Feb. 24, 1970 R. L. McDUFFEE 3,497,188

HUMIDIFIER APPARATUS AND METHOD

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FIG.1

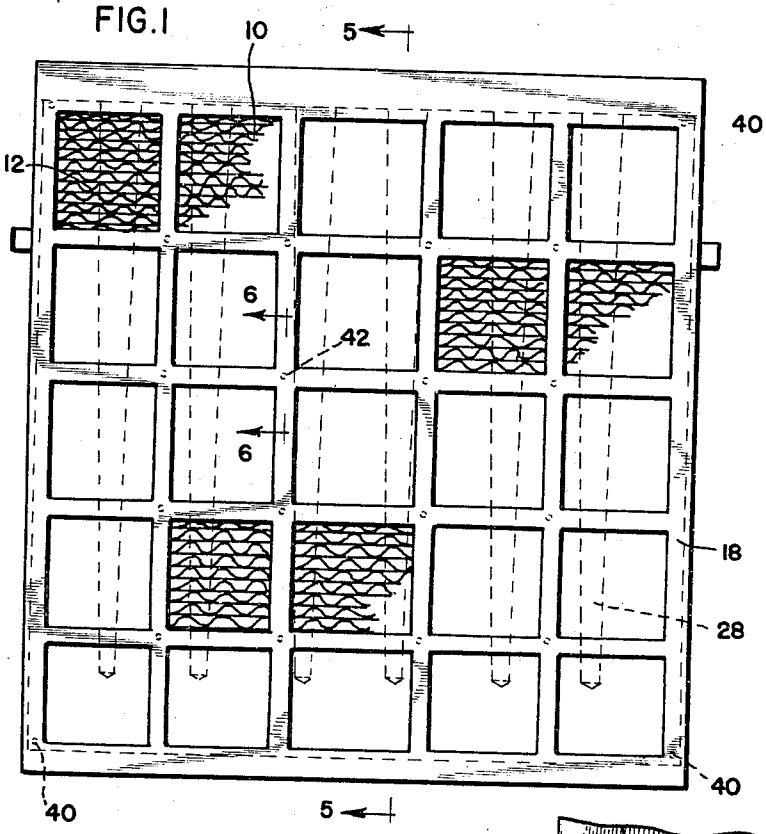



FIG.2

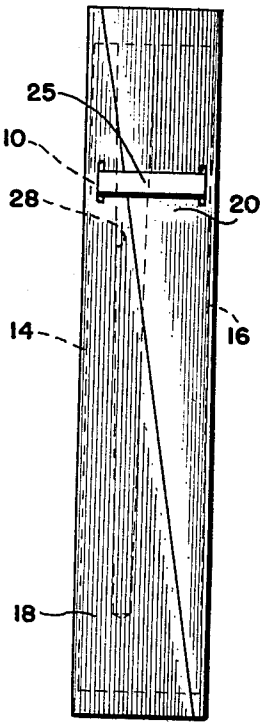



FIG.3

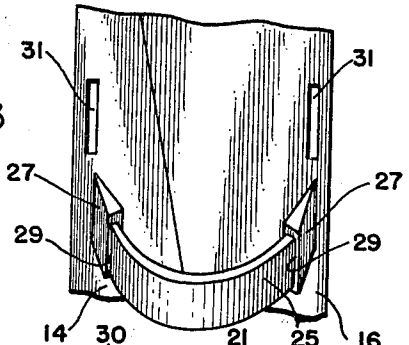
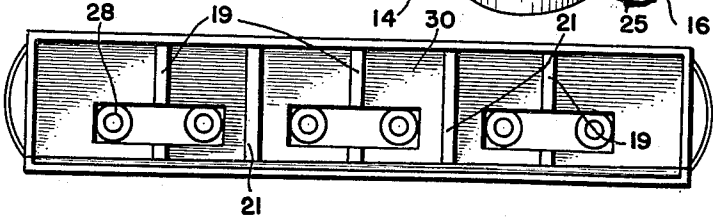



FIG.4

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HUMIDIFIER APPARATUS AND METHOD

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FIG.5

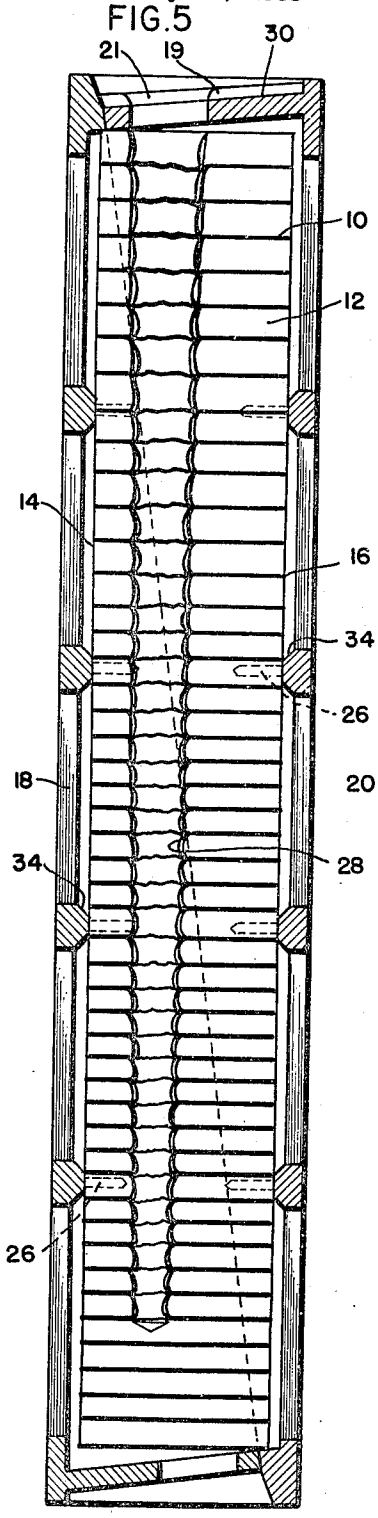



FIG.6

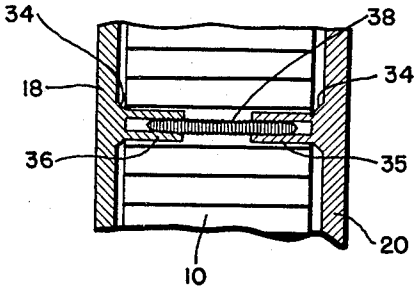



FIG.7

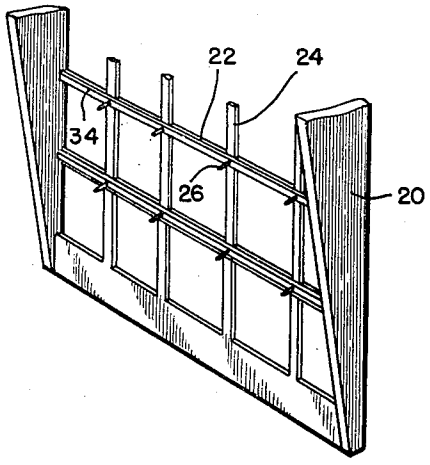
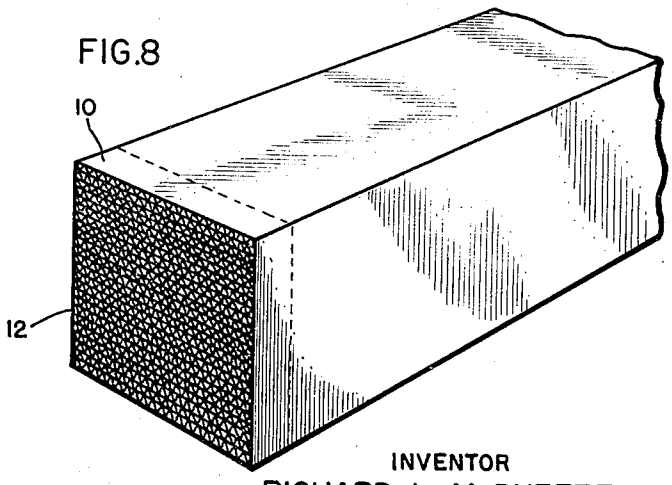



FIG.8

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3,497,188

# HUMIDIFIER APPARATUS AND METHOD

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U.S. Cl. 261—99 13 Claims

## ABSTRACT OF THE DISCLOSURE

An assembly for a humidifier apparatus comprising an absorbent pad and associated frame members. The absorbent pad is formed of a block of corrugated absorbent material with the passages in the corrugated block providing openings for an air stream. Pierced holes are formed in the block transversely of the passages, and water is adapted to be located in the pierced holes for absorption by the corrugated material. The piercing operation provides a means for insuring absorption of the water while minimizing the availability of free water droplets for contact with the air stream. Means are provided for securing the corrugated block between frame members and for controlling the movement of water in the construction to provide maximum efficiency during operation.

This invention relates to a humidifier apparatus, and particularly to an absorbent pad for use in the apparatus.

In the operation of humidifier constructions, an air stream is brought into contact with moisture whereby the air stream emerging from the apparatus will contain more moisture than the stream entering the apparatus. In some instances, pads of material are located in the path of the air stream. The pads are characterized by the ability to retain water, and they are usually designed to provide a large surface area to provide maximum opportunity for the pick-up of water. Mesh materials and corrugated materials have been suggested for such pads.

A significant problem in humidifier constructions relates to efficient pick-up of moisture by air streams. Some pad constructions comprise wire mesh which is treated so that moisture will cling to its surfaces. The wire provides a suitable amount of moisture; however, the moisture is often present in beads of water and, therefore, larger water particles tend to be present in the air issuing from the apparatus. This water may drop out of the stream so that it will serve no significant purpose, and it also tends to damage structures which it contacts, for example by causing corrosion, or by leaving a deposit when the water vaporizes.

Corrugated materials have been utilized, for example corrugated asbestos. These materials absorb water and, therefore, the air streams will tend to pick-up very small particles as opposed to water droplets. Constructions utilizing corrugated material have disadvantages, however, since it is difficult to support the material when it becomes soaked with water, and this lack of support causes clogging and non-uniform operation. Furthermore, it is difficult to control the water additions to the absorbent pads and water droplets occur in localized areas, again causing the droplets to be entrained in the air stream issuing from the apparatus.

It is a primary object of this invention to provide an improved humidifier apparatus design which will increase the efficiency of operation while minimizing damage to other structures, such as forced air conduit systems.

It is a more specific object of this invention to provide an improved design for an absorbent pad and its associated structure whereby moisture additions and pick-up in a a humidifier apparatus can be greatly simplified.

It is a still further object of this invention to provide an improved method for constructing a humidifier apparatus characterized by the features described.



These and other objects of this invention will appear hereinafter and for purposes of illustration but not of limitation, the specific embodiments of the invention are shown in the accompanying drawings in which:

FIGURE 1 comprises a front elevational view of an assembly including an absorbent pad and supporting structure;

FIGURE 2 is a side elevation of the assembly shown in FIGURE 1;

FIGURE 3 is an enlarged fragmentary view illustrating a strap means which can be associated with the construction;

FIGURE 4 is a top plan view of the assembly shown in FIGURE 1;

FIGURE 5 is an enlarged vertical sectional view taken about the line 5—5 of FIGURE 1;

FIGURE 6 is an enlarged fragmentary view taken about the line 6—6 of FIGURE 1;

FIGURE 7 is a fragmentary perspective view illustrating one supporting frame portion; and

FIGURE 8 is a perspective view illustrating a block construction suitable for use in producing the absorbent pad.

The instant invention generally relates to a humidifier apparatus having moisture holding elements disposed therein. Relatively dry air is moved into contact with the surfaces of these elements for pick-up of moisture by the air whereby relatively moist air is discharged by the apparatus. One particular improvement of the invention relates to an absorbent pad which provides the moisture holding surfaces which contact the air stream. The absorbent pad comprises a block of material, for example corrugated material, with passages in the material aligned in the direction of air flow. Holes are pierced in the block transversely of the passages so that water can be introduced into the holes. Due to the absorbing characteristics of the block of material, the water will spread from the holes throughout the block.

The piercing operation is an important aspect of the invention since the formation of holes in this manner provides an ideal arrangement for the absorption of moisture in the construction. The piercing causes material in the block to assume a bent-over position which forms a seal all around the hole. This sealing action prevents the direct flow of water outwardly from the hole into the passages surrounding the hole. Accordingly, the passage of water into the pad is accomplished almost solely through absorption. In this manner, only a minimum amount of direct water pick-up will occur as the air stream flows through the passages.

The invention also provides a frame construction which is ideally suited for use in conjunction with the absorbent pad. The frame includes retaining means which engage the pad and which hold the pad in an essentially constant position even after a great deal of moisture has been absorbed by the pad. Furthermore, the construction includes a means for introducing water into the pad whereby maximum contact with the air streams can be achieved for most efficient operation. The arrangement of the invention is also advantageous in that it can be used with a variety of means for adding water to the pad and need not be positioned in precise location with respect to such means.

The invention also relates to an improved method for providing the absorbent pads and for assembling the pads in the frame constructions. An elongated block of corrugated material is initially manufactured with the passages formed by the corrugations extending the length of the block. The vertical and transverse dimensions of the elongated block are selected to correspond with the

same dimensions of the pad. The thickness of the pad is provided by slicing sections from the elongated block. The assembly operation consists in the utilization of a pair of separable frame portions with the absorbent pad being initially secured to one frame portion and with the other frame portion then being put into place.

As indicated in the accompanying drawings, the apparatus includes an absorbent pad **10** formed of corrugated material with the passages **12** in the block extending from one face **14** to the opposite face **16**.

The pad **10** is disposed within a frame construction which includes a pair of frame portions **18** and **20**. The frame portions are rectangular in shape with each defining a triangularly shaped side wall with a rectangular side wall being presented when the frame portions are assembled.

Each of the frame portions is provided with horizontally extending cross members **22** and vertically extending cross members **24**. At the juncture of the respective cross members, there are provided spikes **26**. These spikes extend inwardly when the frame members are assembled. The spikes press into the corrugated pad so that vertical support for the pad is provided at several locations.

Each of the pads is provided with a plurality of pierced holes **28**. These holes are formed by means of a standard piercing tool having a pointed end a tapered body. As the piercing action takes place, the corrugated material, which may be asbestos, is pressed downwardly in response to the action of the tool. Thus causes portions of the material to bend over and to block passages adjacent the holes. In effect, the bent-over and overlapping portions of material seal off these holes, and when water is introduced into the holes, the water will not flow directly into the passages. On the contrary, the water will collect in the holes and will then be gradually absorbed by the material. This provides very uniform absorption rates and prevents the collection of water droplets in the passages. The air streams passing through the construction will, therefore, not pick-up any water droplets.

At the top of the frame, there is provided a tray **30** for collecting water. A water source provides for delivery of water to the tray surface. As illustrated, the tray is inclined toward the holes **28** so that the water will naturally flow into these holes. It will be appreciated that with the design illustrated, the location of the water source is not critical since the sloped tray will deliver the water to the holes irrespective of the point of delivery of water to the tray.

Ribs **19** and **21** are preferably formed on the tray surface to divide the surface into collecting areas for each hole **28**. A water source can be provided for each hole and the ribs will insure that the water passes to the intended hole even if the frame is not level when installed. Without the ribs and with a tilt in the tray, the water would be unevenly distributed.

The horizontal cross members **22** preferably include a shoulder **34** all along their length. The shoulder **34** operates as a deflection means to pick-up any water which might collect on the faces of the pad. The water moving across a face will encounter a shoulder, and due to the inclusion of the should, the water will move inwardly for absorption by the pad rather than continuing across the face. This arrangement also serves to minimize the presence of water droplets which could be collected by air streams.

It will be noted that the holes **28** are located adjacent the face **14** of the pad which encounters the oncoming air stream. This provides a preferred arrangement since there is a long period of contact between the air stream and moisture carrying surfaces beyond the holes. Thus, a substantial length of the passages, uninterrupted by holes, is provided for the air before discharge from the pad. In the event that any water droplets should be picked up by the air stream, the long path of flow from the area of the holes will increase the likelihood of the water droplets being picked up by a passage wall before issuing from the construction. Thus, if water droplets do form, there will be a greater tendency to form in the area of the holes **28**, and the arrangement illustrated provides a means for removing the water droplets before they are carried out of the apparatus by the air stream.



FIGURE 5 illustrates an arrangement for securing the frame members together. The securing means comprises a sleeve **35** attached to a portion of the frame portion **20** and a corresponding sleeve **36** attached to a portion of the frame portion **18**. A serrated pin **38** is adapted to be inserted in the bore of one of the sleeves. The diameter of the pin **38** is slightly in excess of the bore diameter so that pins can be driven into the sleeves on one frame portion and secured tightly in place with respect to this frame portion. The asbestos pad is located on this frame portion and the sleeves on the other frame portion are then aligned with the pins whereby this other frame portion can be driven into place.

The frame is preferably formed of a high temperature resistant plastic material, for example polypropylene. The design of the frame members permits a molding operation whereby the frame members, with various features such as the spikes **26** and sleeves **35** and **36** can be economically produced. In this connection, the sleeves **35** and **36** may be formed only at the corners of the construction, as shown at **40** in FIGURE 1, or at other locations, for example in the middle of the construction, as shown at **42**, to provide a more secure relationship.

FIGURE 3 illustrates a strap **25** which be formed of plastic. The strap defines ends **27** which are tapered rearwardly to an enlarged shoulder portion **29**. Slots **31** are formed in the frame of the construction, the width of the slots being slightly less than the thickness of the shoulder portions **29**. With this arrangement, the ends **27** can be snapped into the frame to provide a securely attached handle. Slots for the handles may be provided at several different locations around the frame depending on whether the frame is unloaded from the top, side or bottom.

In the production of constructions of the type described, a block of asbestos material such as shown in FIGURE 7 is preferably produced. This block may be several feet long; however, the cross section of the block corresponds with the desired rectangular dimensions of the absorbent pads to be used in the construction. In producing absorbent pads, slices are made from the block with the desired width determining the size of the slice.

Once a pad is available, holes are pierced with the number of holes depending upon the size of the block. In a typical operation, holes may be located in the block at two-inch intervals.

The pad is then placed on one of the frame members with the spikes **26** serving to secure the pad in position relative to the frame members. The second frame member is then put into place at which time the frame members will be secured together with the pad being firmly held therebetween. The entire assembly can then be located in a humidifier apparatus. In this connection, some design changes in the exterior portions of the frame members may be necessary to accommodate a pad humidifier construction.

It will be understood that various changes and modifications may be made in the above described construction which provide the characteristic of this invention without departing from the spirit thereof, particularly as defined in the following claims.

That which is claimed is:

**1.** In a humidifier apparatus wherein relatively dry air is moved into contact with surfaces holding moisture for pick-up of moisture by the air whereby relatively moist air is discharged by the apparatus, the improvement wherein the surfaces for holding moisture are defined by a block of absorbent material which includes a

plurality of passages aligned in the direction of air flow, said block being formed of corrugated material, said passages being located in vertically and transversely extending parallel rows with all passages having substantially the same dimensions, holes pierced in said block transversely of the passages for the introduction of water to the block, the material of the block which defines the walls of said holes being forced into a bent-over position by the piercing operation and thereby serving to substantially close off the passages in the vicinity of the holes whereby direct passage of water into the passages is minimized and whereby the majority of the moisture available for contact with said air comprises water absorbed by the material of the block.

2. An apparatus in accordance with claim 1 wherein said pierced holes extend vertically downwardly to a point adjacent the bottom of said block, and wherein said passages comprise horizontally disposed openings defined by the corrugations of the block.

3. An apparatus in accordance with claim 2 wherein said block is carried by a supporting frame, and including a water tray disposed at the top of said frame, said water tray defining a sloping surface extending downwardly toward openings in the tray, said tray openings being aligned with said pierced holes.

4. An apparatus in accordance with claim 3 wherein said pierced holes are located adjacent the face of said block which is exposed to the dry air entering the block.

5. An apparatus in accordance with claim 3 wherein said frame is formed of a high temperature resistant plastic material.

6. An apparatus in accordance with claim 3 including a curb formed along the length of said tray in approximately the same place as the face of said block from which moist air passes, said curb serving to prevent the pick-up of water in the tray by air passing above said block to thereby minimize the presence of free water in the air stream.

7. An apparatus according to claim 3 including ribs formed on the surface of said tray dividing the tray into individual sections, the ribs preventing the water in one section from passing to another section, and wherein at least one of said holes is in communication with each of said sections.

8. An apparatus in accordance with claim 1 wherein said block is supported by means of a frame, said frame including a plurality of horizontally disposed cross members, each of said horizontally disposed cross members defining a shoulder portion extending the length of the cross member, said shoulder portion being located immediately adjacent a face of said block thereby holding the face of the block in spaced-apart relationship relative to said frame, said shoulder portions acting as deflecting means so that moisture tending to move downwardly over said face will be deflected inwardly upon contact with said shoulder portions.

9. An apparatus in accordance with claim 1 including a frame for supporting said block, said frame comprising a rectangular peripheral portion, and intermediate cross members extending between the peripheral portion, and including spikes carried by said cross members, said spikes being adapted to press into said block when the block is assembled in the frame to secure the block relative to the frame.

10. In a humidifier apparatus wherein relatively dry air is moved into contact with an absorbent pad for pick-up of moisture from the surfaces of the pad and for discharge of relatively moist air from the apparatus, an improved method for the production of an assembly including said absorbent pads comprising the steps of forming an elongated, rectangular block of corrugated material, the openings defined by the corrugated construction extending longitudinally of said block, the cross sectional dimensions of the block corresponding with the size of the pad to be employed in said construction, severing said block into a plurality of slices with each slice having a thickness corresponding with the desired thickness of said pads, disposing said pad between first and second frame members, said frame members each including transversely extending cross members with spikes extending outwardly from said cross members, said pad being pressed into position on one frame member by forcing the spikes on the one frame member into engagement with the pad, and thereafter placing the other frame member into position on the opposite side of the pad with the spikes of the other frame member serving to secure the pad in the assembly, and piercing holes in said pads, said holes extending transversely of said openings between the opposed faces of a pad, said piercing operation causing the material of the pad to bend over whereby a relatively continuous inner wall surface is defined by each hole thereby substantially completely preventing flow of water from said holes into the surrounding pad, the water being spread through the pad by absorption.



11. In a humidifier apparatus wherein relatively dry air is moved into contact with surfaces holding moisture for pick-up of moisture by the air whereby relatively moist air is discharged by the apparatus, the improvement wherein the surfaces for holding moisture are defined by a block of absorbent material which includes a plurality of passages aligned in the direction of air flow, holes pierced in said block transversely of the passages for the introduction of water to the block, the material of the block which defines the walls of said holes being forced into a bent-over position by the piercing operation and thereby serving to at least partially close off the passages in the vicinity of the holes whereby direct passage of water into the passages is minimized and whereby the majority of the moisture available for contact with said air comprises water absorbed by the material of the block, and including a frame for supporting said block, said frame comprising a rectangular peripheral portion, intermediate cross members extending between the peripheral portion, and including spikes carried by said cross members, said spikes being adapted to press into said block when the block is assembled in the frame to secure the block relative to the frame, said frame being formed of separate portions disposed on each side of the block, and including means for securing the frame portions together comprising pin means having one end secured to one frame portion and an exposed opposite end, and means defined by the other frame portion for receiving the exposed end of the pin, said receiving means operating to securely grip said pin means.

12. An apparatus in accordance with claim 11 wherein said pin means comprise a plurality of serrated pins located at least at the corners of the respective frame members.

13. In a humidifier apparatus wherein relatively dry air is moved into contact with surfaces holding moisture for pick-up of moisture by the air whereby relatively moist air is discharged by the apparatus, the improvement wherein the surfaces for holding moisture are defined by a block of absorbent material which includes a plurality of passages aligned in the direction of air flow, holes pierced in said block transversely of the passages for the introduction of water to the block, the material of the block which defines the walls of said holes being forced into a bent-over position by the piercing operation and thereby serving to at least partially close off the passages in the vicinity of the holes whereby direct passage of water into the passages is minimized and whereby the majority of the moisture available for contact with said air comprises water absorbed by the material of the block, and wherein said block is carried by a supporting frame, and including a water tray disposed at the top of said frame, said water tray defining a sloping surface extending downwardly toward openings in the tray, said

tray openings being aligned with said pierced holes, and including slots formed in at least one location on said frame, a handle defining enlarged end portions, said end portions being adapted to snap into said slots for securing said handle to the frame.

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