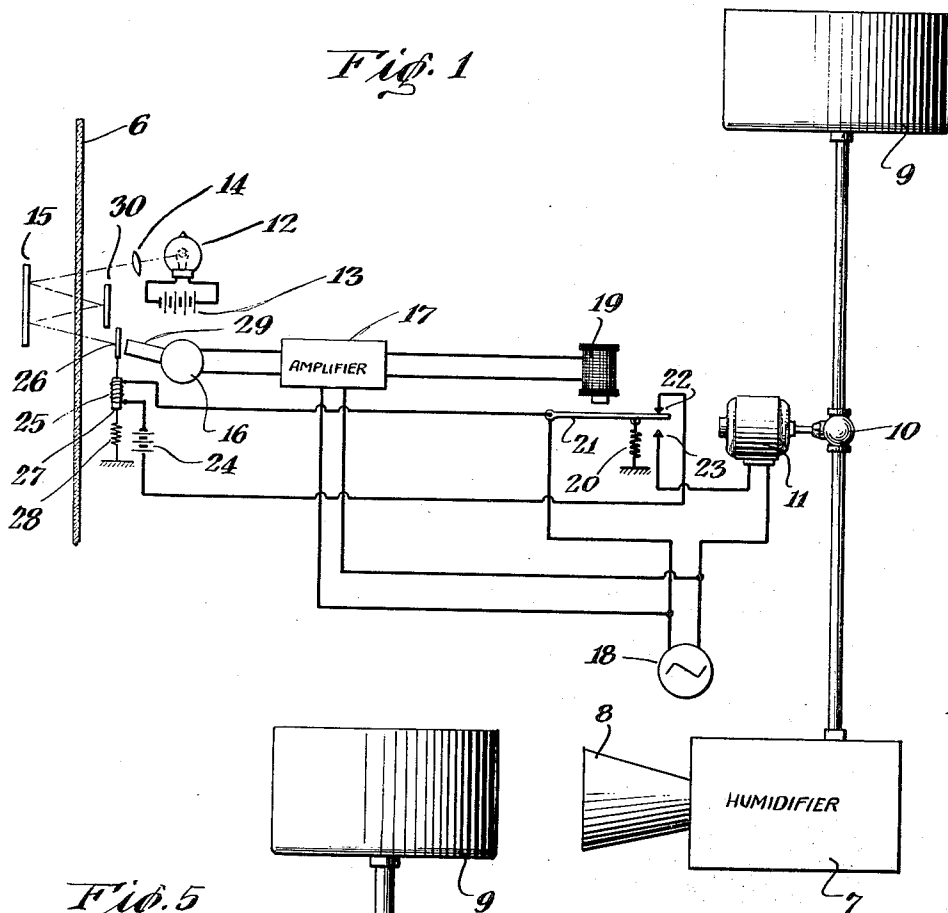
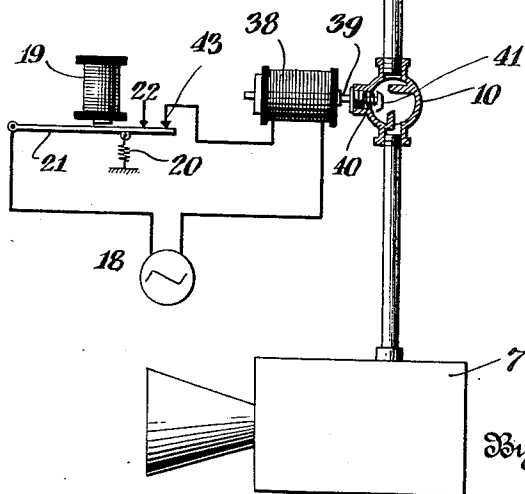


Fig. 5



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Fig. 2

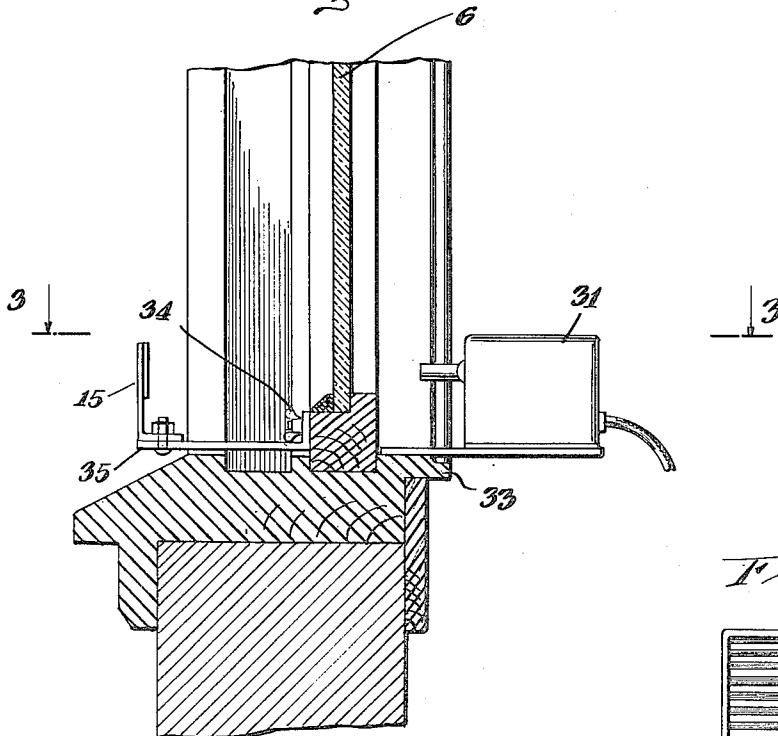


Fig. 3

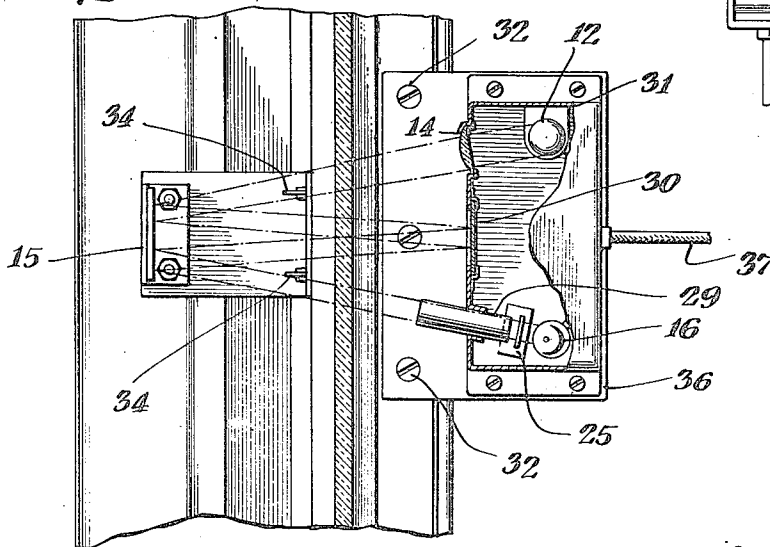
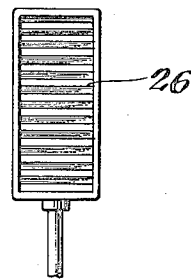


Fig. 4



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UNITED STATES PATENT OFFICE

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FLUID CONDITIONING METHOD AND APPARATUS

Application filed February 6, 1931. Serial No. 513,809.

This invention relates to methods and apparatus for controlling the vapor content of fluids and relates more particularly to methods and apparatus for controlling the relative humidity of the air within an enclosure.

It is becoming better and better known that living conditions in heated rooms are greatly improved when the air within the rooms contains a substantial amount of moisture or water vapor which tends to prevent the drying of the nasal and throat passages of the occupants. This moisture also tends to prevent the circulation of dust, which in itself is undesirable and may be injurious. Also, in certain manufacturing processes, among which are the manufacture of paper and the manufacture of cloth, the presence of a certain amount of moisture is necessary in the air in which the processes are employed. The heating systems generally employed for heating buildings effectively reduce the relative amount of moisture in the air so that it has been found desirable to provide humidifying apparatus for introducing additional moisture to compensate for the loss of relative humidity through the heating process.

A relative humidity of from fifty (50%) to fifty-five (55%) percent is in many cases desirable, but in cold weather and especially in extremely cold weather, such a high degree of moisture in the air of a closed room is attended by a serious disadvantage, in that a low outdoor temperature chills the window panes of the room, causing the moisture in the air of the room to condense thereon, and if this condensation is excessive, the window pane becomes frosted or clouded and the view is obscured. In many cases it may be desirable that the moisture content of the air in a room be as high as possible without producing this condensation of the moisture on the window surface, but due to the wide range of outdoor temperatures during the winter months, and the resulting difference in temperature between the heated air in the room and the outside air, the relative amount of moisture which can be supplied to the room without causing condensation will correspondingly vary within wide limits.

An object of this invention is to control the vapor content of a fluid.

Another object of the invention is to automatically control the supply of moisture to the air within a room by observation of the condensation of moisture from the air on the surface of a window of the room.

In one form of the invention a photo-electric cell which has the property of varying the current in its electrical circuit, proportional to light variations impressed upon it, is subjected to the action of light passing through a window pane, or other similarly located transparent medium of a heated room, and the variation in the light striking the photo-electric cell caused by the condensation of moisture on the surface of the window pane, is caused to actuate control apparatus for controlling the moisture supply. The outer surface of the window or other transparent medium is in contact with and, therefore, responsive to the action of the outdoor temperatures, and the inside surface is in contact with and, therefore, subject to the action of the air within the room.

According to a feature of the invention, as long as the humidity of the air in the room is below the condensation point, the photo-electric cell will be subjected to a maximum amount of light through the window, but as soon as condensation begins to take place upon the inner surface of the window, the intensity of light directed upon the photo-electric cell begins to decrease. This decrease in light actuates through the photo-electric cell, control circuits to automatically control the amount of moisture added to the air from the humidifier or other source. When the condensation has disappeared from the surface of the window, the light striking the photo-electric cell increases, and actuates control circuits to increase the amount of moisture supplied to the air.

The invention disclosed and claimed here is for a modification of the invention disclosed in my Patent No. 1,789,268, issued January 13, 1931, and is for methods and apparatus which have been found practical in the application of my invention to certain types of air conditioning plants.

The invention will now be described with reference to the drawings, of which:

Fig. 1 is a schematic view of one form of the invention for controlling the moisture content of the air within a room;

Fig. 2 is a side view of the apparatus mounted near a window;

Fig. 3 is a plan view of the apparatus shown by Fig. 2;

Fig. 4 is a plan view of a light shutter which is used in the system shown by Figs. 1, 2, and 3 to control the amount of light reaching the photo-electric cell in the system, and

Fig. 5 is a diagrammatic view of a form of valve control which can be used to replace that shown in Fig. 1.

Referring now to Fig. 1, the window pane 6 has its left side (facing the drawing) exposed to the outside air and its other side exposed to the air within the heated room or other enclosure. The humidifier 7 serves to supply moisture through the nozzle 8 into the room. The humidifier 7 is supplied with water from the water supply 9, the amount of water reaching the humidifier being controlled by the valve 10 which is operated by the motor 11. Placed within the room adjacent the window pane 6 is the electric lamp 12, the filament of which is heated by current from the battery 13. The light from the lamp 12 passes through the lens 14, the window pane 6, is reflected by the large mirror 15, through the window pane 6, to strike the small mirror 30, which reflects the light again through the window pane where it again strikes the large mirror 15, and is again reflected through the window pane to strike the light sensitive cathode of the photo-electric cell 16. The projected and reflected light beam is illustrated by the dash-dot lines. The photo-electric cell is connected electrically to the amplifier 17 which is energized from the alternating current source 18, and which amplifies the electrical variations set up in the photo-electric cell by light variations, which electrical variations, in the form of amplified current, pass through the windings of the relay 19. When sufficient current flows through the relay 19 to overcome the force of the spring 20, the armature 21 of the relay pulls up to open the electrical circuit of the motor 11, including armature 21, contact 23, and the alternating current source 18. At the same time an electrical circuit is closed through armature 21, contact 22, battery 24, and solenoid 25, to cause, upon energization of the solenoid 25, the light shutter 26 to be carried by the solenoid plunger 27, against the pull of the spring 28, in front of the tube 29 through which the light through the window reaches the photo-electric cell 16.

In operation, the humidifier supplies atomized moisture into the room through the nozzle 8. When the difference in temperature between the outside and the inside of the room

becomes such that a portion of the moisture within the room condenses on the inner surface of the window pane 6, this film of condensed moisture shuts off and diffuses a portion of the light in the beam between the lamp 12 and mirror 15, between the mirror 15 and the mirror 30, and between the photo-electric cell 16 and the mirror 15. The effect of the condensed moisture is magnified by having it cut off a portion of the light beam each of the four times that the latter passes through the film of moisture and the window pane.

Normally, there is no moisture condensed on the window pane 6, and a strong light beam from the lamp 12 strikes the cathode of the photo-electric cell 16. Due to the strong light, there is maximum current flow in the photo-electric cell circuit, which current is amplified through the amplifier 17 and energizes the winding of the relay 19, with the result that the armature 21 of the relay 19 is pulled up, as shown by Fig. 1, to close the electrical circuit including the armature 21, the contact 22, the battery 24, and the solenoid winding 25. The tube 29, placed between the window pane 26 and the photo-electric cell 16, serves to effectively prevent any light reaching the light sensitive cathode of the photo-electric cell, except that reaching the photo-electric cell from the mirror 15. As moisture condenses on the inner surface of the window pane 6, the intensity of the light reaching the photo-electric cell 16 is so decreased that a much smaller current flows through the photo-electric cell circuit in the amplifier 16 and the energizing winding of the relay 19. The current through the energizing winding is so reduced that the spring 20 is able to pull back the armature 21, this movement of the armature 21 causing the circuit, including the armature 21, the contact 23, the motor 11, and the alternating current source 18, to place the motor 11 in operation to close the valve 10, which shuts off the supply of water from the tank 9 to the humidifier 7. The humidifier 7 then ceases to supply moisture to the enclosure until the moisture disappears from the window pane, when increased light will strike the photo-electric cell and the relay 19 is energized to open the circuit of the motor 11, at which time the valve 10 is again opened by a spring (not shown) to supply water to the humidifier.

When the moisture appears on the window pane to cause the release of the armature 21 by the de-energization of the relay 19, the electrical circuit, including the contact 22, the armature 21, the battery 24, and the solenoid winding 25, is opened, permitting the spring 28 to pull the plunger 27 of the solenoid downwardly and remove the light shutter 26 from between the photo-electric cell tube 29 and the window pane 6. The purpose of the light shutter 26 is to com-

5 compensate for the tendency of a photo-electric cell to sometimes react only to comparatively great changes of light. For example, it has been found that while the photo-electric cell 16 responds, in practically all instances, to the light variations caused by the condensation of moisture upon the window pane, there have been instances where the photo-electric cell, due to its physical inertia or other reasons, failed to react as satisfactorily as is desirable upon the appearance of a slight amount of moisture upon the window pane. It was found that if once the bright light from the lamp 12 was allowed to reach the photo-electric cell 16 without the use of the shutter 26, and with no moisture on the window pane, and then a small amount of moisture did appear on the window pane, the photo-electric cell 16 would, occasionally, not react to the presence of the moisture, unless the light reaching the photo-electric cell was decreased somewhat. With the decreased light, such as caused by the interposition of the shutter 26, the photo-electric cell responds quickly to the presence of a very small amount of condensed moisture on the window pane. When, however, the moisture disappears from the window pane and it is desired that very strong currents flow again through the relay 19, to cause the supply of water to the humidifier, it is desirable that the illumination reaching the photo-electric cell be greatly increased to cause the necessary increase in current for energizing the relay. It becomes desirable, therefore, for the light shutter to be removed from between the photo-electric cell and the window pane, when it is desired that the humidifier be started up again. The control of the electrical circuit of the light shutter solenoid 25, by the movement of the armature relay 21, serves to automatically vary the amount of light reaching the photo-electric cell upon the appearance or disappearance of moisture upon the window pane. The apparatus is so adjusted that, normally, with no moisture on the window pane, the light shutter 26 is between the photo-electric cell 16 and the pane, and the current through the relay 19 is sufficient to overcome the pull of the spring 20 on the armature 21, keeping the electrical circuit of the solenoid closed so that the shutter remains before the photo-electric cell and the electrical circuit of the motor 11 open so that the water supply valve 10 is open, permitting supply of water to the humidifier. Then, when moisture appears on the window pane, the light reaching the photo-electric cell 16 is decreased and the current through the relay 19 is correspondingly decreased so that the spring 20 is enabled to pull the armature 21 away from the relay core, opening the solenoid circuit 25 and closing the motor circuit 11. The closing of the motor circuit causes the motor 11 to close the valve 10,

shutting off the supply of water to the humidifier, and thus discontinuing the supply of atomized moisture to the room. The opening of the electrical circuit of the solenoid 25 permits the spring 28 to pull the plunger 27 down, thus removing the shutter 26 from between the photo-electric cell 16 and the window pane 6. This removal of the shutter from between the photo-electric cell 16 and the window 6 places the photo-electric cell in condition to respond, when the moisture condensed on the window pane disappears, to the increased light caused thereby and again energize the relay 19 to cause it to pull up the armature 21 and to operate the humidifier. Obviously, the light shutter could be placed between the lamp 12 and the window pane 6 instead of between the cell 16 and the pane 6.

In the adaptation of this invention for use in ordinary buildings, it was found most advantageous, as illustrated by Figs. 2 and 3, to mount the photo-electric cell 16 and the lamp 12 in the small enclosure 31, which, in turn, is mounted on the frame 36 which is secured by the screws 32 onto the window sill 33 within a room, the air of which it is desired to humidify. The mirror 15 is attached, as clearly shown by Fig. 2, to the lower portion of the window frame by means of the wing nuts 34 and the frame 35. The enclosure 31, which houses the photo-electric cell 16 and the lamp 12, also has mounted on one of its sides the lens 14, the mirror 30, and the tube 29. The solenoid 25, which controls the light shutter 26, is also mounted within the enclosure 31. The electrical leads to the photo-electric cell 16 are led through the cable 37 to the control and supply apparatus. The leads to the light source 12 are led through other leads (not shown).

A view of the shutter 26 is shown by Fig. 4. This light shutter may be an ordinary piece of glass which is shaded, as indicated, to decrease the amount of light which is permitted to pass therethrough.

Fig. 5 illustrates another form of valve control which may be used to replace the motor operated control of Fig. 1. The solenoid 38 is connected in the electrical circuit in such a way that it is energized from the source 18 by the pull up of the armature 21 to contact with the contact 43. Upon energization, its plunger 39 is pulled into the solenoid against the action of the spring 40 within the valve 10 to cause the piston 41 to become unseated and thus permit the supply of water from the tank 9 to the humidifier 7 when there is no condensation on the window pane. This form of valve control is well known and can be used, if desired, to replace the control motor 11 of Fig. 1. Both types of valve control have the advantages that if the lamp 13 is burnt out, for example, the cessation of light will cause the apparatus to shut down the humidifier and thus avoid the

operation of the system with no control.

Whereas the lamp 12 has been illustrated as energized by the battery 13 and the solenoid 25 by the battery 24, obviously, in a commercial installation there would be no batteries since all of the current requirements would be supplied directly from the alternating current source 18, or from transformers interposed in the current source 18, or from transformers interposed in the current supply lines to supply the voltages and currents required.

The apparatus illustrated by Figs. 2 and 3 has been found particularly suitable for commercial installations. The important apparatus is housed in a compact, neat-appearing enclosure which can be conveniently placed within a room and is thus not exposed to damage from weather changes. The mirror 15, which is the only piece of apparatus mounted outside of the enclosure and exposed to the weather, obviously is not fragile and may be a chromium of any other suitable reflecting surface. The device, by being adapted to be used with an ordinary window pane, permits simplified apparatus and a small installation cost.

The embodiment of the invention illustrated has been described as being placed adjacent a single pane of glass. Obviously, however, the invention could be used equally as well with double or triple glass windows. Furthermore, whereas the beam of light has been shown as being reflected twice to pass through the window pane four times, obviously, the beam could be reflected only once, or could be reflected any number of times without departing from the spirit of the invention, the circumstances surrounding each individual installation, determining, of course, the arrangements and design of each individual installation.

Whereas one embodiment of this invention has been described for the purpose of illustration, it should be understood that the invention is not limited to the exact disclosure described, as many modifications may be made by those skilled in the art without departing from the spirit of the invention.

What I claim is:

1. Apparatus for controlling the amount of vapor in a fluid contained within an enclosure, comprising a vapor source, control means for controlling the addition of vapor from said source, a medium contained within said enclosure having one side exposed to a different temperature from that within said enclosure, means for directing a light beam upon the surface of said medium, means actuated by light variations from said medium caused by any condensation thereon for actuating said control means, and means for decreasing the intensity of the light beam reaching said second mentioned means when there is no condensation of vapor on the surface of

said medium, and for increasing the intensity of the light beam reaching said second mentioned means when said control means have been actuated by the condensation of moisture on the surface of said medium.

2. Apparatus for controlling the amount of moisture added to the air within an inclosure, comprising a moisture supplying source, control means for varying the amount of moisture supplied by said source, a medium contained within said enclosure and having a portion exposed to a temperature different from that within said enclosure, means for directing a light beam upon the surface of said medium, means for changing the light variations leaving said medium caused by any condensation of moisture thereon into electrical variations, means actuated by said electrical variations for actuating said control means, and means for decreasing the intensity of the light beam reaching said second mentioned means when there is no condensation of moisture on the surface of said medium, and for increasing the intensity of the light beam reaching said second mentioned means upon the actuation of said control means to decrease the amount of moisture supplied by said source.

3. Apparatus for controlling the amount of moisture added to the air within an enclosure comprising a moisture supply source, control means for varying the amount of moisture supplied by said source, a medium contained within said enclosure and having a portion exposed to a temperature different from that within said enclosure, means for directing a light beam upon the surface of said medium, a photo-electric cell for changing light variations leaving said medium caused by any condensation of moisture thereon into electrical variations, means actuated by said electrical variations for actuating said control means, and means for decreasing the intensity of the light beam reaching said photo-electric cell when there is no condensation of moisture on the surface of said medium, and for increasing the intensity of the light beam reaching the photo-electric cell upon the actuation of said control means to decrease the amount of moisture supplied by said source.

4. Apparatus for controlling the amount of moisture added to the air within a room having a window pane separating said room from the outside air, comprising a moisture supply source, control means for varying the amount of moisture supplied by said source, means for directing a light beam through said window pane, a reflecting surface outside said room for reflecting said light beam back through said window pane into said room, a photo-electric cell for changing light variations through said window pane caused by any condensation thereon into electrical variations, means actuated by said electrical

variations for actuating said control means, and means for decreasing the intensity of the light beam reaching the photo-electric cell when there is no moisture on the window pane, and for increasing the intensity of the light beam reaching the photo-electric cell upon the actuation of said control means to decrease the amount of moisture supplied by said source.

5. Apparatus for controlling the amount of moisture added to the air within an enclosure comprising a moisture supply source, control means for varying the amount of moisture supplied by said source, a medium contained within said enclosure and having a portion exposed to a temperature of that within said enclosure, means for directing a light beam upon the surface of said medium, a photo-electric cell for changing light variations leaving said medium caused by any condensation of moisture thereon to electrical variations, means actuated by said electrical variations for actuating said control means, and means for introducing a light shutter between said medium and said photo-electric cell when there is no condensation of moisture on the surface of said medium and for removing said light shutter upon the actuation of said control means to decrease the amount of moisture supplied by said source.

6. Apparatus for controlling the amount of moisture added to the air within a room having a window pane separating said room from the outside air comprising a humidifier, means for directing a light beam from within said room through said window pane, a reflecting surface outside said room for reflecting the light beam back through said window pane, a photo-electric cell inside said room in line with the light beam reflected from said surface into said room, control means actuated by said photo-electric cell for reducing the amount of moisture supplied by said humidifier when condensation appears on said window pane to decrease the amount of light reaching said photo-electric cell from said source, and means for introducing a light shutter between said photo-electric cell and said window pane when there is no condensation of moisture on the surface of said window pane and for removing said shutter upon the actuation of said control means to reduce the amount of moisture supplied by said humidifier.

In testimony whereof I affix my signature.
SAMUEL M. ANDERSON.