Aug. 27, 1963 R. L. BOYD ETAL 3,102,185

DUCT HEATER ASSEMBLY

Filed March 31, 1960 3 Sheets-Sheet 1

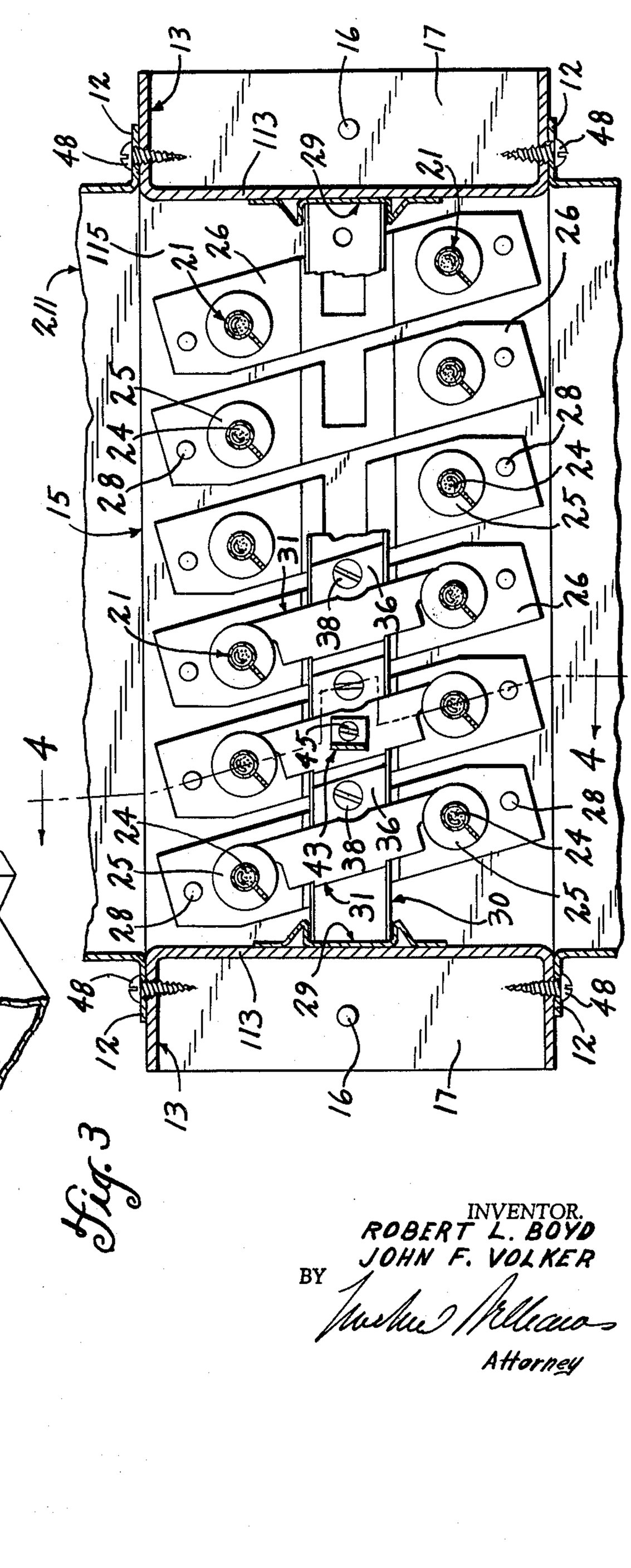

Fig. 3

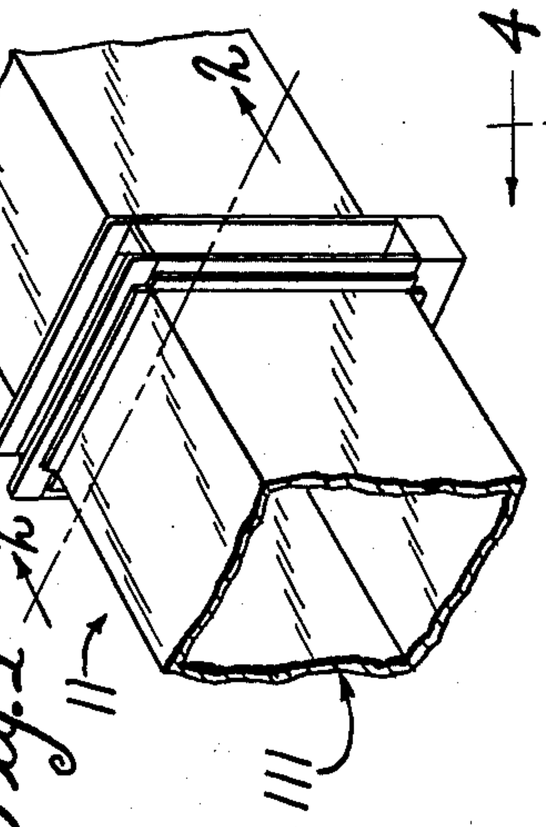

Fig. 1

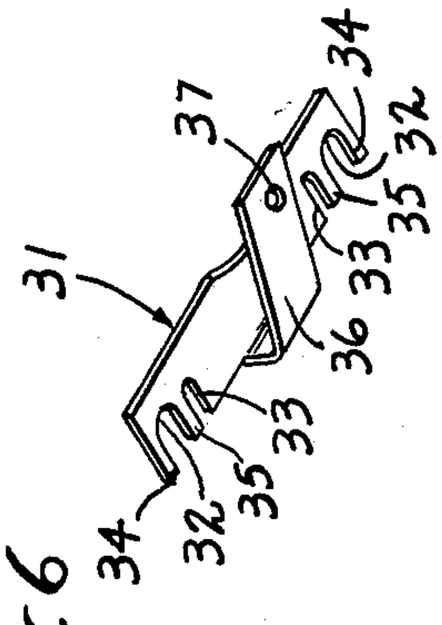

Fig. 6

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DUCT HEATER ASSEMBLY

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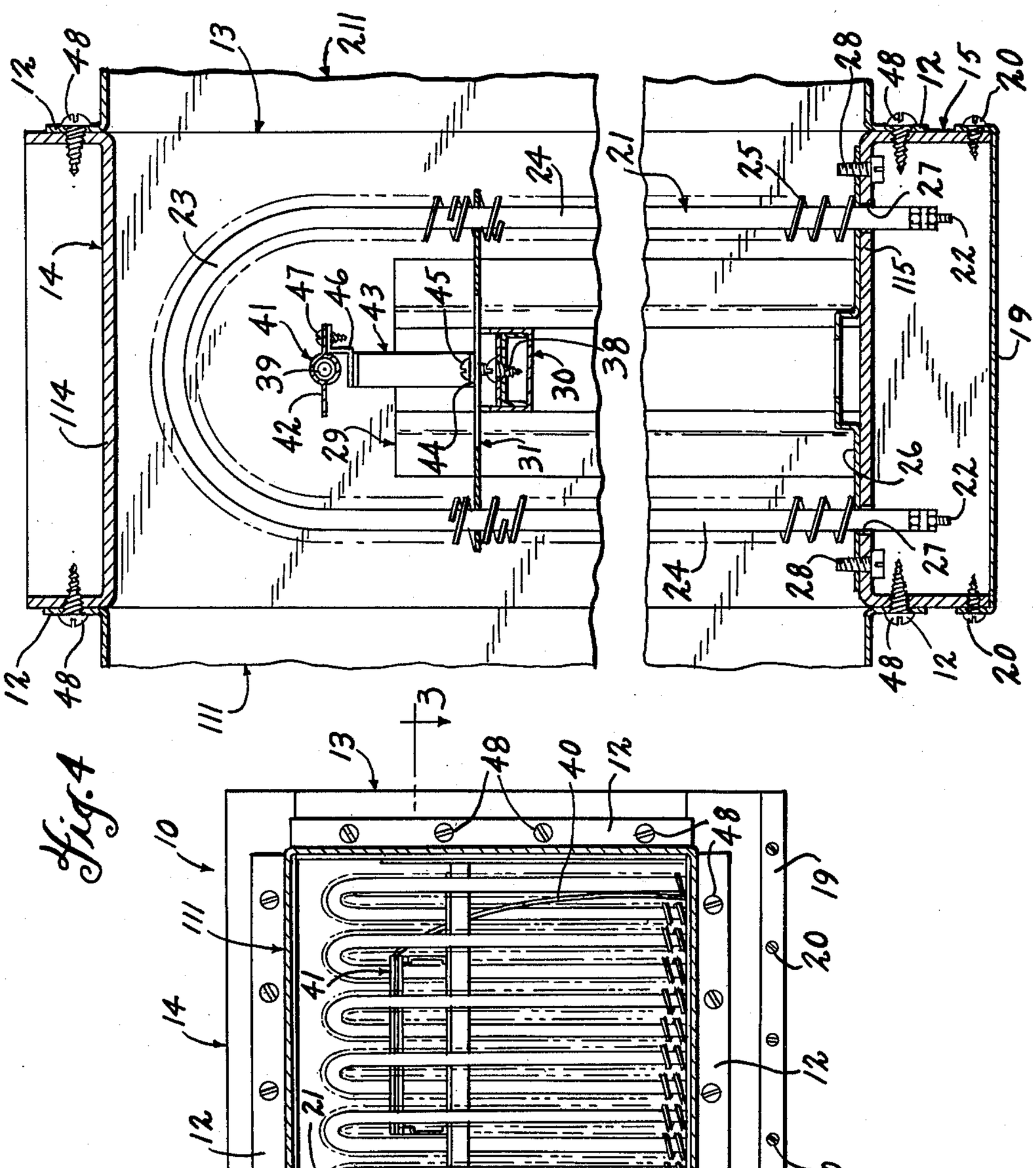

Fig. 4

Fig. 2

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DUCT HEATER ASSEMBLY

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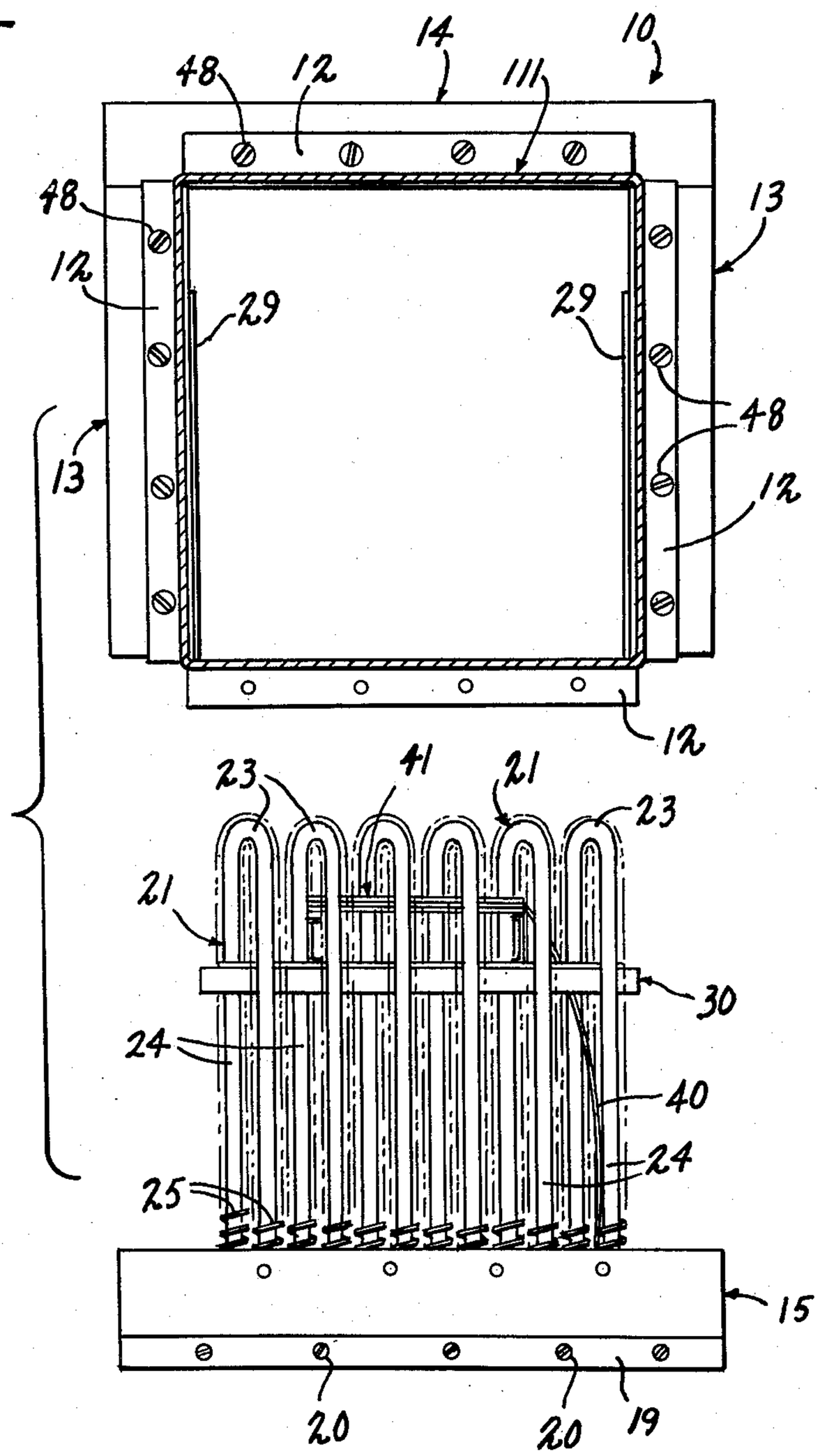
Fig. 5



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3,102,185

Patented Aug. 27, 1963

3,102,185
DUCT HEATER ASSEMBLY

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Filed Mar. 31, 1960, Ser. No. 18,979
4 Claims. (Cl. 219—34)

The present invention relates to electric heater assemblies, more particularly to assemblies of the type for heating fluid moving through a duct or the like, and the principal object of the invention is to provide new and improved assemblies of such character.

Prior art duct heater assemblies of the general type presently contemplated have been difficult to dismantle and reassemble once they were installed in the duct. This is a decided disadvantage since speed and ease of disassembly and assembly is frequently essential, to minimize down time, when the assembly requires inspection and/or replacement or repair of inoperative parts. Such difficulty has been especially prevalent where the heater assembly is relatively large and heavy.

Another disadvantage of prior art heater assemblies has been that owing to the placement of the sensing unit of the usual thermal cut-out switch, improper operation of such switch would occur unless the assembly was properly installed in the duct with respect to the direction of fluid flow therethrough. Furthermore, when prior art assemblies are installed in ducts through which the fluid moves vertically rather than horizontally, switch operation is seldom satisfactory because an additional factor; i.e., convective-induced fluid flow, comes into being. Thus, when the normal direction of fan-forced fluid movement through the duct is opposite to conductive-induced fluid movement, prior art sensing unit placement results in wholly unsatisfactory operation of the thermal cut-off switch.

The present invention eliminates the difficulties attendant with prior art assemblies and these advantages, together with others possessed by the present invention, will readily become apparent from a study of the following description and from the appended drawings.

In the drawings accompanying this specification and forming a part of this application there is shown, for purpose of illustration, an embodiment which the invention may assume, and in these drawings:

FIGURE 1 is a fragmentary perspective view of a duct in which a heater of the present design is installed,

FIGURE 2 is an enlarged sectional view generally corresponding to the line 2—2 of FIGURE 1,

FIGURE 3 is a further enlarged sectional view generally corresponding to the line 3—3 of FIGURE 2 and having portions on the near side broken away to better illustrate the underlying structure,

FIGURE 4 is a broken sectional view generally corresponding to the line 4—4 of FIGURE 3,

FIGURE 5 is a view similar to FIGURE 2 but showing certain parts separated to facilitate inspection and/or repair, and

FIGURE 6 is a perspective view of a detail.

With reference to FIGURE 1, the present invention comprises a heater assembly 10 which is adapted to be installed intermediate the ends of a duct 11 which, as herein illustrated, extends horizontally. A suitable fluid, such as air, is adapted to flow through duct 11 to be heated by the heater assembly and, in so far as the present invention is concerned, it is immaterial in which direction the air moves through the duct. In most cases, a suitable blower device (not shown) will be employed to move the air through the duct. While the present duct is herein shown to be generally square in cross-section, it is to be understood that such configuration is illustrative

only and that ducts having other cross-sectional configurations are contemplated.

In the present embodiment, duct 11 is divided transversely into longitudinally spaced duct portions 111, 211 between which the heater assembly is interposed. As best seen in FIGURES 2 and 3, the adjoining ends of respective duct portions 111, 211 provide outwardly turned flange portions 12 which are adapted to be secured to respective sides of the heater assembly as will later appear.

Turning now to the heater assembly and with particular reference to FIGURE 2, such assembly comprises a U-shaped frame formed of a pair of side members 13 in spaced, side-by-side, generally parallel relation connected together at one end by a cross-member 14. Such members are adapted to be welded or otherwise secured together to form a rigid assembly. As best seen in FIGURES 3 and 4, both the side members 13 and the cross-member 14 are presently channel-shaped in cross-section with their respective web portions 113, 114 directed inwardly to form, in effect, a continuation of the duct. Means are provided for closing the open end of the U-shaped frame aforesaid, such means comprising (see FIGURE 4) a channel-shaped base member 15 also arranged with its web portion 115 directed inwardly. Base member 15 may be removably secured to the frame side members 13 in any suitable manner and is seen in FIGURE 2, a fastening screw 16 may pass through an aperture in the web at one end of the member 15 and be threaded into a plate 17 which is welded or otherwise secured across the lower end of the adjoining side member 13. The opposite end of the base member 15 will, of course, be similarly secured to the other side member 13. For a purpose to appear, each end of base member 15 is closed by a plate 18, only one of which may be seen in FIGURE 2, while the flange portions of such member are spanned by a cover plate 19 removably secured in position by screws 20.

Carried by the web portion 115 of the base member 15 for disposition within the frame provided by the members 13, 14 are a plurality of electric resistance heating elements 21. As herein disclosed, each element is of the well-known type wherein a resistor conductor is disposed within an elongated tubular metallic sheath filled with electric-insulating, heat-conductive material. The resistor conductor preferably terminates short of the sheath ends and has its ends connected to respective terminal pins 22 which project beyond respective sheath ends to provide for making electrical connections thereto.

With particular reference to FIGURE 4, each element 21 is formed to a hair pin configuration to provide a bight portion 23 and spaced-apart, generally parallel leg portions 24. Also, in order to improve the heat-transfer characteristics of the element, the intermediate, heat-generating portion of each is provided with a spiral fin 25 which may be furnace brazed to the exterior of the element sheath. For a purpose to appear, a mounting plate 26 extends between and connects the legs 24 of each element adjacent its sheath ends and such plates may also be brazed to respective elements to form an integrated structure therewith.

As best seen in FIGURES 3 and 4, the elements 21 are adapted to be secured to the base member web 115 in spaced relation longitudinally of the member and with one of the legs of each element adjacent one side of the member and with the other leg of each element adjacent the other side of the member. The element legs are thus arranged in two rows spaced longitudinally of the direction of air movement through the duct. In order to obtain optimum heating efficiency, the elements will be slightly skewed (FIGURE 3) so that one element leg will not be disposed directly behind another where it

would be exposed to air already heated by the element leg in front of it. With the elements thus skewed, each element leg will have substantially equal exposure to unheated air flowing through the duct.

Turning now to the means for securing the elements to the base member **15**, the web portion of the latter is apertured at **27** to pass respective element legs. Screws **28** extend through apertures in such member web portion and are threaded into respective mounting plates **26** to thus draw the latter tightly against the top (in the position of parts shown) of the base member web portion. From the foregoing, it will be apparent that individual removal of the heating elements from the base member may readily be accomplished merely by removing the appropriate screws **28**.

Difficulty is sometimes experienced in disassembling and assembling base member **15** with the frame structure formed by the members **13, 14** once the frame structure has been assembled with the duct. This is particularly true when the assembly is located in a rather inaccessible position or is disposed in a vertically extending duct rather than a horizontally extending one as herein illustrated. The difficulty is, of course, aggravated when the assembly is relatively large and heavy.

To alleviate this difficulty and as best seen in FIGURE 3, side members **13** provide respective guide channels **29** in opposed, facing relation. Each guide channel **29** is generally U-shaped in cross-section and each extends longitudinally of its member **13** from the free end thereof. At the present time, guide channels **29** are spot welded to respective side members **13**; however, other suitable means could as well be employed or such channels could be formed integrally with respective members if desired. Each guide channel **29** is adapted to slidably receive a respective end of a slide bar **30** secured to the heating elements **21** in the following manner.

As best seen in FIGURES 3 and 4, a sheet metal brace **31** extends between respective legs **24** of each element adjacent the latter's bight portion **23**. Referring now to FIGURE 6, each brace preferably comprises a length of sheet metal having a pair of slots **32, 33** at each end thereof entering from one side of the brace and providing at each brace end a pair of tabs **34, 35**. Each slot **32** is of a size to accommodate the heating element sheath and the spacing between such slots corresponds to the spacing between respective legs of each element. Projecting transversely of an intermediate portion of each brace **31** is a tongue which is bent back upon the brace to provide a portion **36** which underlies the latter. For a purpose to appear, the free end of tongue portion **36** is apertured at **37**.

Each brace **31** is adapted to be secured to a respective heating element **21** adjacent the latter's bight portion **23** by disposing a respective element leg in respective brace slots **32**. Brace tabs **34, 35** will then be bent toward each other to at least partially encircle a respective element leg to thus secure the brace in place. It is to be undersood that the spiral fin **25** will not interfere with bending of the tabs **34, 35** since each may be bent to coextend with the adjoining fin. It is also to be understood that the braces are so secured to respective heating elements that the brace tongue portions **36** are aligned with each other.

As best seen in FIGURE 4, the aforesaid slide bar **30** is disposed beneath (in the position of parts shown) the braces **31** for abutment with the brace tongue portions **36**. Suitable screws **38** pass through the tongue portion apertures **37** and are threaded into the slide bar to secure the latter to the braces.

It is common practice with heating assemblies of the general type herein disclosed to utilize a thermally responsive switch which will de-energize the heating elements in event they obtain a dangerously high temperature. Such high temperature might be reached, for example, if air flow past the elements should decrease, or

stop, as a result, perhaps, of a partial blockage of the duct or a cessation of operation of the blower or like device which usually effects the air movement. Since such a switch is a well-known, commercially available product, it has not been illustrated herein; however, it will be understood that such switch may readily be mounted within the channel-shaped base member where is may readily be wired into circuit with the heating elements.

The location of the heat sensing portion of the thermally responsive switch aforesaid with respect to the heating elements is an important feature of the present invention. In the present embodiment, such heat sensing switch portion comprises a bulb connected to the switch by means of a capillary tube; however, switches having other types of heat sensing elements could as well be employed.

In the present embodiment and as best seen in FIGURE 4, an elongated heat sensing bulb **39** is disposed intermediate the legs of respective heating elements and extends transversely thereof. As herein shown, such bulb is presently located centrally of the bight portions of the elements. A capillary tube **40** (FIGURE 2) extends from the bulb to the switch. With the bulb thus positioned between the element legs of respective elements, it will be understood that the thermally responsive switch will operate in the same manner whether the air flows past the elements from left to right or right to left. It will readily be apparent that if the bulb **39** were positioned to one side or the other of the heating elements, a marked difference in switch operation would result between air flow in one direction and air flow in the opposite direction.

With bulb **39** disposed as herein disclosed, it will be exposed to radiant heat from several different directions. Since such exposure could cause premature switch operation, the sensing bulb is disposed within a tubular housing **41** which serves to interrupt the radiant heat. Housing **41** preferably has opposed, longitudinally extending ribs **42** which increase its surface area and facilitate cooling thereof as the air flows therepast. Housing **41** may be supported in position by any suitable means and at the present time, it is preferred to provide a pair of upstanding brackets **43** spaced longitudinally of the slide bar **30**. Each bracket has a lower foot portion **44** securable to an adjoining brace **31** by means of a screw **45** and an upper, offset head portion **46** to which a housing rib **42** may be secured by means of a screw **47**.

Although not shown, it will be understood that the usual power leads may enter the base channel member **15** through an aperture formed therein for connection to the terminal pins of respective heating elements.

Assuming that the heater assembly **10** is secured to the duct **11** by means of screws **48** which extend through apertures in respective duct section flange portions **12** and are threaded into respective adjoining portions of the heater assembly members **13, 14** and **15**, the heater assembly may be dismantled for inspection or replacement of parts as follows: In the event access to the interior of the base member **15** is desired, cover plate **19** may readily be removed by removing the screws **20**. In the event further dismantling is necessary, those duct screws **48** which are threaded into the base member **15** will be removed. Next, the screws **16** will be removed and the base member **15** shifted downwardly to withdraw the heating elements from within the frame structure provided by the side members **13** and the cross member **14**. As the base member is moved downwardly, slide bar **30** will slide along the guide channels **29** as will be evident.

Upon removal of the base member **15** as seen in FIGURE 5, replacement of any of the heating elements will readily be effectuated by removing the slide bar **30**, disconnecting the lead wires (not shown) from the appropriate element terminal pins, and removing the appropriate screws **28**. It may also be necessary to remove one or both of the screws **45** which mount the

brackets 43 to respective braces 31 prior to separating the element from the base member.

Assuming that the parts are disposed as illustrated in FIGURE 5 and that the base member-element sub-assembly is to be re-assembled with the frame provided by the side members 13 and the cross member 14, assembly will proceed as follows: The bight portion ends of the heating elements will be inserted between the frame side members until the ends of the slide bar 30 enter respective guide channels 29. The base member and element sub-assembly will then be shifted upwardly (in the position of parts shown) until the base member abuts the ends of respective side members. The screws 16 will then be installed to retain the parts assembled. If the electrical power leads (not shown) have been disconnected, they will be connected once again and the cover plate installed. Installation of the screws 48 through the duct flanges 12 and into the base member will complete the assembly operation.

It will readily be apparent that once the slide bar has been inserted within the guide channels, the base member-element sub-assembly will easily slide to position, in much the same manner as a drawer is closed, with no juggling being required to keep the parts in alignment. It will also be apparent that the guidance and support provided by the slide bar-guide channel construction will be particularly advantageous in the event the assembly is mounted in a vertically extending duct rather than the horizontally extending one herein disclosed. This is so because the unbalanced condition created by the heavy heating elements being secured to one side of the base member makes installation of the base member-element sub-assembly difficult to handle, especially in the larger heater assembly sizes.

While the base member 15 of the present unit has been shown as being installed from the bottom of a horizontally extending duct, it will be understood that the parts could as well be arranged to assemble the base member from either side or from the top.

In view of the foregoing it will be apparent to those skilled in the art that we have accomplished at least the principal object of our invention and it will also be apparent to those skilled in the art that the embodiment herein described may be variously changed and modified, without departing from the spirit of the invention, and that the invention is capable of uses and has advantages not herein specifically described; hence it will be appreciated that the herein disclosed embodiment is illustrative only, and that our invention is not limited thereto.

We claim:

1. An electric heating assembly for use in a duct work system, comprising a housing adapted to be mounted within the duct work system whereby air flowing through the system enters said housing at one place and exhausts from said housing at a spaced place, a plurality of hair-pin type electric heating elements mounted within said housing, each having a pair of legs extending transversely to the line of air flow therethrough, and thermal cut-out means for interrupting flow of electrical energy to said heating elements when a predetermined temperature is reached in said housing, said cut-out means including a heat sensing element located between opposed sides of the legs of at least certain of said hair-pin heating elements.

2. The construction according to claim 1 wherein said hair-pin type heaters extend cross-wise of the line of air flow, the legs of each heater being spaced along the line of air flow, and wherein said sensing element is elongated and extends longitudinally through the opening defined by the bight of at least certain of said heaters.

3. The construction of claim 2 wherein the legs of said heaters are rigidly connected to a member which covers a side opening in said housing and is removably connected thereto.

4. An electric heating assembly for use in a duct work system, comprising a rectangular box-like sheet metal housing having opposite open ends whereby air flowing in said system enters one end, passes through said housing and exhausts from the opposite end, each side of said housing being channel-shaped with the channel turned outwardly of the housing to provide spaced flanges around said housing for connection to spaced flanges extending from adjoining portions of said duct work system, one of said sides being removably connected to the ends of the two adjoining sides, a plurality of sheathed hair-pin heating elements carried by said one side and insertable into and removable from position within said housing by connection and removal, respectively, of said one side with said adjoining sides, the ends of the legs of each of said heating elements being rigidly connected to and extending transversely through said one side and each leg being of a length so that the bight of the respective element is disposed adjacent to that side wall which is opposite to said one side wall, a cross member connected to and extending cross-wise of said heating elements at a point spaced from said one side and in a direction inward of said housing, said cross-member bracing that part of the heating elements spaced from said one side and having opposed guide portions extending beyond said elements on each side thereof, said two adjoining sides each having spaced guide slides extending parallel to the direction of insertion movement of said heating elements and closely and slidably embracing the same to facilitate assembly movement of said one side and its supported elements with said housing, thermal cut-out means for interrupting flow of electrical energy to said heating elements and including an elongated heat sensing tube which extends through the opening formed by the bight of at least certain of said heating elements.

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